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INSTITUTE OF AGRICULTURAL RESEARCH

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16th National Crop Improvement Conference
Part II

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Addis Abeba

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August, 1985

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Institute of Agricultural Research

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Addis Abeba University: College of Agriculture,
Alemaya

Placement of Phosphorus study on Vertisols young alluvial soils and Regosols occuring in Hararge Highlands, Eastern Ethiopia.

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Introduction

Depending on the soil physical and chemical properties, added phosphorus may become essentially unavailable in the soil when slightly soluble or insoluble phosphorus compounds are formed in the soil. This is why soils are often classified by their phosphorus fixing capacity (Fox, 1972; Sanchez, 1975; Uost, 1978), and many placement methods have been tested to determine efficiency and availability of applied phosphorus to the growing crops.

Crops may respond much better to banded than broadcast phosphorus, especially on soil testing low phosphorus or on soils where high phosphorus fixing capacity precludes easy amanipulation of phosphorus level (Roy, 1980). Where soils are built up to medium or high levels broadcast or banded phosphorus may be equally effective (Barber, 1958, Albosal, 1979; Peterson et.al, 1982; Murphy, (1982).

The methods of phosphorus fertilization influence the amount of phos phorus needed for good yield (Abed et.al, 1978; Turkhede and Prasad, 1980), and phosphorus must be applied early, showing that young roots absorbing

1. Projects: Mz 8.030.3 (81); Sr. 8.030.3 (81) and PO.8.030.2 (80) in IAR Research

phosphorus much more rapidly than old roots (Hagenzieker, 1956; Duncan and Ohlrogge, 1958; Reith, 1959; Lawton and Davis, 1960; Duell, 1964; King and Skogley, 1969; Foote, 1969; Barber 1977, Foud et.al 1979; Lamond, 1981). This type of result is a function of the plant and fixation capacity of the soil; a different plant might require a different width of band, and on a soil with a low fixation capacity broadcasting and ploughing in might be better (Ezedinma, 1965; Adeptu, 1978).

Placement and type of fertilizer are inter-related and the needs of a plant for phosphorus could be met either by placement of a readily soluble phosphorus source or by spreading and mixing a slowly soluble source such as rock phosphate (Singh and Black, 1964; Roy et.al, 1978; Arrogavel, 1979; Lamond, 1981). As it is impossible to saturate all the soil fixation capacity, it is necessary to ensure that enough fixation site is saturated so that intensity is no longer a limiting factor (De Datta et.al, 1965; Engoumendies and Pichot, 1975).

The method of application is a compromise between the volume of soil in which the fertilizer is placed (and where the roots can find it) and the fixation capacity of the soil (Sadaphel and Singh, 1971; Pieri, 1975).

Under a wide range of soil and climatic conditions band application of super-phosphate accelerated the rate of phosphorus uptake by different crops (Barber, 1958; IARA, 1970 b; Virmani, 1971; Massaux et.al, 1974; Malavolta and Neptune, 1977; Delvalle et.al, 1978; Sobulo, 1978; Sadler, 1980).

Table 1 Effect of different methods of phosphorus fertilizer application (23kg P_2O_5/ha as DAP, below recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Alemaya soil series (with water conservation practice).

Methods	1981	1982	1983	prob. level 5%	Mean
50cm under the seed	50.22	73.44	51.89	d	58.52
Two side dressing	46.78	69.00	81.30		65.69
One side dressing	42.11	72.08	71.26	ab	61.82
Broad cast& mix in a plough layer	41.22	65.42	68.52	bc	58.39
Broad cast& not mix in plough layer	38.22	65.49	59.23	cd	54.31
Check (No fertilizer applied)	39.33	57.90	35.28	e	44.17
Probability level at 5%	b	a	ab		

CV = 15.09

DNMRT

Table 2. Effect of different methods of phosphorous fertilizer application (23kgP_2O_5/ha as DAP, Below recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Alemaya soil series (without water conservation practice).

Methods	1980	1981	prob. level 5%	1982	prob. level 5%	Mean
5cm under the seed	25.95	38.50	c	42.55	b	35.67
Two side dressing	27.30	27.08	ab	49.77	b	34.72
One side dressing	23.55	30.56	b	47.73	a	33.95
Broad cast and mix in a plough layer	26.89	28.11	ab	39.59	b	31.53
Broad cast & not mix in a plough layer	23.85	29.69	ab	38.11	b	30.65
Check (No fertilizer aapplied)	26.70	25.31	a	31.08	c	27.70
Probability level 5%	B	B		A		

CV = 14.41
DNMRT

Table 3. Effect of different methods of phosphorous fertilizer application (69kgP_2O_5/ha as DAP, recommended rate) on maize EAH-75 grain yield (Q/ha) grown on Alemaya soil series (with water conservation practice).

Methods	1982	prob. level 5%	1983	prob. level 5%	Mean
5 cm under the seed	65.86	bc	76.59	a	71.22
Two side dressing	69.99	b	70.16	b	70.08
One side dressing	59.76	c	46.00	cd	52.88
Broad cast & mix in a plough layer	76.03	a	58.94	bc	67.49
Broad cast &not mix in a plough layer	78.62	a	43.07	cd	60.85
Check (No fertilizer applied)	65.30	bc	34.97	a	50.14

CV = 13.62

DNMRT

Tabel 4. Effect of different methods of phosphorous fertilizer application (23kg P_2O_5/ha as DAP, below recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Damota series (Alluvial soil).

Methods	1981	prob. level 5%	1982	Mean
5cm under the seed	89.13	c	48.14	68.64
Two side dressing	77.72	b	44.86	61.29
One side dressing	63.89	a	40.83	52.36
Broad cast & mix in a plough layer	72.05	ab	35.02	53.54
Broad cast & not mix in a plough layer	61.53	a	41.71	51.62
Check (No fertilizer applied)	61.53	a	32.97	47.25
Probability level at 5%	a		b	

CV = 10.31

DMRT

Tabel 5: Effect of different methods of phosphorus fertilizer application (92kg P_2O_5/ha as DAP recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Alemaya Balck Soil (Vertisols)

Methods	1982	prob. level 5%	1983	prob. level 5%	Mean
5cm under the seed	32.00	b	25.06	b	28.53
Two side dressing	29.78	b	25.24	b	27.51
One side dressing	36.63	a	26.20	b	31.42
Broad cast & mix in a plough layer	36.36	a	55.93	a	46.10
Broad cast & not mix in plough layer	34.96	a	25.94	b	30.45
Check (No fertilizer applied)	24.60	a	22.16	b	23.38

CV = 15.21
DNMRT

Table 6: Effect of different methods of phosphorus fertilizer application (46kg P_2O_5/ha as DAP, below recommended rate) on maize grain yield (Q/ha) grown on Alemaya Balck soil (Vertisols).

Methods	1982	prob. level 5%	1983	prob. level 5%	Mean
5cm under the seed	35.52	a	25.00	b	30.26
Two side dressing	30.71	a	32.11	a	31.41
One side dressing	29.60	bc	26.83	ab	28.22
Broad cast & mix in a plough layer	31.63	ab	31.95	a	31.79
Broad cast & not mix in a plough layer	30.89	a	18.00	c	24.45
Check (No fertilizer applied)	25.16	c	16.55	c	20.86

CV = 15.17
LNMRT

Table 7: Effect of different methods of phosphorous fertilizer application (69kg P_2O_5/ha as DAP recommended rate) on sorghum (2752) grain yield Q/ha grown on Alemaya soil series with water conservation practice.

Methods	1982	prob. level 5%	1983	Mean
Fivecm under the seed	70.60	ab	63.34	66.97
Two side dressing	76.04	a	57.04	66.54
One side dressing	72.75	ab	116.46	94.61
Broad cast and mix in a plough layer	66.16	b	60.33	63.25
Broad cast and not mix in a plough layer	68.96	ab	58.07	63.52
Check (No fertilizer)	42.96	c	35.11	39.04
Probability level 5%				

CV = 14.22

DNMRT

TAble 8: Effect of different methods of phosphorus fertilizer application (23kg P_2O_5/ha, below recommended rate) on sorghum (2752) grain yield Q/ha grown on Alemaya soil series with water conservation practice.

Methods	1981	1982	1983	Mean
5cm under the seed	38.18	56.92	64.65	53.92
Two side dressing	38.35	66.95	72.83	59.38
One side dressing	35.22	60.90	61.55	52.56
Broad cast & mix in a plough layer	37.86	60.57	68.36	55.60
Broad cast & not mix in a plough layer	37.36	61.88	64.06	54.43
Check (No fertilizer applied)	34.73	46.25	38.65	39.38
probability level 5%	b	a	a	

CV = 10.41

DMRT

TAbel 9: Effect of different methods of phosphorus fertilizer application (69kgP_2O_5/ha as DAP, recommended rate) on sorghum grain yield (Q/ha) grown on Alemaya soil series (without water conseraation practice).

Methods	1982	prob. level 5%	1983	prob. level 5%	Mean
Five cm under the seed	52.71	bc	92.78	a	72.74
Two side dressing	55.96	ab	85.76	b	70.86
One side dressing	57.44	ab	84.93	b	71.19
Broad cast and mix in a plough layer	61.88	a	88.56	b	75.22
Broad cast and not mix in a plough layer	48.44	c	81.16	b	64.80
Check (No fertilizer)	48.06	c	66.97	c	57.52
Probability level 5%	b		a		

CV = 11.33

DMRT

TAbel 10: Effect of different methods of phosphorus fertilizer application ($23kgP_2O_5$/ha, below recommended rate) on sorghum (2752) grain yield Q/ha grown on Alemaya soil series (without water conservation practice).

Methods	1981	prob. level 5%	1982	prob. level 5%	1983	prob. level 5%	Mean
Five cm under the seed	18.44	cb	50.86	ab	78.77	a	49.36
Two side dressing	23.53	d	53.82	a	75.78	a	51.04
One side dressing	18.93	cd	58.42	a	62.55	b	46.63
Broad cast and mix in a plough layer	15.31	abc	51.68	ab	78.61	a	48.53
Broad cast and not mix in plough layer	13.50	ab	59.42	a	56.92	c	43.28
Check (No fertilizer)	12.67	a	43.94	b	54.86	c	37.16
Probability level 5%	c		b		a		

CV = 14.88

DNMRT

Table 11: Effect of different methods of phosphorus fertilizer application (23kg P_2O_5/ha as DAP, below recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Damota series (Alluvial soil).

Methods	1918	1982	Mean
5cm under the seed	47.08	50.53	48.81
Two side dressing	45.76	44.27	45.02
One side dressing	47.24	43.61	75.43
Broad cast & mix in a plough layer	51.52	51.02	51.27
Broad cast & not mix in a plough layer	46.91	39.83	43.37
Check (No fertilizer applied)	42.80	36.33	39.57

CV = 6.14
DMMRT

Tabel 12: Effect of different methods of phosphorus fertilizer application (92kg P_2O_5/ha as DAP, recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya Balck soil (Vertisols)

Methods	1982	prob. level 5%	1983	Mean
5cm under the seed	29.95	d	36.88	33.42
Two side dressing	39.83	bc	49.08	44.46
One side dressing	44.77	ab	36.60	40.69
Broad cast & mix in a plough layer	48.72	a	47.98	48.35
Broad cast & not mix in a plough layer	48.22	a	37.91	43.07
Check (No fertilizer applied)	33.74	cd	40.04	36.88
Probability level 5%				

CV = 14.27
DNMRT

Table 13. Effect of different methods of phosphorus fertilizer application (46kg P_2O_5/ha as DAP, below recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya Black Soil (Vertisol).

Methods	1982	prob. level 5%	1983	Mean
5cm under the seed	49.76	a	15.80	32.78
Two side dressing	43.61	c	17.43	30.52
One side dressing	52.64	c	21.18	36.91
Broad cast & mix in a plough layer	48.88	ab	16.86	32.87
Broad cast & not mix in a plough layer	44.80	bc	22.61	33.71
Check (No fertilizer applied)	34.23	d	36.93	25.52
Probability level 5%	a		b	

CV = 14.33

DNMRT

Tabel 14. Effect of different methods of phosphorus fertilizer application (69kg P_2O_5/ha, recommended rate) on potato tuber yield (Ton's/ha) grown on Alemaya soil series.

Methods	1982	prob. level 5%	1983	prob. level 5%	Mean
5cm under the seed	39.77	a	17.12	a	28.44
Two side dressing	32.20	b	15.38	a	23.79
One side dressing	29.47	b	16.23	a	22.85
Broad cast and mix in a plough layer	26.91	c	16.27	a	21.59
Broad cast and not mix in a plough layer	29.82	b	15.67	a	22.75
Check (No fertilizer applied)	12.11	d	9.87	b	10.99
Probability level at 5%	a		b		

CV= 16.59
DNMRT

Table 15. Effect of different methods of phosphorus fertilizer application (23kg P_2O_5/ha below recommended rate) on potato tuber yield (Ton's/ha) grown on Alemaya soil series.

Methods	1981	1983	Mean
5cm under the seed	40.60	17.76	29.18
Two side dressing	50.31	24.95	37.63
One side dressing	41.04	68.13	54.58
Broad cast and mix in a plough layer	37.55	16.06	26.80
Broad cast and not mix in a plough layer	40.53	15.08	27.81
Check(No fertilizer applied)	28.76	15.31	22.03

CV = 16.54
DMRT

REFERENCE

1. Abed, A.M., F.H. Chandhry and O.A. ER-Tomi. 197 . Phosphorus requirement of crops on a Libya/soil. Agr, Abst. 148.

2. Adepetu J.A.1978. Availability of applied phosphorus from sandy tropical soils as affected by the broadness of the fertilizer band. J.Trop. Agric. Vet. Sci. 16(3): 239-245.

3. Albasel, N.1979. The effect of rate and placemnt of P in fertigation of Tomatoes. Scientific Activities 1974-77. Instituted of woil water; Bet Dagan, Israel, Pamphlet No.174,114 (EN), in phosphorus in Agriculture No. 75,1979.

4. Arogave, A.J., 1979. Efficiency of different methods of applying crude RP and with different grades of acedulation on spring maize on the Mexican High Plateau. Agrociencia, 36: 55-76, in soils and fertilizers, 1982: P3204).

5. Barber, S.A.1958. Relation of fertilizer placement to nutrient uptake and crop yield. I. The interaction of row phosphorus and soil level of phosphorus. Agron. J.50: 535-539.

6. Barber, S.A., 1977. Application desengrais phosphates: methods d'application en function de l'etat phosphorique des sols. Symposium ISMA sur l'importance du phosphore en agriculture. Paris..

7. De Datta, S.K., and J.C.Moomaw. 1965. Availability of phosphorus to sugar cane in Hawaii as influenced by various phosphorus fertilizers and methods of application. Expl. Agric., 1: 261-270.

8. Del Valle, R., 1978. Response of plantains to Banded and Boradcast N and to P Application at Planting and to Residual P on an ultisol. Agric. Univ. Puerto Rico; 62: 29-38. In phosphorus in Agriculture No. 75, 1979.

9. Duell, R.W. 1964. Fertilizer-seed placement with Birdsfoot Trefoil (Lotus conrniculatus L.) and Alfalfa (Medicago sativa). Agron J. 56: 503 - 505.

10. Duncan, W.G., and A.J. phlrogge. 1958. Principles of Nutrient uptake from fertilizer bands, II. Root development in the bands. Agron. J. 50: 605 - 608.

11. Engoumenides, C. and Pichot, J. 1975. Influence de la technique de apport du phosphore sur l'evalution de cet element dans un sol a fort pouvoir fixateur. Agron. Trop. 30 (4): 354-357.

12. Ezendinma, F.O.C.1965. Fertilizer placement for sole-srop cowpeas in southern Nigeria. Expl. Agric. 1: 299 - 303.

13. Foote, L.1969. Fertilizer placement with saddling. Agron. J. 61: 965 - 969.

14. Foun, H.A., M.Zaki, G.W. Amerhom, and I.M.Abdella 1979. Mechanized deep band placement of super phosphate in comparison with other condentional methods in cowpea. Neitr. Trop. Land wirtsch Vet. Med. 17(1): 55 - 60.

15. Fox, R.H. 1972. Nitrogen fertilization in the humid tropics. Agrl. Res. Seminar. Trop. Soils. Ibadan.

16. Hagenzieker, F.1956. Studies on sub - soil palcement of fertilizer at Urambo, Tanganyika Territory. Empire J.Expl: Agric. 24: 109 - 120.

17. I.A.E.A. 1970 b. Fertilizer management practices for maize: results of experiments with isotops Tech. rep.ser. No. 121. IAEA Vienna.

18. King, J.W., and C.R. Skogley 1969. Effect of Nitrogen and phosphorus placements and rates on Turfgrass Establishment. Argon.J. 61: 4 - 6.

19. Lamond, R.E.1981. Evaluations of P rates and application methods on winter wheat. Agron. Abstr. Ann. meetings Am. Soc. Agron. Dec. 1981, 236, in phosphorus in Agriculture.

20. Lawton, K., and J.F.Davis. 1960. Influence of fertilizer Analysis and placement on the emergence, growth and nutrient absorption by wheat seedlings in the Green House. Agron. J. 52: 326 - 328.

21. Malavoltn, and A.M.L. Neptune. 1977. Etude dela localisation des engrais sur des cultures tropicals. Symposium ISMA sul l'importance du phosphore en Agriculture. Paris.

22. Massaux, F., A.J. Gestin, and C.Missre. 1974. Etude de l'absorption radiculaire du cecaoyer a l'aide d'un traceur radioactif dans les conditions ecologiques du sud - Cameroun. Cafi, CaCao., The (Paris) 28 (4): 225 - 236.

23. Murphy, S.L. 1982. Keep Wheat profitable. Don't forget phosphorus Better crops with plant foods, : 8 - 11.

22. Peterson, G.A., D.H. Sanders, P.H- Grabouski and M.L.Hooker 1982. Efficient use of phosphorus on winter wheat. Better crops with plant food, : 3 - 5.

25. Pieri, C.1975. Utilization des engrais dans les sols de la zone semi - aride du Senegal. (miemeo). CNRA Bambey, Senegal.

26. Reith, J.W. S.1959. Fertilizer placement for seedes and Turnips. Empire J. Expl. Agric. 27:300 - 312.

27. Roy, R.N.1980. Importance of fertilizers and their efficient use in exploiting agricultural production potential in India. Phosphorus in Agriculture, 79: 37 - 64.

28. Roy, R.N., S.Seetharaman and R.N. Singh.1978. Efficiency of Different sources of phosphorus. Phosphorus in Agriculture. 74.

29. Sadaphal. M.N. and R.S.P. Singh. 1971. Grain yield attributes, yield and nutrient uptake in sorghum as influenced by nitrogen and rates and methods of phosphorus applications. Int. symp. Soul fertilizer Eval. proc. New Delhi. PP. 585 - 594.

30. Sanchez P.A. and S.W.Buol. 1975. Soils of the tropics and the world food crisis. Science 188: 598 - 608.

31. Saddler, J.M. 1980. Effects of placement location for banded away from the seed on growth and uptake of soil and fertilizer P by flax. Can. J. Soil Sci., 60: 251 - 262.

32. Singh, R.M., and C.A.Black. 1964. Test of the De wit compensation function for estimating the value of different fertilizer placements. Agron. J. 56: 572 - 574.

33. Sobulo, R.A., 1978. Effect of P placement on yield of Tomatoes in South - Western Nigeria. Agron. J. 70: 521 - 524.

34. Turhede B.B., and R.Prasad. 1980. Effects of rates and timing of phosphate application on hybrid sorghum. Zeitschrift fur Ackner Pflanzenban 149 (5): 383 - 390.

35. Virmani, S.M. 1971. Phsophorus fertilization of wheat Int. Symp. soil fert. Eval. Proc. New Delhi. pp. 767 - 772.

36. Yost, R.S. 1978. Effect of Rate and placement an availability and residual value P in an oxisol of central Brazil. Diss. Abstr. Int. B. 39 (2), 1978: 489 - 90. In phosphorus in Agriculture, 75: (1979).

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TIME OF NITROGEN APPLICATION STUDY ON VERTISOILS, YOUNG ALLUVIAL SOILS AND NGOSLY OCCURRING IN HARERGE HIGHLANDS EASTERN ETHIOPIA 1.

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Introduction

The objective of proper timing of fertilizer application is to obtain the highest yield with minimum investment in fertilizer material and labour. At least two different conditions are involved in deciding time of fertilizer application: (1) Cost is reduced if the number of application are kept as minimum and if they are carried out during periods when labour is most available, and (2) efficiency is improved if the application of fertilizer is made at a time when the fertilizer is utilized most efficiently by the crops.

Nitrogen fertilizer may be applied before planting, at time of planting, sidedresses after planting, or in a combination of these practices, the most effective method is dependent upon growth determinant factors such as soil temperature, the fertility levels of the soil and moisture conditions. The latter factor in addition can markedly influence nitrogen losses by leaching or volatilaization (FAO/IAEA, 1970).

Adebayejo (1966) has summarized efficient fertilizers application practices being used in the tropics. A four year study from 1958 - 1962 showed that time of application of nitrogen greatly influenced the yields of grain, the percentage of nitrogen and the crude protein under Nigerian conditions characteristics of the early maize cropping season from March to July.

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1. Sr. 8.030.2 (81); MZ 8.2.(81) P08.090.9(80) in IAR Research Programme for 1976 E.C. (1983/84).

Split application of nitrogen fertilizer significantly increased maize grain yield by 35% when two equal doses were supplied at planting and one month and two months after planting, and 31% when four equal doses were supplied at planting and one month, two months and three months after planting. Yield was significantly reduced when application was delayed two months after planting. High yields of maize were not obtained by supplying the whole of nitrogen fertilizer at one time either at sowing or any time later during the growing season. However, applying all of the nitrogen fertilizer one month after planting significantly increased the percentage of nitrogen and of the crude protein content of the grain. The maize lar weight was favourably influenced by spreading the nitrogen application over the three month period of the maize growth. The results obtained in these investigations seem to suggest that a split application of nitrogen fertilizer is likely to produce higher maize yields in tropical climates than when the application was made in none single dose either at the time of sowing or later.

The proper time of nitrogen application to maize is of matter of concern both economically and environmentally. Preliminary results in Kentucky showed differences in efficiency of nitrogen use from one part of the state to another and similar variability has been reported in Illinois (Miller et al., 1975).

Data from field experiments on rice strongly indicate that higher grain yields were obtained from the same level of nitrogen, when the nitrogen was given in two splits at medium tillering and panicle initiation stages. Early season application were inferior to mid or l ate season applications, particularly when most of the fertilizer was applied at the seedling stage. Apparently the early season application, before commencement of continuous flooding, roots of plants were not well developed yet to make good use of the added nitrogen. Thus most of this nitrogen was lost by denitrification and volatilization (Ghobrial, 1980).

In general, reported research suggest that spring application of nitrogen is more effective than fall application for winter wheat (Blackett, 1957; Doll, 1962; Welch et al., 1966). Nitrogen fertilizer applied to winter wheat at the time of fall seeding are frequently not as effective as top dressings the following spring. Similar results were obtained on other crops (Rehm et al., 1977; Stivenson et al., 1969; Winston et al., 1963). Losses of fall-applied nitrogen may be due to conversion of nitrogen to a leachable form and its subsequent leaching from the root zone and to the volatilization of nitrogen into the atmosphere. Leaching of nitrogen has been shown to be related to the amount of water moving through the profile.

Table 1. Effect of time of nitrogen fertilizer application (150kg N/ha as urea, recommended rate) on maize EAH-75 grain yield (Q/ha) grown on Alemaya soil series (with water conservation practice).

Time of application	1982	1983	prob. level 5%	Mean
All at planting	62.34	53.01	a	57.68
All at 30-40 days after planting	62.90	61.87	a	62.39
All at 50% tassling	59.38	53.87	a	56.63
½ at planting and ½ at 30-40 days after planting	61.23	62.13	a	61.68
½ at planting & ½ at 50% tassling	58.83	62.69	a	60.76
½ at 30-40 days & ½ at 50% tassling	60.00	64.99	a	62.50
Check (No fertilizer applied)	57.35	33.98	b	45.67
Probability level at 5%				

CV = 11.93

Table 2. Effect of time of nitrogen fertilizer application (69kg N/ha as urea, below recommended rate) on Maize (EAH-75) grain yield (Q/ha) grown on Alemaya soil series (with water conservation practice).

Time of application	1981	prob. level 5%	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	87.11	3	70.11	e	40.85	bcd	66.02
All at 30-40 days after planting	85.77	ed	59.57	b	55.05	b	66.80
All at 50% tassling	68.78	cb	62.16	ab	52.50	bc	61.15
½ at planting & ½ at 30-40 days after planting	70.33	cb	52.17	d	71.16	a	64.55
½ at planting & a½ at 50% tassling	52.88	a	64.75	a	37.21	d	51.61
½ at 30-40 days & ½ at 50% tassling	75.00	dc	60.98	ab	70.20	a	68.73
Check (No fertilizer applied)	65.33	b	54.08	c	42.08	bcd	53.83
Probability level at 5%	a		a		a		

CV = 17.61
DNMRT

Table 3. Effect of time of nitrogen fertilizer application (69kg N/ha as urea, below recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Alemaya soil series (without water conservation practice).

Time of application	1981	prob. level 5%	1981	prob. level 5%	Mean
All at planting	28.78	c	44.58	a	33.25
All at 30-40 days after planting	26.14	b	47.17	a	47.38
All at 50% tassling	25.14	b	46.43	a	31.56
½ at planting & ½ at 30-40 days after planting	29.83	c	40.88	ab	34.07
½ at planting & ½ at 50% tassling	28.78	c	34.41	bc	31.60
½ at 30-40 days & ½ at 50% tassling	34.75	d	29.97	c	32.36
Check (No fertilizer applied)	22.64	a	26.64	c	24.64
Probability level at 5%	a		a		

CV= 20.43
DNMKT

Table: 4. Effect of time of nitrogen fertilizer application (46kg N/ha as urea below recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Damota series (Alluvial soil) and P_2O_5 kg/ha.

Time of application	1981	1982	Mean
All at planting	59.44	29.04	44.24
All at 30-40 days after planting	67.66	30.34	40.00
All at 50% tassling	59.69	29.97	44.83
½ at planting & ½ at 30-40 days	65.11	29.10	47.11
½ at planting & ½ at 50% heading	61.86	31.82	46.84
½ at 30-40 days & ½ at 50% heading	64.44	31.82	48.13
Check (No fertilizer applied)	62.44	25.16	43.80
Probability level at 5%	a	b	

CV= 5.42
DNMRT

Table 5. Effect of time of nitrogen fertilizer application (92kg N/ha as urea, recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Alemaya Black soil (Vertisols). P_2O_5 kg/ha.

Time of application	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	52.72	ab	47.29	a	50.01
All at 30-40 days after planting	66.41	a	31.31	c	48.86
All at 50% tassling	50.50	c	37.21	bc	41.95
½ at planting & ½ at 30-40 days	52.17	bc	31.73	c	49.76
½ at planting & ½ at 50% tassling	57.35	b	42.16	ab	45.18
½ at 30-40 days & ½ at 50% tassling	49.76	c	40.60	ab	45.16
Check (No fertilizer applied)	33.67	d	17.97	d	25.82
Probability level at 5%	a		b		

CV= 15.45
DNMRT

Table 6. Effect of time of nitrogen fertilizer application (46kg N/ha as urea, below recommended rate) on maize (EAH-75) grain yield (Q/ha) grown on Alemaya Black soil (Vertisols).

Time of application	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	51.98	bc	34.32	a	43.15
All at 30-40 days after planting	62.34	a	31.00	ab	46.67
All at 50% tassling	60.31	ab	25.91	bc	43.11
½ at planting & ½ at 30-40 days	49.2	a	29.67	ab	39.44
½ at planting & ½ at 50% tassling	64.01	a	31.22	ab	47.62
½ at 30-40 days & ½ at 50% tassling	57.72	abc	24.97	d	36.35
Check (No fertilizer applied)	50.69	bc	22.38	c	36.54
Probability level at 5%	a		a		

CV = 14.17

DNMRT

Table 7. Effect of time of nitrogen fertilizer application (69kg N/ha, below recommended rate) on sorghum (2752) grain yield Q/ha grown on Alemaya soil series with water conservation practice.

Time of application	1981	1982	1983	Mean
All at planting	27.00	43.94	61.22	44.05
All at 30-40 days after planting	26.17	43.78	53.50	41.15
All at 50% heading	25.84	40.82	40.74	35.80
$\frac{1}{2}$ at planting & $\frac{1}{2}$ at 30-40 days	32.10	46.25	45.66	41.34
$\frac{1}{2}$ at planting & $\frac{1}{2}$ at 50% heading	33.91	58.81	59.45	50.72
$\frac{1}{2}$ at 30-40 days & $\frac{1}{2}$ at 50% heading	31.77	57.28	46.60	45.22
Check (No fertilizer applied)	25.02	36.76	28.47	30.08
Probability level 5%	b	a	a	

DNMRT

Table 8. Effect of time of nitrogen fertilizer application (69kg N/ha, as urea, below recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya soil series (without water conservation practice).

Time of application	1981	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	27.16	54.15	a	79.80	a	53.70
All at 30-40 days after planting	24.69	38.78	d	45.77	c	36.41
All at 50% heading (flowering)tasselling	21.23	50.20	b	52.56	c	41.33
Half at planting and half at 30-40 days after planting	20.08	59.42	a	63.41	b	47.64
Half at planting and half at 50% heading (flowering) tasselling	25.51	41.31	cd	7[illegible].20	a	47.01
Half at 30-40 days after planting and half at 50% heading (flowering) tasselling	27.19	44.06	c	44.37	c	38.64
Check (No fertilizer)	16.63	36.76	cd	24.96	d	26.17
Probability level 5%	b	a		a		

CV= 24.29

DNMRT

Table 9. Effect of time of nitrogen fertilizer application (150kg N/ha as urea, recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya soil series (with water conservation practice).

Time of application	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	72.42	b	59.98		66.20
All at 30-40 days after planting	47.56	b	63.09		55.33
All at 5'% heading (flowe-ring) tasselling	35.55	bc	50.00		42.78
Half at planting and half at 30-40 days after planting	54.93	b	79.2		67.07
Half at planting and half at 50% heading (flowering) tasselling.	41.15	a	56.34		48.76
Half at 30-40 days after planting and half at 50% heading (flowering) tasselling	42.46	a	55.37		48.92
Check (No fertilizer)	40.28	c	43.91		42.10
Probability level 5%					

CV= 15.70

DNMRT

Table 10. Effect of time of nitrogen fertilizer application (150kg N/ha as urea, (recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya soil series (without water conservation practice).

Time of application	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	67.66	a	63.36	a	65.51
All at 30-40 days after planting	50.80	c	67.08	a	58.94
All at 50% heading (flowering)tasselling	57.28	b	38.98	b	48.13
Half at planting and half at 30-40 days after palnting	47.89	cd	66.67	a	57.28
Half at planting and half at 50% heading (flowering) tasselling	42.46	de	45.49	b	43.98
Half at 30-40 days after planting and half at 50% heading (flowering) tasselling	40.98	3	58.55	a	49.77
Check (No fertilizer)	37.52	e	37.81	b	37.67
Probability level 5%					

CV = 18.80

DNMRT

Table 11. Effect of time of nitrogen fertilizer application (23kg N/ha as urea, below recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Damota (Alluvial soil).

Time of application	1981	prob. level 5%	1982	mean
All at planting	51.51	cb	19.91	35.71
All at 30-40 days after planting	52.51	cb	20.57	36.54
All at 50% heading	48.55	ab	19.58	34.07
½ at planting & ½ at 30-40 days	54.32	c	51.68	53.00
½ at planting & ½ at 50% heading	52.18	cb	23.37	37.78
½ at 30-40 days & ½ at 50% heading	61.39	d	22.55	41.97
Check (No fertilizer applied)	46.91	a	18.59	32.75
Probability level 5%	a		b	

CV = 20.86

DNMRT

Table 12. Effect of time of nitrogen fertilizer application (92kg N/ha as urea recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya Black soil (Vertisols).

Time of application	1982	1983	Mean
All at planting	53.65	38.84	46.25
All at 30-40 days after planting	61.23	50.43	55.83
All at 50% heading	43.12	32.55	37.84
½ at planting & ½ at 30-40 days	72.42	38.64	55.53
½ at planting & ½ at 50% heading	50.62	60.46	58.54
½ at 30-40 days & ½ at 50% heading	58.10	60.17	59.14
Check (No fertilizer applied)	50.03	35.33	42.68
Probability level 5%			

CV = 19.42
DNMRT

Table 13. Effect of time of nitrogen fertilizer application (46kg N/ha as urea, below recommended rate) on sorghum (2752) grain yield (Q/ha) grown on Alemaya Black Soil (Vertisols)

Time of application	1982	prob. level 5%	1983	Mean
All at planting	42.46	c	58.62	50.54
All at 30-40 days after planting	57.11	b	56.75	56.93
All at 50% heading	36.37	d	37.98	37.18
½ at planting & ½ at 30-40 days	70.28	a	52.27	61.28
½ at planting & ½ at 50% heading	40.16	cd	68.97	54.57
½ at 30-40 days & ½ at 50% heading	39.66	c	71.03	55.35
Check (No fertilizer applied)	36.21	d	29.99	33.10
Probability level 5%				

CV = 26.12

DNMRT

Table 14. Effect of time of nitrogen fertilizer application (150kg N/ha, recommended rate) on potato tuber yield (Tons/ha) grown on Alemaya soil series

Time of application	1982	prob. level 5%	1983	prob. level 5%	Mean
All at planting	36.33	b	19.07	a	27.70
All at 30-40 days after planting	40.35	a	15.87	ab	28.11
All at 50% flowering	30.88	c	16.71	ab	23.79
½ at planting & ½ at 30-40 days after planting	36.12	b	20.04	a	28.08
½ at planting & ½ at 50% flowering	40.70	a	15.04	ab	27.87
½ at 30-40 days and ½ at 50% flowering	37.81	b	13.26	b	25.53
Check (No fertilizer applied)	40.16	a	12.86	b	26.51
Probability level at 5%	a		b		

CV = 14.21
DNMRT

Table 15. Effect of time of nitrogen fertilizer application (69kg N/ha, below recommended rate) on potato tuber yield (Tons/ha) grown on Alemaya soil series.

Time of application	1981	1983	prob. level 5%	Mean
All at planting	13.96	30.81	a	22.38
All at 30-40 days after planting	13.93	17.33	c	15.63
All at 50% flowering	11.30	9.46	d	10.38
½ at planting and ½ at 30-40 days	14.09	19.35	bc	16.72
½ at planting and ½ at 50% flowering	17.23	20.79	b	19.01
½ at 30-40 days after planting and ½ at 50% flowering	11.36	14.95	c	13.15
Check (No fertilizer applied)	7.87	6.37	c	7.12

CV= 61.65

DNMRT

REFERENCES

1. Adebayejo A.Fwyemi, 1966. Effects of time of nitrogen application on yield of maize in the tropics. Experimental Agriculture- 2(2): 101-105
2. Blackett G.A., 1957. The effect of rate and time of application of nitrogen on the yield of winter wheat. Empire J. of experimental agriculture 25(97): 19-23.
3. Doll E.C., 1962. Effects of fall applied nitrogen fertilizer and winter rainfall on yield of wheat. Agron. J. 54: 471-473.
4. FAO/IAEA, 1970. Fertilizer managements practices for maize. Results of experiments with isotops, Technical Reports series No. 121.
5. Ghobrial George I., 1980. Effects of level, time and splitting of urea on the field of irrigated direct seeded rice. Plant & Soil 56: 2, 209-215.
6. Miller H.F., John Kauanaugh, and G.W.Thomas, 1975. Time of nitrogen application and yields of corn in wet alluvial soils. Agron. J. 67(3): 401-404.
7. Rehm G.W., R.C.Sorensen and W.J. Moline 1977. Time and rate of fertilizer seeded worm - season and Blugrass pastures II quality and nutrient content. Agron. J. 69(6): 955-961.
8. Stevenson C.K. and C.S.Baldwin., 1969. Effect of time and method of nitrogen application and source of nitrogen on the yield and nitrogen content of corn (Zea mayl.). Agron. 61(3): 381-384.
9. Welch L.F., P.E.Johnson, T.W.Pendlecton and L.B.Miller, 1966. Efficiency of fall versus spring applied nitrogen for winter wheat. Agron. J. 58(3): 271-274.
10. Winston M.Laughein, 1963. Bromegross Responses to rate and source of nitrogen applied in fall and spring in Alaska Agron. J. 55: 60-62.

The effects of soil types on the yield of improved high yielding varieties of maize, sorghum and potato.

By

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Introduction

Crop varieties may vary greatly in their ability to utilize native and/or applied plant nutrients from the soil. Therefore it is important to use a variety which has been proven to be high yielding for the ecological zone and a specific soil type in the area, to utilize high fertility levels from the soil and/or give stable and comparable higher yields when grown at normally prevailing moisture conditions or under unfertilized conditions.

Varieties adopted to low fertility conditions will often not respond to increased fertility conditions. Thus crop varieties differ in their ability to respond to applied fertilizers.

The objective of this study is therefore to investigate the comparative performance of the high yielding improved varieties of maize, sorghum and potato grown on major soil types occuring in Harerge highlands under various soil ammendment practices.

Results and Discussions

The detailed data is presented in tables 1 to 14 and the summary is given in tables 1 to 8.

Major Findings

All five maize varieties gave much higher grain yields on Damota series (alluvial soil) as compared to Alemaya series when no fertilizer was applied and no water conservation practice was used (summary table 1). But similar yields were obtained on both soil types under fertilized conditions and no water conservation practice (summary table 2)

2. Alemaya composite gave comparatively highest yields followed by EAH - 75 and KCC under all soils and treatments used. But the yield levels attained by all five maize varieties under unfertilized conditions and no water conservation practice on Damota series (alluvial soils) were much higher than the yield levels on Alemaya series. (summary tables 1,3 and 4).

3. On Alemaya series all five maize varieties gave higher yields when water conservation practice and fertilization were used (summary tables 3 and 4).

4. The yields of five improved sorghum varieties were similar on both Alemaya series and balck soils but higher yields were obtained under fertilized conditions on Alemaya soil series. An exception, sorghum variety 3235 gave higher grain yield (40 Q/ha) on black soils as compared to (27.5Q/ha) on Alemaya series when no fertilizer was used (summary tables 5,6 and 7).

5. On Alemaya series, potato tuber yields of five improved varieties were much higher when grown under fertilized condition and lower yields under no fertilizers (summary tables 8).

Conclusions and Recommendation

1. The comparative yield levels of crop varieties greatly vary when grown on different soil types occuring on a given landscape. Therefore improved varieties should be tested for their yield levels on more than one major soil type in a given region before any recommendation is made to release variety. In other words national yield trials should be carried out on more than one major soil type in a given region.

2. Maize varieties are more sensitive to respond to variation in soil moisture levels than sorghum varieties.

3. The comparative yield levels of crop varieties greatly vary when grown under fertilization and no fertilization. The national yield trials should be carried out both under fertilized and unfertilized condition.

Summary tables for variety

Soil Interaction

Table 1 Grain yield data (Q/ha) for five improved high yielding maize varieties grown on two major soil types occuring in Harerge highlands under no fertilization with no water conservation practice.

Variety	Damota Series (1970, 1981)	Rank	Alemaya Series (1980, 81, 82)	Rank
KCC	48.66	3	25.56	3
EAH-75	49.72	2	25.97	2
Alemaya Composite	50.46	1	28.15	1
Ca 5	36.02	4	22.85	4
Bukuri	33.59	5	19.72	5

Table 2 Grain yield data (Q/ha) for five improved high yielding maize varieties grown on two major soil types occurring in Harerge highlands under fertilized condition and no water conservation on practice.

Variety	Damota Series (1980,81)	Rank	Alemaya Series (1980, 81, 82)	Rank
KCC	52.09	2	48.05	2
EAH-75	55.53	1	47.09	3
Alemaya Composite	48.72	3	53.65	1
Ca 5	36.20	4	38.40	4
Bukuri	35.84	5	36.60	5

Table 3 Grain yield data (Q/ha) for five improved high yielding maize varieties grown on Alemaya series with no fertilization, with and without water conservation practices.

Variety	with H_2O Conserv.	Rank	No H_2O Conserv.	Rank
KCC	42.83	2	25.56	3
EAH-75	36.01	3	25.97	2
Alemaya Composite	48.12	1	28.15	1
Ca 5	28.89	5	22.85	4
Bukurri	29.11	4	19.75	5

Table 4: Grain yield data (Q/ha) for five improved high yielding maize varieties grown on Alemaya series under fertilization, with and without water conservation practices.

Variety	Wtih H_2O Conserv.	Rank	No. H_2O Conserv.	Rank
KCC	65.67	2	48.05	2
EAH-75	59.84	3	47.09	3
Alemaya Composite	71.42	1	53.65	1
Ca 5	47.31	4	38.40	4
Bukurri	40.13	5	36.68	5

Table 5: Grain yield data (Q/ha) for five improved high yielding sorghum varieties grown on two major soil types occurring in Hararge highlands under no fertilization and no water conservation practice.

Variety	Alemaya Soil	Rank	Black soil	Rank
2752	29.65	1	32.55	2
Murra	29.21	3	30.72	4
3235	27.52	4	40.12	1
Al-70	29.32	2	30.89	3
ETS-04946	25.87	5	28.15	5

Table 6: Grain yield data (Q/ha) for five improved high yielding sorghum varieties grown on Alemaya series under no fertilization, with and without water conservation practices.

Variety	With H_2O Conserv.	Rank	No H_2O Conserv.	Rank
2752	31.56	2	29.65	1
Murra	33.95	1	29.21	3
3235	22.88	5	27.55	4
Al-70	29.62	3	29.32	2
ETS-04946	28.43	4	25.87	5

Table 7: Grain yield data (Q/ha) for five improved high yielding sorghum varieties grown on Alemaya series under fertilization, with and without water conservation practices.

Variety	with H_2O Conserv.	Rank	No H_2O Conserv.	Rank
2752	43.14	4	44.40	5
Murra	47.62	1	56.40	1
3235	45.69	3	49.74	3
Al-70	41.47	5	46.31	4
ETS-04946	46.66	2	50.13	2

Table 8: Tuber yield data (Tons/ha) for five improved high yielding potato varieties grown on Alemaya series without and with fertilization.

Variety	Unfertilized	Rank	Fertilized	Rank
Al-250	21.26	1	36.44	1
Al-204	19.91	2	31.54	4
Al-578	18.30	4	36.01	2
Al 572	7.68	5	16.08	5
Al-211	18.95	3	33.71	3

Time of Nitrogen application

Results and Recommendation

1. When recommended rate of Nitrogen was applied, there was no difference in maize grain yield due to differences in time of N application on Alemaya series and Damota series (Tables 1 and 4). When below recommended rate of Nitrogen was applied there was maize grain yield differences due to different time of N application during individual years but there was no statistical difference between the three years average yield.

From the individual year data and field observation of experimental plots, there was observable and significant growth difference between plots where starter fertilizer was applied and those without it during the first 50 days after sowing. (Tables 2,3 and 5).

Higher yields can be obtained if part of the Nitrogen is applied during planting as a starter fertilizer and the remaining when the plant is 50 cm high if higher grain yield is required or at 50% tasseling if higher protien in the grain is required.

2. On Damota soil series no significant yield difference due to difference in time of N application.

3. Generally similar results to those of maize were obtained when the test crop used was sorghum and/or potato. (tables 6,7,8,9,11,12,13,14 and 15).

4. The statistically significant variation of data from one year to the other can be explained by difference in variation of rainfall distribution from one year to the other, from month to month in a year and amount and fair distribution of rainfall during the critical growth period of the crop, which may play a major role in the balance of soil and applied nitrogen.

Method of Phosphorus application

Results and Recommendation

For all crops tested on all the major soil types occuring in Hararge Highlands, Band application of phosphorus (5 cm under the side, two side dressing and one side dressing) gave higher grain yields as opposed to broadcasting. (Summary Tables 1 - 15).

TERMINATION OF DIAPAUSE IN THE LARVAE OF BUSSEOLA FUSCA (FULLER) AT AWASA.

By
Assefa G/Amlak

ABSTRACT

At Awasa (Ethiopia) the termination of diapause of *Busseola fusca* larvae has been studied for three years (1981-1983) under natural conditions by splitting and termination of diapause as indicated by pupation of the larvae occurred from March to May. In an attempt to study the relationship between termination of diapause and external factors increase in relative humidity is strongly correlated with pupation of the diapausing larvae of *B. fusca*. On the other hand decrease in temperature and increase in rainfall are not associated with termination of diapause in the larvae of *B.fusca*.

Introduction

Lepidopterous borers are among the most important insect pests of maize and sorghum with *Busseola fusca* (fuller) as probably the most damaging and wide spread (1,7). Larvae of the maize stalk borer, *B.fusca* go into diapause in the stalks of maize and sorghum (3). Facultative diapause in the larvae of insect occurs during periods of unfavourable conditions particularly in dry seasons (2,4,5,). Development in the diapausing larvae of *B.fusca* can be initiated by bringing them into contact with water (4). Reports from Nigeria, however, showed that water does not terminate diapause in the larvae of *B.fusca* but would rather enhance the emergence of moths from the maize stubbles after development in the diapause larvae has been completed (5). Termination of diapause has been also observed with increasing rainfall and relative humidity and low temperature (2).

The present investigation attempts to show the periods of the termination of diapause in the larvae of *B.fusca* in the maize stalk at Awasa. The study also attempts to findout the relationships between the onset of pupation of diapausing larvae of *B.fusca* and physical factors like temperature, rainfall and relative humidity.

MATERIALS AND METHODS

Infested maize stalks were left in the field after harvest of maize cobs. In 1981 dry season (March - May) some preliminary observations were made by splitting fifty stalks of maize in the field. In 1982 dry season, the observation was started in April and splitting of stalks was carried at regular intervals of ten days. The observation continued up to the end of June. In 1983 dry season, the observation started in January and continued up to the end of May at intervals of ten days. At each interval the stalks examined were randomly selected.

During each observation, population of diapausing larvae was recorded. In addition number of pupae and percent pupation were included in the record in later parts of the observation. All pupae encountered during the observation were allowed to emerge and indentification was done by comparing with previously identified *B.fusca* specimen.

Metereological data on rainfall, temperature and relative humidity were obtained from Awassa Agricultural station (IAR).

RESULTS AND DISCUSSION

The population of diapausing larvae of *B.fusca* in the field in the 1981 dry season was presented in Table 1. In the month of March 1981, sixty nine diapausing larvae and only two pupae of *B.fusca* were recorded. On the other hand in April the population of diapausing larvae dramatically declined while numbers of pupae increased. Observations made in May showed no diapausing larvae in the stalks of maize. The present observation indicated that pupation of diapausing larvae of B.fusca started in March with 2.8% pupation while 89.3% pupation was recorded in April. In the 1981 dry season pupation of diapausing larvae of *B.fusca* completed in May (Table 1).

Table 1. Population of diapausing larvae of *B.fusca* in the field during the 1981 dry season.

Month	No. of diapausing Larvae/50 stalks	No. of pupae /50 stalks	percent pupation
March	69	2	2.8
April	3	25	89.3
May	-	4	100.0

Observation on termination of diapause in the larvae of B.fusca during the 1982 dry season are shown in Table 2. These observations showed that the highest number of diapausing larvae of B.fusca was recorded at the beginning of April while the number of pupae at this time was the lowest (Table 2). Starting with the second week of April the population of diapausing larvae dropped while the number of pupae gradually increased. Around the end of April, 71% of the diapausing larvae of B.fusca pupated (Table 2). Despite the fact that a few diapausing larvae were recorded in early May 1982, pupation of the insect completed around the middle of the same month (Table 2). This could be the reason why all observations made in June indicated only pupal stages eventhough the number was lower than the previous month. The low number of pupae in June could be due to increased emergence of adult moths from pupae.

Table 2 Population of diapausing larva of B.fusca in the field during the 1982 dry season.

Date of observation	No. of diapausing larvae/50 stalks	No. of pupae/50 stalks	percent pupation
1/4/82	22	3	12.0
11/4/82	2	4	66.7
22/4/82	2	5	71.4
3/5/82	2	5	71.4
12/5/82	0	9	100
22/5/82	0	22	
1/6/82	0	3	
11/6/82	0	7	
22/6/82	0	3	

Data on the termination of diapause in the larvae of B.fusca in the 1983 dry season are given in Table 3. There was no sign of termination of diapause in the months of January or February. It was in the last week of March that pupation (7.7%) in the diapause larvae of B.fusca was observed in 1983 (Table 3). The rate of pupation (%) gradually increased reaching 92.9% in last week of April. The remaining diapause larvae 7% pupated in the first week of May (between 1/5/83 and 19/5/83). In general observations made in the 1983 dry season showed that termination of diapause in the larvae of B.fusca started in March and completed in May.

Table 3. Population of diapausing larvae of B.fusca in the field in the 1983 dry season.

Dates of observation	No. of diapausing larvae/50 stalks	No. of pupae/50 stalks	percent pupation
1/1/83	37	0	0
10/1/83	17	0	0
20/1/83	38	0	0
30/1/83	18	0	0
9/2/83	12	0	0
19/2/83	23	0	0
1/3/83	38	0	0
11/3/83	35	0	0
21/3/83	31	0	0
31/3/83	36	3	7.7
10/4/83	19	7	26.9
20/4/83	11	19	63.3
30/4/83	1	13	92.9
10/5/83	0	0	-
20/5/83	0	0	-
30/5/83	0	0	-

The effects of rainfall, relative humidity and temperature on termination of diapause in the larvae of B.fusca has been studied under field conditions at Awasa. Increase in relative humidity has increased the rate of pupation of the diapausing larvae of B.fusca (fig 1). Increase in relative humidity and percent pupation (which is an indication of the termination of diapause in B.fusca larvae) have strong positive correlation with r=0.82 and 0.86 for 1982 and 1983 respectively. Observations on the effects of relative humidity on termination of diapause are in agreement with the works of Harris(2). On the other hand decrease in temperature appeared to have very poor correlation with termination of diapause in the larvae where r=0.25 and 0.05 in two dry seasons. Eventhough diapause in the larvae of B.fusca is broken at the onset of the next rainy season as reported by Hill(3), increase in rainfall was poorly correlated with r=0.28 and 0.41 in 1982 and 1983 dry seasons respectively.

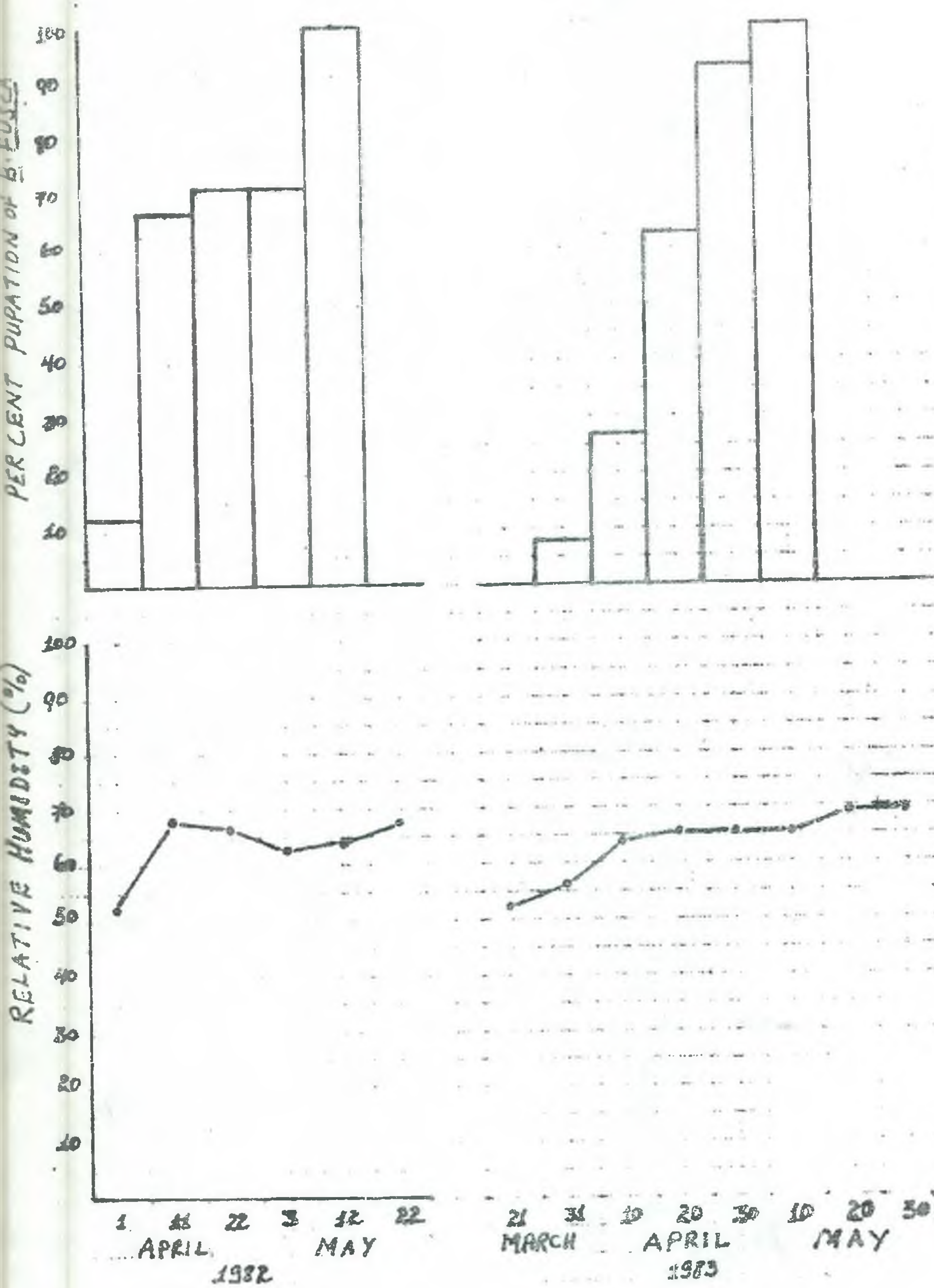

FIG 1. PUPATION OF DIAPAUSING LARVAE OF B. FUSCA AS AFFECTED BY RELATIVE HUMIDITY.

LITERATURE CITED

1. Assefa G/Amlak and Tessema Megenassa. 1981. Some studies on the maize stalk borer, B.fusca (fuller)(Lep: Noctuidae) in southern Ethiopia. M.Sc. Thesis, Addis Abeba University.

2. Harris, K.M 1962. Lepidopterous stalk borers of cereals in Nigeria. Bull. Ent. Res 53: 139 - 171.

3. Hill, S.D. 1975. Agricultural insect pests of the tropics and their control. Cambridge University press, London. 293 - 294.

4. Smithers, C.N. 1959. Some recent observation on B.fusca (fuller) (Lep: Noctuidae) in southern Rhodesia. Bull. Ent. Res. 50: 809 - 819.

5. Swaine, G. 1957. The maize and sorghum stalk borer, B.fusca in peasant agriculture of Tanganyka Territory. Bull. Ent. Res. 43: 711 - 722.

6. Usua, E.J. 1966. Diapause in the maize stem borer. M.Sc. dissertation, University of Ibadan.

7. Walker, P.T. 1976. Development in the maize stem borer control, including use of insecticide granule. Ann. Appl. Biol. 54 (1).

SURVEY OF LEPIDOPTEROUS STEM BORERS ATTACKING MAIZE AND SORGHUM IN ETHIOPIA.

Assefa G/Amlak

ABSTRACT

In the survey of lepidopterous stem borers attacking maize and sorghum which was undertaken in 1982 and 1983 crop seasons in Ethiopia three species of stem borers, namely Busscola fusca, Chilo partellus and sesaamia calamistis were recorded. B.fusca and C.partellus were found to be the major species of stem borer while S.calamistis was a minor pest of sorghum and maize in many localities. B.fusca was the dominant stem borer species in higher altitudes (1160 to 2500m) and cooler areas whereas C.partellus was the most important stem borer in the work and lower altitude areas (510 to 1690m) S.calamistis was recorded at lower to medium altitude areas (1200 - 1750m) in Ethiopia. Along with the stem borer species, two parasites, Apanteles sesamiae, a larval parasite and procerchasmias nigromaculaus, a pupal parasite were recorded in the survey. In addition, earwings diaperestcum erythrocephal were recorded as predators of larvae B.fusca in one of the localities.

INTRODUCTION

Maize and sorghum which are among the major cereal crops in Ethiopia ususaly suffer from attack of lepidopterous stem borer. According to a preliminary survey in 1980 crop season three species of lepidopterous borers, Busscola fusca, Chilo partellers and sesamia calamistis were recorded in southern Ethiopia (1), These stem borers are wide spread all over maize and sorghum growing regions in the country.

Reports from some other African countries showed that the maize stalk borer B.fusca is the most wide spread and notorious species of all borers attacking maize and millets in the African continent (6). It was recorded in East Africa at altitudes of 600 to over 2700m (2). The pest seems to be of greater importance at high altitudes (3). Recent survey in Kenya had similar results in that B.fusca was found to be the dominant stem borer species in the cooler and higher altitude areas above 1140m (5).

Chilo partellus is the most improtant species of stalk borers found at low altitudes, particularly the East African Coast region (3). According to Hill (4) C. partellus is essentially a pest of hot lowland areas and is seldom seen above an altitude of 1500m. On the other hand in Kenay, it was recorded at altitudes of 21 to 1670. (5).

However, there are few records of the species of the lepidopterous stem borers and their distribution in Ethiopia.

This study, therefore. was initiated

1. to find out the species of lepidopterous stem borers attacking maize and sorghum.

2. study the general distribution pattern of the stem borers by altitudes.

3. determine the major species of stem borers in the country.

4. record natural enemies of the target pests in Ethiopia.

MATERIALS AND METHODS

The survey of lepidopterous stem borers attacking maize and sorghum was carried out in 1982/83 and 1983/84 crop seasons in six administrative regions, namely Gamo Gofa, Kefa, Illubabor, Hareghe, Sidamo and Welega. These administrative regions are the major maize and sorghum producers in Ethiopia. In each administrative region, fields of maize or/and sorghum were inspected for signs of lepidopterous stem borer infestation. After indentification of the infested field, altitudes and names of localities were recorded. Twenty infested maize of sorghum plants were dissected with knife from each locality to find out the species of stem borers involved in damaging the crop in that particular locality. Larvae of common species of stem borers were readily identified in the field and recorded for that locality. In addition some of the larvae were kept in vials with spirit solution. Some other larvae or/and pupae in stalks were kept in plastic tubes for further identification. Upon emergence, the moths were kept in insect boxes having the following information date of collection, locality, altitude and administrative region on the label.

These moths were compared with the already identified speciment of lepidopterous stem borers to confirm the field identification. At the same time parasites of the stem borers were collected from larvae and pupae kept in the plastic tubes during the survey. Identification of the parasites were made by comparing with speciment previously identified.

Major or minor species of stem borers were determined at each locality by taking counts of larvae, pupae and moths for each species. Species of relatively high counts were considered to be the major stem borers in each locality where the survey was undertaken.

RESULTS AND DISCUSSION

Reference to Table 1 indicates that two species of stem borer, namely B.fusca and C.partellus were recorded in Illubabor. B.fusca was found to be the major pest of sorghum and maize in localities with altitudes above 1600m. The same species of stem borer was widely distributed compares with the other species of stem borer (Table 1). C.partellus which was second stem borer species in Illubabor was limited to areas of low altitude. It was recorded as a major stem borer at Gambela with altitudes of 510 - 540m.

Table 1. Species of stem borers, their distribution by altitude in Illababor administrative region.

Locality	Altitude (m)	Species recorded	Major species
Bedele	2000	B.fusca	B.fusca
Chora	1900	B.fusca	B.fusca
Metu	1800	B.fusca	B.fusca
Metu	1740	B.fusca	B.fusca
Bure	1630	B.fusca	B.fusca
Bure	1590	Busscola fusca	unknown
Gambella	510 - 540	Chilo partellus	C.partellus

Data for species of lepidopterous stem borers and their distribution in Kefa are presented in Table 2. Two species of stem borers were recorded in Kefa administrative region. Out of these stem borer species. B.fusca was the most predominant and widely distributed stem borer in the region. It covers a wide range of altitudes 1160 to 2080m. On the other hand C.partellus was recorded obly at Gibe with altitude of 1160m. Even at Gibe which was the lowest area included in the survey, C.partellus was not a major of maize of sorghum (Table 2).

Table 2. Species of stem borers, their distribution by altitude and status in Kefa administrative region.

Locality	Altitude (m)	Species recorded	Major Species
Dedo	2190	-	-
Mana	2080	B.fusca	B.fusca
Sokoru	1910	B.fusca	unknown
Sokoru	1830	B.fusca	B.fusca
Seka	1780	B.fusca	B.fusca
Dedo	1760	B.fusca	B.fusca
Goma	1600	B.fusca	B.fusca
Gibe	1450	B.fusca	B.fusca
Gibe	1340	B.fusca	B.fusca
Gibe	1250	B.fusca	B.fusca
Gibe	1160	B.fusca C.partellus	B.fusca

Records of Gamo Gofa administrative region in Table 3 shows that there are three stem borer species attacking maize and sorghum. These are B.fusca C.partellus and S.calamistis. B.fusca was recorded from all localities with altitudes of 1200 to 2310m (Table 3), although its importance declined below 1850m.

C.partellus was the most important insect pest in the localities with altitudes of 1200 to 1690m. S.calamistis was recorded at low and intermediate altitude areas of Gamo Gofa but was not a major stem borer species.

Table 3. Species of stem borers, their distribution by altitude and status in Gamo Gofa administrative region.

Locality	Altitude (m)	Species recorded	Major species
Kete	2310	B.fusca	B.fusca
Arguba	2200	B.fusca	B.fusca
Sorfella	2000	B.fusca	B.fusca
Wolyte	1850	B.fusca	B.fusca
"	1690	B.fusca C.partellus	B.fusca
Dogato	1600	B.fusca C.partellus, S.calamistis	C.partellus
Wolyte	1500	B.fusca C.partellus	C.partellus
Konso	1400	B.fusca C.partellus	C.partellus
"	1300	B.fusca C.partellus	C.partellus
Wazeka	1255	B.fusca C.partellus S.calamistis	C.partellus
Chano Mille	1230	B.fusca C.partellus S.Calamistis	C.partellus
Ulgo	1200	B.fusca C.partellus S. Calamistis	C.partellus

Data for species of stem borers attacking maize and sorghum and their distribution in Harerghe administrative region are presented in Table 4. Three species of stem borers, namely B.fusca, C.partelles, S.calamistis were recorded. B.fusca was found to be the major stem borer above 1700m. However, its importance as a pest of maize and sorghum declined above 2500m. This was noticed in Chercher and Karamille where fields of maize or sorghum did not suffer from serious damage inspite of slight leaf or stalk infestation. The lowest altitude area where B.fusca was recorded in Harerge administrative region was Asebot (1520) where it is no more an improtant pest.

C. partellus seems to be of greater importance to low altitude areas below 1700m (Table 4). It was the only stem borer species observed attacking maize and sorghum below 1200m. For example at Buri Arba (1150m) and MelkaWerer (750m) C.partellus was the major and the only stem borer species recorded. On the other hand S.calamistis was recorded in some localities with altitude of 1200 to 1960m (Table 4). However, results of the survey in Hararghe administrative region showed that S.calamistis is not among the major species of stem borers except at Asaliso where it was observed to be of equal importance when compare with C.partellus (Table 4).

Table 4. Species of stem borers, their distribution by altitudes and status in Hararge administrative region.

Locality	Altitude (m)	Species recorded	Major species
Hadess (chercher)	2600	-	-
Beroda (Karamille)	2500	B. fusca	unknown
Kulubi	2300	B. fusca	unknown
Alemaya	2050	B. fusca	B. fusca
Killiso (chercher)	1820	B. fusca	B. fusca
Jijiga	1690	B. fusca, C. partellus S. calamistis	C. partellus
Asebot	1520	B. fusca C. partellus S. calamistis	C. partellus
Huss sodoma (Meiso)	1450	C. partellus S. calamistis	C. partellus
Babile	1400	C. partellus S. calamistis	C. partellus
Asaliso (Urso)	1200	C. partellus S. calamistis	S. calamistis C. partellus
Buri Arba	1150	C. partellus	C. partellus
Melka Werer	750	C. partellus	C. partellus

Reference to Table 5 indicates that there were three stem-borers species recorded on maize and sorghum in Sidamo administrative region. These were B.fusca, C.partellus and S.calamistis. Out of the three species, ~~B.fusca~~ seems to be wide spread in that it was recorded in all localities where the survey was undertaken. It is the major stem borer in areas with altitudes of 1550 to 2450m. However, it was not recorded as a dominating stem borer species at Yabelo (1700m) which seems to be warmer than Samero Gambela (1550m). C.partellus was recorded from two localities, Negele and Yabelo (Table 5). In these two localities C.partellus was recorded as the major stem borer species.

Despite the fact that S.calamistis was recorded at Awassa and Samero Gambela it was not found to be the major insect pest either on maize or sorghum in Sidamo administrative region.

Table 5. Species of stem borers, their distribution by altitudes, and status in Sidamo administrative region.

Locality	Altitude (m).	Species recorded	Major species
Fisseha Genet	2450	B.fusca	B.fusca
Fisseha Genet	2260	B.fusca	B.fusca
Kibre Mengist	1990	B.fusca	B.fusca
Damot Woyde	1900	B.fusca	B.fusca
Aleta Wendo	1860	B.fusca	B.fusca
Awassa	1750	B.fusca, S.calamistis	B.fusca
Yabelo	1700	B.fusca C.partellus	C.partellus
Samero Gambela	1550	B.fusca S.calamistis	B.fusca
Negele Borana (liben)	1470	B.fusca C.partellus	C.partellus

Lepidopterous stem borers of maize and sorghum in Welega administrative region are given in Table 6. Two stem borer species, namely B.fusca and S.calamistis were recorded. Despite the fact that S.calamistis was observed in one of the localities (Mendi) B.fusca appeared to be the most improtant stem borer species in Welega. It was recorded from all localities except Didessa state farm where all the crop residues are destroyed often after harvest. On the other hand C. partellus which was the most improtant stem borer at lowland areas of Gamo Gofa, Harerge, Illubabor and Sidamo was not sampled from Welega. Absence of C.partellus could be accounted to cool condition in Welega administrative region.

Table 6. Species of stem borers, their distribution by altitudes and status in Welega administrative region.

Locality	Altitude (m)	Species recorded	Major species
Rob Gebia	1950	B.fusca	B.fusca
Enago	1900	B.fusca	B.fusca
Nedjo	1800	B.fusca	B.fusca
Sibu Sire	1800	B.fusca	B.fusca
Nedjo	1640	B.fusca	B.fusca
Hoha Settlement	1520	B.fusca	B.fusca
Mendi	1490	B.fusca S.calamistis	B.fusca
Wama state farm	1480	B.fusca	unknown
Diga	1355	B.fusca	unknown

Natural enemies of the stem borers of maize and sorghum in Ethiopia are shown in Table 6. There were two parasites recorded in the survey. These were Apanteles sesamiae (larval parasite of B.fusca, C.partellus and S.calamistis) and procerachasmias nigromaculaus (a pupal parasite of B.fusca and C.partellus). Out of these two parasites, A.sesamiae was found to be wide spread in most of the administrative regions included in the survey while p.nigromaculaus was recorded only in Kefa, Sidamo and Welega. Records of the parasites of the current study are in agreement with that of 1980 in Southern Ethiopia (1)

In addition earwings, Diaporasticus erythrocephala was observed preying upon B.fusca larvae at Dembi Dolo (Welega) for the first time.

Table 7 Natural enemies of stem borers of maize and sorghum in Ethiopia

	Natural enemies recorded	
Administrative region	parasites	predators
Gamo Gofa	Apanteles sesamiae	- -
Keffa	A.sesamiea procerachasmia nigromaculaus	-
Illubabor	P. nigromaculaes	-
Hrerge	A.Sesamiae	-
Sidamo	A.sesamiae P. nigromaculaus	-
Welega	A.sesamiae	D.erythrocephala

Conclusions

Out of the three species of stem borers, B.fusca, C.partellus S.calamistis recorded in the survey, B.fusca and C.partellus were found to be the major stem borer species in Ethiopia. B.fusca was a dominant stem borer in the higher altitude and cooler areas whereas C.partellus is the important stem borer species in the warm and lower altitude areas.

There are some conflicting reports regarding distribution of these two major stem borer species in Africa. For example Hill (4) states that B.fusca is the major pest in areas with altitudes greater than 700m while de pury (3) says that B.fusca is seldom seen below 900m. Bohlen (2) reported that B.fusca and C.partellus occur at altitudes of 600 to over 2700m and 0-1500 respectively. On the other hand recent work in Kenya showed that C,partellus is found to be the most important stem borer species at altitudes of 21 to 1670m (4).

In Ethiopia B.fusca os the predominant stem borer species at higher altitudes in Gamo Gofa, Hararge and Sidamo above 1700m wheras in Kefa, Illubabor and Welega it is improtant even at altitudes below 1700m. In keffam for example B.fusca was the major stem borer all throughout the surveyed localities at altitudes of 1160 to 2080m. Illubabor, it maintains its status as a major pest at altitudes of 1590 to 2000 meters except at Gambella (510-540m) where it was replaced by C.partellus.

C.partellus was recorded at altitudes of 510 to 1690m in Ethiopia. In Gamo Gofa, Harerge and Sidamo, it was observed to be the major stem borer below 1700m. The situation appeared to be different in Western Ethiopia. No record of C.partellus was made in Welega at even altitudes below 1700m. A single moth of C.partellus was recorded in Kefa at Gibe (1160m) where B.fusca was still the major stem borer. It became the most improtant stem borer species in Gambella at altitudes 510 to 540m.

The difference in population of either B.fusca or C.partellus on similar altitude but in different administrative regions could be attributed to difference in rainfall, relative humidity and temperature in the west and the other parts of the country. Reports in East Africa showed that distribution of stem borer species is influenced by the above mentioned factors (5). Therefore, this study suggests that ecology of each species of stem borers should be studied.

S.calamistis was not found to be a major stem borer species in Ethiopia. As reported by Hill (4) it could have sporadical improtance in some administrative regions like Gamo Gofa, Hararge and Sidamo.

ACKNOWLEDGEMENT

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LITERATURE CITED

1. Assefa G/Amlak 1981. Some studies on the maize stalk borer, B.fusca (Fuller) (Lep: Noctuidae) in southern Ethiopia, M.Sc these in Addis Abeba University.

2. Bohlen, E.1973. Crop pests in Tanzania and their control. Verlag Paul Parey Berlin. pp 86-87.

3. de pury, J.M.S. 1974. Crop pests of East Africa. Oxford University press, Nairobi. pp 115-116.

4. Hill, S.D. 1975. Agricultural insect pests of the tropics and their control. Cambridge University press, London. pp 293-294.

5. International center for Insect Physiology and Ecology. 1981. Ninth annual report. Nairobi pp 26-28.

6. Jepson, W.K. 1954. Critical review of the lepidoptorous borers of graminecous crops. 127 pp. London. Common w. Inst. Ent.

POPULATION DYNAMICS OF BARLEY APHIDS

by

Adugna Haile

Introduction:

In Ethiopia barley is attacked by several insect pests such as grasshoppers, Barley fly, army worm, etc. But in recent years it was being attacked by aphids. The problem of this pest was first reported in May 1974 in Tigrai Administrative Region around Adigrat and Atsbi. A year or two later the problem was reported in Welo. At present aphid infestations are reported from all barley and wheat growing areas, specially in those areas where barley is growing over 2400 meters above sea level. Besides this, the problem of aphids is severe when barley or wheat is grown under low rainfall conditions or during the dry season. At this time the population of the aphids increases rapidly and causes crop damage.

Objective:

The objective of this study was to observe the population build-up of the different aphid species during the growing season so that time of control can be identified and recommended to users.

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Materials and Methods:

The observation was carried out at Chacha. Locally available variety of barley was sown at the rate of 100 kg/ha on 3m X 5m plot, non-replicated. The spacing between rows was 20cm. and fertilizer was applied at the rate of 57/57 Urea/DAP.

Beginning on the 15^{th} day after germination, twenty plants were sampled at random and every ten days there after plants were pulled out and put in plastic bags. The aphids were separated into their species and were counted. Any new species found was identified. This procedure continued approximately every 15 days until the maturity of the crop.

Results and Discussions:

Fig 1-3 show patterns of species distribution during the growing season. In the study, it was observed that barley was attacked by several aphid species such as Diuraphis noxius, Rhopalosiphum maidis, Sitobion spp., Metaplophium dirhodum and Sehizaphis graminum. Among these, D.noxius is the most important followed by R.maidis. The rest of the species are minor; their populations were low and they appeared irregularly.

The population of D.noxius increases with the decrease of moisture or during low rainfall periods (Fig 1-3). But once sufficient rain starts, its population declines (Fig. 1-3). For example, the rain in 1981 started early in July and the population of the aphid declined early at 41 aphids / tiller (Fig. 1). On the other hand, in 1982 and 1983 the rain started late in July, and the populations of the aphids reached 87 and 95 aphids / tiller respectively. But after the on-set of rain the population of the aphid declined (Fig. 2 and 3.)

During the study the pupulation of the natural enemies was also followed-up. <u>Aphidius hortensis</u> and <u>Aphidius seliger</u> among parasitoides and <u>Adonia varicgata</u> among predators were the most important ones. But their population remained low throughout the season with 1.6 to 9.2% level of parasitism and 0.01 to 0.3 predators per plant. This showed that the efficiency of the natural enemies is low, and they appeared late in the season when the aphid population was at its maximum build-up.

<u>Conclussion:</u>

Barley is attacked by several species of aphids, of which <u>D.noxius</u> is the most important. The population of this aphid builds up during the dry or low rainfall conditions. Therefore, in areas where the rainfall condition is scanty, barley should not be grown. However, if it is grown, control measures (in the Chacha areas) should out carried be early and late June to avoid crop damage.

Fig 1 : Aphid Population Build - up During the growing Season of Barley, 1981

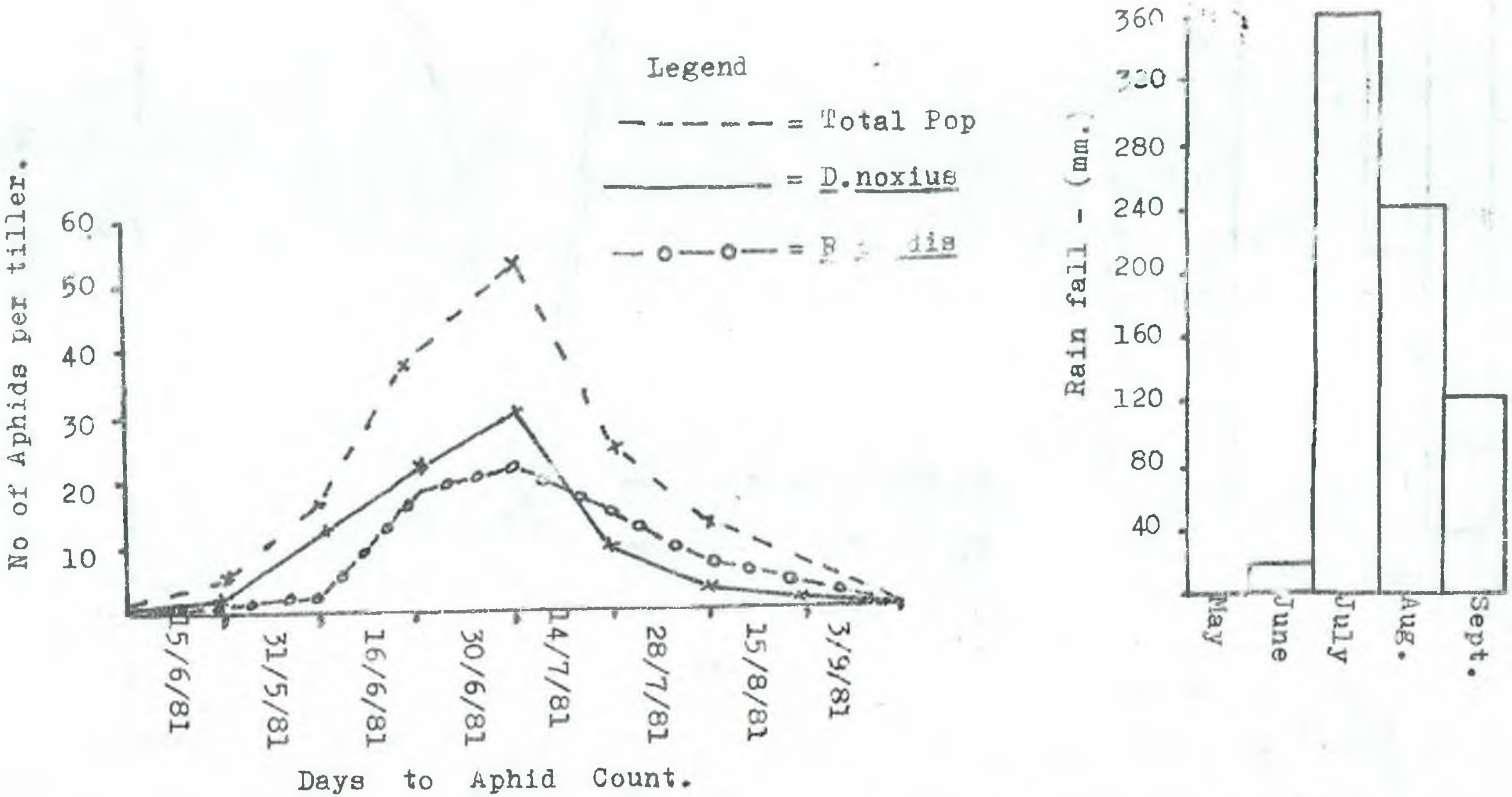


Fig. 2 Aphid Population Build - up During the Growing season of Barley, 1982.

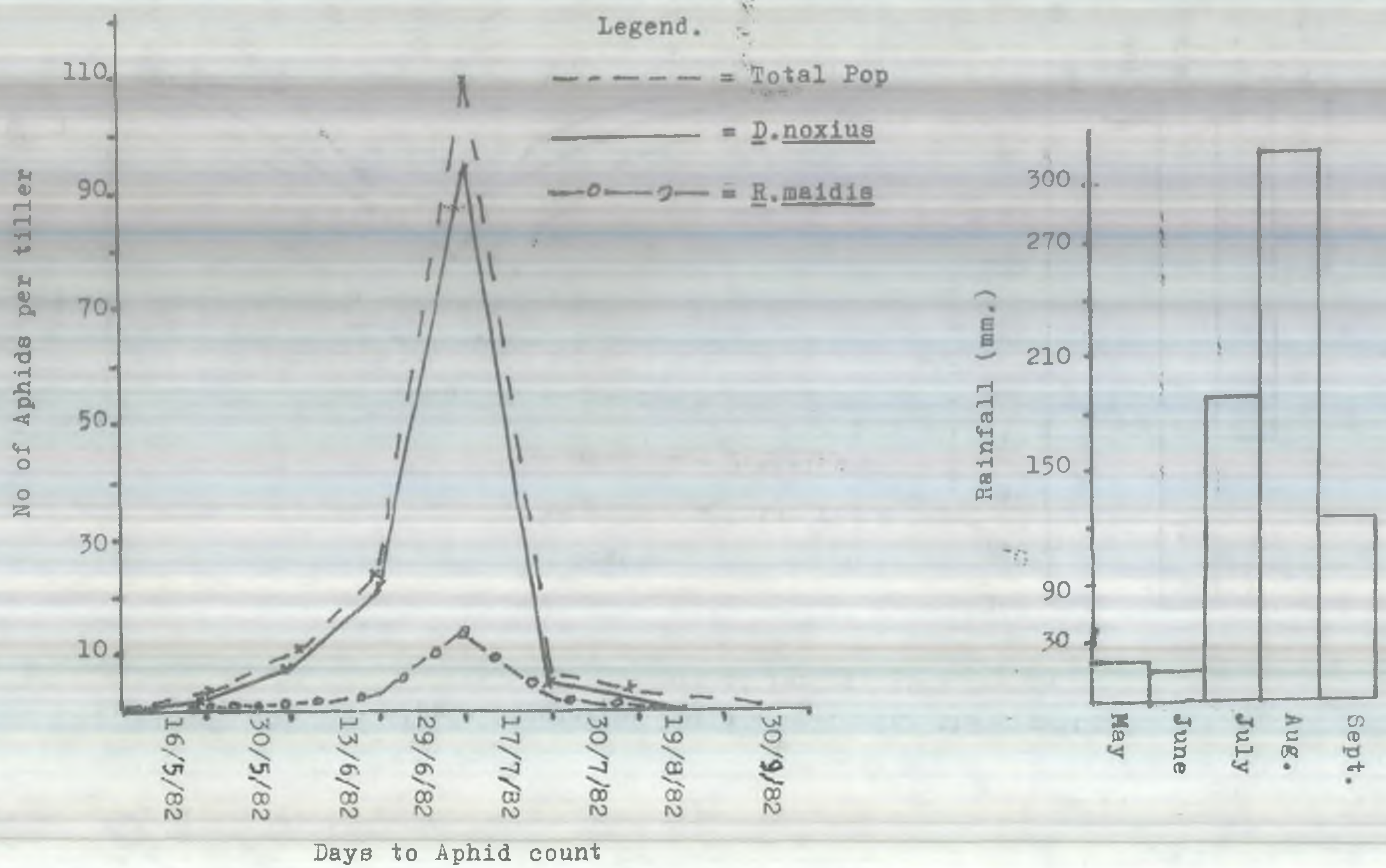
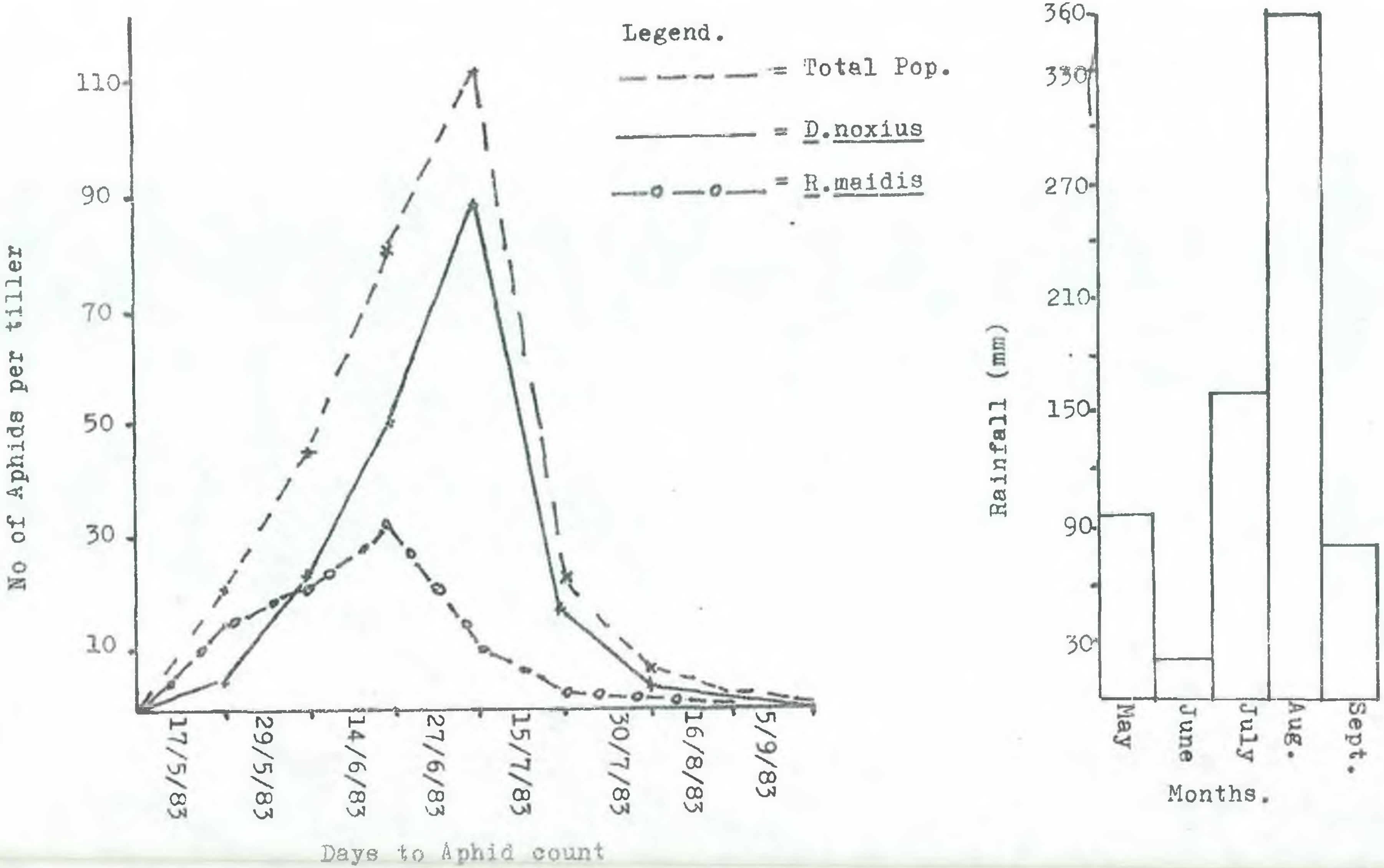


Fig. 3 : Aphid Population Build - up During the Growing season of Barley, 1983



CHEMICAL CONTROL OF BROAD LEAVED WEEDS IN WHEAT AND BARLEY [1]

Rezene Fessehaie [2]

ABSTRACT

The activities of post-emergence applocation of Brominal, Brominal Plus, Blefit, Springclene, Lontrel, Cleaval, Hormoprop, Dipro, Mepro-Special, Dicamba + CMPP Hormothuho Super, and Britox against broad-leaved weeds in wheat and Barley were assessed. Each herbicide was tested at 3 different rates. A twice weeded and untreated (weedy check) treatments were included for comparision. The effect of broad-leaf weeds on wheat and Barley development appeared to be density dependent under overage growth conditions. Moderate infestations of several broad-leaf weed species did not significantly affected both crops. Consequently adequate control with some of the good herbicides resulted only in small yield increases. Among the major broad-leaved weeds. Polygonum nepolense, Corrigiola littoralis and Oxalis sp. were found to be susceptible to all herbicides tested. Hormoprop Dipro, Hormothuho Super failed to give effective control of Galium spurium but moderate control of this weed was obtained by the rest of herbicide treatments. In wheat, Britox, Spring clene, Dicamba + CMPP, Cleaval, Hormoprop and Lontrel showed better selectivity. On the other hand the best herbicide treatments in Barley were: Britox, Spring clene, Cleaval, Lontrel, Dicamba + CMPP and Mepro-Special.

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[1] Paper presented at the 1984 National Crop Improvement Conference.

[2] Assistant Research Officer
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Holetta.

Table 1 Chemical Control of Bread-leaved Weeds in Wheat - 1982/83 - Holetta

Treatments	Rate in litres a.i/ha	Crop Phytotoxicity Score*	Bread leaf Weed Control %	Wheat yield Q/ha
Weedy Check			0.0**	
Weeded "			71.20	46.44
Hormoprop	1.2	4.5	65.0	27.92
"	1.5	2.5	64.40	36.06
"	1.8	3.5	75.2	36.12
Dipro Hormoprop	1.6	2.5	27.8	40.32
Dipro	1.0	2.5	27.0	40.02
"	2.0	3.0	36.6	35.64
"	2.4	2.5	51.4	42.27
Mepro-special	0.9	2.5	60.6	42.80
"	1.2	2.0	79.8	36.34
"	1.5	2.0	67.6	41.61
Dicamba + CMPP	1.04	4.0	76.0	41.94
"	1.73	2.0	84.8	40.30
"	2.07	2.0	77.0	40.60
Hormotnuho Super	0.5	3.5	18.0	41.14
"	0.625	2.0	41.0	42.33
"	0.75	4.0	45.4	43.35
Britox	0.3	2.0	58.4	39.04
"	0.5	1.0	70.4	43.03
"	0.7	1.0	84.2	52.40
Mean				40.41
S.E.				± 4.88 N.S
CV%				21%

x Crop Phytotoxicity - Scale, 1.0. - 9.0

Where 1.0 represents no effect on the crop and 9.0 repreesent crop damage.

xx Number of Broad-leaf weed plants/m^2 in the weedy check was

Table 2 Chemical Control of Broad-leaf Weeds in Wheat 1983/84 - Holetta

Treatments	Rate in litres a.i/ha	Crop Phytotoxicity Score*	Broad-leaf Weed control %	Wheat yield Q/ha
Weedy Check		1.0	0.0**	8.39
Weeded "		1.0	61.11	16.93
Hormoprop	1.2	2.5	13.61	13.68
"	1.5	3.0	55.0	12.19
"	1.8	2.5	68.8	15.31
Dipro	1.6	2.5	52.77	13.91
"	2.0	3.5	63.61	12.34
"	2.4	3.5	60.0	15.31
Mepro special	0.9	2.5	65.0	11.42
"	1.2	3.0	54.4	11.94
"	1.5	3.0	85.20	13.48
Dicamba + CMPP	1.04	2.5	81.94	14.33
"	1.73	2.5	85.55	12.78
"	2.07	2.5	80.83	15.18
Hormothuho Super	0.5	3.0	54.16	9.08
"	0.625	2.5	44.16	12.26
"	0.75	2.5	63.05	14.45
Britox	0.3	3.0	82.50	13.12
"	0.5	2.0	78.05	16.03
"	0.7	2.0	57.57	20.13
Mean				13.61
S.E				± 1.87
LSD 0.05				5.34
CV				24%

* Crop Phytotoxicity - scale 1.0-9.0
where 1.0 represents no effect on the crop and 9.0 represents complete crop damage.

** Number of Broad-leaf weed plants/m^2 in the weedy check was

Table 3 Chemical Control of Broad-leaf Weeds in Wheat
1982/83 - Holetta

Treatments	Rate in litres a.i/ha	Crop Phytotoxicity Score*	Broad-leaf Weed Control %	Barley yield Q/ha
Weedy Check			0.0 **	27.59
Weedy "			78	47.42
Brominal	0.84	2.0	35	40.10
"	0.72	1.0	32	46.36
"	0.96	2.0	52	39.96
Brominal Plus	0.48	2.0	40	40.24
"	0.72	4.0	45	34.32
"	0.96	2.0	51	40.02
Blefit	1.5	1.0	26	46.58
"	2.0	2.0	45	49.76
"	2.5	4.0	48	36.09
Spring clene	0.425	3.0	71	42.79
"	1.75	1.0	78	46.26
"	1.95	3.0	70	44.4
Lontrel	0.9	3.0	37	25.65
"	1.2	1.5	45	39.06
"	1.5	2.0	55	39.21
Cleaval	1.5	2.0	32	35.75
"	2.5	4.0	58	30.37
"	3.5	3.5	80	27.63
Mean				38.98
S.E				± 5.8 ns
LSD 0.05				
CV %				27 %

* Crop phytotoxicity - scale 1.0-9.0
where 1.0 represents no effect on the crop and 9.0 represents complete crop damage

** Number of Broad-leaf weed plants/m^2 in the weedy check was

Table 4 Chemical Control of Broad-leaved Weeds in Barley 1983/84 - Holetta

Treatments	Rate in litres a.i/ha	Crop phytotoxicity score *	Broad-leaf Weeds Control %	Barley yield Q/ha
Weedy Check			0.0 **	7.91
Weeded "			71.92	16.14
Brominal	0.48	6.0	0.0	11.02
"	0.72	5.0	0.45	13.3
"	0.96	4.0	11.41	14.19
Brominal Plus	0.48	3.5	2.85	14.93
"	0.72	5.5	38.34	13.08
"	0.96	5.0	54.80	13.41
Blefit	1.5	5.0	- 19.0	11.16
"	2.0	4.0	- 10.0	13.61
"	2.5	3.0	16.37	15.65
Spring clene	0.425	3.0	63.96	17.65
"	1.75	5.0	63.21	20.50
"	1.95	4.0	71.02	17.65
Lontrel	0.9	4.0	17.42	11.29
"	1.2	5.0	70.27	16.61
"	1.5	4.0	85.89	14.45
Cleaval	1.5	4.0	40.69	14.27
"	2.5	4.5	48.05	13.55
"	3.5	4.5	35.59	16.19
Mean				14.66
S.E				± 1.78
LSD 0.05				5.09
CV				21.0%

* Crop phytotoxicity - Scale 1.0 - 9.0
where 1.0 represents no effect on the crop and 9.0 represents complete crop damage

** Number of Broad-leaf weed plants/m^2 in the weedy check was:

Table 5 Herbicide activity against major broad-leaf weeds.

Herbicides	Polygonum nepalense	Galium spurium	Spergula arvensis	Corrigiala Littoralis	Plantago lanceolata	Oxalis latifol
Brominal	+	+	−	++	+	+
Brominal Plus	+	+	−	+	+	+
Blefit	+	+	−	++	−	+
Springclone	+	+	+	+	+	+
Lontrel	++	+	+	++	+	+
Cleaval	++	+	−	++	+	+
Hormoprop	++	−	+	++	−	+
Dipro	+	−	+	++	+	+
Mepro-Special	+	[illegible]	+	+	+	+
Dicamba + CMPP	++	+	+	+	+	+
Hormothuho Super	+	−	−	[illegible]	+	+
Britox	+	+	−	+	[illegible]	+

Key

− Shows no activity

+ Moderate activity

++ Excellent activity

Table 1 1 Chemical Control of Broad-leaved Weeds in Barley 1982/83

Treatments	Rate in litres a.i/ha	Crop phytotoxicity Score**	Broad-leaf Weed Control %	Barley yield Q/ha
Weedy check		1.0	0.0**	21.05
Weeded "		1.0	47.45	23.15
Hormoprop	1.2	2.5	57.64	23.26
"	1.5	3.5	31.71	22.60
"	1.8	4.0	66.06	18.69
Dipro	1.6	3.0	19.68	19.36
"	2.0	3.0	44.68	21.40
"	2.4	4.0	31.71	21.50
Mepro Special	0.9	2.5	68.29	23.08
"	1.2	3.5	69.68	22.76
"	1.5	5.0	76.85	20.82
	1.04			
Dicamba + CMPP	1.73	3.5	52.55	21.15
"	2.07	5.0	73.15	17.33
"		4.0	75.93	21.71
Hormothuho Super	0.5	3.0	13.19	24.44
"	0.625	3.0	18.06	23.35
"	0.75	3.5	36.57	26.39
Britox	0.3	2.5	67.59	25.42
"	0.5	2.5	68.75	25.39
"	0.7	5.0	93.52	21.34
Mean				22.21
S.E.				± 2.55 n.s.
CV				20.0%

* Crop phytotoxicity – Scale 1.0 – 9.0
Where 1.0 represent no effect on the crop and 9.0 represents complete crop damage.

** Number of Broad-leaf weed plants/m^2 in the weedy check was

Table 2 Chemical Control Broad-leaved Weeds in Barley
1983/84 - Holetta

Treatments	Rate in litres a.i/ha	Crop phytotoxicity Score *	Broad-leaf weed control %	Barley Yield Q/ha
Weedy check			0.0 **	13.19
Weeded "			46.71	16.83
Hormoprop	1.2	4.0	70.90	18.22
"	1.5	3.0	67.79	20.67
"	1.8	3.0	75.54	15.71
Dipro	1.6	5.0	38.95	16.86
"	2.0	3.0	53.28	15.70
"	2.4	3.0	70.65	13.15
Hepro-Special	0.9	5.0	47.89	13.90
"	1.2	4.0	69.47	18.25
"	1.5	3.0	66.28	16.77
Dicamba CMPP	1.04	3.0	75.04	17.73
"	1.73	2.0	78.24	19.85
"	2.07	4.0	77.57	17.28
Hormothuho-Super	0.5	5.0	23.27	15.69
"	0.625	5.0	35.41	14.83
"	0.75	3.5	18.04	14.79
Britox	0.3	3.0	32.37	15.20
"	0.5	3.0	48.73	18.14
"	0.7	2.0	41.98	21.62
Mean				16.72
S.E				± 2.36 ns
CV %				24%

* Crop phytotoxicity - Scale 1.0 - 9.0
Where 1.0 represents no effect on the crop and 9.0 represents complete crop damage.

** Number of Broad-leaf weed plants/m^2 in the weedy checks was

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Table 3 Chemical Control of Broad-leaf weeds in Barley 1982/83 - Holetta

Treatments	Rate in litres a.i/ha	Crop phytotoxicity Score*	Broad-leaf Weeds control	Barley Yield q/ha
Weedy check			0.0**	21.23
Weeded "			77.0	35.04
Brominal	0.48	4.5	13.6	24.56
"	0.72	4.0	31.9	29.05
"	0.96	4.5	36.1	19.29
Brominal plus	0.48	3.5	24.1	30.53
"	0.72	5.0	6.8	23.24
"	0.96	5.0	42.4	15.04
Blefit	1.5	6.0	19.9	17.28
"	2.0	4.5	- 2.4	23.48
"	2.5	4.0	23.7	23.79
Springclene	0.425	2.0	63.1	34.74
"	1.75	3.0	74.9	24.74
"	1.95	3.0	66.4	29.93
Lontrel	0.9	5.0	28.5	23.01
"	1.2	3.0	46.4	27.72
"	1.5	2.5	24.6	35.48
Cleaval	1.5	3.0	36.4	23.45
"	2.5	3.0	47.8	36.68
"	3.5	2.0	53.9	31.59
Mean				26.49
S.E				± 4.65 ns
LSD 0.05				
CV%				30%

Mea

Crop phytotoxicity - Scale, 1.0 - 9.0

Where 1.0 represents no effect on the crop and 9.0 represents complete crop damage

Number of Broad-leaf weeds plants/m^2 in the weedy check was

Table 4 Chemical Control of Broad-leaf weeds in Wheat
1983/84 Holetta

Treatments	Rate in litres a.i/ha	Crop phytotoxicity Score *	Broad-leaf Weed Control %	Wheat yield q/ha
Weedy check			0.0**	14.57
Weeded "				20.80
Brominal	0.48	2.0	-26.44	13.57
"	0.72	3.0	9.1	13.38
"	0.96	2.5	13.37	14.79
Brominal plus	0.48	3.0	31.3	14.61
"	0.72	2.5	36.77	16.94
"	0.96	3.0	58.66	14.50
Blefit	1.5	2.0	3.03	17.72
"	2.0	2.0	51.97	20.55
"	2.5	2.0	61.39	19.02
Spring clene	0.425	2.0	82.06	18.76
"	1.75	2.5	66.26	20.03
"	1.95	2.5	80.54	19.00
Lontrel	0.9	2.0	73.55	17.13
"	1.2	2.5	79.02	17.57
"	1.5	2.0	84.49	17.95
Cleaval	1.5	2.0	65.65	18.16
"	2.5	2.0	45.89	17.01
"	3.5	3.0	79.93	18.08
Mean				17.21
S.E				±1.29
LSD 0.05				3.68
CV				13.

* Crop phytotoxicity - Scale 1.0 - 9.0
Where 1.0 represents no effect on the crop and 9.0 represents complete crop damage.

** Number of Broad-leaf weed plants/m^2 in the weedy check was

Appendix 1 Details of the Herbicides Tested

Common Name	Trade Name	Formulation	Manufacturer
	BLEFIT	500 FW	CIBA GEIGY
Mecoprop + Bromoxynil + Loxynil	BRITOX	20 % EC	MAY and BAKER
Bromoxynil	BROMINAL	48% EC	AMCHEM
Bromoxynil + MCPA	BROMINAL PLUS	48% EC	AMCHEM
Mecoprop + Cynazine	CLEAVAL		SHELL
Dicamba + CMPP		34.5% EC	VELSICOL
Dichloroprop + MCPA	DIPRO	80% EC	KIMRAS
Mecoprop + MCPA	HORMOPROP	60% EC	KIMRAS
MCPA	HORMOTHUHO SUPER	25 WP	KIMRAS
	LONTREL	300 g. a.e/l	DOW CHEMICALS
Mecoprop + MCPA + Dicomba	MEPRO SPECIAL	47.2 % EC	KIMRAS
Mecoprop + Bromoxynil + Toxynil + Linuron	SPRING CLENE	39%	FISONS

The Use of Trap Crops for the Control of African Bollworm on Haricot Bean

By

Tsedeke Abate

ABSTRACT

In an attempt to establish integrated pest management of the African bollworm (ABW), Heliothis armigera, experiments with trap crops to divert the egg laying moth from the main crop were carried during the 1981/82 to 1983/84 seasons. Results from these trials indicated that: a) when haricot bean was interplanted with maize, the ratio of ABW population on maize to haricot bean, on the average was 18:1. b) when five trap crops (hyacinth bean, lupin, maize, pigeon pea, and sunflower) were compared with haricot bean, all trap crops caught statistically greater number of ABW than did haricot bean, their order being: lupin $\geq$ pigeon pea $>$ hyacinth bean $\geq$ maize $\geq$ sunflower $>$ haricot bean. However, haricot bean plots interplanted with maize showed statistically lower per cent pod damage than the rest of the treatments; yield mean was also highest for maize treatment although none of the treatment means was statistically different. It is suggested that experiments to determine the optimum proportion of the main crop to trap crop be carried out in the future.

The African Bollworm (ABW), Heliothis armigera, is the number one insect pest of haricot bean in Ethiopia. Attempts have been made to establish integrated management of this pest since 1979. Experiments with trap crops to divert the egg laying moth from the main crop (haricot bean) as one component of IPM was launched in the 1981/82 crop season.

The trial was conducted for three consecutive years. In the first season (1981/82), haricot bean was interplanted with maize in a 100 m by 100 m. area; the planting arrangement was such that two rows of maize were planted on either side of the field and then at 25 meter intervals so that there were a total of five 2-row patches of maize in the whole field. Counts of ABW eggs and larvae were taken on ten I-meter rows (that were randomly selected) of maize, haricot bean adjacent to (HA 1) and 5 m. (HA 2) and 10m. (HA 3) away from the maize rows, starting at early flowering and three weeks later.

In the 1982/83 and 1983/84 seasons, however, five trap crops (hyacinth bean, lupin, maize, pigeon pea and sunflower) were compared with haricot bean (check) in 25 m by 25 m plots replicated five times. Each plot was 5 m. apart and blocks were 7.5 m. away from each other. Trap crops were planted on either side of each plot. Sampling was made as in the previous year but the sample size was on five one-metre rows, instead of ten. In all cases, adjustments were made in planting dates so that the main crop and trap crops flower about the same time. Moreover, percent pod infestations and yield data were also included in the last two experiments.

Results for the first year experiment are shown in Table 1. It can be seen that the ABW population on maize is appreciably higher than that on HA 1, HA 2 or HA 3. Said in other words, the ABW population on maize was roughly 12.6 -, 21.8 and 21.8 - folds that on HA 1, HA 2, and HA 3, respectively. On the average, the ratio of ABW population on maize to that on haricot bean was nearly 18:1.

Table 2 shows the mean number of ABW population on the six treatments and their respective HA 1, HA 2 and HA 3. Comparing ABW population among trap crops, all treatments caught significantly greater eggs and larvae than did the check (haricot bean). Of the trap crops, lupin and pigeon pea significantly out performed the rest.

Table 1: Comparison of ABW Population on Maize and haricot bean - Melkasa, 1981/82

Time of Counting	Mean Number of ABW eggs & larvae/10 m. row on				
	Maize	HA 1	HA 2	HA 3	Total
at early flowering	75.20	3.25	1.00	1.75	81.20
3 weeks after flowering	22.80	4.50	3.50	2.75	33.55
Total	98.00	7.75	4.50	4.50	
Mean	49.00	3.88	2.25	2.25	
S.E.M.	12.19	0.69	0.65	0.49	

Table 2: Mean number of ABW population 15 m row on the trap crops and haricot bean Melkasa (2 yr. avg.)

Treatment	No. of ABW/5m. row on			
	Trap Crop	Haricot bean		
		HA 1	HA 2	HA 3
Haricot bean (check)	9.40 d	1.90 b	4.50 ab	2.70 a
Hyacinth bean	99.50 b	1.10 ab	2.70 ab	1.40 a
Lupin	232.50 a	1.90 b	1.60 a	2.30 a
Maize	74.20 bc	1.10 ab	2.30 a	2.90 a
Pigeon pea	209.50 a	0.70 a	1.90 a	2.40 a
Sun flower	54.00 c	0.80 ab	3.10 ab	1.80 a
Mean	113.18	1.25	2.68	2.25
S.E.M.	8.45	0.35	0.61	0.78

* Means followed by the same letters, within a column, are not significantly different from each other at the 5% level (Duncan's New Multiple Range Test)

Table 3: Effect of Trap Crops on ABW infestation and Yield of Haricot bean, Melkasa (2 year average)

Trap Crop	Mean Percent Pod damage at			Pooled % Pod Damage	Yield in Kg per plot
	HA 1	HA 2	HA 3		
Haricot bean (check)	10.42 a*	14.36 c	12.13 ab	12.30 b	143.97 a
Hyacinth bean	6.12 a	10.78 abc	8.96 a	8.62 ab	126.41 a
Lupin	7.19 a	8.05 ab	16.14 b	10.46 ab	124.75 a
Maize	4.36 a	7.54 ab	9.79 a	7.23 a	152.13 a
Pigeon pea	11.94 a	6.92 a	10.47 a	9.78 ab	136.61 a
Sun flower	5.17 a	12.92 bc	12.87 ab	13.28 b	143.88 a
Mean	7.53	10.10	11.73	10.28	137.96
S.E.M.	2.38	1.84	1.77	1.54	9.16

* Means followed by the same letters within a column, are not significantly different from each other, at the 5% level (Duncan's New Multiple Range Test).

In short, the bollworm population on lupin = pigeon pea > hyacinth bean > maize > sunflower haricot bean. In other words, ABW population on lupin, pigeon pea, hyacinth bean, maize and sunflower was roughly 25 -, 22 -, 11 -, 8 -, and 6 - folds of that on haricot bean. At 5 m. away from the trap crop (Ha 1), plots interplanted with pigeon pea caught significantly fewer number of ABW than the check: the rest of the treatments were intermediate between the check and pigeon pea. Five meters away (HA 2), lupin, maize and pigeon pea were superior to the remaining treatments, hyacinth bean and sunflower wer were not statistically different from the check. At 10m. away from the trap crop (HA 3) none of the treatments was significantly differett from each other.

Results of percent pod damage of haricot bean interplanted with the var various trap crops and yield data are presented in Table 3. At Ha 1, none of the treatments was statistically different from each other. At HA 3, pigeon pea treated plots were significantly superior to the check; this was followeddby maize, lupin, hyacinth bean and sunflower. At HA 3, hacinth bean, maize, and pigeon pea were superior to lupin treatments; there was no difference between the check and sunflower here. Considering pooled data (i.e. mean of HA 1 + HA 2 + HA 3)maize treated plots were significantly superior to the check; the check and sunflower were statistically the same while the rest of the treatments were intermediate. None of the yield means was significantly different from each other; this lack of difference is perhaps due to the fact that the trap crops were planted too far apart.

In summary, trap crops do divert the egg laying moth from the main crop; the overall performance of maize was apparently superior to the rest of the trap crops. Prior to making final recommendations, experiments must be conducted to determine the optimum proportion of the land area between the trap crop and haricot bean. In the meantime, haricot bean can be interplant interplanted with maize at about 10 m intervals.

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Ha/BNF 26.2 (81) Chemical control of beans fly *Ophiomyia phaseoli* (Tryon)

By

Ferede Negasi and

Tsedeke Abate

Abstract

Chemical control trials of bean fly using seed dressing insecticides were conducted at two IAR research stations in the 1981/82-1983/84 seasons. Results obtained were variable. In general higher doses of carbofuran appeared more effective in reducing bean fly population. However this insecticide caused some degree of phytotoxicity.

Introduction

The bean fly, *O. phaseoli*, is a major pest of haricot bean in Ethiopia. It also attacks mung bean, cowpea and soybean. The fly has two fold damage on the crop. First, the adult punctures on the leaves and feeds on the Oazing cell sap and forms dark brown spots. Secondly, the larvae cause the stem to swell and leaves turned brown and stunted in growth and finally the plant withers and dies.

The yield potential of the existing varieties was not still known. Losses in yield due to attack by the pest have not been determined. In this country Crowe & Shitaye (1971) and Hill (1975) recommended aldrin seed-dressing in effectively controlling this pest. Aldrin has residual effect and a less objectionable product is needed for use on beans destined especially for export. Hence thi s led us to undertake the present investigation to screen insecticides that can give effecitve control without leaving much residue in the crop.

Materials and methods

The trial was carried out in two IAR stations Kobo and Mekele in 1981/82 - 1983/84 seasons. The design was rendomized complete block design with six replications in a plot of 2.4m x 6m. The treatments were three levels of carbofuran 35% liquid, one level of Aldrin 40% W.P. and untreated check. All the chemicals were treated before planting.

Observation begins right after emergence and the following data were taken, the stand count after germination weekly count of plants with bean fly symptoms per plot, stand count per plot before harvest. The main criteria for evaluating the efficacy of the chemicals were pupal count by taking 20 plants/plot at harvest, and the yield. These were subjected to analysis of variance using Duncan's multiple range test to determine the significance of the difference between treatemnts.

Results and discussion

Data for Kobo site are presented in Table 1. As can be seen from the table, the highest dose of carbofuran have significant control of bean fly population than did the untreated check or the rest of the treatments Regarding yield, there was no statistical difference among the yield means for all treatments. The mean yield though not significant, the highest rate of carbofuran gave highest yield/plot and this is equal to nearly 12.3% increase in yield over the check.

Table 2 represents data for Mekele. As can be seen from here, all the treatment insecticides gave signfiicant control in che king the population of bean fly than the untreated check. Regarding yield, aldrin followdd by carbofuran highest dose gave significantly higher yield as compared to the check or the rest of the treatments.

In general chemcial control of bean fly using seed dressing chemicals were not outstanding, and the results were variable in the two locations. Carbofuran, highest rate though shows some degree of phytotoxicity, it soon recovers when it gets enough rainfall and gave a good control on the population of bean fly. In Mekele and Kobo where there was a Cronic shortage of rainfall, a yield increase of 11.3% and 12.3% respectively had been obtained by the application of this insecticide. So in times of good rainfall more yield increament could be expected by the application of carbufuran highest dose.

Table 1. Effect of seed-dressing on the population of bean fly and yield of haricot bean. Kobo (2 yrs. avg.)*

Treatment	Rate (gms/kg of seed)	No. of pupae/ 20 plants**	Yield*** (kgs/plot)
Aldrin 40 wp	5	11.72 ab	1.77 (24.58) a
Carbofuran 35% liquid	15	13.91 b	1.82 (25.28) a
" " "	20	13.50 ab	1.87 (25.97) a
" " "	28.75	11.42 a	2.01 (27.92) a
Check	-	12.60 ab	1.79 (24.86) a
Mean		12.63	1.85 (25.69)
S.E.M		0.71	0.08 (1.11)
CV		13.81%	10.56%

10.9%

~~13.9~~

Table 2. Effect of seed-dressing on the population of bean fly and yield of haricot bean. Mekele (3 yrs. avg.)*

Treatment	Rate (gms/kg of seed)	No. of pupae/ 20 plants*	Yield*** (kgs/plot)
Aldrin 40 wp	5	12.03 bc	0.79 (10.97) a
Carbofuran 35% liquid	15	11.37 ab	0.63 (8.75) c
" " "	20	10.86 a	0.67 (9.31) bc
" " "	28.75	10.30 a	0.75 (10.42) ab
Check	-	13.08 c	0.68 (9.44) bc
Mean		11.53	0.70 (9.72)
S.E.M		0.37	0.03 (0.42)
CV		7.83%	10.97%

13.9%

* Means within column followed by the same letters are not significantly different from each other at the 5% level (Duncan's new multiple range test)

** Data transformed to $x + \frac{1}{2}$

*** values within parenthesis indicate yield in Q/ha

Literature cited

Crowe, T.J. & Shitaye G.M. 1972. Crop pest handbook. Institute of Agricultural Research Addis Abeba. 42 pp

Hill, Dennis S. 1975. Agricultural insect pests of the tropics and their control. Cambridge University Press, Cambridge. 516 pp.

EFFECT OF PLANT DENSITIES, WEEDING TIME AND CHEMICALS ON THE SPREAD AND DEVELOPMENT OF COMMON BACTERIAL BLIGHT IN HARICOT BEAN

Habtu Assefa, Mohammed Yesuf & Emebet Shiferaw.

Beans (Phaseolus vulgaris L.) are considered as some of the improtant 'traditional pulses' grown in Ethiopia, and are a basic component in the cropping systems of the small farmers and in the diet of the people in Eastern Africa. However, national bean productivity in Ethiopia is low.

Diseases, insects, low soil fertility and periodic water deficits form the principal production constraint associated with the low average yields (6). From an extensive survey conducted in the last 10-12 years bean rust, bacterial blights, Anthracnose viruses, Angular leaf spots, floury and 'Phoma' leaf spot are identified as the principal diseases of beans (2). Among these, Common Bacterial Blight (CBB) caused by Xanthomonas Phaseoli (E.F. Smith) DOWSON is one of the four diseases of beans which is widely distributed and causes significant economic losses.

Lars Ohlander (4) indicated that differences in attacks of diseases were one of the major factors responsible for yield variation from year to year, in the more humid areas. He obtained a high negative correlation between disease scored particularly of bacterial blight and seed yield in Mexican 142. Wallen and Galway (8) also attributed a yield loss of 32-33% in beans to this disease.

Initial Infection by CBB appears as water soaked spots on the underside of leaves and leaf lets. These spots subsequently enlarge irregularly and adjacent lesions may Coalesce. Infected lesions are usually encircled intiially by a narrow zone of lemon-yellow tissue which may latter turn necrotic. Stems and pods may also be infected. The bacterium survives in seed as well as in the diseased plant

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portions and is usually transmitted by diseased seeds, plant remains, blown soil, splashing rain. High relative humidity and temperature above 22°c enhance the pathogenecity of the disease (3).

Although sources of tolerance to CBB have been identified, they often occur in cultivars with grain types which have low commercial acceptance either on the world market or for home consumption. However, the lines which are accepted most, in both cases, are often susceptible to CBB. For such lines, other methods of control have been tried. Treating Kidney bean seeds with chemicals reduced infection of Cotyledons and the first trifoliate leaves (7). In other instances, spraying of streptomycin every 8 days (5) and Bordeaux mixture and copper hydroxide (1) during the period of maximum susceptibility reduced bacterial blight incidence. However, a reduction in diseases was not accompanied by an increase in seed yield in all cases.

To reduce disease pressure in the field, several factors including population densities, time of weeding and cultivation, chemical application and resistant or tolerant varieties have to be considered. Although there are several diseases, which constitute severe problems in beans, CBB has been considered in this report because of its importance in the country. It was in the light of the fore going that experiments were designed to investigate the effects of plant population densities weeding practices and chemicals on the incidence and spread of this bacterial disease.

Materials and Methods

Three experiments were carried out during the summer months of 1981, 82 and 83 on the field plots of the Institute of Agricultural Research Station at Melkassa. The soil which has not been fully described is a fairly well drained sandy loam.

In all experiments, disease scores were determined at Anthesis and seed maturity, when leaves were still green, using a 5 point scale. Zero represented no infection, 1 slight infection (1-10% of the plants infected), 2 low infection (11-25% of the plants infected), 3 moderate infection (26-50% of plants infected), 4 high infection (51-75% of plants infected) and 5 very severe infection (76-100% plants infected).

Stand counts were taken approximately fifteen days after emergence. Unless otherwise indicated, weeding was done as needed. No fertilizers were applied. Seeds were harvested at maturity and seed yield and seed size were expressed as grams/plot and 1000 seed size respectively. The significance of differences between means were calculated (Steel and Torrie, 1960) and none lower than p 0.05 is reported.

Experiment 1. Effects of weeding and plant density on CBB infection and seed yield in haricot beans.

A2 x 9 split plot arrangement in an RCBD with 4 replications were used in two separate trials which were similar, except that cv mexicam 142 was used in one whilst large white was planted in the other. Two levels of weeding (weeding in the morning when leaves were still covered with dew and weeding in the after noon when the dew on leaves had dried out) were applied to the main plots. Hence plant density treatments constituted the sub-plots (Table 1.)

Table 1. Population density treatments used in Experiment 1.

Spacings (in cms)	Population density (plants/ha)
20 x 5	1,000,000
20 x 10	500,000
20 x 20	250,000
40 x 5	500,000
40 x 10	250,000
40 x 20	125,000
60 x 5	333,333
60 x 10	166,667
60 x 20	83,333

One seed per hill was planted on 9 July 1981, 3 July 1982 and 26 July 1983. Central rows each measuring 5 meters long and bordered on all sides by a row of guard plants were used as Experiment 2. Effect of seed treatment on the incidence of CBB

The experiment was laid out as a 2 x 5 split-plot arrangement in an RCBD with 6 replications. The main plot treatments consisted of two levels of variety (Mexican 142 and Negro Mecentrau) and 5 levels of chemical treatment were allocated to the sub-plots. The types of chemicals, and rates and mode of application were as shown below:

Table 2. Seed Treatments Used in Experiment 2.

Treatments	Active ingredient in %	Rate of application	Mode of application
Bleach	6.25%	1 cc/litre	Soaking for 15 minutes
Streptomycin	20 % wp	1 gm/litre	"
Copper Count	8%	1 cc/litre	"
Kocide	77%	2.2 gms/litre	"
Control (Untreated seeds)			

The experimental plots consisted of 4 central rows bordered on all sides by rows of growing plants.

Soon after the chemical treatments seeds were allowed to air dry over night and they were then sown the next day on 11 July 1981 in 5 m rows spaced 40 cm apart. This is intended to obtain a population density of 250,000 plants per hectare. The other cultural pravcises used were the same as described in Experiment 1.

The number of seedlings infected by the disease was counted 2 - 3 times every other day from seedling emergence for 10 days. Thereafter, it was not deemed necessary to continue the assessment fo the disease, due to the high probability that secondary transmission of the pathogens from diseased plants to healthy ones might have occured. In order to minimize or prevent the dissemination of the disease, neither weeding nor cultivation was done during the period disease assessment was being carried out.

About 5 random samples of diseased plants were collected from each plot. On each occasion the number of infected seedlings were determined. The samples were used to determine the presence of the disease. Disease scores were taken and seedsize and yield data were collected from all plants in the central rows as described in Experiment 1.

Experiment 3. Effect of chemical sprays on the control of CBB.

The experimental design was a 2 x 5 split - plot arranged in an RCBD with 6 replications. Two varieties (Mexican 142 and Nazret Large White) were assigned to the main plots. The chemicals were assigned in the sub - plots. The types of chemicals, rate and mode of application were as shown below:

Table 3. Chemical sprays used in experiment 3.

Treatments	Active ingredients	Rates of application	Mode of Application
Kocide	77%	2.2 kg/ha	Spray
Copper Count	8%	0.1 /%	Spray
Streptomycin	20% wp	1 kg/ha	Spray
Kasumin	2% EC	1.5 l/ha	Spray

Seeds were planted on 7 July 1981 and the chemicals were sprayed with a knap sack sprayer at weekly intervals from the first symptom observed to 8 weeks. Plot size, cultural methods used and the determination of disease scores, seed yield and seed size were the same as described in Experiment 2.

Experiment 4. Effect of seed treatment and chemical spray on the control of CBB.

Two separate trials were conducted in 1981 in an RCBD with 6 replications. Two of the best treatments that have shown promising results in the seed treatment and spray trial were selected and tried together on one set of experiment. The experimental plots in both trials (one for cv Mexican 142 and the other Large White) consisted of 4 central rows bordered on all sides by rows of plants. Seeds were planted in 8 July 1982 in 5 cm. rows 40 cm apart. The types of treatments applied is shown below:

Table 4. Treatments used in experiment 4.

Treatments	Mode of Application
1. Control (untreated)	
2. Copper Count	Soaking
3. Streptomycin	Soaking
4. Kocide	Spray
5. Streptomycin	Spray
6. Copper Count + Kocide	Soaking + Spray
7. Copper Count + Streptomycin	Soaking + Spray
8. Streptomycin + Kocide	Soaking + Spray
9. Streptomycin + Streptomycin	Soaking + Spray

The active ingredients and rates of application for each treatment has been used as described in Experiment 2 and 3. Plot size, cultural methods, disease determination, seed yield and seed size were the same as described in Experiment 2 and 3.

RESULTS

Experiment 1.

Results on the effect of weeding practise and plant densities on halo blight disease are given in tbales 5 (a,b,c,d).

Disease was rather severe in 1981 and 1982 but due to late planting and a long dry spell prior to planting the incidence of the disease in 1983 was very low. In 1981 only disease scores were considered while in 1982 and 1983 seed yield, seed size and stand count were evaluated to supplement disease data.

The 1981 results indicate that the over all mean score for the dry and wet weeding treatments is 2.25 and 2.13 at first score and 2.3 and 2.3 at later score, respectively. It is clear from the results obtained that time of weeding was not a serious factor for disease spread and development at Melkassa. However, the spacing treatments were more improtant for the spread of the disease than weeding period. The lowest score (1.62) was recorded from the wider spacing (60 x 20) and the highest score (2.87) was obtained from the narrowest spacing (20 x 5) which also contained the most densely populated plants among the treatments tested (table 5a)

Although there was no significant difference among treatments, there was a tendency for the disease to progress from infected to healthy plants at a lower rate as spacing increased (ie. as population of plants decreased).

The 1982 results, more or less, confirmed the 1981 results except that two varieties were tested in 1982. The varieties were mexican 142 and Nazret Large White. Spacing the plants under different conditions was found to be more important for the spread of the disease than weeding time. The mean difference in disease scores between the various treatments was significnnt at 5%. The highest disease score (2.9,3.0) were obtained from the narrower spacings (20 x 5, 40 x 5) respectively in Mexican 142, while the lowest disease score was recorded when plants were spaced sparsely at 60 x 20 (table 5a). As shown in the same table intrarow spacing favoured the development of the disease more than did inter-row spacing. Thus, the incidence of the disease progressively decreased as the inter-row space increased dfrom 5-20 cm and inter-row space increased from 20-60cm. The results obtained holds true for both varieties.

Seed yield as measured in g/plot did not seem to be a reflection of the disease incidence best rather on the population densities. The higher the population, the higher the yield and the lower the population the lower the yield and the difference between them was significant at 5% level for both varieties. However, the difference in yield between the times of weeding was not significant. There was no definite corelation between either spacing, weeding time or disease incidence and seed size.

Table 5 Effect of Cultural practises on the incidence of Common Bacterial Blight, yield and seed size in haricot bean (5a)

(a) Effect on disease* (0-5 ratings)

Spacing	MeXICAN 142 (1981)				MEXICAN 142 (1982)		NAZRET LARGE(1982)	
	1st score (22-9-81)		2nd score (13-10-81)					
	WEEDING DRY	WEEDING WET	WEEDING DRY	WEEDING WET	WEEDING DRY	WEEDING WET	WEEDING DRY	WEEDING WET
20 x 5	2.50	2.50	3.00	2.75	2.80	3.00	3.00	2.80
20 x 10	2.25	2.00	2.50	2.00	2.50	2.50	3.00	2.30
20 x 20	2.50	2.25	2.75	2.25	2.30	2.30	2.50	2.00
40 X 5	2.50	2.50	2.50	2.75	2.80	3.30	2.80	3.00
40 x 10	2.00	2.25	2.50	2.25	2.30	2.30	2.50	2.50
40 x 20	2.25	2.00	2.00	2.50	2.00	2.30	2.30	2.30
60 x 5	2.25	2.25	2.25	2.50	2.50	2.50	2.80	3.00
60 x 10	2.00	2.00	1.75	2.50	2.30	2.30	3.00	3.00
60 x 20	2.00	1.50	1.75	1.50	2.00	2.00	2.50	2.30
Mean	2.25	2.13	2.33	2.33	2.40	2.50	2.70	2.60
LSD 0.05	-	-	-	-	between spacing means = 0.48		between spacing means = 0.40	

* Mean value of 4 replications

(5b) Effect of plant density and weeding time on Seed Yield (grams/plot)

SPACING	MEXICAN 142 (1982)		NAZRET LARGE (1982)		MEXICAN 142 (1983)		NAZRET LARGE (9183)	
	WEEDING DRY	WEEDING WET	WEEDING DRY	WEEDING WET	WEEDING DRY	WEEDING WET	WEEDING DRY	WEEDING WET
20 x 5	2120	2264	2025	2070	1900	1500	2100	1800
20 x 10	1712	1863	2256	2202	1600	1400	2200	1900
20 x 20	1430	1700	1977	1842	1400	1300	2100	1600
40 x 5	1422	1375	1545	1326	1200	1300	1400	1600
40 x 10	1106	1246	1464	1525	920	1200	1600	1500
40 x 20	1208	897	1037	951	770	920	1100	1200
60 x 5	764	739	1317	1156	770	720	1150	1000
60 x 10	737	818	1018	974	800	670	920	950
60 x 20	523	448	797	947	470	620	870	720
Mean	1225	1261	1493	1444	1100	1100	1500	1400
LSD 0.05	between spacing means = 203.8		between spacing means = 262.7		between spacing means = 200		between spacing means = 520	

(5c) Effect of plant densities and weeding time on seed size (grams/1000 seeds)

Spacing	1982				1983			
	MEXICAN 142		NAZRET LARGE		MEXICAN 142		NAZRET LARGE	
	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet
20 x 5	150	145	229	221	148	148	132	129
20 x 10	142	136	241	238	146	145	132	136
20 x 20	130	131	248	232	144	138	139	132
40 x 5	139	135	227	232	144	143	135	129
40 x 10	129	150	223	228	140	144	135	135
40 x 20	141	138	235	242	138	139	130	137
60 x 5	148	137	244	235	145	142	136	185
60 x 10	136	140	246	238	148	140	139	137
60 x 20	128	138	238	258	135	144	143	136
Mean	138	139	236.8	236.1	142.8	142.6	135.6	139.6
LSD 0.05								
Between								
Spacing means								

(5d) Effect of plant densities and weeding time on stand (total number of germinated plants per middle rows)

Spacing	1982				1983			
	MEXICAN 142		NAZRET LARGE		MEXICAN 142		NAZRET LARGE	
	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet
20 x 5	409	442	474	482	457	424.3	618.5	578.3
20 x 10	279	286	336	348	314.5	242.3	315.5	345.0
20 x 20	149	162	178	172	180.5	172.5	178.8	172.8
40 x 5	171	167	210	210	176	184.5	273.8	242.8
40 x 10	130	106	142	145	120	115.8	131.8	143.8
40 x 20	60	64	74	70	70	70.8	74.5	71.5
60 x 5	83	85	106	108	88.5	77.8	177.5	128.0
60 x 10	59	76	68	72	67.3	60.5	73.5	69.8
60 x 20	30	28	37	37	35.3	31.8	35.3	37.0
Mean	152	157	181	181	167.7	153.4	203.2	198.8
LSD 0.05								
Between								
Spacing means	39.2		18.8					

* Number of middle rows are variable as when distance between rows is 20 there are 10 rows
40 " " 4 rows
60 " " 2 rows

Experiment 2.

The results of the seed treatment effects on the control of the seed-borne pathogen, Xanthomonas Phaseoli, in Mexican 142 and Negro Mecentrau are given in tables 6a and 6b. For Mexican 142 the number of infected plants counted in the various treatments did not differ significantly from the control. However, treating the seeds with copper count seemed to have resulted in a lower number of infected plants as compared to the other treatments including the control (the untreated check). However the disease later on spread dramatically to all plots probably due to secondary transmission.

The effects of the seed treatments on cv Negro Mecentrau was almost the same as cv Mexican 142 except that there was a higher number of infected plants at the latter count in Negro Mecentrau. Disease score taken later when the plants mature produced a higher incidence of CBB and there was complete lack of difference between the treatments.

Table 6 Effect of seed treatment on stand count of Common Bacterial Blight,
(a) Mexican 142, 1981.

Chemicals	Stand (X/200)	NUMBER OF CBB INFECTED PLANTS			LEAF DISEASE SCORE (0-5)		Yield in gm.	Seed size grams/
		1st	2nd	3rd	1st	2nd	/plot	1000 seeds
Control	165.0	47.0	61.8	129.3	2.8	4.0	1528	150.4
Bleach	164.2	51.2	67.8	128.2	2.7	3.8	1509	152.2
Streptomycin	143.2	40.3	48.0	110.3	2.5	3.8	1282	148.4
Copper Count	153.8	32.5	54.0	128.3	3.0	4.0	1490	153.2
Kocide	165.8	59.2	76.3	139.8	3.0	4.0	1594	152.9
Mean	158.4	46.0	61.6	127.2	2.8	3.9	1481	151.4
LSD 0.05	10.0	-	-	-	-	-	-	-

(6b) Negro Mecentrau 1981

Chemicals	Stand (X/200)	Number of CBB Infected Plants			Leaf Disease Score (0-5)		Yield in gm. /plot	Seed size (gram/1000 seeds)
		1st	2nd	3rd	1st	2nd		
Control	165.5	67.7	112.2	140.3	1.3	3.2	1548	158.0
Bleach	172.3	75.7	114.3	145.0	1.3	3.2	1507	157.4
Streptomycin	165.0	104.3	93.3	128.8	1.5	3.3	1488	158.8
Copper Count	159.7	77.7	119.7	145.1	1.3	3.2	1434	162.2
Kocide	166.3	72.5	110.6	138.7	1.2	2.8	1382	158.7
Mean	165.8	79.6	110.1	139.6	1.3	3.1	1472	159.0
LSD 0.05	10.1	-	-	-	-	-	-	-

Experiment 3.

As shown in tables 7a and 7b Mexican 142 treated with Kocide had the lowest score (2.5) but this variety did not produce the highest seed yield. Highest yield was obtained from the plots sprayed with copper count and Kasumin sprayed plots produced the lowest seed yield. The same set of treatments tested on Negro Mecentrau gave scores ranging from 3.2 - 3.3. The mean score was 3.2, indicating lack of variability in disease incidence for the various treatments. Among the various treatments none of them gave significantly higher yield than the control and except Kasumin treated plots the rest produced a lower seed yield than the control. However, the response with regards to seed size was different. Treated plots produced larger seeds that did the check. Except the Kasumin treated plots the differences was significant at 5%.

Table 7 Effect of chemical spray on Common Bacterial Blight

(7a) Mexican 142 1981.

Chemical	Stand (X/200)	Disease score (0-5) 29-9-81	Yield in Grams/20 plants	Seed size (grams/1000 seeds)
Control	163.3	3.5	265.2	159.0
Kocide	160.5	2.5	259.0	160.0
Copper Count	168.0	3.7	290.0	166.7
Streptomycin	171.0	3.8	263.8	156.2
Kasumin	175.3	3.8	227.2	152.5
Mean	167.6	3.5	261.0	158.9
LSD 0.05	-	-	-	8.9

(7b) Negro Mecentrau 1981

Chemicals	Stand (X/200)	Disease score 29-9-81	Yield in Grams/20 plants	Seed size (grams/1000 seed)
Control	174.5	3.2	264.7	164.8
Kocide	173.2	3.2	255.5	182.7
Copper Count	178.8	3.3	249.2	178.6
Streptomycin	172.3	3.2	249.3	176.0
Kasumin	175.5	3.2	267.3	167.5
Mean	174.9	3.2	257.2	173.9
LSD 0.05	-	-	-	8.7

Experiment 4.

Results for this experiment are presented in tables 8a and 8b. The results obtained showed a lack of definite trend probably showing that the chemicals were ineffective for the control of the disease.

In both varieties separate seed treatments and spraying had been better influence than the various combinations either on disease, seed yield or seed size. For all the data collected there was complete lack of significance difference between the various treatments.

Table 8 Effect of chemical treatments

(8a)* Mexican 142 - (1982)

Treatments	Stand (X/160) 30/7	Number of Infected plants 11/8	24/8	Leaf Disease Score (0-5) 7/9	16/9	Seed Yield in gram/ plot	Seeds Size (gram/ 1000
Control	135	39	74	1.2	2.7	868	141
Copper Count (Seed)	136	41	70	1.2	1.8	802	137
Streptomycin (Seed)	131	33	80	1.0	1.7	847	141
Kocide (Spray)	136	49	68	1.2	2.0	811	138
Streptomycin (Spray)	144	42	84	1.0	1.8	912	140
Copper Count (Seed) + Kocide(spray)	134	35	66	1.2	2.2	671	139
Copper Count (Seed) + Streptomycin (Spray)	137	33	77	1.2	2.0	792	140
Streptomycin (Seed) + LKocide (Spray)	129	37	73	1.0	1.7	637	136
Streptomycin (Seed) + Streptomycin (Spray	134	39	83	1.3	2.2	783	136
Mean	135	39	75	1.1	2.0	792	138

(8b) Nazret Large White (1982)

Treatments	Stand (X/160) 30/7	Number of infected plants 11/8	24/8	Leaf disease Score (0-5) 7/9	16/9	Seed yield g/plot	Seed size (gram/1000 seeds)
Control	133	53	107	1.7	2.5	979	229
Copper Count (Seed)	132	59	99	1.2	2.5	1022	224
Streptomycin (Seed)	138	55	108	1.5	3.0	929	234
Kocide (Spray)	130	48	100	2.2	2.8	908	221
Streptomycin (Spray)	133	47	106	1.8	2.7	931	246
Copper Count (Seed) + Kocide (Spray)	130	57	95	2.2	2.8	880	226
Copper Count (Seed) + Streptomycin (Spray)	128	60	98	2.0	3.3	827	228
Streptomycin (Seed) + Kocide (Spray)	136	68	100	2.0	3.0	810	220
Streptomycin (Seed) + Streptomycin (Spray)	130	61	108	1.8	3.0	827	216
Mean	132	56	102	1.8	2.9	901	183
LSD 0.05	-	13.9	-	-	-	-	-

DISCUSSION

At Melkassa the rainfall pattern is normally erratic and unpredictable, the temperatures are high whilst humidity is low. The variability in disease pressure among years and lack of response to weeding time were probably due to these peculiar climatic conditions. With regards to dissemination of disease pathogens and the creation of an epiphytotic bacterial disease the high rainflll coupled with the high temperatures and relative humidity were likely to be responsible (6).

The severity of the infection of the disease was moderate throughout the experimental period except in 1983 when it was slight. This low disease pressure in 1983 was due to the long dry spells during planting time and the high temperatures which were subsequently experienced by the plants during the growing period. Neither morning weeding on the presence of dew nor weeding late in the morning when the leaves were devoid of dew influenced the incidence of CBB. This of course may not be true for other bean growing areas where the climatic condition may be significantly different than the one at Melkassa.

Despite moderate incidence of the disease and unfavorable weather conditions the spacing treatments consistently influenced the dissemination of the disease. Intra-row spacing favoured the development of the disease more than the inter-row spacing. Although the disease progressively decreased as spacing increased this did not result in a concomitant decrease in seed yield as the disease becomes more severe. The highest population density of plants might have compensated for the slightly higher disease pressure. By using various population rates seed size was not affected which might possibly indicate that slightly denser populations may not affect the quality of the seed.

Our study which tested two Copper based fungicides and two bacteriocides confirmed that none of the treatments influenced the disease significantly over the control and they did not have a pronounced effect on seed yield as well. Although Bernet (1) and Plopper (5) showed that some chemicals such as copper hydroxide and streptomycin were effective in the control of bacterial blight such effect did not result in an increase in seed yield. Seed treatments such as copper count seemed to have reduced the bacterial disease at least, at the early seedling stage 'but this control measure used for the prevention of seed transmission was not adequate for the field (secondary) transmission of the disease, especially when the weather was conducive. As far as CBB is concerned, none of the tested chemicals were effective enough to warrant either seed treatmentcor spraying at epidemic levels.

In conclusion, the results studied being reported here have shown that it is (absolutely) essential to use disease free seeds when growing beans either at Melkassa or at any bean growing areas. Hence it is necessary to produce disease-free seeds, under irrigation, in drier areas such as MelkaWerer, for planting at the various bean producing areas. In the mean time the search for either tolerant or resistant varieties has to be strengthened. Moreover in areas such as Melkassa we can at least follow the same cultural practices (planting seeds at 40 x 10 cm and weeding before the dew on the leaves completely dry out) which are still a happy medium for both disease development and the operation at farm level.

LITERATURE CITED

1) Bernat, N.; Raicu, C. 1974. The control of bacteriosis and anthracnosis in bean crops, Productiva Vegetalia, Horticultura 23(10): 36-39.

2) Institute of Agr. Research, Crop Protection Department Progress Report 1976-1979, 1980-82 (Inprint).

3) Kranz, J., Schmutterer, H., and Kohch, Kl, 1977. 'Bacterial Diseases' in Diseases, pests, and weeds in Tropical crops, p. 68.

4) Ohlander, L.J.R. 1980. Research on haricot bean (Phaseolus Vulgaris L.) production in Ethiopia 1972-1976, Swedish university of Agricultural Sciences, Department of plant Husbandry, Rapport 82.

5) Plopper, L.D.; Ramallo, N.E.V.D.E. 1975. Estimation of streptomycin sulphate residues in bean plants. Revista Industrial Agricola de Tucumen. 52(1): 77-82.

6) Schwartz, H.F., et.al. 1978. Field problems of beans in Latin America, CIAT, Sefies GE-19, Cali, Columbia.

7) Shpiter, L. KH. 1976. Bacterial Diseases of Kidney bean and soybean. Zashchita Rastenii, No 4, 46 (Eng. summary)

8) Wallen, V.R., Galway, D.A. 1977. Bacterial blight of field bean: Disease progress, yield loss and crop canopy development in principal cultivars in Ontario, Canadian plant Disease survey 53 (3/4): 61-64.

Effect of plant densities, weeding time and chemicals on the spread and development of halo blight in mung bean

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Mung bean (*Vigna radiata* (L.) Wilczek) is an important pulse crop throughout South East Asia and particularly in the Indian sub-continent. In Ethiopia where pulses in general comprises 13-15% of the total cropped area, and upto 30% in some parts of the country, mung bean is not one of the predominantly grown crops. At present no figures are available concerning production and area covered under mung beans.

But, in Ethiopia where pulses are the main source of total protein, mung bean not only provide as source of protein but is also adopted to a wide range of climatic conditions. Mung beans are adopted in types of warm, arid, erratic rainfall zones such as Kobo and Humera to warm, moist zones such as Jima, Bako and Didesa.

From preliminary survey conducted in the last few years, mung bean has been found to be grown by farmers in Harerge (Godie), Welo (Kobo) and Northern Shewa (Shewa Robit - Rassa area) regions. But farmers' yield in general is low.

Since the beginning of a nationally coordinated research work in February 1972 the Institute of Agricultural Research, Nazret Station initiated a national program toward increasing the yield potential of this popular source of protein for especially the water-stressed regions of the country. In the last few years, however, the breeding program of mung bean has to be suspended due to severe disease incidences. The major constraint to increase yield and wide spread cultivation of mung bean was due to the bacterial disease - halo blight. This disease was first observed on a few plants in Kefa (8). Later on the disease was recorded from (Melkasa) Shewa, (Shewa Robit) Northern Shewa and (Kobo) Welo Administrative Regions.

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The intensity at Melkasa has been very severe and in some cases the national variety trial and other trials had to be abandoned. During the rainy season infection of susceptible varieties generally cause heavy difoliation and greatly reduce yield, sometimes close to 100% yield loss was observed.

The causal organism identified as Psuedomonas phaseolicola (Burk) DOWS has a wide host-range including Phaseolus vulgaris, P. coccineus, P. lunatus, Glycine max, Pisum sativum and Vigna unguiculata (5). The pathogen is a gram negative oval shaped bacterium that possessed cream - colored exudate. The main source of infection is seed from diseased plants (12). In the field the bacterium spreads from plants in rain drops, wind spread dew or by means of insects. Rain, moisture and cool weather promote the spread of the disease and development of the bacterium and optimum temperature for symptoms development is 16-20^{o}C (5).

Many attempts have been made to control halo blight disease in haricot bean and numerous fungicides have been tested for their suitability to control the disease (3, 4, 6, 7, 11). Antibiotics proved the most promising. However, information on the control of the disease on mung bean is not available. In this paper we are reporting our finding on the effect of population densities, seed treatment and foliar spray on the spread and development of halo blight on mung beans.

Materials and methods:

From 1981 through 1983 the author and his colleagues conducted series of experiments on identifying methods to control halo blight on mung bean. The experiments were conducted on the field plots of the Institute of Agricultural Research Station at Melkasa. The soil which has not been fully described is a fairly well drained sandy loam.

In all experiments disease score were determined at anthesis and seed maturity, when leaves were still green, using a 5 point scale.

zero represented no infection

1.	"	Slight infection (1-10% of the plants)
2	"	low infection (11-25% of the plants)
3	"	Moderate infection (26-50% of the plants)
4	"	High infection (51-75% of the plants)
5	"	Very severe infection (76-100% of the plants)

Stand counts were taken approximately fifteen days after emergence. Unless otherwise indicated weeding was done as needed. No fertilizers were applied. Seeds were harvested (more than once for the indeterminate cultivars) at maturity and seed yield and seed size were expressed as grams/plot and 1000 seed size respectively. The significance of differences between means were calculated (Steel and Torrie, 1960) and none lower than P 0.05 is reported.

Experiment 1. Effects of weeding time and plant density on halo blight infection in mung beans

A2 X 9 split- plot arrangement in an RCBD with 4 replications were used in Cv. V2008. Two levels of weeding (weeding in the morning when leaves were still covered with dew and weeding in the afternoon when the dew on leaves had dried out) were applied to the main plots. Hence, plant density treatments constituted the sub-plots (table 1).

Table 1. Population Density Treatments Used In Experiment 1.

Spacing (cms)	Population density (plants/ha)
20 X 5	1,000,000
20 X 10	500,000
20 X 20	250,000
40 X 5	500,000
40 X 10	250,000
40 X 20	125,000
60 X 5	333,333
60 X 10	166,667
60 X 20	83,333

One seed per hill was planted on 7 July 1981, 8 July 1982 and 2 July 1983. Central rows each measuring 5m. long and boardered on all sides by a row of guard plants were used as experimental plants on the individual plots.

Experiment 2. Effect of seed treatment on the incidence of halo blight

The experiment was laid out as a 3 X 5 split-plot arrangement in an RCBD with 6 replications. The main plot treatments consisted of 3 levels of variety (M76, M1134 and V 2008) and 5 levels of se d treatments were allocated to the sub-plots. The types of treatments and mode of application were as shown below:

Table 2. Seed Treatments Used In Experiment 2.

Treatments	Active ingredient	Rate of application	Mode of application
Copper Count	8%	1cc/litre	Soaking
Sodium hypo chlorite	6.25%	1cc/litre	"
Streptomycin	20% Wp	1 gm/litre	"
Hot water	-	45-50°C for 15 min.	"

The experimental plots consisted of 4 central rows bordered on all sides by rows of growing plants. Soon after the seeds were treated, they were allowed to air dry over night and sown the next day on 7 July, 1981 in 5m. rows 40cm apart. This is intended to obtain a population density of 250,000 plants per hectare.

The number of seedlings infected by the disease was counted 3 times every other two days from seedling to 10 days. There after, it was not deemed necessary to continue the assessment of the disease, due to the high probability that secondary transmission of the pathogens from diseased plants to healthy ones might have occured. In order to prevent or minimize the dissemination of the disease neither weeding nor cultivation was done during the period disease assessment was being carried out.

About 5 random samples of diseased plants were collected from each plot on each occasion the number of infected seedlings were determined. The samples were used to determine the presence of the disease.

Experiment 3. Effect of chemical sprays on the control of halo blight

The experimental design was a 3 x 7 split-plot arranged in an RCBD with 6 replications. Three varieties (M76, M1134 and V2008) were assigned to the main plots. The chemicals are assigned in the sub-plots. The types of chemicals, rates and mode of application were as shown below:

Table 3. Chemicals used in experiment 3

Treatments	Active ingredients	Rates of application	Mode of application
Control (unttrated plot)	-	-	-
Water	-	-	-
Kocide	77%	2.2 kg/ha	spray
Streptomycin	20% WP	1 kg/ha	spray
Cupravit	35% WP	625 g/100 lit	spray
Copper-Count-N	8%	0.1%	spray
Kasumin	2%	1.5 lit/ha	spray

Seeds were planted on 7 July 1981 and the chemicals were sprayed with a knapsack sprayer at weekly intervals from the first symptom observed to 8 weeks. Experimental plots consisted of 4 rows of 5m. long and 40 cm apart borderd on all sides by rows of growing plants.

Experiment 4. Effect of seed treatment and chemical spray on the control of halo blight

In 1982 and 1983 two of the treatments that performed better from each of the seed treatment and spray trial conducted in 1981 were selected and tested. The experimental design was a 2 x 9 split-plot arranged in an RCBD with 6 replications. Two varieties (M1134 and V2008) were assigned to the main plots and chemicals were assigned in the sub-plots. Seeds were planted on 8 July 1982 and 2 July 1983. The types of chemicals, and mode of application is as shown below. Rates of application was used as indicated in experiment 2 and 3.

Table 4. Treatments used in experiment 4.

Treatments	mode of application
1. Control (untreated)	-
2. Copper Count	Soaking
3. Hot Water	Soaking
r. Kocide	Spray
5. Cupravit	Spray
6. Copper Count + Kocide	Soaking + Spray
7. Copper Count + Cupravit	Soaking + Spray
8. Hot Water + Kocide	Soaking + Spray
9. Hot Water + Cupravit	Soaking + Spray

Trial management and collection of all necessary data were similar to the previous experiments.

Results

Experiment 1

Results on the effect of population densities and weeding time on halo blight incidence, seed yield and seed size are presented in tables 5a and 5b. Plants were already heavily infected when the first weeding and cultivation was done. Thereafter, the disease developed rapidly and had become severe in almost all plots resulting in heavy defoliation of the leaves. This was true in 1981 and 1982. In 1983 due to a long dry spell prior to planting and after emergence stand of the seeds was very poor resulting in poor and highly variable stand. Therefore, no data was collected in 1983.

Halo blight severity was estimated on 26 August and 23 September 1981 and 10 August and 15 September 1982. In the 1981 experiment wider spacings (i.e, lower population densities) tended to decrease the disease spread at early stage but later the differences between the spacing treatments were not significant at 5% level. Weeding time did not influence the spread of the disease where on the average scoring for both treatments were similar in all cases. The 1982 results also confirm the 1981 findings.

Yields were significantly affected by the plant density treatments but the difference between the weeding time were not significant. These differences were mainly due to the number of plants per plot (Table 5b) presumably because the denser the population the higher the yield despite heavy incidence of the disease. Plots planted with the denser population yielded almost 6 times higher than the lesser populated plots.

Table 5. Effect of population and weeding time on the incidence of halo blight seed yield and seed size in mung bean var. V2008.

(5a)Effect on Disease (0-5 score)

Spacing	1981				1982			
	26 Aug.		23 Sept.		10 Aug.		15 Sept.	
	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry
20 X 5	3.5	2.2	3.8	3.2	4.1	4.0	4.0	3.0
20 X 10	2.5	2.0	3.2	3.0	4.4	4.0	4.0	3.8
20 X 20	2.5	2.2	3.5	3.0	4.1	3.8	3.8	3.8
40 X 5	2.5	2.0	3.0	3.0	4.0	4.2	3.8	3.9
40 X 10	2.0	1.8	3.0	3.0	4.1	4.4	3.5	3.8
40 X 20	1.2	2.0	2.8	3.0	4.2	4.1	3.8	3.5
60 X 5	2.0	2.2	3.0	3.2	4.1	4.1	4.0	3.8
60 X 10	1.2	2.0	2.5	3.0	4.2	4.2	4.0	3.5
60 X 20	2.2	1.8	3.2	3.0	3.9	3.8	3.5	3.5
Mean	2.2	2.1	3.1	3.0	4.1	4.1	3.8	3.7
LSD 0.05 - Spacing means	0.72		-		-		-	

* Means of 4 replication

(5b) Effect of population densities and weeding time on stand count and seed yield* (1982)

Spacing	Stand Count (No. of Emerged)		Seed Yield (grams/plot)	
	Weeding Wet	Weeding Dry	Weeding Wet	Weeding Dry
20 X 5	462.5	441.8	315	311
20 X 10	278.8	248.3	175	248
20 X 20	134.5	146.5	136	184
40 X 5	216.3	204.5	135	123
40 X 10	118.0	128.8	79	94
40 X 20	59.8	56.3	52	42
60 X 5	99.0	103.8	84	79
60 X 10	88.8	67.0	46	80
60 X 20	33.5	40.0	54	34
Mean	165.8	159.6	120	133
LSD 0.05 spacing	8.6		46	

* Net plot size was 6.4m^2

Experiment 2

The results of the seed treatment effects on the control of Pseudomonas Phaseolicola causing halo blight in CVs. M76, M1134 and V2008 are given in tables 6a and 6b. The disease was first observed a week after emergence and by this time the first disease assessment was done. At the first count on 7 August 1981 the number of infected plants differ significantly to the treatments applied. For CVs M76 and M1134 the lowest disease incidence was counted when seed were treated with hot water followed by copper count-n. But, for Cv. V2008 seed treatments did not seem to have any effect.

On the second assessment, still, the lowest number of infected plants in CVS M76 and M1134 were obtained from the same treatments. However at later counting on 18 August 1981 showed a slightly different observation and results were not consistent with varieties. This may be due to the secondary spread of the disease and the death of infected seedlings. In almost all cases the highest number of infected seedling were counted from Cv. V2008.

Table 6 Effect of seed treatment on the intensity of halo blight, stand, seed yield and seed size in mung beans

(6a) effect on disease (Number of plants infected)

Treatments	1st count (7 Aug. 81)			2nd Count(10 Aug.81)			3rd Count 18 Au…		
	M 76	M1134	V2008	M76	M1134	V2008	M76	M1134	V20…
Control	2.83	2.50	1.33	1.83	4.16	10.66	10.66	23.66	36.
Copper Count	2.16	0.16	2.33	0.50	4.00	6.33	7.66	21.83	34.
Bleach	3.50	2.66	3.33	4.33	9.50	8.83	14.16	41.66	37.
Streptomycin	2.50	1.33	1.66	0.50	2.83	17.50	4.16	28.50	41.
Hot water	1.00	0.16	2.83	0.00	2.50	7.66	9.66	31.33	30.
Mean	2.40	1.36	2.30	1.43	4.60	10.20	9.26	29.4	36.
LSD 0.05									
- Chemicals		1.26			-			-	
- Varieties		-			5.83			16.15	

(6b) éffect on Disease (over all summary)

Chemicals	Aug. 7/81	Aug.10/81	Aug.18/81	Varieties	Aug.7/81	Aug.10/81	Aug. 18/81
Control	2.22	5.55	23.72	M76	2.40	1.43	9.[illegible]
Copper Count	1.55	3.61	21.33	M1134	1.36	4.60	29.[illegible]
Sodium hypo-chloride	3.16	7.55	30.94				
Streptomycin	1.83	6.94	24.66	V2008	2.30	10.20	26.33
Hot water	1.33	3.38	23.83				
Mean	2.02	5.41	24.90	Mean	2.02	5.41	24.90

Experiment 3

In 1981 fungicides and antibiotics were foliarly sprayed beginning the first onset of the disease. As shown in table 7, CVS M76, M1134 and V2008 treated with Kocide and Cupravit produced the lowest diseases score and the highest seed yield and seed size. Kocide sprayed plots had the lowest (1.00, 1.00, 1.83) disease score taken at anthesis. But when score was taken at seed maturity cupravit sprayed plots produced the lowest disease score (1.50, 1.00, 1.50) at seed maturity on CVS M76, M1134 and V2008 respectively. Over all the highest mean disease incidence was recorded on CV V2008 and the lowest on CV. M1134, and the difference between the cultivars was significant at 5% level (table 7.).

The highest seed yield and seed size was obtained when plots were sprayed with Kocide followed by Cupravit both of which are Copper based fungicide. Whilst plots sprayed with streptomycin and kasumin produced the lowest seed yield even when compared to the untreated check. CV. M1134 also produced a high seed yield and seed size than either V2008 or M76.

In the 1983 trial the same set of treatments were repeated. The first disease was observed a week after emergence and at this time number of infected plants were counted. On 10 August assessment the lowest number of infected plants were counted from the combined seed and spray treatments. Despite the steady increase of infection of plants in the plots, seeds treated with copper count and sprayed with cupravit produced the lowest number of plants infected.

On 26 August and 19 September 1983 leaf disease was assessed. Significantly lower disease score was observed when plots were sprayed either with cupravit or Kocide - cupravit producing better efficacy on both varieties. At a later stage seed treatments did not influence the spread of the disease. Again M1134 showed a lower disease score (1.9) than V2008 (3.3). Seed yield but not seed size was significantly increased by spraying either Kocide or Cupravit. Kocide when applied at weekly intervals resulted in a 22% and 75% increase in seed yield for CVS M1134 and V2008, respectively.

The least effective treatments were seed treatments when no sprays were supplemented. Seed size, though was not significantly affected, tend to increase when plants were sprayed with either Kocide of Cupravit. On the average the increase in seed size was 2.3 gms per 1000 seeds.

Table 7 Effect of chemical sprays on disease, seed yield and seed size in Mung bean 1981.

Chemicals	Disease Score (0-5) 26-8-81			24-9-81			Seed Yield (g/plot)			Seed size (g/1000 seed)		
	M76	M1134	V2008	M76	M1134	V2008	M76	M1134	V2008	M76	M1134	V200
Control	1.66	1.33	2.50	2.00	1.33	3.17	96.2	108.0	80.7	31.8	43.6	40.
Water	1.66	1.66	2.83	2.17	1.00	3.17	82.2	102.3	85.5	37.6	39.9	39.
Kocide	1.00	1.00	1.83	1.67	1.00	2.50	105.3	113.7	105.0	42.4	44.7	44.
Streptomycin	1.83	1.50	2.83	2.17	1.33	3.83	77.2	92.3	91.5	34.7	41.3	38.
Cupravit	1.33	1.00	2.00	1.50	1.00	1.50	98.7	126.7	96.0	37.0	47.0	43.
Copper count	1.66	1.33	2.50	2.50	1.17	3.17	80.0	100.7	81.7	37.7	41.2	40.
Kasumin	1.66	1.66	3.33	2.00	1.67	3.83	77.8	91.8	76.5	34.1	40.5	36
Mean	1.54	1.35	2.54	2.00	1.21	3.02	88.2	104.9	88.1	36.4	42.6	40.
LSD 0.05												
- Varieties		0.509			0.55			13.2			1.89	
- Chemicals		0.437			0.67			18.1			2.90	

Experiment 4.

Results from this experiment are presented in tables 8, 9a, 9b and 9c. Stand count taken two weeks after emergence in the 1982 experiment indicated a significant difference among the treatments. Seed treated with hot water and copper count produced the lowest stand. Whilst the highest stand were produced when seeds were either not treated or treated with hot water and sprayed with Kocide. When number of infected plants were counted at emergence they have not produced consistent results between the varieties. For V2008 the lowest number of infected seedlings were obtained when seeds were treated with copper count and sprayed immediately whilst for M1134 the lowest figure was recorded when seeds were treated with coppercount and sprayed with either Kocide or cupravit.

Disease assessed on 13 September 1983 at seed maturity showed that plots sprayed with Kocide or Cupravit produced the lowest disease score (1.5 from CV M1134 and 3.0 for V2008). Plots sprayed with either Kocide or Cupravit at weekly intervals were effective in reducing disease, increasing yield and seed size.

Table 8. Effect of seed treatment and foliar spray on halo blight, stand, seed yield and seed size 1982

	Stand at emergence 10-8-82		Disease Incidence				Seed Size (g./1000 seeds)			
	Number out of 160		% infected				(0-5)		Seed yield in gm./plot	
	V2008	M1134	V2008	M1134	V2008	M1134	V2008	M1134	V2008	M1134
Control	138	130	87	71	3.3	1.8	42	48	183	520
Copper Count (seed)	125	135	90	71	3.3	1.7	44	40	217	624
Hot water (seed)	120	140	93	75	3.3	1.6	42	48	175	656
Kocide (spray)	127	138	85	66	3.3	1.6	46	50	259	707
Kupravit (spray)	132	137	81	64	3.1	1.5	46	50	256	708
Copper Count (seed) + Kocide (spray)	126	132	80	62	3.1	1.9	46	49	314	588
Copper Count (seed) + Cupravit (spray)	115	136	85	61	3.2	1.5	43	50	197	583
Hot water (seed) + Kocide (spray)	138	136	88	72	3.4	1.8	48	50	250	595
Hot water (seed) + Cupravit (spray)	130	146	93	67	3.0	1.8	57	49	260	678
Mean	128	137	87	77	3.2	1.7	45	49	235	629
- LSD 0.05										
- Varieties	12.1		-		0.28		1.7		41	
- Chemicals	7.2		7.3		0.20		2.1		67	

Table 9a. Effect of seed treatment and foliar sprays on stand and halo blight 1983

	Stand at germination		Number of plants infected							
	In Percent		10-8-83		13-3-83		16-8-83		18-8-83	
	V2008	M1134	V2008	M1134	V2008	M1134	V2008	M1134	V2008	M1134
Control	60.5	67.3	57.7	15.0	69.2	25.8	86.5	53.0	91.7	64.5
Copper Count (seed)	63.7	70.4	44.7	17.2	51.8	25.7	70.8	48.3	81.7	56.8
Hot water (seed)	72.2	64.9	48.0	13.3	59.3	25.2	71.5	38.3	96.3	67.8
Kocide (spray)	69.8	71.5	30.8	3.8	33.7	8.3	45.0	15.2	66.5	28.2
Cupravit (spary)	50.5	66.0	8.0	2.8	14.8	4.5	42.0	10.8	32.8	23.3
Copper count (seed) + Kocide (spray)	60.1	65.3	34.7	6.3	46.2	13.0	63.5	10.5	58.5	26.0
Copper count (seed) + Cupravit (spray)	58.9	68.2	8.2	2.2	13.0	4.3	25.2	12.7	39.0	22.3
Hot water + Kocide	7[illegible].3	69.9	34.0	3.7	40.0	7.5	57.8	8.8	67.0	25.5
Hot water + Cupravit	67.0	72.4	13.5	2.2	18.7	4.7	35.5	8.0	60.0	24.8
Mean	64.3	68.4	31.3	7.4	38.5	13.2	55.3	22.9	65.9	37.7
LSD 0.05										
- Varieties	-		7.2		7.2		6.7		8.8	
- Chemicals	7.3		11.8		12.2		16.9		13.7	

Table 9b. Effect of seed treatment and foliar spray on stand and seedling disease

(over all summary)

	Stand	10-8-83	13-8-83	16-8-83	19-8-83	Varieties	Stand	10-8-83	13-8-83	16-8-83	19-8-83
Control	63.9	36.3	47.5	69.8	78.1	V2008	64.3	31.3	38.5	55.3	65.9
Copper count (seed)	67.1	30.9	38.8	59.6	69.3	M1134	68.4	7.4	13.2	22.9	37.7
Kocide (spray)	70.6	17.3	21.0	30.1	47.3						
Cupravit (spray)	58.2	5.4	9.7	26.4	28.1						
Copper Count + Kocide	62.7	20.5	29.6	37.0	42.3						
Copper Count + Cupravit	63.6	5.2	8.7	18.9	30.7						
Hot water + Kocide	72.1	18.8	23.8	33.1	46.3						
Hot water + Cupravit	70.7	7.8	11.7	21.8	42.4						
Mean	66.4	19.3	25.8	39.1	51.8	Mean	66.4	19.3	25.8	39.1	51.8

Table 9c Effect of seed treatment and foliar spray on disease, seed yield and seed size

Chemicals	Disease Score (0-5)				Seed Yeeld in grams/6.4m^2		1000 Seed Weight in grams	
	26-8-83		19-9-83					
	V2008	M1134	V2008	M1134	V2008	M1134	V2008	M1134
Control	2.5	1.0	3.8	2.3	337.3	748.0	42.2	43.2
Copper Count (seed)	2.2	1.0	3.8	1.8	360.0	869.8	42.4	43.6
Hot water (seed)	2.2	1.3	4.0	2.5	397.0	685.2	42.3	41.7
Kocide (spray)	1.2	1.0	3.0	1.7	445.8	915.2	43.4	44.2
Cupravit (spray)	1.2	1.0	3.0	1.7	390.5	909.5	44.1	44.2
Copper Count + Kocide	1.3	1.0	3.0	1.8	488.0	873.2	43.4	44.6
Copper Count + Cupravit	1.3	1.0	2.8	1.5	481.2	809.7	44.9	43.5
Hot water + Kocide	1.3	1.0	3.0	1.8	592.2	878.5	43.4	44.4
Hot water + Cupravit	1.0	1.0	2.8	1.7	480.3	767.0	44.6	44.7
Mean	1.6	1.0	3.3	1.9	434.4	839.6	44.6	44.7
LSD 0.05								
- Varieties	0.2			0.35	71.5			
- Chemicals	0.2		0.56	0.56	96.1			

D I S C U S S I O N

Guy and Wimalajeera (13) has attributed the severe outbreaks of halo blight due to the relatively high levels of seed infection. This has been observed in our study. The incidence of halo blight was very severe beginning right after emergence. The degree of severity varies between the cultivars used. After the first observation of the disease, it spreads very fast and within 2-3 weeks the whole plot was infected.

The spread of the disease in the field was not influenced by the weeding time i.e, whether the weeding was done early in the morning when the leaves were conered with dew or late in the morning when the dews on leaves dried out. In the two successive years the results indicate that, at Melkassa condition at least, weeding time did not seem to influence the spread of the disease. The spread of the disease has not been also influenced by plant densities except at early weeding when the denser population show a higher incidence than the sparsely populated plots. At later stages, the disease spread equally faster irrespective of population densities. In our experiment there was a difference in yield, and despite lack of difference in disease, this variation in yield can only be attributed to the relative difference in the number of plants per unit area.

Seed treatments and fungicide sprays (1,3,10,11) have been found to be effective in reducing halo blight in Phaseolus vulgaris. The degree of infection of Pseudomonas phaseolicola on bean seed, checked as % of infected seedlings in the field, was reduced from 45% to 9-17% by the soaking of seed ineither Copper sulphate, streptomycin, Kasugomycin or by heat treatments (12). In their experiment, however, heat treatments eradicated seed infection but reduced seed emergence by 85-98%. In our experiment neither soaking in chemicals nor heat treatment eradicated seed infection and did not affect seed emergence. Soaking seeds in Copper-Count-n solution and heat treatments seem to reduce the seedling infection but later in the growing stage of the crop the disease spread to the healthy plants and the seed treatment effects as a result was nullified.

Bernat and Raica (1974) obtained good control of Pseudomonas Phaseolicola when they sprayed their plots with Bordaux mixture and copper hydroxide. For three successive years by spraying mung beans with Kocide (Cupric hydroxide) and Cupravit (Copper hydroxide) the halo blight disease has been effectively controlled. The reduction in disease was also reflected by an increase in seed yield and seed size The effect had been pronounced more on the tolerant variety M1134 than the susceptible variety V2008.

In conclusions we can say that seed treatment alone, unless there is a complete eradication of seed infection, may not be effective in controlling the disease, especially when the weather condition is favourable for the development of the disease. However, if seed treatment is followed by fungicide spray the disease can be controlled. The control could be more effective if we use a less susceptible variety and begin spray as early as possible when we suspect the presence of the disease and if there is a favourable environment. In addition, however, emphasis must be given on producing disease free seed in the dryer regions of the country where the climatic conditions will not favour the development of the disease. Wimalajeere and Nancarow (1978) suggested that losses due to halo blight could be considerably reduced by time of planting. This factor and the search for resistant or tolerant varieties are other areas where emphasis must be given in the future research programme of the medium to lowland pulses research team.

LITERATURE CITED

1. Adam, D.B. 1936, Halo blight in French beans. A report on measures for its control. J. Dept. Agric. Victoria, Australia 34: 34-35.

2. Bernet, N., Raica, C. 1974. The control of bacteriosis and anthraconis in bean crops. Productia Vegetalia, Horticultura 23(10) : 36-39.

3. Hildreth, R.C. e Starr, C.H. 1950. Antibiotics alone and in combination for the control of bacterial blight of beans. J. Colorado, Wyoming Acad. Sci. 4:58.

4. Humaydea, H.S., Harmen, G.E., Nedrow, B.L., e Dinitto, L.V. 1980. Eradication of <u>Xanthomonas campastris</u>, the causal agent of black rot, from brassica seeds with antibiotics and sodium hypochlorite. Phytopathology 70: 127-131.

5. Kranz, J., Schmutteres, H., and Koch, W. 1977. Bacterial Diseases' in Diseases, pests, and Weeds in Tropical Crops, P. 58.

6. Person, L.H., e Edgerton, C.W. 1939. Seed treatment for the control of bacterial blight of beans. Phytopathology 29:19.

7. Smith, W.L. 1949. Seed treatment with Streptomycin for the control of bacterial blight of beans. J. Colorado, Wyoming Acad. Sci., 4: 49.

8. Stewart E., Dagnatchew, Y. 1967. Index of Plant Diseases in Ethiopia. DebreZeit Experiment Station Bulletin number 30, Addis Abeba University, College of Agriculture, Alemaya.

9. Taylor, J.D. 1970. The quantitative estimation of the infection of bean seed with <u>Pseudomonas Phaseolicola</u> (Burkh.) Dowson. Ann. Appl. Biol., 66: 29-36.

10. Taylor, J.D., e Dudley, C.L. 1977. Seed treatment for the control of halo blight of bean (Pseudomonas Phaseòlicola). Ann. Appl. Biol., 85: 223-232.

11. Taylor, J.D., e Dye, D.W. 1976. Evaluation of streptomycin and seed treatment for the control of bacterial blight of Peas (Pseudomonas pisi sackett 1916). New Zealand J. Agric. Res., 19: 91-95.

12. Tamiett., Gracomo. 1982. Evaluation of different seed treatments in controlling the halo blight of bean. Informatore Fitopatologico 6: 47-50.

The prevalence & severity of purple stair of seeds (Cercospora kikuchi T. matsu and Tomoyasu chupp) on soybean.

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Introduction

Soybean (Glycine max) is an introduced legume crop to Ethiopia. It is produced primarily for protein and oil source. The seeds of modern varieties have 16% oil and 30 to 50% protein content. It is used for the manufacture of baby food FAFA in our country, besides its great demand on the world market. The production of soybean covers an area more than 1000 ha under state farms. It gives 10-12Q/ha under large scale production.

As soybean production expands in the country, disease have increased in number and severity. Various fungal, bacterial and viruslike diseases have been recorded in Ethiopia. Some of the most predominating diseases observed in various soybean fields at present are bacterial blight (Pseudomanas glycinea coerper) bacterial pustule (xanthomonas phaseoli E.F. Smith) pyrenochaeta leaf spot (pyrenochaeta glycines R.B. Stewart) and purple stain of seeds cercospora Kikuchi (T. matsu & tomaoyasu).

Purple seed stain of soybean has been reported in Ethiopia long ago by Robert B. Stewart. The disease does not reduce yields but a high percentage of the seeds may be stained at harvest. Discoloration is not determinental to seeds for processing, because the color disappears upon heating. United States grading standards, however, allow no more than five percent purple stained seeds in No. 1 yellow soybeans (1). Infected seeds frequently exhibit reduced germination or often produce diseased seedling.

Seed discoloration varies from pink or pale purple to dark purple. The disease overseasons in diseased leaves, stems and seeds. Planting purple stained seeds may serve to introduce the pathogen into a field but the percentage of purple stain in the seed planted usually has little influence on the percentage of purple stained seeds in the resulting crop (1).

The significant importance of the disease in seed processing was known in other countries. Therefore once the disease is introduced with the seed in our country, it is important to know the prevalence and severity of the disease. With this objective a survey was proposed to know the distribution and severity of the disease in our country .

Survey results

Purple seed stain on soybean is becoming an important disease. From the survey done in the last three years the severity and distribution of the disease is increasing from year to year. It is observed in production fields on released varieties with moderate incidence. The disease is distributed in most soybean research sites like Awasa, Bako, Jima and Arsi-Negele with very severe incidence of some varieties. Ninty four varieties from the national observation nursery were checked for their incidence of purple seed stain and most of them were found to be attacked by the disease.out of these, nine varieties were found to be free of the disease.

Varieties such as 7138, TGm-273-2-2340 and G-2120 show 94%-97% infection level and varieties like AGS-62 40% crowford 29.8% AGS-135 27-2%, Desseto 25.2% AGS-131 23.8% cutler 71 16.4%, AGS-66 14.4%, Williams 9.2% and forest 8.8% infection. This infection percentage is very high as compared to the United States grading standard.

From the preliminary observation done infected seeds reduce germination to about 72.1% as compared to healthy seeds and results to reduction in yield.

Summary & conclusion

Since the pathogen is transmitted by seed, the chance of distribution of the disease to other soybean growing areas and research sites like the IAR/ADD is very high. Therefore, clean seeds free of purple stain must be sent to the research sites where NYT & PNYT are excuted. It is necessary in the mean time to screen resistant varieties and to screen effective seed dressing and supplimentary spraying fungicides to get clean seed for processing and exporting soybean to the world market.

Literature cited

1. American phytopathological society U.S.A 1975
Compendium of soybean diseases p. 22-24

2. "Institute of Agricultural Research" (IAR), Addis Abeba
1982 soybean production guideline p.9

3. Plant disease reporter Vol. 63 No. 63 No. 7 July 1979

4. Rober B. Stewart and Dagnatchew Yirgu 1967
Index of plant diseases in Ethiopia.
Debre Zeit Experiment Station, bulletin No. 30
College of Agriculture p.51

The Use of Trap Crops for the Control of African Bollworm on Hot Pepper

By

Tsedeke Abate

ABSTRACT

In an effort to develop integrated management of the African bollworm (ABW), *Heliothis armigera*, on hot pepper, investigations into the use of lupin as a trap crop were made during the 1981/82 and 1982/83 crop seasons. Results obtained from the two years experiments indicated that lupin caught appreciably higher number of ABW population than did hot pepper; this ranged from 4-folds in the 1981/82 season to upwards of 18-folds in 1982/83. It is recommended that the optimum proportion of the land area between lupin and hot pepper be determined experimentally.

The African bollworm (ABW), Heliothis armigera, is a major pest of hot pepper in Ethiopia. Information on the chemical control aspect of this pest is fairly well understood. In an effort to develop integrated management of ABW, investigations into use of trap crops as one component of integrated pest management (IPM) started in the 1981/82 crop season at the Bako Research Station of IAR. Lupin was used as a trap crop in this trial; the experiment was conducted for two consecutive years, 1981/82 and 1982/83.

The trial was laid out in a non-replicated field; hot pepper was interplanted with lupin in an approximately 100 m by 100 m area. The planting arrangement was such that five (1981/82) or three (1982/83) rows of lupin were planted on either side of the field and then at 25 meter intervals so that there were a total of five patches of lupin in the whole field.

Counts of ABW eggs and larvae were made beginning at early flowering and then at weekly or fortnightly intervals. Samples were taken on the whole row in the first season and on ten one-metre rows in the second. Population counts were made on the row of lupin, pepper adjacent to the lupin row (HP 1) and then at 5 (HP 2) and 10 m (HP 3) away from lupin row.

Tables 1 and 2 show results for the 1981/82 and 1982/83 seasons, respectively. As can be seen from the tables, the trap crop caught more ABW than did hot pepper at any one of the distances - i.e. HP 1, HP 2, or HP 3. For example, the overall mean ABW population on lupin row for the first experiment was 109.95 while that for HP 1, HP 2 and HP 3 were 34.44, 23.75 and 22.38, respectively (Table 1). In other words, the ABW population on lupin was roughly 3.2 —, 4.6 —, and 4.9 times higher than that on HP 1, HP 2, and HP 3. On the average, the ratio of ABW population on the trap crop to main crop was 4:1.

Table 1: Comparison of ABW Population on Hot Pepper and lupin - Bako : 1981/82

Counting date	Mean number of ABW eggs & larvae Per row on				
	Lupin	HP 1	HP 2	HP 3	Total
19-viii-81	155.40	61.75	21.25	21.75	260.15
31-viii-81	182.20	31.75	36.50	41.75	292.20
14-ix-81	65.00	19.25	10.00	15.00	109.25
22-ix-81	.20	25.00	27.25	11.00	100.45
Total	439.80	137.75	95.00	89.50	
Mean	109.95	34.44	23.75	22.38	
S.E.M.	15.06	4.77	2.77	3.28	

Overall mean for hot pepper = 26.85 ± 2.24

Table 2: Comparison of ABW Population on Hot Pepper and Lupin - Bako, 1982/83

Counting date	Mean number of ABW eggs and larvae/10 m row				
	Lupin	HP 1	HP 2	HP 3	Total
10-viii-82	21.20	0.25	1.75	1.50	24.70
23-viii-82	41.20	0.25	1.75	1.75	44.95
30-viii-82	55.00	3.50	3.25	2.50	64.25
6-ix-82	72.40	2.25	2.75	1.75	79.15
13-ix-82	45.80	3.25	3.25	4.75	57.05
20-ix-82	3.20	1.00	0.50	2.75	22.45
28-ix-82	17.40	1.00	1.75	1.00	21.15
4-x-82	5.60	0.25	0.25	1.00	7.10
11-x-82	8.80	0.25	0.00	0.25	11.30
18-x-82	1.60	0.25	0.00	0.00	1.85
25-x-82	0.40	0.20	0.00	0.00	0.60
1-xi-82	0.50	1.60	0.00	0.00	2.10
8-xi-82	5.20	0.00	0.00	0.00	5.20
Total	285.30	14.05	15.25	17.25	
Mean	21.94	1.08	1.17	1.32	
S.E.M.	6.68	0.33	0.36	0.39	

Overall mean for hot pepper = 1.19 ± 0.36

Ct/RSC 26.1(81) CHEMICAL CONTROL OF RED SCALE

Tsedeke Abate*

Abstract

Three experiments were conducted to evaluate the efficacy of several organophosphate (OP) insecticides, white oil, and combinations of OP's and white oil against Aonidiella aurantii on citrus in the 1981 and 1982 seasons. Results from these experiments indicated that all insecticides tested gave superior results to the untreated check. Where the OP's and 2% white oil were tested alone, the white oil treatment was as good as any one of the OP insecticides. Where OP/white oil combinations were tested, superior results were obtained with OP's + 1.5% white oil than when the former were used alone. Most satisfactory results were obtained with 0.045% Methidathion + 1.5% white oil, 0.075% ethion + 1.5% white oil, and with 2% white oil alone.

Introduction

Red scale, Aonidiella aurantii, is the most important insect pest of citrus in most citrus growing areas of Ethiopia causing nearly 5% culling of fruit as unmarketable, in addition to considerable losses in quality and so forth (15). OP insecticides such as methidathion have been recommended for the control of this pest in this country (6); however, recent observations have indicated that red scale has become extremely difficult to control with the recommended insecticides and its importance increased. It has thus been surmised that this might have been brought about by development of resistance OP's as is commonly known in South Africa (2,3,5,7,13), and/or decimation of natural enemies which are very sensitive to OP's especially when spray applications are made without due consideration to the time of application (9).

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Similar results were obtained in the 1982/83 season. Here, ABW numbers on lupin were approximately 20.3 —, 18.8 —, and 16.6 folds of those on HP 1, HP 2, and HP 3, respectively. On the average, the ratio of ABW on lupin to that on hot pepper was about 18:1.

To sum up, appreciably more number of ABW is caught on lupin than on hot pepper; this ranged from 4-folds in the 1981/82 season to well over 18-folds in 1982/83. Before making final recommendations, it may be necessary to determine the optimum proportion of the land area between the trap crop and hot pepper. This is already underway.

Responsibilities:	Solomon Eshete,	ARO	(1981/82)
	Abraham Tadesse,	ARO	(1982/83)
	Kumsa Gemene,	SFA	(both seasons)

It was therefore suggested that a sound integrated pest management (IPM) programme based on the understanding of population dynamics of red scale and its natural enemies, and selection of effective and selective insecticides must be launched to achieve effective control of the pest (15). Results on population studies have been reported elsewhere (16). Results of insecticides tested for the control of red scale are reported here.

Materials and Methods

Three experiments were conducted to evaluate the efficacy of several OP insecticides, three levels of white oil, and combinations of OP's and 1.50% white oil in the 1981 and 1982 seasons. Details of treatments used in each experiment are shown in Table 1-3.

Experiments 1 and 2 were conducted at the Melkawerer Research Station (MWRS) of the Institute of Agricultural Research (IAR), while Experiment 3 was done at Degaga citrus orchard, near Sodore. Experiment 1 was a non-replicated observation (3 trees/plot) while Experiment 2 was replicated three times (2 trees/plot) and Experiment 3 four times (1 tree/plot). A single spray application was made in each experiment using either Dorman(R) wheel-barrow sprayer (MWRS) or Hardi(R) tractor mounted sprayer (Degaga).

In experiment 1, each experimental tree was divided into four quadrants, as suggested by Rosen (12), and 10 leaves were randomly collected from each quadrant from a height of about 2 m, as used by Campbell (4), giving a total of 40 leaves per tree. The leaves thus collected were brought to the laboratory and counts of living and dead second instar and adult female scales were made by lifting the armour of the scale with a needle under a dissecting microscope.

In experiment 2, data were collected by taking four fruits at random from each quadrant of the experimental tree (a total of 16 fruit/tree). Percentages of dead scale were determined as Experiment 1 above.

Table 1:- Insecticide treatments and their rates used in Experiment 1 at Melkawerer.

Treatment	RATE	
	Amount (ml) of product/100 l. water	Equivalent% a.i.
Check (untreated)	-	-
Diazinon (Basudin) 60% EC 1	150	0.0900
Diazinon (Diazole) 60% EC 2	150	0.0900
Malathion (Malapaz) 50% EC	250	0.1250
Methidathion (Supracide) 40% EC	150	0.0600
Ethion (Ethopaz) 50% EC	200	0.1000
Dimethoate (Rogor) 40% EC	250	0.1000
White Oil (Medopaz) 80% 1	1250	1.0000
White Oil (Medopaz) 80% 2	1875	1.5000
White Oil (Medopaz) 80% 3	2500	2.0000
Diazinon 1 + White Oil 2	112.50 + 1875	0.0675 + 1.5000
Diazinon 2 + White Oil 2	112.50 + 1875	0.0675 + 1.5000
Malathion + White Oil 2	187.50 + 1875	0.0938 + 1.5000
Methidathion + White Oil 2	112.50 + 1875	0.0450 + 1.5000
Ethion + White Oil 2	150.00 + 1875	0.0750 + 1.5000
Dimethoate + White Oil 2	187.50 + 1875	0.0750 + 1.5000

Table 2:- Insecticide treatments and their rates used in Experiment 2 at Melkawerer

Treatment	R A T E	
	Amount (ml) of product/100 l. water	Equivalent % a.i.
Check (Untreated)	-	-
Diazinon (Basudin) 60% EC	150	0.0900
Dimehoate (Rogor) 40% EC	250	0.1000
Ethion (Ethopaz) 50% EC	200	0.1000
Malathion (Malapaz) 50% EC	250	0.1250
Methidathion (Supracide) 40% EC	150	0.0600
White Oil (Medopaz) 80%	2500	2.0000

Table 3:- Insecticide treatments and their rates used in Experiment 3 at the Degaga Farm

Treatment	Amount (ml) of product/100 l water	Equivalent % a.i.
Check (Untreated)	-	-
Diazinon (Basudin) 60% EC	150	0.0900
Mecarbam (Murphotox) 68% L	100	0.0680
Ethion (Ethopaz) 50% EC	200	0.1000
Malathion (malapaz) 50% EC	250	0.1250
Methidathion (Supracide) 40% EC	150	0.0600
White Oil (Medopaz) 80% 1	1250	1.0000
White Oil (Medopaz) 80% 2	1875	1.5000
White Oil (Medopaz) 80% 3	2500	2.0000
Diazinon + White Oil 2	112.50 + 1875	0.0675 + 1.5000
Mecarbam + White Oil 2	75.00 + 1875	0.0510 + 1.5000
Ethion + White Oil 2	150.00 + 1875	0.0750 + 1.5000
Malathion + White Oil 2	187.50 + 1875	0.0938 + 1.5000
Methidathion + White Oil 2	112.50 + 1875	0.0450 + 1.5000

A similar procedure to Experiment 1 was used in Experiment 3 except that 20 leaves/tree were sampled in the latter. In all cases a total of at least 200 scales were counted per tree. Sampling was made at two-to four - week intervals after the spray application. A 0.025/ Citowett(R) was added to all OP insecticides where white oil was omitted.

Results and Discussion

Experiment 1

Data for this experiment are shown in Table 4. As can be seen from the table, there were appreciable differences between treatments all at 2, 4 and 8 weeks after spray (WAS). At 2 WAS, 0.075% ethion- 1.5 white oil (WO2) combination followed by 2% white oil, 0.045% methidathion + WO2, 0.0675% diazinon 1 + WO2, and WO2 alone, in that order, gave highest kill of red scale.

Methidathion, dimethoate, ethion, and dimethoate + WO 2 did not seem to differ much from the untreated check. The remaining treatments gave intermediate results. At 4 WAS, all insecticide treatments resulted in considerably higher percentage kill of the insect than the check. At 8 WAS, most of the treatments outperformed the untreated check; diazinon 2 + WO2 was as good as the check. Here, best results were obtained with 2% white oil, ethion + WO2, malathion + WO2, methidathion + WO2, diazinon 1 + WO2, dimethoate + WO2, methidathion, and diazinon 1. Malathion, ethion, and dimethoate were intermediate.

Table 4:- Effect of insecticide sprays on the population of *Aonidiella aurantii* on citrus leaves at Melkawerer, 18-3-81 - 18-5-81

Treatment	Percent dead female red scale at			
	Prespray	2 WAS	4 WAS	8 WAS
Check (untreated)	20.59	24.40	10.61	29.19
Diazinon 1	13.74	67.23	53.06	77.96
Diazinon 2	20.24	35.87	59.55	79.10
Malathion	20.50	35.19	47.03	52.12
Methidathion	25.30	23.28	54.55	78.62
Ethion	17.35	28.64	42.30	43.17
Dimethoate	20.39	27.06	59.09	52.84
White Oil 1	12.90	35.16	66.48	89.71
White Oil 2	21.31	67.20	49.56	77.76
White Oil 3	22.22	76.78	56.02	88.91
Diazinon 1 + WO2**	16.29	72.49	50.10	63.74
Diazinon 2 + WO2	23.65	43.37	49.19	28.54
Malathion + WO2	19.19	45.80	50.18	85.80
Methidathion + WO2	23.49	75.48	61.71	82.81
Ethion + WO2	25.03	80.29	56.05	88.82
Dimethoate + WO2	17.31	28.44	62.03	79.09
Mean	19.97	47.92	51.72	68.64

* WAS = weeks after spray, **WO = white oil

Experiment 2

Table 5 shows the effect of six insecticide spray treatments on red scale on citrus fruit. Here, differences between means of the seven treatments at prespray were nonsignificant. At 2 and 4 WAS, however, all insecticider sprays significantly (P=0.05) outperformed the untreated check; none of the insecticide treatments was statistically different from each other. At 6 WAS, again all insecticides gave significantly higher kill than the check. Dimethoate and diazinon were statistically superior to malathion and white oil, while methidathion and ehtion were intermediate between the two groups. The superiority of dimethoate in this experiment is in agreement with Giliomee's (8) report which stated that dimethoate is more effective on fruit.

Experiment 3

Results of this experiment are presented in Table 6. At prespray, there was no statistical difference among the treatments. At 2 WAS, most insecticide treatments significantly outperformed the untreated check. Here, best result was obtained with methidathion + WO2, followed by 2% white oil alone, which in turn, was followed by ethion + WO2, diazinon alone, diazinon + WO2, and malathion + WO2 (no significant difference among the last four). Mecarbam and malathion alone were not significantly different from the check.

At 4 WAS, all insecticide treatments, except malathion and mecarban, resulted in significantly superior kill of the insect than the check. Again, best results were obtained with methidathion + WO2, followed by methidathion alone, 2% white oil, diazinon + WO2, ethion + WO2, and malathion + WO2, none of which were significantly different from each other. The next group of treatments that gave good kill consisted of diazinon, ethion, 1% white oil, and mecarbam + WO2. Mecarbam and malathion alone were not significantly different from the check.

Table 5:- Effect of insecticide sprays on the population of Aonidiella aurantii on citrus fruit at Melkawerer : 6-5-81 - 20-6-81

Treatment	percent dead female red scale at			
	Prespray	2 WAS	4 WAS	6 WAS
Check	13.20 a	26.17 b	31.72 b	43.96 c
Diazinon	10.83 a	69.34 a	66.76 a	86.37 a
Dimethoate	11.98 a	69.57 a	77.16 a	87.23 a
Ethion	12.35 a	52.50 a	59.50 a	76.12 ab
Malathion	18.13 a	65.68 a	62.49 a	67.03 b
Methidathion	12.56 a	74.31 a	77.84 a	76.74 ab
White Oil	11.60 a	54.47 a	60.41 a	71.03 b
Mean	12.95	58.85	62.27	72.64
S.E,M.	2.40	8.25	7.37	3.99

* Means followed by the same letters are not significantly different from each other at the 5% level (Duncan's New Multiple Range Test).

At 6 WAS, methidathion + WO2 was significantly superior to all other treatments; it was followed by ethion + WO2 and malathion + WO2. These were, in turn, followed by 1% white oil, 2% white oil, diazinon + WO2, and mecarbam + WO2. Diazinon, mecarbam, and malathion were statistically superior to the check but inferior to all other treatments.

Eight weeks after spray, all insecticides significantly outperformed the check, the methidathion - white combination still being in the lead. The decreasing order of efficacy for the remainder of the treatments was:

1) 2% white oil and malathion + WO2;
2) diazinon + WO2, ethion + WO2, mecarbam + WO2, and methidathion;
3) 1% white oil, 1.50% white oil, and ethion; 4) diazinon. 5) mecarbam; and
6) check.

Table 6:- Effect of insecticide sprays on the population of <u>Aonidiella aurantii</u> on citrus leaves at the Degaga Farm, 11-v-82 2-viii-82

Treatments	Percent dead female red scale at						
	Prespray	2 WAS	4 WAS	6 WAS	8 WAS	10 WAS	12 WAS
Check	3.45 a	18.25 d	15.75 d	18.32 e	17.38 e	21.43 f	22.80 d
Diazinon	3.01 a	39.33 abc	45.05 abc	46.09 d	51.28 cd	46.60 cde	43.73 bcd
Mecarbam	3.26 a	25.74 cd	32.47 cd	43.80 d	42.53 d	37.03 ef	33.70 cd
Ethion	5.14 a	28.14 bcd	47.21 abc	67.8/ bc	64.23 bcd	54.55 cde	51.25 abcd
Malathion	4.52 a	24.21 cd	33.38 cd	45.14 d	43.13 d	43.88 de	38.15 cd
Methidathion	5.52 a	37.21 abcd	64.00 ab	67.94 bc	74.38 abc	60.30 abcd	43.68 bcd
White Oil 1	3.25 a	36.97 abcd	47.48 abc	69.44 abc	62.33 bcd	55.38 bcde	51.25 abcd
White Oil 2	5.36 a	28.50 bcd	42.73 bc	63.43 c	53.48 bcd	49.58 cde	48.20 bcd
White Oil 3	2.54 a	49.02 ab	61.85 ab	73.25 abc	75.95 ab	57.65 bcd	63.15 abc
Diazinon + WO2	5.58 a	39.90 abc	64.94 ab	72.71 abc	67.98 abc	63.15 abcd	57.95 abcd
Mecarbam + WO2	2.98 a	30.37 bcd	55.45 abc	78.94 abc	74.23 abc	65.35 abc	42.50 cd
Ethion + WO2	3.81 a	41.16 abc	59.57 ab	83.49 ab	74.20 abc	80.48 a	79.53 a
Malathion + WO2	5.44 a	38.95 abc	58.50 ab	81.42 ab	74.88 ab	62.85 abcd	63.05 abc
Methidathion + WO2	1.89 a	53.94 a	70.37 a	85.91 a	90.90 a	75.63 ab	73.55 ab
Mean	3.98	35.12	49.91	64.13	61.92	55.27	50.89
S.E.M.	1.48	6.20	7.45	4.98	6.99	6.06	8.81

At 10 and 12 WAS, best results were obtained with ethion + WO2, followed by methidathion + WO2. The rest of the treatments can be categorized (no significant difference within a category) in descending order as follows:-

a) 10 WAS: 1. mecarbam + WO2; 2. methidathion, diazinon + WO2, and malathion + WO2; 3. 2% White oil, 4. 1% white oil; 5. diazinon, ethion, and 1.50%and 6. check.

b) 12 WAS : 1. 2% white oil and malathion + WO2; 2. ethion, 1% white oil, and diazinon + WO2; 3. diazinon, methidathion, and 1.50% white oil; 4. mecarbam, malathion, and mecarbam + WO2. and 5. check.

The following general statements can be made regarding Table 6: First, the efficacy of OP insecticides can be improved by adding 1.5% white oil. This is an agreement with the findings of Schoonees and Giliomee (13) who reported a forty-fold increase in the toxicity of methidathion to a resistant strain of red scale when 1% white oil was added. Secondly, most satisfactory results were obtained with methidathion + WO2, ethion + WO2, and 2% white oil; other OP-white oil combinations also gave good results; mecarbam-white oil combination was not as consistent. The superior performance of white oil alone is of special significance since it is the only safe scalicide to natural enemies of red scale (1,11) and is said to be the only solution available to control resistant red scale (2, 3, 4). Thirdly, of the OP's tested, methidathion gave consistently superior percentage kill to others, thus confirming results reported by other workers (1, 10, 14).

It can be concluded that 2% white oil can give as effective control of red scale as the commonly used OP's or OP-white oil combinations. However, use of white oil must be emphasized because of its compatibility with IPM programmes.

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LITERATURE CITED

1. Anonymous. 1975. Insect pest control in citrus. Qd. Agric. J. 101: 22-27.

2. Bedford, E.C.G. 1979. An integrated pest management programme to citrus in the Lowveld. Citrus & Subtrop. Fruit J. (August): PP. 10.15.

3. ___________. 1979. Recommendations for the integrated control of the citrus pest complex in the lowveld. Citrus & Subtrop. Fruit J. (September): pp. 11-18.

4. Campbell, M.M. 1976. Colonisation of Aphytis melinus DeBach (Hymenoptera, Aphelinidae) in Aonidiella aurantii (Mask.) (Hemiptera, Coccidae) in South Australia. Bull. Entomol. Res. 65: 659-688.

5. Chamberlain, J. 1979. OP resistant red scale: its influence on present and future pest control. Citrus & Subtrop. Fruit J. (August): pp 19-20.

6. Crowe, T.J. & Shitaye G.M. 1977. Crop pest handbook, third (revised ed.). Inst. Agric. Res., Addis Abeba. 55 pp.

7. Georgala, M.B. 1975. Possible resistance of the red scale Aonidiella aurantii Mask. to corrective spray treatments. Citrus & Subtrop. Fruit J. (December): 5-17.

8. Giliomee, J.H. 1981. Management of red scale Aonidiella aurantii (Mask.) on citrus in South Africa. Citrus & Subtrop. Fruit J. No. 566: pp. 6-7, 10-12.

9. Milne, D.L. & E.A. De Velliers. 1975. Danager periods for applying certain pesticides to citrus. Citrus & Subtrop. Fruit J. No. 496: pp. 17-18

10. Rawhy, S. et al. 1978. Studies on some insecticides against certain scale insects infesting citrus trees. Agric. Res. Rev. 56(1): 175-179.

11. Rosen, David. 1967. Effect of commercial pesticides on the fecundity and survival of Aphytis holoxanthus (Hymenoptera: Aphelinidae). Israel J. Agric. Res. 17(1): 47-50.

12. ______. 1973. Methodology for biological control of armoured scale insects. Phytoparasitica 1(1): 47-54.

13. Schoonees, J. & J.H. Giliomee. 1982. The toxicity of methidathion and citrus spray oil to mature and immature stages of OP - resistant and susceptible red scale, Aonidiella aurantii (Mask.) (Hemiptera: Diaspididae). J. Entomol. Soc. Sth. Afr. 45(1): 1-13. (Rev. Appl. Entomol. 70 (10): Abst No. 6050).

14. Smith, D. 1977. Control of Aonidiella aurantii (Maskell) and Chrysomphalus ficus Ashmead on citrus in south-eastern Queensland. Qd. J. Agric. Anim. Sci. 34(1): 75-86.

15. Tsedeke Abate. 1981. Preliminary notes on the citrus insect and mite pest situation in Ethiopia. Eth. J. Agric. Sci. 3(2): 121-128

16. ______________. 1983. (In preparation). Population dynamics of the red scale, Aonidiella aurantii (Maskell) (Homoptera: Diaspididae), and its natural enemies on citrus in Ethiopia.

Chemical Control of Onion Thrips

By

Tsedeke Abate

ABSTRACT

The onion thrips, *Thrips tabaci*, is the major insect pest of onions in Ethiopia. Experiments to determine effective insecticides for dipping seedlings during transplanting, and for use as foliar sprays in the field were carried out during the 1981/82 and 1982/83 seasons. The results obtained from the two years' experiments showed that: a) dipping seedlings in a 0.1% a.i.diazinon solution gave significantly superior reduction of onion thrips (at Nazret) to the untreated check or DDT; however, yield differences among diazinon, DDT and the check were not significant.
b) the synthetic pyrethroids, cypermethrin and decamethrin gave the most effective control of the thrips and highest bulb yield. c) yield losses in onions due to thrips damage ranged from 26.00 to 42.76%. It is recommended that the frequency and spray concentrations of cypermethrin be determined experimentally.

Onions (and shallots) are important vegetable crops grown in Ethiopia both for export market and domestic consumption. The onion thrips, <u>Thrips tabaci</u>, is the most improtant insect pest limiting production of the crop in this country. Dipping seedlings in a 0.18 % a.i. DDT solution just before transplanting and foliar sprays with a 0.025 % a.i. phenthoate or fenitrothion have been used in the past. However, results obtained using these recommendations were unsatisfactory; moreover, it was found to be necessary to replace DDT with an insecticide that would pose less residue hazards.

Consequently, experiments were carried out to determine effective chemicals for dipping seedlings and for use as foliar spray applications in the field in the 1981/82 and 1982/83 seasons.

The experiment was laid out in a split- plot design in three replications (except the 1981/82 season trial at Melkawerer which had only 2 reps) with dippings as main plots and foliar sprays as subplot treatments; plot sizes were 4.8 by 5.0m for both seasons at Nazret and 4.2 by 4.8 m in the 1981/82 and 1982/83 seasons at Melkawerer, respectively.

The treatments used were:

a) Main Plots:-
1. Check (untreated)
2. 0.1875% a.i. DDT dippings
3. 0.1000% a.i. diazinon dippings

b) Sub-plots:-
1. Check (untreated)
2. Cypermethrin (Ripcord) -100 g a.i./ha
3. Decamethrin (Decis) -12.5 g a.i./ha
4. Fenitrothion(Sumithion) -500 g a.i./ha
5. Malathion -1000 g a.i./ha
6. Methomyl (Lannate) -250 g a.i. /ha
7. Methidathion(Supracide) -200 g a.i. /ha

After the crop establishemnt, the number of thrips per 10 randomly selected plants per plot was counted and recorded twice a week; insecticides were sprayed within the threshold level of an average of 5 or more thrips per plant was reached. Three spray applications were made. Post spray counts were also made at 2, 6, 10 and 14 day intervals. Thrips counts from the three spray applications were pooled and combined analysis were made.

Results of the experiments (2 yr. avg.) for Nazret (NRS) and Melkawerer (MWRS) are presented in tables 1 and 2 respectively. The following conclusions can be made:-

a) dipping seedlings in diazinon gave significantly superior reduction of thrips population to the check and/or to DDT at NRS, while none of the main plot treatments was statistically different from each other at Melkawerer. Differences among main plot yield means were also insignificant.

b) all spray treatments were statistically superior to the check in controlling the thrips thereby resulting in significantly higher yields. Most satisfactory results were obtained with the pyrethroids, cypermethrin and decamethrin.

c) onion thrips can cause up to nearly 43% yield losses unless proper control measures are taken.

Table 1: Effect of insecticede treatments on the population of *Thrips tabaci* and yield of onions (two season average)

Treatment	Main number of thrips per 10 plants at Nazret*					Yield in
	pre-spray	2 DAS	6 DAS	10 DAS	14 DAS	kg plot
A. Main plots						
1. Check	97.24 c	92.43 a	255.00 b	176.71 a	225.24 a	44.83 a
2. DDT	74.48 b	92.25 a	262.00 c	169.05 a	233.62 a	42.97 a
3. Diazinon	40.48 a	83.52 a	220.84 a	188.57 a	227.76 a	44.86 a
Mean	70.73	89.63	245.95	178.11	230.54	44.22
S.E.M.	5.63	6.15	7.75	7.05	13.19	0.95
B. Sub plots						
1. Check	68.44 a	529.22 b	767.33 c	564.89 c	757.89 d	34.43 c
2. Cypermethrin	72.44 a	4.89 a	13.22 a	18.44 a	29.89 a	50.87 a
3. Decamethrin	65.67 a	7.33 a	37.00 a	42.00 a	61.11 a	50.12 a
4. Fenitrothion	69.33 a	16.11 a	189.22 b	122.22 b	159.89 b	44.83 b
5. Malathion	77.78 a	10.22 a	230.22 b	150.33 b	157.78 b	42.41 b
6. Methomyl	64.78 a	21.44 a	210.89 b	153.78 b	187.78 b	44.36 b
7. Methidathion	76.67 a	38.22 a	273.78 b	195.11 b	259.48 c	42.54
Mean	70.73	89.63	245.95	178.11	230.54	44.22
S.E.M.	8.84	18.06	27.25	23.62	18.06	1.20

* Means followed by the same letters are not significantly different from each other at the 5% level. (Duncan's New Multiple Range Test).

Table 2: Effect of insecticide treatments on the population of *Thrips tabaci* and yield of onions (two season average)

Treatment	Mean number of thrips per 10 plants at Melkawerer*					Yield in kg/plot
	pre-spray	2 DAS	6 DAS	10 DAS	14 DAS	
a. Main plots						
1. Check	66.14 a	80.90 a	202.05 b	144.90 a	238.52 a	32.45 a
2. DDT	48.33 a	65.05 a	181.43 ab	126.24 a	250.57 a	27.36 b
3. Diazinon	58.67 a	72.43 a	157.67 a	129.29 a	241.81 a	29.45 b
Mean	57.71	72.79	180.38	133.48	243.63	29.7[illegible]
S.E.M.	7.51	10.28	9.04	5.91	15.51	0.71
b. Sub plots						
1. Check	62.11 a	326.33 c	448.11 c	317.44 c	505.22 c	2[illegible]
2. Cypermethrin	73.00 a	12.89 a	30.33 a	19.33 a	77.67 a	34.[illegible]
3. Decamethrin	48.44 a	18.22 a	36.11 a	32.00 a	97.67 b	35.[illegible]
4. Fenitrothion	54.78 a	32.11 ab	178.22 b	144.78 b	246.11 b	30.[illegible]
5. Malathion	50.67 a	22.67 a	154.56 b	113.56 ab	241.67 b	29.[illegible]
6. Methomyl	60.89 a	46.11 b	174.56 b	138.00 b	251.56 b	29.[illegible]
7. Methidathion	54.11 a	51.22 b	240.78 b	169.22 b	285.56 c	26.[illegible]
Mean	57.71	72.79	180.38	133.48	243.63	29.75
S.E.M.	9.67	7.31	26.87	33.69	33.48	1.77

* Means followed by the same letters are not significantly different from each other at the 5% level. (Duncan's New Multiple Range Test).

Recommendations:-

Effective control of the onion thrips can be achieved with dipping onion seedlings in a 0.1% a.i. diazinon solution prior to transplanting and then applying cypermethrin or decamethrin when the economic threshold is reached. However, it is necessary to determine the frequency and amount of spray concentrations of cypermethrin experimentally. Experiments to this end are being carried out at NRS and MWRS.

Chemical Control of Sweet Potato Leafminer

By

Tsedeke Abate

ABSTRACT

Experiments to determine effective insecticides to control the sweet potato leafminer, Bedellia somnulentella, and thereby assess the yield loss caused by this pest were carried out at the Bako Station of IAR during the 1981/82 to 1983/84 seasons. Results, assessed in terms of the number of living larvae/100 leaves, number of damaged leaves/100 and yield (1981/82), showed that almost all insecticides were superior to the check in reducing the former two parameters; highest yield was obtained with methamidophos than the check and the rest of the treatments although these were non-significant. Yield loss was estimated to be 22.71%. No infestation was observed in the latter two seasons and it is concluded that the pest is sporadic and therefore the trial be suspended.

The sweet potato leafminer, Bedellia somnulentella (Zeller), was first recorded in Ethiopia by Gentry (1965), who reported heavy infestations (up to 20%) at Jima. Schmutterer (1971) also noted this pest to be a common leafminer in the Bako area. This author observed heavy outbreaks of B.somnulentella at Bako in the 1979 and 1980 crop seasons.

Elsewhere, the leaf miner is known to attack many plant species in the family Convolvulaceae including sweet potato, Ipomoea batatas; hedge bindweed, Convolvulus sepium; morning glory, Ipomoea purpurea, etc. (Parrella & Kok, 1977; Shorey and Anderson, 1960). Shorey and Anderson (1960) tested several insecticides against B. somnuletella and reported that foliar applications of diazinon and malathion, among other insecticides, gave effective control.

The objective of this trial was to determine insecticides that can effectively control the leafminer. An experiment consisting of eight insecticides and an untreated check laid out in a randomized complete block design with 6 m. by 6 m. plots, replicated four times, was therefore conducted during the 1981/82-1983/84 crop seasons at the Bako Research Station.

Slips of a locally recommended variety, White Star, were dipped in a o.1875% a.i. DDT solution at planting to avert the sweet potato weevil damage. Number of living larvae and mines per 100 randomly chosen leaves per plot were recorded at prespray and then 3, 7, 10 and 15 days after spray. Only one spray was made using a Gloria-160(R) Knapsack sprayer. Yield data were also recorded.

Data for the 1981/82 crop season are presented in Table 1. Three days after spray, differences between the insecticide treated means and the untreated check were nonsignificant as regards living larvae. However, seven days after spray (DAS), all insecticide treatments, except profenofos and methamidophos, resulted in significantly lower number of living larvae/100 leaves than did the check. Ten DAS, all insecticides gave significantly fewer larvae than the check, with no significant difference among the insecticide treated means. Fifteen DAS, profenofos, methamidofos and cypermethrin gave significantly fewer living larvae than the check while the rest of the chemicals were intermediate between the two categories.

Table 1: The effect of insecticide sprays on the population of B. somnulentella and yield of sweet potato Bako, 1981/82

TREATMENT	Rate	Mean No. of Living Larvae/100 Leaves at				Mean No. of Damaged Leave/100 at			Yield (Kg/plot)
		3 Days	7 Days	10 Days	15 Days	7 Days	10 Days	15 Days	
Check (untreated)		5.50 a*	1.25 b	2.75 b	1.75 b	31.00 b	23.50 b	34.00 b	44.98 a
Diazinon (Basudin) 60 EC	0.50 l/ha	3.75 a	0.25 a	0.00 a	0.75 ab	28.25 ab	13.00 a	22.50 ab	53.10 a
Decamethrin (Decis) 2.5% EC	12.5g a.i/ha	3.00 a	0.00 a	0.25 a	1.00 ab	17.25 ab	10.75 a	12.75 a	46.77 a
Malathion 50% EC	2.00 l/ha	6.25 a	0.00 a	0.25 a	0.50 a	18.25 ab	15.75 ab	17.25 ab	52.98 a
Cypermethrin (Ripcord) 10% EC	100 g a.i/ha	2.50 a	0.00 a	0.50 a	0.25 a	28.50 ab	12.50 a	11.00 a	55.35 a
Fenitrothion (Sumithion) 50% EC	1.00 l/ha	6.00 a	0.25 a	0.25 a	0.75 ab	22.75 ab	11.25 a	14.50 a	57.84 a
Carbaryl (Sevin) 85% WP	1.50 kg/ha	2.25 a	0.25 a	0.00 a	0.50 a	13.50 a	9.00 a	16.50 a	51.73 a
Profenofos (Selecron) 50% EC	1.40 l/ha	3.00 a	0.75 ab	0.50 a	0.00 a	19.00 ab	16.25 ab	10.50 a	52.52 a
Methamidophos (Tamaron) 50% EC	3.00 l/ha	6.50 a	0.50 ab	0.00 a	0.00 a	31.50 b	10.00 a	11.50 a	58.20 a
Mean		4.31	0.31	0.50	0.62	23.33	13.56	16.73	52.65
S.E.M.		1.46	0.27	0.33	0.43	4.53	2.49	5.10	4.73

* Means followed by the same letters are not significantly different from each other at the 5% level (Duncan's New Multiple Range Test)

Mean number of damaged leaves per 100 seven DAS was significantly lower for carbaryl than the check and methamidophos. The remaining chemicals were intermediate between carbaryl and the check/methamidophos. Ten DAS, diazinon, decamethrin, cypermethrin, fenithrothion, carbaryl, and methamidophos resulted in significantly lower damaged leaves than the check while malathion and profenofos were intermediate between the above mentioned insecticides and the check. Fifteen DAS, a significantly superior result to the check was obtained with decamethrin, cypermethrin, fenitrothion, carbaryl, profenofos and methamidofos; diazinon and malathion were intermediate between these insecticide treatments and the check.

All insecticide treatments outyielded the check; however, none of the treatments was significantly different from each other. It can be seen that the yield loss due to the sweet potato leafminer damage is 22.71%.

Insecticide applications were not made in the 1982/83 and 1983/84 seasons because of total absence of leafminer infestation and thus no data are available for the two years. The status of this pest could therefore be described as "sporadic".

Responsibilities:-	Solomon Eshete,	ARO	(1981/82)
	Kumsa Gemene,	SFA	
	Abraham Tadesse,	ARO	(1981/82 & 82/83)
	Tsedeke Abate		

Literature Cited

Gentry, J.W. 1965. Crop insects of northeast Africa-southeast Asia. USDA Agric. Hndbk. No. 173, Washington, D.C. 210 pp.

Parrella, M.P. and L.T. Kok. 1977. The development and reproduction of Bedellia somnulentella on hedge bindweed and sweet potato. Ann. Entomol. Soc. Am. 70(6): 925-1928.

Schmutterer, H. 1971. Contribution to the knowledge of the crop pest fauna in Ethiopia. Z. Angew. Entomol. 67: 371-389.

Shorey, H.H. and L.D. Anderson. 1960. Biology and control of the morning-glory leaf miner, Bedellia somnulentella, on sweet potatoes. J. Econ. Entomol. 53(6): 1119-1123.

Effect of Captafol and Ridomil (R) Mz in the control of late blight (Phytophthora infestans) and septoria leaf spot (Septoria lycopersici) on tomato (Lyc. esculenta)

BY

Tesfaye Tedla, NRS

Abstract

Late blight (Phytophthora infestans) and septoria leaf spot (Septoria lycopersici) are the main limiting factors for growing tomatoes in the rainy season in Ethiopia. Experiments conducted at Awasa and Melkasa showed that Captafol 80% WP at 0.3% concentration and Ridomil (R) Mz 63.5% WP at 0.27% separately and in combined form significantly reduce the incidence of late blight and septoria leaf spot. At Melkasa from Captafol and Captafol plus Ridomil (R) sprayed plots 22.1 and 21.4 tons, per hectare marketable fruit was obtained, respectively, compared to 13.3 tons from the control. At Awasa 52.2 and 66.6 tons per hectare was obtained in the given order. But with respect to cultural practice, staking has not influenced the disease situation and yield significantly. Although there was a tendency of high disease pressure when staking was practiced.

Further investigation on the concentrations and spray interval of the combined form of these two fungicides indicated that 0.2% Captafol plus 0.23% Ridomil (R) sprays at 7- day intervals was found to be the best combination both in reducing the incidence of the two important tomato diseases and increasing yield by 2173.3% over the control. With regard to the net return, of the three concentrations and intervals used, the highest was obtained from the above mentioned ones.

Introduction:-

Vegetable production is becoming one of the important farm enterprises in some administrative regions of Ethiopia. Of these, tomato is the most popular one. It has long been grown in a very limited scale in gardens mainly in the rainy season. However, late blight (Phytophthora infestans) and Septoria leaf spot (Septoria lycopersici) are usually the main limiting factors for growing tomatoes in Ethiopia in the rainy season.

The fungus that causes late blight of tomatoes also causes a disease of the same name on potato and eggplants. The disease attacks any part of the tomato plant above ground (2). Septoria leaf spot also attacks the plant at any stage of development. In the field it usually becomes severe after the plant have begun to set fruits (2.6).

A seventeen year study in Eastern Canada indicated that the loss due to late blight ranged from 24 to 52% on potato at various level of disease pressure. It was further noted that early infection was more important than late infection in relation to yield loss (5). Eventhough the yield loss has not yet been determined here in Ethiopia a considerable amount of yield could be reduced due to those diseases on tomato in the rainy season. During this time the supply on the market is low and the price is exorbitant. This made it necessary for us to look for a control measure.

The Horticultural Development Corporation has had plans to grow tomatoes for fresh consumption in the rainy season in order to bridge the gap between demand and supply. But none of the available varieties in the country is observed to be resistant to these diseases. Therefore, chemical control was considered as an immediate solution and a series of experiments were conducted to study the influence of staking on the incidence of diseases on foliage and fruits and the effect of Captafol and Ridomil (R) at two experimental sites (Awasa and Nazret Research Stations).

Materials and methods

Field plot experiments were conducted at Awasa and Melkasa Research Stations since 1979, where supplementary irrigation water is available. Tomato cultivar Pearson Improved (1979-1981) and Money Maker (1982-83) were used for these studies.

Experiment 1

In this first experiment the effect of cultural practice (staking Vs nonstaking) and fungicides (Captafol 80% WP at 0.3% and Ridomil (R) 63.5% WP at 0.27%) were studied in a split plot design where the cultural practice arranged in the main plots and fungicides to the subplots in four replications. Each plot replicate occupied an area of 6m long and 5m wide. Spraying was started on the average 28 days after transplanting and a total of 7 sprays on the average were made at 7-day intervals.

Disease scores were made at 15 day intervals for late blight and septoria leaf spot according to the international scale for late blight on potato. The percentage total leaf area infected was estimated (Key British Mycological Society 1947) for the former and a 0 to 5 developed severity scale was used for the latter, where 0 means no symptom developed and 5 almost all leaves are dead or dropped.

Tomato fruits were harvested from the middle three rows. The first pick was done 15-days after the last spray.

Experiment 2

This second part of the experiment was executed only at Awasa where the incidence of both diseases are relatively high. In this study emphasis was given (a) to the different levels of fungicides (1, 0.1% Captafol 80% WP with 0.15% Ridomil (R) Mz 63.5% WP and (2) 0.2% Captafol 80% WP with 0.23% Ridomil (R) Mz 63.5% WP) and (3) 0.3% Captafol 80% WP with 0.31% Ridomil (R) Mz 63.5% WP and (b) spray intervals (7, 14 and 21 days) in a split plot design where spray intervals were assigned to the main plots and fungicides concentrations to the subplots in four replications. The plot size was the same as experiment one. Fungicides spraying were commenced right after the on set of the diseases (after the first symptom was observed). A total of 10 sprays at 7 day intervals 5 at 14 and 21 days were made. Records were kept for the time taken to spray the fungicides yield per hectare, and cost of fungicides were determined and checked for the best economical effective concentration and appropriate spray intervals. Net return was calculated by subtracting total production cost from total sale. Disease scores and harvesting was done as experiment one. There was an incidence of Nematode at early stage of crop development. Furadan and Temik 6mg/m^2 and 10 gm/m^2 of product, respectively, were applied.

Results

Awasa

Results for experiment 1 at Awasa are presented in Table 1, 2, 3 & 4. The incidence of Septoria leaf spot was significantly reduced by applying Captafol 0.3% alone and a combination of Captafol 0.3% and Ridomil (R) 0.27%. The severity of the diseases in Captafol and Captafol plus Ridomil sprayed plots was 0.63 and 0.46, respectively as compared to 1.4 in the control. That is, the damage was reduced by 55 and 67% over the control using these fungicides. As shown in Table 1 there was no significant difference between Ridomil sprayed plots and the control. With regard to cultural practice staking has not influenced the disease situation significantly, although there was a tendency of higher disease pressure when staking was practiced.

Table 1. Disease score for septoria leaf spot on 0 to 5 scale at Awasa (three year average)

Treatments	Cultural practice			Chemical in % of the
	Staking	Nonstaking	Mean	Control
Untreated control	1.40	1.40	1.40 b	100. 0
Water + Citowett	1.46	1.40	1.43 b	102. 0
Captafol 0.3% + Citowett	0.66	0.60	0.63 a	45.00
Ridomil (R) Mz 0.27% Citowett	1.46	1.26	1.36 b	97.10
Captafol 0.3% + Ridomil (R) 0.27%	0.46	0.46	0.46 a	32.80
Cultural Practice Mean	1.09	1.02		

Different letters show a significant difference at the 5% level

In all the three year studies the incidence of late blight was severe at this experimental site. As shown in Table 2, Ridomil alone and Ridomil in combination with Captafol was effective in reducing the incidence of late blight significantly. There was a 91 and 95% control when these fungicides were applied, respectively, as compared to the control. No significant difference was observed whether staking was practiced or not.

Table 2. Percent late blight incidence at Awasa (three years average)

Treatments	Cultural practice		Chemical	in % of the
	Staking	Nonstaking	Mean	Control
Untreated control	28.42	20.15	24.29 c	100.00
Water + Citowett	17.03	20.42	18.73 c	77.10
Captafol 0.3% + Citowett	10.36	10.03	10.26 b	41.90
Ridomil (R) Mz 0.27% + Citowett	2.17	2.17	2.17 a	8.90
Captafol 0.3% + Ridomil (R) 0.27%	0.18	2.11	1.15 a	4.70
Cultural Practice Mean	11.63	10.98		

Different letters show a significant difference at 5% level

One of the factors that contributed to loss in quality of tomato fruits was sunscorch. High incidence of this disorder was observed in the untreated control, Water and Ridomil sprayed plots. As shown in Table 3 Captafol and Captafol plus Ridomil reduce the incidence by 49 and 89%, respectively. But no difference was observed between Ridomil alone sprayed plots and the control and between the cultural practice.

Table 3. Percentage of sunscorched fruits at Awasa (three years average)

Treatments	Cultural practice		Chemical	in % of the
	Staking	Nonstaking	Mean	Control
Untreated control	35.10	24.20	24.60 b	100.00
Water + Citowett	17.20	21.80	19.50 b	79.00
Captafol 0.3% Citowett	12.90	12.10	12.50 a	50.80
Ridomil (R)Mz 0.27% + Citowett	17.70	20.30	19.00 b	77.20
Captafol 0.3% + Ridomil (R) 0.27%	5.00	0.33	2.66 a	10.50
Cultural Practice Mean	15.50	15.70		

Different letters show a significant difference at 5% level

With regard to plot yield, the highest yield was obtained from Captafol and Captafol plus Ridomil sprayed plots. The yield obtained were more than 52 and 66 tons/hectare, respectively, which was about 127 and 190% increase over the control. As shown in Table 4, the mean yield of staked tomato fruits was 34 tons while it was about 37 tons/hectare of the nonstaked ones.

Table 4. Yield in tons per hectare at Awasa (three years average)

Treatments	Cultural practice		Chemical in % of the	
	Staking	Nonstaking	Mean	Control
Untreated control	24.30	21.60	23.00 c	100.00
Water + Citowett	6.20	5.30	5.30 c	25.20
Captafol 0.3% + Citowett	46.10	58.30	52.20 ab	226.90
Ridomil (R) Mz 0.27% + Citowett	33.60	26.20	29.90 bc	130.00
Captafol 0.3% + Ridomol (R) 0.27%	60.00	73.20	66.60 a	289.50
Cultural Practice Mean	34.00	36.90		

Different letters show a significant difference at 5% level.

Melkasa:-

Septoria leaf spot was high at this site. The severity of the disease was 1.6 and 1.3 in Captafol alone and Captafol plus Ridomil (R) sprayed plots, respectively as compared to 2.5 of the control. This was 36 and 48% control of the disease. No significant difference was observed between Ridomil alone sprayed plots and the control (see Table 5). The mean score for septoria leaf spot in the staked tomato plots was 2.3 as opposed with 1.8 of the nonstaked plots showing no singificant difference between cultural practice on the incidence of the disease.

Table 5. Disease score for septoria leaf spot on a 0 to 5 scale at Melkasa (three years average)

Treatments	Cultural practice		Chemical in % of the	
	Staking	Nonstaking	Mean	Control
Untreated control	2.90	2.20	2.50 c	100.00
Water + Citowett	2.80	2.30	2.50 c	100.00
Captafol 0.3% + Citowett	1.80	1.50	1.60 ab	64.00
Ridomil 0.27% + Citowett	2.70	1.70	2.20 b	88.00
Captafol 0.3% + Ridomil 0.27%	1.30	1.30	1.30 a	52.00
Cultural Practice Mean	2.30	1.80		

Different letters show significant difference at 5% level.

With regard to yield, from Captafol sprayed plots alone 22.1 tons per hectare was obtained. This was 66% increase over the control. From the combination of Captafol and Ridomil 21.4 tons was recorded. Which was about 60% increase over the control. As shown in Table 6 the mean yield of staked tomato (17.8 tons/ha) plots was about the same to the mean yield of nonstaked (17.2 tons/ha) tomato plots.

Table 6. Yield in tons per hectare at Melkasa (three years average)

Treatments	Cultural practice		Chemical in % of the	
	Staking	Nonstaking	Mean	Control
Untreated control	14.40	12.10	13.30 c	100.00
Water + Citowett	16.50	10.40	13.50 c	101.50
Captafol 0.3% + Citowett	20.50	23.70	22.10 a	166.10
Ridomil (R)Mz. 0.27% + Citowett	19.60	14.90	17.30 b	130.00
Captafol 0.3% + Ridomil 0.27%	17.80	25.0	21.40 a	160.90
Cultural Practice Mean	17.80	17.20		

Different letters show significant differences at 5% level using DMRT.

Experiment 2

Effect of the different concentrations of fungicides and spray intervals on the incidence of septoria leaf spot

The first symptom of Septoria leaf spot was observed 21 days after transplanting. The mean disease score for all the three spray concentrations was almost the same. But less disease damage (Septoria leaf spot) was encountered from the middle (0.2% Captafol plus 0.23% Ridomil) and higher (0.3% Captafol plus 0.31% Ridomil) levels. As shown in Table 7 a significant differences in disease infection was observed among spray intervals. 0.2% Captafol plus 0.23% Ridomil at 7 day intervals showed a score of 1.4 as oppcsed to 3.2 of the control. As spray intervals increase from 7 to 21 days, the mean of disease infection was increased from 1.5 to 2.6.

Table 7. Disease score for septoria leaf spot on a 0 to 5 scale at Awasa (two years average)

Spray Concentration	Spray Intervals				Con. Mean
	Control	7-day intervals	14-day intervals	21-day intervals	
0.1% Captafol + 0.15% Ridomil	3.30	1.60	2.40	2.70	2.50
0.2% Captafol + 0.23% Ridomil	3.20	1.40	2.20	2.70	2.40
0.3% Captafol + 0.31% Ridomil	3.10	1.50	2.40	2.50	2.40
Interval Means	3.20 c	1.50 a	2.30 bc	2.60 bc	

Different letters show significant differences at 5% level (using DMRT).

Effect on late blight

The disease appears after 36 days of transplanting. As indicated in Table 8, higher percentage (25%) of late blight incidence was recorded in the control plots. The incidence of late blight in the sprayed plots regardless of the spray concentrations was slight. Of the three intervals less percent (0.01%) late blight infection was observed at 7-day intervals.

Table 8. Percent late blight incidence at Awasa (two years average)

Spray Concentration	Spray Intervals				Con. Mean
	control	7-day intervals	14-day intervals	21-day intervals	
0.1% Captafol + 0.15% Ridomil	25.00	0.02	0.30	1.80	6.80
0.2% Captafol + 0.23% Ridomil	25.00	0.02	0.30	1.30	6.70
0.3% Captafol + 0.31% Ridomil	25.00	0.00	0.20	0.30	6.40
Interval Means	25.00 b	0.01 a	0.30 a	1.13 a	

Different letters show significant difference at 5% level using DMRT.

Effect on yield

The yield was increased by all spray concentrations. The highest (34.1 tons/ha) was obtained from the middle level (0.2% Captafol plus 0.23% Ridomil) at 7-day intervals. This was more than 2000% increase over the control (See Table 9). A difference in yield was also recorded among spray intervals. A mean of 30.4 tons/ha was obtained at 7-day intervals while it was 10.4 at 21-day intervals and 0.9tons/ha when no spray was made. In general the increase in yield attributed to fungicide application.

Table 9. Marketable yield in tons' per hectare (two years average)

Spray Concentration	Spray Intervals				Con. Mean
	control	7-day intervals	14-day intervals	21-day intervals	
0.1% Captafol + 0.15 Ridomil	0.30	24.20	7.10	7.00	9.70 b
0.2% Captafol + 0.23% Ridomil	1.50	34.10	14.90	9.50	15.00 a
0.3% Captafol + 0.31 % Ridomil	0.90	32.90	19.80	14.90	17.10 a
Interval Mean	0.90 c	30.40 a	13.90 b	10.40 b	

Different letters show significant difference at 5% level using DMRT.

The major expense in the production of tomato during the rainy season was spraying fungicides. Of total cost 59.2% (only for the middle level) was spent for fungicides only. As shown in Table 10 with the very high cost of production, from the middle concentration (0.2% Captafol plus 0.23% Ridomil) at 7-day spray intervals a total of 20006 Birr per hectare net return was obtained when tomato were sold at 80 cents per kg.

Table 10. Yield, cost and net return in tomato production

Concentration	Yield Q/ha	Total direct production cost	Price Birr/kg	Gross value of product Birr	Net return Birr/ha
0.1% Captafol + 0.15 Ridomil (R) Mz	242.80	5551.29	0.80	19424.00	13872.71
0.2% Captafol + 0.23% Ridomil (R) Mz	341.20	7289.69	0.80	27[illegible]96.00	20006.31
0.3% Captafol + 0.31% Ridomil (R) Mz	329.40	8602.09	0.80	26352.00	17659.91

Discussion and Conclusion

A result of an evaluation of fungicides for the control of tomato leaf disease in Nigeria at Ahmadu Bello University indicated that Captafol 80% WP at 3.4 kg/ha at 7 or 14-day intervals gave good control of Septoria lycopersici and found to be one of the best fungicides in controlling this disease (1). In 1974/75 study was made to compare the effect of 10 fungicides against early and late blight at Bako Research Station. Of the tested fungicides Captafol 80% WP at the rate of 1.2 kg/ha gave significantly higher yield (3).

The infection by late blight at Melkasa experiment site was slight indicating that Melkasa might not really be a conducive environment for late blight as the same phenomena was observed throughout the study periods. As shown in tables 1 and 6, Captafol alone showed good control of septoria leaf spot. Eventhough Captafol reduced the incidence of late blight, it was not as effective as Ridomil in the control of late blight. In Nigeria low volume Captafol (50%) application at 7, 10 or 14-day intervals did not control late blight (4) which is in line to this finding.

Although there was a tendency of higher disease pressure (both septoria and late blight) when staking was practiced, cultural practice did not significantly influence the disease situation.

Sunscorch caused by the fruit exposure to bright sun light by premature desication and abscission of the leaves due to septoria infection was one of the important problems which was observed throughout the study periods. But application of Captafol reduced the incidence of this disorder since the effect of this fungicides over septoria is very high.

The economic analysis for all the three concentrations in relation to yield was made. Of the total cost 46.4%, 59.27% and 65.8% (for lower, middle, and higher levels, respectively) were spent only for fungicides. The net return as shown in Table 10 was calculated for each of them. The benefit cost ratio was ran and it was 2.49 for the lower, 2.74 for the middle and 2.03 for the higher levels. From this analysis the middle level (0.2% Captafol plus 0.23% Ridomil) were found to be economical and the best of all.

Late blight and Septoria leaf spots are mainly found together especially under favourable condition such as Awasa. As no commercially resistant tomato varieties are yet available in the country, application of fungicides are imperative to produce tomato. Hence, it may be concluded from these studies that quality tomatoes can be produced during the rainy season in the vicinity of Awasa and Melkasa if timely application of a combined form of Captafol and Ridomil at the rate of 0.2% and 0.23 are made, respectively.

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Literature Cited

1. Ahmadu Bello University 1977. An evaluation of fungicides spray for controlling tomato leaf disease during the rains in the northern state of Nigeria. Acta Horti. 53: 83-87.

2. Chupp, Charles and Arden F. Sherf 1960. Vegetable diseases and their control. Ronald Press Company, New York pp 552-55.

3. Institute of Agricultural Research. Bako Research Station, Progress Report 1974/75. Fungicidal application against leaf diseases of tomatoes pp 140-41 Addis Abeba.

4. Institute of Agricultural Research 1980. An epiphytotic of late blight of tomatoes in Nigeria. Plant Disease 64(7) 701-702.

5. James, W.C. et al. 1972. The quantities relationship between late blight of potato and loss in tuber yield. Phytopathology 62: 92-96.

6. USDA Agricultural Research Service 1972. Tomato diseases and their control. Agri. hand book No. 203.

Host preference study of potato tuber moth, Phothorimaea operculella (Zeller) under field & laboratory conditions in Ethiopia.

Adhanom Negassi (ARS)

The potato tuber moth (PTM), Phthorimaea operculalla (Zeller), is an important insect pest of potato in most potato growing countries of the world. In Ethiopia, it was first observed in 1943 (Jannone, 1944); and in recent years its importance in this country has increased because of increase in hectarages of potato.

In an attempt to establish integrated pest management of this pest, progress has been made in the screening of resistant/ tolerant potato varieties/ clones, selecting effective insecticides (for use in the field and storage), and use of cultural practices. In order to make best use of the integrated approach, it has become necessary to identify the host plants of PTM before one grows large acrages of potato in the field. Many species of the family solanaceae cultivated or otherwise are hosts of PTM. Among the cultivated species are:-

Solanum tuberosum L. potato
Nicotiana tabacum L. Tobacco
Lycopersicum esculentum Mill. Tomato
Solanum melongena L. Egg plant.

Among the few non - solanaceous hosts is also Beta vulgaris, the sugar beet (Haines, 1977).

It has also been recorded in America and Europe from the following wild host plants : Solanum carolinense, Solanum nigrum, Solanum paniculatum, Solanum torvum, Solanum verbascifolium, Datura stromonium, physalodes physolodes, Solanum commersoni, Solanum delcamara, Solanum maglia, Solanum Miniatum and Nicotiana sylvestris (Cunningham, 1966).

Therefore the objective of this study was to identify as far as possible, those alternate hosts, cultivated or wild which serve as sources of infestation of the potato in the field.

Materials and methods

An experiment was carried out to study host preference of PTM in the field at Melkasa, (I.A.R) Nazret in 1980/81 growing season. The following host plants were grown:

Datura stromonium
Solanum tuberosum
Lycopersicum esculentum
Nicotiana tabacum
Solanum incunum
Beta vulgaris
Solanum melangana
Capsicum spp.

Each of the species was grown in single alternate rows 6 meters in length replicated four times. Thiry five days after planting, counts of live larvae and mines from 9 plants per row (total of 36 plants) in situ were recorded. Three counts at an interval of 15 days were made throughout the season at natural infestation.

Leaving the host preference study under field condition, an experiment was conducted to study the feeding preference of PTM under laboratory at Awasa, (I.A.R) in 1981/82 and 1982/83 because of irrigation problem. Four barrels with a dimension of 44 cms X 55 cms were used to grow the same host plants that were tested in the field at Melkassa. However, *Solanum melangena* was not grow in the 1982/83 trial due to lack of planting material. Thirty new emerged moths irrespective of their sex were released into the barrels to oviposit on the host plants of their choices. Barrels were caged by clothe meshes to avoid escape of moths. One week after infestation, counts of live larvae and number of mines were recorded from each plant for three times in the season.

Results and Discussion

Feeding preference of PTM on the different host plants at field condition (Table 1) showed that the leaves of Solanum tubersosum and Nicotiana tabacum were the most prefered among the cultivated plants and the leaves of Datura stromonium among the wild ones. This has also been observed by Meisner et.al (197). Beta vulgaris and Solanum incanum were the least preferred hosts by the larvae of P. operculella. The mean number of mines in these plants were significantly fewer than those other host plants. Lycopersicum esculentum and Solanum melangana were intermediate between the least and most preferred host plants. The most preferred ones were with many larvae and mines as shown in Table 1.

Under laboratory condition as shown in Table1, Solanum tuberosum followed by Nicotiana tabacum was the most preferred among the cultivated species and Datura stromonium among the wild host plants. As it is indicated in Table 2 Nicotiana tabacum from the cultivated species followed by Solanum tuberosum and Datura stramonium from the wild species were highly preferred by the moth. This observation was in agreement with the above result of the field study. Beta vulgaris and Solanum incunum were the least preferred hosts since they had fewer mines. Comparison among the mean number of mines showed significant differences among the mean number of larvae between host plants except Solanum tuberosum which showed statistically higher mean number of mines and larvae.

This indicates that one larva could cause more than one mine if it infests a favourable host plant. Beta vulgaris, Capiscum spp. Solanum incunum and Lycopersicum esculentum were the least preferred while Solanum melongana was intermediate between the most and least preferred host plants as far as mean number of mines were con concerned since mines caused are indications of preference by the larva. Therefore, all tubers of potato at harvest must be removed from the soil and should be destroyed quickly, preferably by burning all the debris. The soil should be cultivated well and any overlooked tubers should be destroyed since volunteer plants form foci of infestation. Any wild solanaceae such as Datura stromonium which incidentally is one of the commonest weeds should be destroyed since it acts as a reservoir for population of the moth. Rotation of crops, so that susceptible plants (potato, tobacco, etc.) should never be planted on the same ground in two successive years.

Table 1.

Feeding preferences of PTM on foliages of different host plants under field condition at Melkasa 1981 and laboratory condition at Awasa 1982.

Host Plants	1981/a Mean number of Mines	1981/a Mean number of Larvae	1982/b Mean number of Mines	1982/b Mean number of Larvae
Beta vulgaris L.	5.7 a**	1.5 a	8.75 a	2.50 a
Solanum incunum	7.2 a	1.7 a	10.50 a	3.50 ab
Capiscum spp.	13.7 b	5.0 a	16.75 ab	4.00 ab
Lycopersicum exculentum Mill	21.0 c	10.0 bc	23.50 bc	5.75 ab
Solanum melongana L.	24.5 c	9.0 b	27.25 cd	9.75 bc
Nicotiana tabacum L.	34.7 d	13.0 cd	34.50 d	12.50 c
Datura stromonium	47.7 e	15.5 d	36.50 de	14.25 c
Solanum tuberosum L.	71.7 f	35.2 e	45.75 e	18.25 c
Mean	28.27	11.36	25.43	8.81
S.E.	2.00	1.20	3.25	2.30

a/ 1981 trial was conducted under field condition. 9 plants taken from each of four replicates in each host plant.

b/ 1982 trial was conducted under laboratory condition; 4 plants taken from each of four replicates.

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 2. Feeding preference of PTM on foliages of different host plants under laboratory condition. 1983

Host Plants a/	Mean number of	
	Mines	Larvae
Capsicum spp.	* 0 a	0 a
Lycopersicum esculentum	0 a	0 a
Beta vulgaris	0.5 aa	0 a
Solanum incunum	1.25 a	2.0 a
Solanum tuberosum	5.00 a	7.75ab
Nicotiana tabacum	10.75 b	15.0 b
Datura stromonium	10.75 b	18.0 b
Mean	4.03	6.10
S.E.	1.40	3.14
L.S.D at 1% level	5.60	12.56

a/ 2 plants taken from each of four replicates in each host plant

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

LITERATURE CITED

1. Cunningham, I.C. 1969. Alternative host plants of tobacco leaf miner (Phthorimaea operculella (Zeller). Queensland J.Agric. Animal Sci. 26 (1) 107-111.

2. Haines, C.P. 1977. The potato tuber moth, phthorimaea operculella (Zeller) a bibliography of recent literature and review of its biology and control on potatoes in the field and in store. Tropical products Institute, Ministry of Overseas. page 4.

3. Jannone, G. 1944. Sulle aree de diffusionae der parasiti delle painte in base ae rapporti di vicnato trai vari paesi (The distribution of plant parasites in relation to intercourse between various countries (Boll. Soc. ital Med (Sez. Eritrea). 4 (1) 153-165.

* Evaluation of Varietal Resistance of Potato to Potato Tuber Moth (PTM) Phthorimaea operculella.

Adhanom Negasi, AFS

As in any other insect host relationships, interaction between the potato plant and its insect pest, the potato tuber moth, varies from one cultivar to another. The relationship sometimes favours the host plant resulting in a tolerant or resistant cultivar or a susceptible plant if otherwise. This offers an opportunity to screen a variety with a degree of resistance or tolerance to the pest attack. No study on the selection of resistant varieties of the potato to the insect has been carried out in this country. However, the worldwide distribution of the potato and its insect pest, Phthorimaea operculella, has given to an emple source of research information. Differences in the development of the moth have been observed on different varieties of potato on the field and tubers in store (Haines 1977). Comparison based on the proportion of damaged tubers in 20 cultivars tested in one study showed a variation ranging from 28.7 to 61.56% (Guglehmetti, 1978). Ohter trials involving 20 cultivars of potato were tested in the field for relative levels of leaf and tuber infestation (Foot, 1976). None showed evidence of resistance except those varieties with prolonged upright growth habit and fewer leaves close to the soil surface sustained lower leaf mine injury, and varieties with deeper tuber settings showed lighter tuber infestation at harvest. Three clones out of 100 tested showed resistance to tuber moth at CIP (1979) under laboratory condition.

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* I.A.R., Project No. Po/PTM 24 (80).

Larvae penetrated either through the eyes of tubers or through the skin and fed inside susceptible tubers whereas in the resistant varieties there were fewer tuber eyes or skin injury due to antibiosis, produced in those parts (CIP, 1979).

Therefore the objective of this study was to evaluate varieties which show potential resistance to potato tuber moth as growing plants in the field.

Materials and Methods

A trial was carried out at Melkassa, Institute of Agricultural Research (I.A.R.) Nazret in 1980 - 81. An area of 0.08 hectare field was divided into 44 plots, each 2.1 meters (3 rows) wide and 4.5 meters long with hills 30 cms apart and 70 cms between rows and was planted with eleven varieties of potato. All other usual cultural practices were followed and the source of moisture was rain supplemented by irrigation water The trial was arranged in a completely randomized block design replicated four times. The varieties tested were eleven in number.

Nine plants from each plot replicated four times per variety (a total of 36 plants) were selected at random and assesed for number of mines and larvae every two weeks beginning one month after planting through harvest. Height, lateral growth and distance of lower leaves above the soil surface of the same number of plants as above were measured Depth of tuber settings of each variety was also measured at harvest. Ten samples of 20 tubers were selected at random from all the three rows of each variety of the four replicates (800 tubers from each variety) and examined for tuber worm injury. The tubers were graded into categories according to degree of infestation. Tubers with 1 to 2 larval burrows were classed as lightly infested; those with 3 to 5 burrows were designated medium and those with 6 or more burrows per tuber were classified as heavily infested.

In the 1981-82 and 1982-83 trials varieties were planted into a single row replicated three times. However, the data taken for both years was the same as the 1980-81 trials.

Results and Discussion

Of the eleven varieties of potato tested in the field, in Nazret, Melkassa, 1980-81, for relative levels of leaf and tuber infestation by larvae of Phthorimaea operculella (Zeller) none showed any evidence of resistance, but a few of the varieties showed some difference in foliage attack and tuber burrowings.

Comparison among the mean number of mines (Table 1) showed significant difference among the mean number of larvae between varieties. The activities of the potato tuber worms (leaf miners) were shown to be more important than their numbers because an insect larva could cause more than one mine during its life time if conditions are favourable. This has also been observed by El-Hemassy et.al., (1974). AL-253 with smaller number of mines was significantly different from AL-562, Al-257, and AL-560. AL-517 had smaller mean number of mines which was significantly different from those of AL-257 and AL-560. The mean number of mines for variety, AL-200 was smaller and significantly different from that of variety AL-560. No statistical differences in mean number of mines were observed among the other varieties. This could be attributed to the susceptibility of the cultivars to PTM attack as has also been observed by fFoot (1979). An examination of cultivars for relative degree of damages (Table 2) showed significant differences in the percentage of damaged tubers at harves (30.89 - 74-63). Differences in infestation appear to be attributed to tolerance of attack of the varieties to PTM. Varieties with lower percentage infestation (Table 3), about two thirds of the infested tubers, were in the lightly infested category (1 - 2 larval holes) and those with higher percentage infestation, the majority of the infested tubers, were in the more heavily infested category, 3 - 6 larval holes per tuber).

Varieties with higher leaf attack were also observed to be prone to higher tuber attack. Enough number of larvae and moths present within each cultivar may leave the dying foliage and enter soil openings to infest tubers of their respective varieties. Larvae present within each cultivar also have funneled through the stems to reach tubers as has also been observed by Bacon (1960) and Richardson (1966).

Out of the twenty varieties of potato tested in the field in Nazret, Melkassa, 1981-82 for relative levels of leaf and tuber infestation by PTM, none showed evidence of resistance, but a few of the varieties showed some difference in foliage attack and tuber burrowings as shown in Table 4 and 5. However, there was no statistical difference among the mean number of larvae between varieties. This could be attributed to the fact that activities of the potato tuber worms were shown to be more important than their numbers because an insect larva could cause more than one mine during its life time if conditions are favourable. AL-563 with smaller number of mines was significantly different from AL-556 and AL-646. No statistical differences in mean number of mines observed among the other varieties. An examination of cultivars for relative degree of damage (Table 5) showed no significant differences in the percentage of damaged tubers of harvest though the mean damage ranges from 31.10 to 73.88 percent.

Out of the seventeen varieties of potato tested in the field in Nazret, Melkassa, 1982-83 for relative levels of leaf and tuber infestation by PTM, none showed evidence of resistance, but a few of the varieties showed some difference in foliage attack and tuber burrowings. Comparison among the mean number of mines and mean number of larvae between varieties showed no significant difference as it is shown in Table 7. However, mean percentage infestation of tubers among varieties showed statistical difference as indicated in Table 8. AL-563, AL-517, AL-634 and AL-568 showed lower mean percentage infestation of tubers than the remaining varieties.

Table 1. The effect of varietal difference on mining injury and larval count. 1980-81.

Variety	Mean number of mines and larvae on leaves and stems.	
	Mines	Larvae
1. AL - 253	* 27.25 a	21.00 a
2. AL - 517	28.75 ab	23.75 a
3. AL - 200	31.57 abc	25.25 a
4. AL - 615	32.75 abc	24.75 a
5. AL - 563	36.25 abcd	21.75 a
6. AL - 575	43.25 abcd	30.25 a
7. AL - 578	43.50 abcd	35.00 a
8. AL - 580	46.00 abcd	32.50 a
9. AL - 562	56.75 bcd	36.00 a
10. AL - 257	51.25 cd	21.00 a
11. AL - 560	57.75 d	39.75 a
Mean	41.02	28.27
S.E.	5.01	5.89
L.S.D. at 1% level	19.50	-

* Means followed by the same letters are not statistically different at 1% level (Duncan's New Multiple Range Test).

Table 2.

The effect of varietal differences on mean percentage infestation of tubers by Potato Tubers Moth.
1980 - 81.

Variety	Mean percentage infestation of tubers.
1. AL - 517	* 30.89 a
2. AL - 578	40.25 b
3. AL - 563	42.88 b
4. AL - 253	44.50 b
5. AL - 562	46.63 b
6. AL - 575	47.38 bc
7. AL - 257	47.88 bc
8. AL - 560	56.75 c
9. AL - 200	58.00 dc
10. AL - 615	67.13 de
11. AL - 580	74.63 e
Mean	50.63
S.E.	2.26
L.S.D. at 1% level	8.80

a/ 200 tuber samples taken from each of four replicated in each cultivar on Sept. 20, 1980.

* Means followed by the same letters are not statistically different at 1% level (Duncan's New Multiple Range Test).

Table 3.

The influence of varietal difference on the degree of tuber injury by PTM.

1980 - 81

Variety	No. of infested tubers with 1 - 2 Holes	3 - 5 Holes	6^{+} a/ Holes	Total infested tubers b/
1. AL - 517	145	77	25	247
2. AL - 578	155	122	45	322
3. AL - 563	115	163	65	343
4. AL - 253	177	125	54	356
5. AL - 562	145	147	81	373
6. AL - 575	199	120	60	379
7. AL - 257	220	108	55	383
8. AL - 560	153	196	105	454
9. AL - 200	189	186	89	464
10. AL - 615	185	301	51	537
11. AL - 580	247	220	130	597

a/ Tubers classified as lightly infested (1 - 2 holes); medium infested tubers with (3 - 5 holes); heavily infested (6^{+} holes) per tuber.

b/ 200 tubers samples taken from each of four replicates in each cultivar on Sept. 29, 1980.

Table 4.

The effect of varietal differences on mining injury and larval count. 1981 - 82.

Variety	Mean number of mines and larval on leaves and stems	
	Mines	Larvae
1. AL - 563	* 6.06 a	1.93
2. Local	6.33 a	2.30
3. AL - 204	6.46 a	1.86
4. AL - 253	6.93 a	2.53
5. AL - 568	7.33 a	2.40
6. AL - 569	7.33 a	4.80
7. AL - 108	7.46 a	3.20
8. AL - 148	8.06 a	3.46
9. AL - 570	8.20 a	2.06
10. AL - 578	8.33 a	3.20
11. AL - 575	8.46 a	2.26
12. AL - 615	9.13 a	3.66
13. AL - 601	9.80 abc	3.33
14. AL - 624	10.40 abc	5.26
15. AL - 580	10.80 abc	4.26
16. AL - 567	10.86 abc	4.60
17. AL - 634	11.33 abc	4.06
18. AL - 517	12.40 abc	5.66
19. AL - 556	14.86 bc	3.06
20. AL - 646	16.46 c	4.20
Mean	9.35	3.41
S.E.	1.93	1.04
L.S.D at 5% level	5.53	N.S

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 5. The effect of varietal differences on mean percentage infestation of tubers by PTM.

1981 - 82.

V	Variety	Mean percentage infestation of tubers
1.	AL - 634	31.10
2.	AL - 575	34.99
3.	AL - 517	39.99
4.	AL - 108	43.33
5.	AL - 615	45.55
6.	Local	47.77
7.	AL - 556	47.77
8.	AL - 148	48.33
9.	AL - 580	48.33
10.	AL - 253	50.55
11.	AL - 601	51.66
12.	AL - 569	53.33
13.	AL - 563	56.11
14.	AL - 204	51.66
16.	AL - 578	59.44
16.	AL - 567	60.00
17.	AL - 646	62.66
18.	AL - 568	66.66
19.	AL - 624	66.66
20.	AL - 570	73.88
	Mean	51.98
	S.E.	12.19
	L.S.D at 5%	N.S.

Table 6.

The influence of varietal differences on the degree of tuber injury by PTM. 1981 - 82

Variety	No.of infested tubers with 1 - 2 holes	3 - 5 holes	6^+ holes a/	Total infested tubers b/
1. AL - 634	57	7	12	76
2. AL - 575	36	12	15	63
3. AL - 517	47	17	8	72
4. AL - 108	29	32	17	78
5. AL - 615	47	25	10	82
6. Local	51	34	11	86
7. AL - 556	42	33	11	86
8. AL - 148	41	31	15	87
9. AL - 580	45	29	17	91
10. AL - 253	42	26	21	89
11. AL - 601	35	38	15	88
12. AL - 569	39	30	27	96
13. AL - 563	39	45	17	101
14. AL - 204	37	44	26	107
15. AL - 578	60	34	13	107
16. AL - 567	45	39	34	118
17. AL - 646	58	33	22	113
18. AL - 568	54	49	17	120
19. AL - 624	50	41	19	110
20. AL - 570	63	57	14	134

a/ Tubers classified as lightly infested (1 - 2 holes); medium infested 3 - 5 holes; heavily infested (6^+ holes) per tuber.

b/ 60 tuber samples taken from each of three replicates in each cultivar.

Table 7. The effect of varietal differences on mining injury and larval count. 1982-83

Variety	Mean number of mines and larvae on leaves and stems	
	Mines	Larvae
1. AL - 575	15.27	7.73
2. AL - 568	16.07	13.20
3. AL - 253	16.93	10.67
4. AL - 578	17.20	11.07
5. AL - 108	19.20	14.53
6. AL - 624	20.20	13.07
7. AL - 646	20.73	11.08
8. AL - 580	22.47	11.53
9. AL - 204	24.27	11.13
10. AL - 517	25.07	12.80
11. AL - 567	25.67	14.93
12. AL - 634	29.60	21.40
13. AL - 563	30.00	17.07
14. AL - 148	34.27	13.73
15. AL - 615	36.13	15.33
16. AL - 556	36.47	12.67
17. AL - 601	40.87	23.80
Mean	25.32	13.91
S.E.	6.94	4.62
L.S.D. at 5%	N.S	N.S

Table 8. The effect of varietal differences on mean percentage infestation of tubers by PTM.

Variety		Mean percentage infestation a/ of tubers
1. AL - 563	*	2.21 a
2. AL - 517		2.77 a
3. AL - 634		5.81 a
4. AL - 568		5.41 a
5. AL - 624		5.92 b
6. AL - 108		6.00 b
7. AL - 601		6.57 b
8. AL - 556		6.85 b
9. AL - 575		6.96 b
10. AL - 578		7.40 b
11. AL - 615		8.32 b
12. AL - 204		8.92 b
13. AL - 580		10.28 b
14. AL - 646		11.49 b
15. AL - 567		12.43 b
16. AL - 253		19.74 b
17. AL - 148		19.83 b
Mean		8.60
S.E.		4.11
L.S.D. 5% level		11.86

a/ 180 tuber samples taken from each of three replicates in each cultivar.

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 9.

The influence of varietal difference on the degree of tuber injury by PTM.

Variety	No of infested tubers with 1 - 2 holes	3 - 5 holes	6^+ holes	Total infested Tubers.
1. AL - 563	38	8	7	53
2. AL - 517	23	8	4	35
3. AL - 634	16	6	2	24
4. AL - 568	47	13	11	71
5. AL - 624	26	5	6	37
6. AL - 108	51	2	2	55
7. AL - 601	6	9	2	17
8. AL - 556	20	2	1	23
9. AL - 575	11	2	0	13
10. AL - 578	10	0	0	10
11. AL - 615	40	1	1	42
12. AL - 204	18	0	0	18
13. AL - 580	18	12	6	36
14. AL - 646	23	6	1	30
15. AL - 567	29	19	0	48
16. AL - 253	12	1	1	14
17. AL - 148	27	6	3	36

a) Tubers classified as lightly infested (1-2 holes) medium infested (3-5 holes); heavily infested 6^+ holes per tuber

b) Maximum 180 tuber samples taken from each of three replicates in each cultivar, but there were deficient cultivars in tuber production.

LITERATURE CITED

1. Bacon, O.G. 1960. Control of the potato tuber worm in potatoes. Journal of Economic Entomology 53:868-71

2. EL-Hemaesy A.H. Hammad, S.H. zeid, M.I.Tantawy, G.1974. Control of the leaf miner, Phthorimaea operculella (Zeller) on potato. Lepidoptera: Gelechiidae). Bulletin of the Entomological Society of Egypt No. 8, 137-143. RAE (1976). 64(6).

3. Foot, M.A 1976. Susceptibility of twenty cultivars to the potato tuber moth at Pukekohe: a preliminary assessment. New Zealand. Journal of Experimental Agriculture 4(2)239-242.

4. Gugleihmetti, M.H. 1978. Study of the susceptibility of 20 potato cultivars to the potato tuber moth (Phthorimaea operculella (Zeller) Agricultural Technical, 38(1) 40-41. Field crop Abstract (1981), 33(1): 61

5. Haines, C.P 1977. The potato tuber moth Phthorimaea operculella (Zeller) a bibliography of recent literature and review of its biology and control on potatoes in the field and store.

6. International Potato Center (CIP) 1979. Monthly report, Lima, Peru.

7. Richardson, M.E and D.L.W, Rose (1967) Chemical Control of Potato Tuber Moth, P.opercnlella (Zell), in Zimbabwe. Bull. Entomological Research 57 (2): 271-278.

* Chemical Control of Potato Tuber Moth
(Phthorimaea Operculella (Zeller)
in the field.

Adhanom Negasi

The potato tuber worm P.Operculella has long been considered to be a storage pest rather than a pest of crops in the field (Akade et. al., 1970). Control measures devised by earlier workers (Mukherjee, 1949; Lal, 1949; Rahman, 1944, Nirula, 1960; Nirula and Kumae, 1964) were mainly confined to storage. However, this pest has been taking a heavy toll of potato, both in the field and in the stores in many parts of potato,growing regions. According to Akade (1970), larvae of potato tuber moth damage reached 30 to 70 percent at field condition in the plateau regions of India. Since the initial infestation of the pest is carried from the field to stores greater attention on field is also called for. Control of PTM by insecticides is one of the methods applied in the field. Several chemicals have been observed to be effective against PTM in the field. Bacon (1960) found endrin and azinphos methyl to be effective against PTM in the field. Isobenzan and endrin were effective in India as evaluated by Kumar and Nirula (1964). Carbaryl, formathion, bromophos methyl, demeton-s were the best treatments against leaf mining larvae of P-Operculella on potato in feild plots tested in Egypt (EL - Hemaesy et. al., 1975). Moreover, the following chemicals have been reported as giving food control of the insect on other solanaceous plants. Organophosphorus compounds (azinophos - ethyl, azinophosmethyl, chlorfenvinphos, dimethoate, fensulfathion, formathion, phorate, phosalone and phosphamidon); Organochlorine compounds (DDT, endrin other compounds (carbaryl, isobenzan). Among those most studied and recommended recently have been azinophos- ethyl, azinphos - methyl and carbaryl (Gubbaih and Thontadarya, 1975; Dethe and Naik, 1975; Foot, 1975; Awate and Naik, 1970; Hofmaster and Waterfield, 1972; Mahajan and Mogal et. al., 1977; EL - Malsy, 1974).

Materials and Methods

Experiments were carried out at Melkassa I, (IAR), Nazret in 1980 - 81, 1981 - 82, 1982 - 83. The trial was carried out on a light soil of a 0.064 hectare field divided into 28 plots, each 2.1 meters (3 rows) wide and 4.5 meters long with hills 30 cms apart and 70cms between rows planted with a local variety in 1980 - 81 and ANITA in the other years. All the usual cultural practices were followed. The source of moisture was irrigation. Treatments were arranged in a completely randomized block design replicated four times. The insecticides used and their rate of application are as follows:-

Chemicals		Rate of Application Kg. a.i./ha
Parathion methyl	50 E.C.	0.450
Methamidophos	50 E.C.	2.150
Decamethrin	2.5% E.C	0.018
Selecron	500 E.C	0.750
Diazinon	60% E.C	0.300
Cypermethrin	10 E.C	0.150
Check		Untreated.

The insecticides were applied with Gloria 160 Knapsack sprayer at the rate of 700 litres of water per hectare. Three applications at 15 days interval were carried out. Two counts were taken every seven days following each application. Nine plants from each plot replicated four times per treatment (Total of 36 plants) were selected at random and counts to determine the effects of insecticides on live larval and mines on the foliage were made without uprooting the plants. Tubers from each plot were separated into two categories those with no holes were considered marketable and those with one or more holes were identified as unmarketable. Weights of marketable tubers in each plot were recorded.

Results and Discussion

Table 1 shows the overall mean number of mines and live larvae of the potato tuber worm for the first, second and third applications of the 1980 - 81. The overall observation show that application of methamidophos, decamethrin and cypermethrin resulted in the fewest number of mines which means that these three insecticides were more effective than the others tested in decreasing larval activitiss followed by selecron. Diazinon was the poorest of all the insecticides tested in controlling PTM throughout the season. The mean number of live larvae showed that decamethrin, cypermethrin and methamidophos were the best insecticides used against PTM larvae. According to the results obtained, the effects of the insecticides were more dramatically evident on the numebr of mines because they curtailed the activities of the larvae which were responsible for the mines out of proportion to their number as was noted by EL - Hemeasy (1974).

Good results were obtained from a study on the effects of PTM control on the quality of potatoes. Table 2 shows that Decamethrin and cypermethrin gave significantly higher yields of marketable potatoes over diazinon and the untreated check. Some of the insecticides, for example parathion methyl, methamidophos and selecron which were good in controlling foliage attack were not good in the control of tuber attack by the PTM larvae because their yields were the same as that of diazinon and the untreated check. The treatments in controlling leaf miners on the foliage throughout the season though control foliage infestation did not always prevent tuber infestation as was also reported by Bacon (1960) EL - Hemaesy (1974) and Foot (1974).

The overall observation of the 1981 - 82 trial as indicated in Table 3 application of cypermethrin, diazinon and selecron resulted in the fewest number of mines. The mean number of live larvae showed that cypermethrin, diazinon and selecron were the best insecticides used against PTM larvae. However, there was not significant difference on the yield of marketable potatoes among the treatments as shown in Table 4.

The 1982 - 83 trial showed that application of decamethrin, selecron and cypermethrin resulted in the lowest number of mines. The mean number of live larvae as shown in Table 5 indicated that decamethrin, cypermethrin and selecron were the best insecticides used against PTM larvae. Though decamethrin gave the highest marketable yield followed by diazinon and parathion methyl, there was no significant difference on the marketable yield among treatment.

Out of the six insecticides evaluated at Melkassa, Nazret Research Station for controlling the potato leaf mine, Ph. Operculella on potato foliage, the best were decamethrin 2.5% E.C at 0.018 Kg. active, cypermethrin 10% E.C at 0.150 Kg active and selecron 500 E.C at 0.750 Kg. active per hectare, respectively.

Table 1.

Average post treatment counts of leaf mines and larvae of PTM on field planted potato
1980 - 81

Treatments		Application Rate Kg. a.i./ha	Mean No. mines	Mean No. larvae
Methamidophos	50% E.C	2.150	* 4.58 a	1.60 ab
Decamethrin	2.5% E.C	0.018	5.18 a	1.16 a
Cypermethrin	10% E.C	0.150	5.65 a	1.33 ab
Selecron	500 E.C	0.750	8.20 ab	1.83 ab
Parathion methyl	50 E.C	0.450	11.27 bc	2.94 bc
Diazinon	60% E.C	0.300	14.12 c	3.47 cd
Check		Untreated	13.48 c	4.80 d
Mean			8.92	2.44
S.E			1.76	0.55
L.S.D at 5%			5.23	1.62

* Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 2.

Chemical control of PTM on the weight of marketable potatoes. 1980 - 81

Treatments		Application Rate Kg. a.i./ha	Mean weight in Kg/plot.
Decamethrin	2.5% E.C	0.018	* 14.30 a
Sypermethrin	10% E.C	0.150	13.61 a
Methamidophos	50 E.C	2.150	12.70 ab
Parathion methyl	50 E.C	0.450	12.34 abc
Selecron	500 E.C	0.750	11.08 abc
Diazinon	60% E.C	0.300	9.74 bc
Check		Untreated	9.13 c
Mean			11.84
S.E			1.15
L.S.D. at 5% level			3.41

*) Means followed by the same letters are not statistically different at 5% level by Duncan's New Multiple Range Test.

Table 3.

Average post treatment counts of leaf mines and larvae of potato tuber moth on field planted potatoes.

1981 - 82

Treatments	Application Rate Kg. a.i./ha	Mean No. mines	Mean No. larval
Cypermethrin 10% E.C	0.150	* 3.23 a	0.165 a
Diazinon 60% E.C	0.300	3.49 ab	0.490 ab
Selecron 500 E.C	0.750	4.82 abc	1.415 ab
Decamethrin 2.5 E.C	0.018	6.40 bcd	1.310 ab
Methamidophos 50 E.C	2.150	7.41 cd	2.910 bc
Parathion methyl 50 E.C	0.450	9.06 de	4.740 c
Check	Untreated	11.50 e	5.410 c
Mean		6.55	2.34
S.E		0.97	0.810
L.S.D at 5%		2.87	2.73

*) Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range test).

Table 4.

Chemical control of potato tuber moth (PTM) on the weight of marketable potatoes.

1982 - 83

Treatments		Application Rate Kg. a.i./ha	Mean Wt. in Kg/plot.
Methamidophos	50% E.C	2.150	11.57
Diazinon	50 E.C	0.300	9.80
Selecron	500 E.C	0.750	9.32
Parathion- methyl	50 E.C	0.450	9.25
Decamethrin	2.5% E.C	0.018	8.60
Cypermethrin	10% E.C	0.150	7.22
Check		Untreated	7.12
Mean			8.98
S.E			1.180
L.S.D at 5%			N.S

Table [illegible]

Average post [illegible] count [illegible] on field pl[illegible] potato.

1982 – 83

Treatments			Application Rate Kg.a.i./ha	Mean No. mines	Mean No. larvae
Decamethrin	2.5%	E.C	0.015	* [illegible].21 a	* 1.25 a
Selecron	500	E.C	0.750	6.08 a	2.71 a
Cypermethrin	10%	E.C	0.150	6.33 a	1.33 a
Methamidophos	50%	E.C	2.150	8.00 ab	3.63 a
Parathion methyl	50	E.C	0.450	10.92 ab	8.58 ab
Diazinon	60%	E.C	0.300	17.25 b	9.67 ab
Check			Untreated	27.50 c	14.53 b
Mean				11.61	5.95
S.E				2.32	2.93
L.S.D at 1%				9.44	--
L.S.D at 5%					8.71

*) Means followed by the same letters are not statistically different at 5% level (Duncan's New Multiple Range Test).

Table 6.

Chemical control of PTM on the weight of marketable potatoes.

1982 - 83.

Treatments			Application Rate Kg. a.i./ha	Mean Wt. in Kg/plot
Decamethrin	2.5%	E.C	0.018	12.17
Diazinon	60%	E.C	0.300	11.22
Parathion methyl	50	E.C3	0.450	10.33
Methamidophos	50	E.C	2.150	9.76
Cypermethrin	10	E.C	0.150	9.74
Selecron	500	E.C	0.750	8.32
Check			Untreated	11.56
Mean				10.44
S.E				1.35
L.S.D at 5%				N.S.

LITERATURE CITED

1. Akade, M.N., P.M. Tidke and M.K. Patkar. 1970. Control of potato tuber moth. (Gnorimoschema operculella) in Decan plateau through insecticides and depth of planting. Indian Journal of Agricultural Science 40 (12) 1071-1076.

2. Awate, B.G. and Naik, L.M. 1979. Efficiencies of insecticidal dusts applied to soil surface for controlling potato tuber worm Phthorimae operculella (Zeller) in the field. Journal of Maharashtra Agricultural Universities. 4(1) 100. Field crop Abst. (1950).

3. Bacon, O.G. 1960, Control of the potato tuberworm in potatoes. Journal of Economic Entomology 53: 868 - 71.

4. Dethe, M.D and Naik, L.M. 1975. Effect of soil application of insecticidal dusts on the application of potato tuber worm (Pathorimaea operculella (Zeller). Research Journal of Mahatama Phule Agricultural University 6 (1) 49 - 51. RAE (1976). 64 (10).

5. EL-Hemaesy, A.H; Hammad, S.H. Zeid, N.I; Tantawy, G. 1974. Control of the leaf miner, Phthorimaea operculella (Zeller) on potato. (Lepidoptera:Gelechiidae) Bulletin of the Entomological society of Egypt No. 8, 137 - 143 RAE (1976). 64 (6): 1037.

6. Foot, M.A. 1976. Laboratory assessement of several insecticides against the potato tuber moth, P.Operculella (Zeller). (Lepidoptera: Gelechiidae). New Zealand Journal of Agri. Research, 19 (1) 117-125. RAE (1976). 64 (12): 2038.

7. Gubbaiah and T.S. Thontadarya. 1975. Chemical control of the potato tuberworm, Gnorimaschema operculella (Zeller) (Lepidoptera: Gelechiidae) in Karnataka. Mysore Journal of Agri. Sciences. 9(3): 415-517. RAE (1976). 64(7). 1239-1240.

8. Hofmaster, R.N. and R.L. Waterfield. 1972. Insecticide control of the potato tuberworm in late crop potato foliages. American potato Journal. 49 : 10.

9. Lal. B.S.1949. Preliminary observations on the bionomics of potato tuber moth (Gnorimoschema operculella (Zeller) and its control in Bihar, India. Indian J. of Agricultural science 19 (2) : 295 - 306.

10. Mahajan, S.V, Mogal, B.H and Chundurwar, R.D. 1976. Chemical control of the Potato Tuber Moth (Phthorimaea operculella - (Zeller) Lepidoptera: Gelechiidae). Marathwada Krishi Vidyapeeth, Parbhani, Maharashatra, India, Pesticides (India). 10 (7) 50-51. Abstracts in Tropical Agriculture (1977). 3 (3) 110.

11. Mukherjee, A.K. 1949. Life history and bionomics of potato tuber moth Gnorimoschema operculella (Zeller) at Allahabad (V.P) together with some notes on the external morphology of the immature stages. Journal Zool. Soc, India. 1 (1):9:26.

12. Nirula, K.K. 1960. Control of Potato Tuber Moth. Indian Potato Journal 2 : 47 - 51.

13. Rahman, A. 1944. Prevention of Damage to stored potatoes by the tuber moth. Curr. Sci. 13 : 133-4.

* Chemical Control of the Potato Tuber Moth, Phthorimaea operculella (Zeller) (Lepidoptera: Gelechiidae) on stored Potatoes.

Adhanom Negasi

One of the principal limiting factors in the production and storage of potatoes is the potato tuber moth, Phthorimaea operculella (Zeller). At present no adeuuate methods have been divised to store seed and/or table potatoes free of this pest in **Ethiopia.** In most areas, great quantities of potatoes are available during and for some weeks after the rainy season (June, July and August). But supplies soon dwindle and become limited later in the year resulting in large price fluctuations. It is obvious that tubers which are to be used for next season's planting need to be stores for some time. Elimination of infested tubers before storage could minimize the risk of a total loss; but adult moths could migrate from field to store and cause damage there in (7). Destruction of such tubers in itself may not ensure clean potatoes.

To-date, chemical control is one of the most effective means of protection against this insect. Historically, a wide variety of chemicals and formulations have been used to protect potatoes in store. Fumigation of carbon disulfide(CS_2) was recommended more than 50 years ago by Steward (10). Delassus (4) recommended paradichlorobenzine (PDB) which killed all larvae and freed tubers from infestation without affecting their germination. Methyl bromide (CH_3BR) was first tried to control P. operculella by Mackie and Carter (9). Walker and Anderson (11) reported fumigation of infested potatoes with this chemical and effective control of all stages was achieved with no residue problems.

DDT is the most widely used contact insecticide but the residue after six months was not completery removed by washing or boiling (1). Chandhuri (3) recommended the use of DDD which gave

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* I.A.R. Project No. Po/PTM 26.1 (80)

excellent protection to sound tubers and consequently much saver table potatoes than was the case with DDT. Another excellent contact insecticide, according to Lioyd (8) was Gamma BHC which gave complete protection to tubers directly dusted and stored in treated bags and boxes. However, its toxicity to higher animals was reported to be two and half times that of DDT (2). Al - Ali and Talhouk (1) recommended carbaryl for use on stored table potatoes on account of its lower mammalian toxicity than DDT and Gamma BHC. It is the objective of this experiment to compare the relative safety and efficacies of the insecticedes as protectants against the potato tuber worm in stored potatoes.

Materials and Methods

This trial was carried out at Melkassa and Awasa, Institute of Agricultural Research for three consecutive years. Batches of 500 clean potato tubers were put in wooden crates (49 X 31 X 29cms). The tubers for each treatment, arranged in a completely randomized design with three replications, were dipped in solutions of one of the following insecticides: fenithrothion, decamethrin, diazinon, methamidophos, progenofos at 1 ppm, 0.10 ppm a.i., 11 ppm a.i,, 9 ppm a.i and 139 ppm a.i respectively and one untreated control dipped in plain water. The treated potatoes were kept in a room with 20 - 25° C and 30 - 35% relative humidity. All the treated potato tubers were examined 90 days after infestation by the potato tuber worms. This period was considered long enough for at least three generations of the insect (one generation being Ca= 1 month) according to an earlier report by Dutt(5) who observed as many as 14 generations a year in warmer climates. The criterion used to measure the efficacy of the insecticides tested was the number or larval holes or mines in the tubers.

Five tuber samples from each treatment were submitted for residue analysis in which the organo - phosphate insecticides, diazinon, fenithrothion, profenofos and methamidophos were analyzed by alkali flame ionization detector (AFID) and the synthetic pyrithroids, decamethrin, on electron capture detector (CED).

Results and Discussion

Table 1 shows mean percent infestation ranging from 2.33 to 91. There were significant differences among the treatments at the 1% protection level. Profenofos showed significantly better performance overall the other treatments with 2.33% infestation compared to 20.8, 37.8 and 52% for decamethrin, diazinon and fenitrothion, respectively. There was significant difference between decamethrin and diazinon. Methamidophos with 91% infestation gave the least protection against the moth and there was no significant difference between the latter and the plain water treated check. Fenitrothion, diazinon, decamethrin and profenofos (selecron) showed 34, 52, 73 and 97 reduction in percentage infestation, respectively over the check as it is indicated in Table 2.

In 1981-82 season, infestation percentage ranged from 53.73 to 97. Statistically, there was significant difference among treatments at 1 percent protection level. Only methamidophos 50 E.C showed an inferior result to the check though the difference was not statistically significant as it is shown in Table 3. Profenofos showed significant superiority over all the treatments followed by decamethrin and diazinon with mean percentage infestation of 53.73, 61.46, 68.93 respectively. Profenofos, decamethrin and diazinon showed 41.55, 33.14 and 25.02 reduction percentage infestation, respectively over the untreated check.

In the 1982 - 83 season, infestation percentage ranged from 55.80 to 96.93 as shown in tbale 5. Statistically there was significant difference among treatments at 1 epercent protection level. Methamidophos 50 E.C showed an inferior result to the untreated check though the difference was not statistically significant. Selecron showed significant superiority over all the treatments followed by decamethrin and diazinon.

The insecticides to be recommended for use against this moth must show certain advantages such as low cost, longer residual actions and lower mammalian toxicity as reported by Al-Ali and Talhouk (1). If potatoes are to be stored as seed, insecticides with low cost and lasting residual effects will be preferred. This was also reported by the same authors. If potatoes are to be stored for human consumption, however, insecticides with lower mammalian toxicity and with more rapid detoxification and elimination from tissues are preferred(1).

Analysis for diazinon in stored potatoes showed residues of 6ppm, whereas decamethrin, fenitrothion, profenofos, and methamidopohs left no residues following the same period of storage. The residue 6ppm diazinon was shown to exceed the recommended limits of tolerance established by FAO/WHO (1974). Thus diazinon may be recommended for use on seed potatoes because of its relatively long residual toxicity whereas potatoes for human consumption may be treated with the other insecticides provided factors other than mammalian toxicity are not limiting.

Table 1.

Comparison of several insecticides as protectants against PTM on stored potato tubers.

1980 - 81

Treatments		Application Rate (in ppm.)	Mean percentage infestation. d/
Selecron	500 E.C	139	* 2.33 a
decamethrin	2.5% E.C b/	0.1	20.80 ab
diazinon	60% E.C	11	37.80 bc
fenitrothion	1% D.P. a/	1 c/	52.00 c
methamidophos	50 E.C	9	91.00 d
Check		Untreated	73.4 d
Mean			47.01
S.E			4.94
L.S.D at 1% level			21.35

a/ D.P = Stands for dusting powder

b/ E.C. = Emulsifiable concentrate

c/ ppm = Parts per million

d/ 500 tuber samples taken from each of three replicates in each treatment.

* Means followed by the same letters are statistically different at 1% level (Duncan's New Multiple Range Test).

Table 2.

The effect of several insecticides applied to stored potatoes on the level of infestation by PTM. 1980 - 81

Treatments	Applicationn Rate (% a.i.)	No. of infested tubers with 1-2 holes	3-5 holes	6^+ holes	Total infested tubers/1500	% infestation	Reduction% infestation
Selecron 500 E.C.	0.375	30	5	0	35	2.33	97.03
Decamethrin 2.5% E.C	0.00025	191	112	9	312	20.80	73.47
Diazinon 60% E.C.	0.03	259	268	40	567	37.80	51.79
Fenitrothion 1% D.P.	10 ppm	263	253	59	775	51.66	34.11
Methamidophos 50 E.C.	0.05	235	634	496	1365	91.00	-
Check	Untreated	285	596	295	1176	78.40	-

Table 3.

Comparison of several insecticides as protectants against PTM on stored potato tubers.

1981 - 82.

Treatments	Application Rate(% ai.i)	Mean percentage infestation b/
Selecron 500 E.C.	0.375	* 53.73 a
Decamethrin 2.5% E.C. a/	0.00025	61.46 ab
Diazinon 60% E.C.	0.03	68.93 abc
Methamidophos E.C.	0.05	97.00 c
Check	Untreated	91.93 bc
Mean		74.61
S.E.		± 7.24
L.S.D at 1% level		32.45

a/ E.C. = Emulsifiable concentrate

b/ 500 tuber samples taken from each of three replicates in each treatment.

* means followed by the same letters are not statistically different at 1% level (Duncan's New Multiple Range Test).

Table 4.

The effect of several insecticides applied to stored potatoes on the level of infestation by PTM. 1981 - 82

Treatments	Application Rate (% a.i.)	No. of infested tubers with 1-2 holes	3-5 holes	6+ holes	Total infested tubers/1500	% infestation	Reduction % infestation
Selecron 500 E.C.	0.375	78	89	639	806	53.73	41.55
Decamethrin 2.5% E.C.	0.00025	209	237	476	922	61.46	33.14
Diazinon 60% E.C.	0.03	124	159	751	1034	68.93	25.02
Methamidophos 50 E.C.	0.05	14	22	1419	1455	97.00	-
Check	Untreated	32	73	1274	1379	91.93	-

Table 5.

Comparison of several insecticides as protectants against PTM on stored potato tubers. 1982 - 83.

Treatments	Application Rate (% a.i)	Mean percentage infestation b/
Selecron 500 E.C.	0.375	* 55.80 a
decamethrin 2.5% E.C a/	0.00025	61.86 ab
Diazinon 60% E.C.	0.030	69.73 abc
Methamidophos 50 E.C.	0.05	96.93 c
Check	Untreated	92.60 bc
Mean		75.38
S.E.		± 7.48
L.S.D at 1% level		33.49

a/ E.C. = Emulsifiable Concentrate

b/ 500 tuber samples taken from each of three replicates in each treatment.

* Means followed by the same letters are not statistically different at 1% level (Duncan's New Multiple Range Test).

Table 6.

The effect of several insecticides applied to stored potatoes on the level of infestation by PTM.

1982 - 83

Treatments		Application Rate (% a.i)	No. of infested tubers with 1-2 holes	3-5 holes	6^+ holes	Total infested tubers/1500	% infestation	Reduction infestation
Selecron	500 E.C.	0.375	86	92	659	837	55.80	39.75
Decamethrin	2.5% E.C.	0.00025	211	238	479	928	61.86	33.20
Diazinon	60% E.C.	0.03	128	168	757	1046	69.73	24.70
Methamidophos	50 E.C.	0.05	12	17	1425	1454.0	96.93	-
Check		Untreated	34	71	1284	1389.0	92.60	-

LITERATURE CITED

1. AL-ALI and A.S. Talhouk. 1970. The potato tuber moth, its biology and control. Am. Univ. Beirut Pub. Bol. 44, 30 pp.

2. Brown, A.W.A. 1951. Insect control by chemicals. Wiley and sons Insc. New York.

3. Chaudhuri, R.P. 1958. Studies on the methods of protecting stored potatoes from potato moth damage. Indian J. Ent. 19: 268 - 278. RAE (1959) 47: 386 - 387.

4. Delassus, M. 1926. Sur un nouveau procede de lutte contre là teigne de la pomme de terre (P. operculella) C.R.Acad. Agric. Rance III: 38 - 39. Paris. RAE (1926). 14: 115.

5. Dutt, H.L. 1914. Potato storage work in Bihar and Orissa in 1913. Bihar and Orissa Agric. Jouranl Patan. ii 48 - 68 RAE (1915). 3: 323.

6. FAO/WHO. 1974. Recommended international maximum limits for pesticide residues. Codex Alimentrius Commission CAC/RS 65 - 1974.

7. International Potato Center (CIP). 1979. Volume VII No. 5 Lima, Peru.

8. Lioyd, N.C. 1943 - 44. The potato moth. Experiments in its control. Agric. Gaz. N.S.W. 54: 323 - 327. RAE. (1945). 33: 184 - 185.

9. Mackie, D.B and D.H. Carter. 1939. Bureau of Entomology and plant quarantine. Bull. Dept. Agri. Calif. 28: 530 - 566. RAE (1941). 29: 231.

10. Stoward, F. 1913. The insectivity of the life forms of the potato tuber moth to various poisons. Australian Assn. for the advancement of science. Melbourne. RAE (1973) 1: 377.

11. Walker, H.G. and L.D. Anderson. 1944. Fumigation with methyl bromide for potato tuber worm. J. Econ. Ent. 37: 539 - 40.

CHEMICAL CONTROL OF WEEDS IN LINSEED[1]

Rezene Fesseh .[2]

The selectivity of pre-emergence applications of Linuron, Metobromuron and Eradicone, and post emergence applications of MCPA, Mecoprop, Bromoxynil, NaTCA + MCPA and Fluazitopbuthyl against annual weeds in Linseed was assessed. A twice weeded and untreated (weedy check) treatments were included for comparision. In general, linseed was found to be sensitive for most of the crop post emergence application of herbicides. Those found to selective are only effective against certain target weeds i.e. either broad-leaves or grassy species. For proper use, application of such kind of herbicides should be followed by supplementary hand weeding as necessary to control further development of resistant weed species. On the other hand application of pre-emergence herbicides showed better selectivity both interms of crops health and wide spectrum control of annual broad-leaves and grassy weeds. Among the herbicides tested Linuron 50WP at 1.0 - 1.5 kg a.i/ha and Metobromuron 50WP at 2.0 kg a.i/ha as pre-emergence treatments and MCPA 40% EC at 1.6 kg a.i/ha as post-emergence treatments were found to be effective.

1. Paper presented at the 1984 16th NCIC.

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Table 1 CHEMICAL CONTROL OF WEEDS IN LINSEED - 1980/81 - Holetta

Treatments		Rate in kg a.i/ha	Crop Phytotoxicity Score*	Broad-leaf Weeds Control %	Grass-Weeds Control %	Linseed Yield Q/ha
Linuron		1.0	3.5	93.7	69.1	9.32
"	+HW	1.0	3.0	92.5	54.4	8.83
"		1.5	6.0	96.6	0.0	6.74
"	+HW	1.5	4.5	94.4	82.3	9.05
Bromoxynil		0.48	3.0	0.2	- 8.8	4.96
"		0.64	4.0	27.7	- 5.8	5.80
Mecoprop		1.5	4.0	10.5	-58.8	5.51
"		2.0	3.0	21.7	-16.1	7.02
NaTCA + MCPA		4.6 + 0.4	2.0	26.5	-29.4	6.43
" "		5.4 + 0.8	2.5	17.9	20.5	6.08
MCPA		1.6	2.0	4.3	32.3	7.61
Metobromuron		2.0	2.0	85.4	16.1	7.26
"	+ HW	2.0	3.0	88.0	36.7	8.67
Weeded Check			-	60.2	-27.9	7.64
Weedy "			-	0.0**	0.0***	4.38
Mean						7.02
S.E						± 1.04
$LSD_{0.05}$						2.99
CV						25%

* Crop phytotoxicity scale: 1.0 - 9.0

where 1.0 represents no effect on the crop and 9.0 complete crop damage.

** Number of broad-leaf weed plants/m^2 in the weedy check was - 418

*** Number of grass weed plants/m^2 in the weedy check was - 68

Tabel 2 CHEMICAL CONTROL OF WEEDS IN LINSEED - 1981/82 - Holetta

Treatments	Rate in kg a.i/ha.	Crop Phytotoxicity Score *	Broad-leaf Weeds Control %	Grass-Weeds Control %	Linseed Yield Q/ha
Linuron	1.0	5.0	56.9	51.5	4.21
" HW	1.0	5.0	66.3	63.1	2.84
"	1.5	5.0	61.6	60.7	2.60
" HW	1.5	5.0	60.0	44.6	2.11
Bromoxynil	0.48	4.0	31.2	- 1.5	4.34
"	0.64	4.0	17.9	19.2	3.65
Mecoprop	1.5	5.5	0.0	7.3	3.27
"	2.0	5.5	10.06	16.9	3.01
Ia MCA + MCPA	4.6+0.4	4.0	26.7	39.2	4.54
" "	5.4+0.6	4.5	7.1	43.1	3.49
MCPA	1.6	3.0	31.4	14.6	4.22
Metobromuron	2.0	5.0	53.2	55.3	4.53
" +HW	2.0	3.5	55.2	64.6	3.78
Weeded Check	-	-	- 1.1	31.5	3.72
Weedy "	-	-	0.0 **	0.0 ***	3.38
Mean					3.97
S.E.					1.30
$LSD_{0.05}$					2.24
CV					30%

* Crop phytotoxiciety scale : 1.0 - 9.0
where 1.0 represents no effect on the crop and 9.0 represents complete crop damage

** Number of broad-leaf weed plants/m^2 in the weedy check was 362

*** Number of grass weed plants/m^2 in the weedy check was 130

Table 3 CHEMICAL CONTROL OF WEEDS IN LINSEED - 1983/84 - Holetta

Treatments	Rate in kg a.i/ha	Crop Phytotoxicity Score *	Broad-leaf Weeds Control %	Grass Weeds Control %	Linseed Yield Q/ha
Linuron	1.0	2.0	23.9	45.7	11.37
"	1.5	2.0	26.3	37.3	13.03
Brominol	0.48	4.0	59.6	- 8.3	6.20
"	0.64	5.0	75.8	-32.6	4.21
Eradicane	2.34	3.0	12.6	18.8	7.41
"	3.12	3.0	40.0	52.6	8.56
Fluazifop butyl	0.125	5.0	10.4	35.3	6.04
"	0.25	4.0	29.7	52.6	9.48
Metobromuron	2.0	2.0	36.9	13.4	7.05
MCPA	1.6	3.0	38.7	-45.0	8.37
Weeded Check	-	-	63.4	36.1	12.27
Weedy "	-	-	0.0 **	0.0 ***	5.57
Mean					8.39
S.E					± 1.61
$LSD_{0.05}$					4.72
CV					33%

* Crop phytotoxicity scale:- 1.0 - 9.0

Where 1.0 represents no effect on the crop and 9.0 complte crop damage.

** Number of broad-leaf weed plants/m^2 in the weedy check was 593

*** Number of grass weed plants/m^2 in the weedy check was 260

Highlights on lines of investigations of the Scientific Phytopathological Laboratory 1983/84

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Background

The Scientific Phytopathological Laboratory (SPL) was established in accordance with the agreement between the Government of USSR (represented by Ministry of Agriculture of the USSR) and the Ethiopian Government (represented by Ethiopian Science and Technology Commission) for the purpose of strengthening and consolidating friendly relations and mutual cooperation between the two countries.

For the purposes specified in the agreement the SPL was allotted with 60 hectares of land. The experiment site is situated at Ambo district, Shewa Administrative Region (130 km west to Addis Abeba) on vertisols at an altitude of 2250 m above sea level.

For the past period the Soviet and Ethiopian staff of the SPL tried to do their best to fulfill the following two main objectives:

1. To cooperate in carrying out the scientific investigations in the field of crop protection with the aim of finding effective measures against plant diseases, insect pests and noxious weeds.

2. To train and staff the laboratory with qualified Ethiopian specialists on plant pathology, virology, bacteriology, entomology and other aspects connected with plant protection.

   For the successful fulfillment of the above mentioned objectives the research staff has at its disposal, modern scientific equipment and facilities.

Training of the Ethiopian staff continues to be a major component in SPL's activities. To show advantage of modern technology the Scientific phytopathological Laboratory worked out plans to put into effect research results at farmers fields.

In confirmity with the agreement on its termination in 1986-1987 the Soviet Government will turn over the laboratory premises and installations (equipment, transport and technical facilities) to Socialist Ethiopia as a gift and free of charge.

This paper is prepared for 16^{th} National Crop Improvement Conference and it is a brief information on the research results, lines of investigations and output of the SPL. The more detailed information concerning research trends is represented in SPL Review - 1983/84.

Information on the main research results, 1983/84

Research activity of the SPL focused at the following lines of investigations:

- rust diseases of wheat;
- diseases of barley and oats;
- tef diseases;
- diseases of pulses;
- bacterial leaf spot on hot pepper and sesame;
- virus diseases of pepper;
- diseases of potato;
- insect pests of maize and sorghum;
- weed control research on wheat, barley and maize.

At present the SPL is working under National Research Programme only. In 1983 the SPL presented more than 60 research programmes which have been previously discussed and approved at the IAR Annual Agricultural Preview and Review Meetings: fungi diseases - 36; virus diseases - 5; bacterial diseases - 5; insect pests - 6; weed control - 7. In addition to this, researches on National and Pre-National Yield

Trials were conducted. Cooperation with National Research Institutions, International Research Centers and other organizations in carrying out of scientific investigations was widened.

Thus, in this paper the major findings in respect with the above listed activities are represented.

Rust diseases of wheat

One of the main directions in the SPL acitvity is to study distribution, biological peculiarities, population composition and resistance of wheat rust. Thus, more attention was paid to the following matters:

- Supplement of collection, documentation and evaluation germplasm of wheat varieties and lines resistant to rust;
- Screening varieties from National and International Research Centers;
- Evaluation of wheat varieties to leaf, stem and stripe rust in major wheat growing regions;
- Determination of prevalence and distribution of physiological races of wheat rust;
- Studies on the artificail methods of inoculation, chemical control of rust diseases and yield loss assessment.

The SPL collection(1983) included more than 3000 wheat lines and varieties with different genotypes of resistance to rust. All these materials have been registered in the SPL catalougue. The following groups of varieties were included:

- Varieties and lines from National and International Centers;
- Established varieties, newly released varieties and advanced pipeline varieties;
- Land races PGRC/E;
- Varieties and lines which are used for genetical and phytopathological investigations.

The collection is evaluated annually under artificial diseases pressure in greenhouse and in the field. Collected varieties and lines which are found resistance to rust diseases are included annually into the Special Nursery for additional evaluation in different agroclimatic zones. The main goal of this trial is to evaluate resistant varieties of wheat to rust diseases with increasing agroclimatic stress in major wheat growing regions of Ethiopia. Based on the results of evaluation conducted during the last three years (1981-1983) the following varieties were not affected by three types of rust:

- Veery"S"CM33027-F-15M-500Y-OM;
- Au-TobxGrefa CM30833-N-2Y-2M-2Y-2M-OY;
- Cno-ChriesxOn/Nar 59-ON SE454-115-2S-1S-OS;
- CCxCal-Sr;
- K.Paa.

For the past period SPL is participating in International Programmes on the following Nurseries:

Nursery	Number of varieties	Resistant to			
		Stem	Leaf	Stripe	Three Types
19^{th} ISWYN (Mexico)	50	32	39	39	28
13^{th} LSEPTON (Mexico)	103	66	81	103	64
16^{th} IBWSN (Mexico)	255	206	230	255	185
14^{th} IDYN (Mexico)	30	5	7	29	3
4^{th} ESWYT (Mexico)	30	21	24	30	21
RDTN (Mexico)	200	69	104	147	48
F_2SRR (Mexico)	99	0	14	99	0
RDYT (Syria)	24	2	4	24	0
RWYT (Syria)	24	17	16	24	14
DON (Syria)	150	37	56	150	31
Triticale (Mexico)	170	153	159	170	148
Total	1135	608	734	1070	542
		53.6%	64.71%	32%	47.71%

Many of durum wheat varieties were found to be susceptible to stem and leaf rusts. The majority of bread wheat varieties from Mexico were found resistant to three types of rust. Evaluation of all varieties resistant to rust diseases at seedling stage is conducting in greenhouse in the off season.

Besides, preliminary data were obtained that some land races from PGRC/E were resistant to rust.

For rust samples collection 13 Rust Spore Samples Nurseries were organized in different Administrative Regions of Ethiopia. On the results of this trial it was recorded that in 1983 high epidemic development of stripe and leaf rusts and depression of stem rust were observed in the Administrative Regions of Shewa, Arsi, Bale and Gonder. As the result of analysis of rust population the following races were identified:

Stripe rust: 17 races were identified. As in the previous year races 2E0 and 6E0 were found prevalent in the population. Virulence of population was unsignificant. The monogenic lines yr 3, 4, 5, 8, 10 were not attacked by stripe rust.

Leaf rust: 13 races were identified. Races 1, 3, 6 were found prevalent. Monogenic line Lr9 was found resistant to all leaf rust races.

Stem rust: 15 races were identified. In this population races 86, 53, 117, 89, 15 were found prevalent. There was no serious shift in the dynamic of race composition of stripe and leaf rusts. In some rust populations race 86 and 89 are increasing.

Diseases of barley

Four national and two international nurseries were evaluated:

- Malting Barley National Yield Trial (MBNYT);
- Food Barley National Yield Trial (FBNYT);
- Food Barley Pre-National Yield Trial (FBPNYT);
- Screening of barley varieties for their resistance to leaf and stem rusts (SBV);
- Barley Observation Nursery for ICARDA (BON);
- Collection of barley from VIR (Col. B).

Nursery	Number of varieties	Resistant to			
		Stem	Leaf	Stripe	Three types
MBNYT	8	2	0	8	0
FBNYT	12	0	0	12	0
FBPNYT	15	5	0	15	0
SBV	48	44	6	48	6
BON	145	134	68	145	68
Col. B	83	83	50	83	50

The affection of barley by stripe rust was not indicated. Slight affection of barley by stem rust and high affection by leaf rust was indicated.

Tef diseases

The main directions in tef research activity were screening of tef materials from National Breeding Programmes, screening of fungicides against main tef diseases and crop loss assessment due to damping-off and rust. The last two trends of the research were carried out from 1981 to 1983 and completed this year.

Tested fungicides: Campogran, Brassicol, Rizolex, Bronopol can be recommended for the protection of tef from seed and soil-born infections and Calixin from foliar diseases. It is necessary to replace the high toxity Ceresan and to apply fungicides rotation in order to avoid the fungicides resistance.

Based on the information obtained correlation between damping-off severity and yield loss was not recorded. It is suggested that immediate steps for the increase of tef yield should be taken to improve farming practices and also to evlove cultivar resistant to water lodging on seedling stage and lodging before maturing as the main agents of yield loss.

Diseases of pulses

In 1983-1984 SPL participated in national nursery trials of haricot bean, faba bean snd soybean. Surveys on the occurence of the major pulses diseases in high and low altitude regions were conducted and samples collected (Ambo, Bako, Holetta, Debre-Zeit, Nazret, Kulumsa, Diksis and Awasa).

Preliminary observations indicate that some local varieties of haricot bean may be resistant or tolerant to rust. The best way to control this disease is to use resistant cultivars. To our opinion further evaluation of resistance of all varieties available against bean rust in greenhouse conditions seems to be very important too.

Bacterial diseases

In 1983 investigations in the Bacteriology Section were carried out along the following lines:

-Screening of pepper and sesame varieties for resistance to bacterial leaf spot;

-Screening of chemicals to control the leaf spot disease of pepper;

-Studying of the disease develcpent peculiarities and serological characteristics of leaf causal agent.

These investigations were carried out under five current research programmes. As the result of the evaluation trial, the varieties Mareko Fana and Bunched Santaka were found to be resistant to bacterial leaf spot, and thus can be used in the breeding work and recommended into production.

Good results were obtained in control of the disease by means of chemicals. Application of 100% to 50% Chlorox commercial product had the highest effectiveness against bacterial leaf spot on pepper. The treatment of pepper seeds by Chlorox before sowing can also be recommended to farmers.

In order to obtain sesame varieties resistant to bacterial leaf spot caused by *Xanthomonas sesami*, the method of artificial inoculation under greenhouse condition was worked out.

Alongside with X. sesami, which has been previously recorded in Ethiopia, a new pathogenic bacterium was discovered. its identification will be carried out this year.

Based on the suggestion of the Ministry of State Farms Development the control of pepper bacterial diseases could be conducted in one of the state farms if the final agreement with the Ministry will be achieved.

Virus diseases

In the last year the main body of the research works performed by the Virology Section was dealed with the three crops, namely pepper, potato and tomato. The surveys on pepper virus diseases have been conducted at the state farms and farmers fields in Shewa and Welega Administrative Regions. The results of these surveys together with the data of the identification trials strongly indicate that the most common virus disease of pepper was caused by the TMV strains, mainly ribgrass and common ones. This virus was identified by electron microsoopy, serological and indicator methods. Besides, some thread like virus particles were observed in infected pepper plants under electron microscope. This result has been confirmed this year by the electron microscope analysis of pepper samples from Guder state farm. The further identification of viruses affecting pepper will be continued this year.

This work is closely correlated with the other studies performed in SPL - the study of the dynamics of TMV spreading in the field and the study of influence of the virus development due to the growth stages of pepper on the loss of pods yield. The latter was measured both quantitatively and qualitatively. It has been shown that TMV infection causes the most drastic loss of yield when the disease was started at the four leaves growth stage of the plant (46% of total yield loss as compared with 37% and 21% losses for flowering and pod formation stages, respectively). Mareko Fana was found to be more susceptible to the virus infestation than Bako local. The latter one, together with the varieties Hante-2, Bako 12N5, M-75(a) and M-36(b) was also found to be moderatly resistant to TMV in a separate evaluation trial. These varieties can be recommended for breeding as well as for production in the regions of high viral disease incidence.

The surveys on viral diseases on potato and tomato have also been conducted in the last year. It has been shown that potato crops in research stations of Bako, Awasa and Jima are affected by viruses. The identification of the pathogens maintained in the greenhouse will be conducted this year. The preliminary identification indicates that potato virus X is widely distributed in these regions.

Potato diseases

In 1983/84 crop season satisfactory results were obtained in different trials such as screening blight resistant potato clones, fungicide trial, race identification, assessment of losses, seed treatment and maintenance of seed foundation using mass selection.

Some promising potato varieties and clones like Kenya Baraka, Spunta, Diamant, Cardinal and Ramenski were tested by increasing them in the cooperative farms under our close observation. About 70 potato clones and varieties are maintained in a modern cold storage. They were obtained from CIP (International Potato Center) through the coordinator of Alemaya, College of Agriculture and other sources too. As the result of screening trials conducted in different sites some potato clones and varieties has shown high yields and satisfactory field resistance to late blight, such as Kenya Baraka (AL-100), IND-73 (AL-264) Anita (AL-148), Avensa (AL-120), Cebeco (AL-108) and others too. Concerning fungicide trial Ridomil MZ63.5 (3 Kg/ha) is found to be the most effective fungicide to control potato blight.

Disease free basic seed foundation is a decisive factor for potato production in any country. Therefore, the laboratory invites all the concerned organizations to meet together in order to lay out the structure and coordination for seed production. The SPL is ready to participate with its full potential.

Insect pests of sorghum and maize

The investigations in the field of entomology on screening of maize varieties resistant to pests, chemical control of sorghum, maize and pepper pests and Biological control of maize and sorghum pests were carried out accoridng to approved programmes including two new research activities - botanical control of maize stalk borer (Busseola fusca)and studying natural enemies pests as the main factor of biological control of the maize and sorghum.

The obtained data showed that there is a great number of natural predatory and parasitoids entomophages in Ethiopia both in species composition and in their number. Parasitic nematodes Fam. Mermitidae were eliminated from larvae of stalk borer. The predatory mites from Order Acarifomes were monitored in great amount on wild uncultivated plants around crop fields.

At present time more than 20 species of predatory insects were identified and their population density was monitored. It was determined that at the certain moments on 1 ha of maize there are more than 80 thousand of useful predatory entomophages, and it is necessary to protect them.

More than 70 maize sample varieties were evaluated on their resistance to maize stalk borer using the method of artificial infestation of plants. Unfortunately none of these varieties was sufficiently resistant to maize stalk borer.

Weed control research

Investigations have been carried out in three directions, including seven research programmes.

Observation of weed population in wheat, barley, tef, maize and sorghum were conducted in SPL experimental field, Guder state farm, Ambo Agricultural College, cooperatives and peasant farms of Ambo Region. Dynamics of weed flora composition and frequency of the most spread and harmfull weeds were studied. In the first part of cereals vegetative period broad leaved weeds, especially polygonum nepalense, Galinsoga parviflora, Amaranthus retroflexus, Nicandra physaloides, Commelina benghalensis, plantago lanceolata, Bidens pilosa, Trifolium spp.were predominant. In the second part of vegetative season Guizotia scabra, Medicago fulcata, Phalaris paradoxa and Snowdenia polystachya created a great problem in crop production.

Testing of new promising herbicides Tribunal and Metoxuron was carried out in barley. Optimum rates and time of application of herbicides recommended for other regions were ascertained. Like in the previous years the best results were obtained from Tributrine application at the rate of

0.75 Kg a.i. per ha (pre-emergence) and Fluorodifen application at the rate of 2.5 Kg a.i. per ha (pre-emergence). These herbicides can be tested in production trial.

New data on the influence of different modes of tillage, fertilizers and weedings on the level of infestation and yield were obtained. On maize the ploughing with turning soil, herbicide primagram and high rates of fertilizers had considerable advantages over shallow cultivation, two handweedings and low rates of fertilizers, correspondingly. On wheat variety Enkoy the ploughing with turning soil, Terbutrine and fertilizers $N_{60}P_{60}$ were the optimum combination.

Besides, joint trials on testing herbicides in wheat and vineyard with Ambo Agricultural College were conducted.

Research Programmes for 1984/85 Crop Season

In 1984 the SPL have presented more than 50 programmes concerning phytophathological aspects, weeds and pests control and agrotechnical methods in applying to cereals, pulses and horticultural crops. These research proposals were discussed and approved as national programmes by the IAR Annual Agricultural Preview Meetings. In addition, the SPL will be a participant of the major programmes on national and pre-national yield trials.

Six programmes have been presented as completed, i.e. four on rust and damping-off on tef and two on bacterial diseases of pepper.

This year the certain novel research directions and subjects for study have been introduced in the SPL projects. In the previous years the studies on bacterial and viral diseases were focused on horticultural crops only, namely on potato, tomato and pepper. The development of the control measures against viral diseases of pepper conducted at the SPL in the recent years was dealt with chemical treatments against seed-transmitable infection. However, the results of the surveys clearly indicate that pepper crops in Ethiopia are often affected with a variety of viruses having different modes of spreading and pathogenicity. This necessitates the concentration of the research activity on applying of valid and express methods for virus checking and identification, including modification of the serological technique, ELISA-test.

On the other hand, the various bacterial and virus affections of cereals and pulses represent an actual international problem in the crops production. Some of the respective causal agents have been indexed in Ethiopia (Stewart and Dagnatchew's Index), but more detailed and extensive research was not conducted. Therefore, the development of the studies on identification, spreading and pathogenicity of bacteria and viruses infecting cereals and pulses, involved in the four SPL projects, seems to be rather important and actual.

The other three new programmes offered this year concerned fungi diseases and weeds control research of these crops.

The new directions for studies of cereals and pulses also implicate some renovation of the current SPL programme content. Thus, the evaluation and screening of wheat varieties to leaf and stem rusts at seedling stage will be controlled. This approach could give an opportunity for expressing of evaluation of segregating material at early stages of screening and selection independently to season and thus be useful for breeders. In this respect, the other particular but rather important question, the correlation between greenhouse and field trials data on evaluation of wheat resistance to rust, will also be under study.

The other on-going programmes of the SPL will be continued in 1984 with only few minor modifications.

SPL training programmes, advisory work, seminars and workshops

As it is well known, SPL was established to serve as a center for agricultural research and training. Through its training programmes, the laboratory prepares agricultural scientists to replace Soviet experts upon the cancellation of the agreement signed between the Government of the USSR and the Government of Ethiopia. The laboratory also trains research workers, i.e. laboratory, field and technical assistants to assist agricultural specialists to transfer new technology to farmers.

Training of the SPL Ethiopian staff continues to be a major component in laboratory's activities. Scientific staff training was continued this year in accordance with chosen speciality of a staff under supervision of Senior Research Officer to assimilate modern methods of research.

In the degree-training related programmes, three staff members are continuing their education in the USSR, three specialists with B.Sc. left for M.Sc. to Addis Abeba University. This year three staff members who had completed Ambo agricultural College, were planned to leave Socialist Ethiopia to continue their postgraduate studies in one of the agricultural institutes of the USSR in 1983. But unfortunatley, due to unforseen circumstances their leave was postpond to 1984.

Course training programme was organized for a period of 10 days for all technical staff in October 1983 on "Methods of investigations in plant protection", including practical training on the use of electron microscope.

Research staff of the laboratory has actively participated in professional meetings, conferences and workshops. Some members of the staff also participated in giving lectures for the students of Alemaya and Ambo Agricultural Colleges, in advisory work and took part in the work of Examining Board as external examiners in Alemaya.

Workshops In the period from December 1982 to December 1983 two workshops in collaboration with Ethiopian Phytopathological Committee were organized. On December 28, 1982 Bacteriology Section of the SPL organized three-days workshop on the basis of phytobacteriology with the special stress on isolation of plant pathogens, preparation of pure culture and pathogenicity tests. Participants of the workshop were represented by EPC members, students from Alemaya College and other scientific institutions of Ethiopia. On September 29, 1983 Phytopathological Department organized three-days workshop on "Methods of artificial inoculation and evaluation of resistance of wheat to rust disease". More than 40 specialists from different IAR research stations, ILCA, PGRC/E, Agricultural Colleges and State Farms took part in this workshop.

Seminars The laboratory has responded to the request from the Regional Peasants Association for agricultural skills and technology training for the farmers of Jebat and Mecha Region. For the period from February 13, 1983 to November, 1983 three seminars where scientific staff members presented reports on the achievements of high yields using resistant varieties and modern technology of agronomic practices were organized. Based on the above, new trends in distribution of wheat, tef, maize and potato varieties resistant to diseases and pests among farmers have been worked out. At the meeting of All-Ethiopian Peasants Association of the region scientific staff was awarded with a gift for rendering assistance and strengthening Farmers Associations. This work was also highly appreciated by the members of the Advisory Committee held in Addis Abeba in December, 1983.

Race Composition of Leaf Rust in Some Regions of Ethiopia

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Abstract

Results of the work carried out for the last ten years 1974-1983 for identifying leaf rust race composition and its dynamics are presented. During this period 57 different races were identified and from among these the 1st race was the most wide spread. Data indicating the frequency of occurence of the most wide spread race in the population are given. The genotypic component of the leaf rust population is characterized with high virulence. The lowest concentration of virulent genes in this population was registered to genes Lr9 and Lr19.

Introduction

Leaf rust is wide spread in wheat fields under Ethiopian conditions. It is found in all highland areas. The fact that it is found in different areas is attributed to the natural climatic condition favouring it and the susceptibility of cultivars and other local varieties of wheat. Susceptibility of cultivars and local varieties of wheat largely depends on rust population composition and this is why researchers are interested in identifying its race composition.

In the Annual Reports of IAR for 1968-1969, 1969-1970 and 1970-1971, it is indicated that during the period 1963-1970 races 12, 20, 26, 57, 77, 119, 158, 184 were reported from the population of leaf rust in Ethiopia. From among this population race 77 was registered as the most virulent. This race is wide spread in wheat fields of Europe (USSR), and Asia (India). According to A.Voronkova - 1980, in Western Europe, biotypes of race 77 attack varieties such as Kavkaz and Aurora which actually are highly resistant to other races. In this article we try to present data obtained in our laboratory such as composition of leaf rust population and its genotypic characteristic in the regions of Shewa, Arsi and Bale for the last 10 years.

Materials and Methods

Genotypic and race composition wheat leaf rust population is studied in green house conditions in Ambo. The collection of inoculum (infecting material) was obtained from cultivars and varieties under cultivation in the production areas of Shewa (Ambo, Bako, Holetta, Sheno, Debre Zeit, Nazret), Arsi (Kulumsa, Diksis, Arsi Negele), Bale (Adaba, Dodola).

Complete differential varieties and monogenic lines are used for identifying race composition. Quick race and genotypic composiiton identification methods are used on detached leaves (Person, Samborski, Forsyth, Mihaylova, Kvitko). Registration of virulent genes is carried out with the help of Greens method (Green, 1965).

Results and Discussion

For the last 10 years different number of leaf rust races were recorded, for example 23 races in 1975, 6 races in 1978. Every year 3-7 new races appear in the population (Table 1). For this period a total of 57 races were identified. From among all races, race 1 was met during 10 years. Races 53 and 58 within seven years; 62 and 123 within six years; 2, 6, 11, 15, 25, 61, 141, 167 within five years; 14 and 38 within four years; 76, 120, 124, 161, 176 within three years; 3, 5, 36, 70, 74, 92, 133, 139, 156, 179, 223 within two years and the rest 26 races within 1 year. The most frequently occuring race 1 (Table 2, Figure 1) was very low in virulence to differential varieties and its frequent occurence is attributed to rhe susceptibility of many of the local wheat varieties such as _Triticum aethiopicum_, _Tr. durum_ and _Tr. dicocum_.

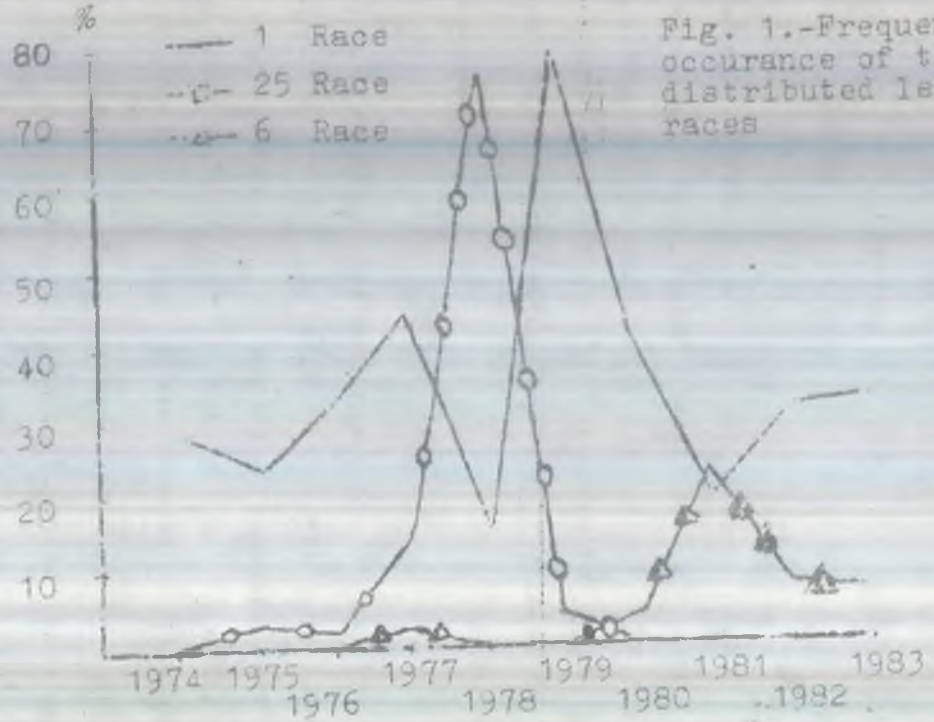

Fig. 1.-Frequency of occurance of the most distributed leaf rust races

The local variety Tr.aethiopicum is wide spread in farmers fields. The presence of different local wheat varieties in field and the different natural climatic conditions of highland Ethiopia seems to us the reason for the occurence of different races of leaf rust and for the races to change yearly. A proof can be found from other countries where only one type of wheat is grown on large scale. In these places the number of rust races are very little and they are not changed every year that much. It is necessary to note that since 1977 races 2, 6, 15 have appeared in the race population and since 1982 races 3 and 5 were registered for the first time. These races then were found in the population in 1983. Races 2, 3, 6 and 15 were more virulent to some varieties of Kenyan origin (Enkoy, Romany B.C. and Kenya Nyoka), Egyptian origin (Giza 155), but were not virulent to varieties of Mexican origin (Tobari 66) (Table 3).

Table 3. Affection of some wheat varieties by the most distributed leaf rust races

Variety-samples	Races						
	1	2	3	6	15	53	58
1. Enkoy	R56/S44	-	R40/S60	S	S	-	R50/S50
2. Romany B.C.	R71/S29	R	R40/S60	S	R50/S50	S	R50/S50
3. K.nyoka	R71/S29	S	-	S	R50/S50	S	S
4. Giza 155	R86/S14	-	-	S	S	-	R50/S50
5. Tobari 66	R	R	-	R	R	R	R

Increase in population and frequency of occurence of the amount of leaf rust on Enkoy can be attributed to the susceptibility of this variety which at present occupied large areas under production. For example the susceptibility of Enkoy in 1980 with leaf rust was (0 to TS), in 1981 (5S-10S), in 1982 up to 30S and in 1983 up to 40S. Characteristics of the leaf rust were supplemented and confirmed significantly with the help of monogenic lines. As a whole population of leaf rust was characterized (Table 4) with large number of genotypes (119 in 1980), high virulence of one genotype (7.7 in 1983) and annual increase of genotypes from 100 isolates taken (from 31 in 1978 up to 82.6 in 1983).

Table 4. Indexes of virulence of leaf rust population in 1978, 1980, 1981, 1983

Years	Monogenic lines	Monopustule isolates	Genotypes	Genotypes per 100 isolates	Isolates per 1 genotype	Average virulence of genotype
1978	13	126	39	31	3.2	5
1980	17	167	119	71.2	1.4	6
1981	23	137	69	50.4	2.0	4.3
1983	23	92	76	82.6	1.2	7.7

The data obtained show some tendency in the increase of the amount of genotypes when the virulence of a genotypes when the virulence of a genotype increases. From among the population the most wide spread races had weak virulence genotypes. For example in 1980 the most frequent non-virulent genotypes of the population were Lrl, 2a, 2b, 2c, 3, 3Ka, 9, 10, 11, 14a, 16, 17, 18, 19, 24, B,T/-4.3%. In 1981 and 1983 years Lrl, 2a, 2b, 2c, 2d, 3, 3Ka, 4, 9, 10, 11, 12, 13, 14, 14a, 14b, 16, 17, 18, 19, 24, B,T/-18.2% and 15.2% accordingly.

The most virulent genotypes Lr2a, 9/1, 2b, 2c, 2d, 3, 3Ka, 4, 10, 11, 13, 14, 14a, 14b, 16, 17, 18, 19, 24, B, T were found in the population of leaf rust in 1983 in a signifioant amount (1.1%).

It is necessary to note that the presence of highly virulent genotypes even at a small concentration can be dangerous for new varieties introduced for production. Therefore, before introducing new varieties it is necessary to check their resistance to rust in different agroolimatic conditions and check their resistance thereafter.

The greater frequency of occurence of less virulant genotypes might be due to wide spread of race 1 in the population. This race is slightly virulent on differential varieties and on monogenic lines. Though this is the case race 1 is highly various genotypically. In 1983 race 1 was composed of 14 different and mainly less virulent genotypes from which 7 isolates were from non virulent genotypes Lr1, 2a, 2b, 2c, 2d, 3, 3Ka, 4, 9, 10, 11, 12, 13, 14, 14a, 14b, 16, 17, 18, 19, 24, B, T/-and this was 7.7% or half of the isolates of the given genotype in 1983. Race 1 also is composed of 6 genotypes (8 isolates), which contained one virulent gene. The remaining 7 genotypes had 2-16 genes of virulence. It is necessary to note that along with the less virulent genotypes of race 1 in 1983, less virulent genotypes to the slightly infected genes Lr 19, Lr 3Ka and to the slightly infected genes in 1978, Lr1, and Lr 2a were found. In race 1 the virulent genes to Lr 2d, Lr 9 and Lr 24 were not found. Frequency of occurence of genotypes virulent to these three genes is having a decrease in tendency. Race 1 has an average of 2, 3 virulent genotypes. This means that one isolate of race 1 leaf rust had two virulent genes and was to attack varieties where resistance is controlled with complementary genes. An average of 1, 6 isolates is obtained from 1 genotype of race 1. In comparison to characteristics of all population (Table 4) race 1 had less virulence and more amount isolates per gene.

In comparison with race 1 and with all the population the 6^{th} and 3^{rd} races had greater virulence (13, 4 and 16, 5 accordingly) and less amount of isolates per gene (1 and 1 accordingly).

The infection of monogenic lines with the nine most spread races namely 1, 2, 3, 6, 15, 25, 53, 58, 62 showed (Table 5) that the following genes Lr9 (with race 25) Lr19 (with biotypes of races 1 and 6); Lr 3Ka (with biotypes of races 1 and 3), Lr1 (with biotypes of races 1, 3 and 6) and Lr 2a (with biotypes of races 1, 3, 6 and 58) were less affected than others.

The most highly affected monogenic lines were Lr10, Lr 14a, Lr 14b, and Lr 16.

The dynamics of change in frequency of occurence of virulent genes of leaf rust for the years is given in Table 6. As we see it, the least concentration of virulent genes on the population of leaf rust was on genes Lr9, Lr19, Lr24 and Lr3Ka, (frequency of their occurence equaled to 0,0; 9,8; 6,6 and 9,8% in 1983). The highest concentration of virulent genes was noted on Lr16, Lr14a, and Lr14b (55,4, 54,3 and 53,3% in 1983 accordingly).

In comparison with the years 1978, 1980 and 1981 in 1983 tje concentration of virulent genes increased on Lr1, Lr2a, Lr12, Lr13, Lr14, Lr19, LrT and decreased on Lr2d, Lr3Ka, Lr9 and Lr24. As in the previous years in 1983 concentration of virulent genes in the population of leaf rust under Ambo conditions grew as the plants develop. Thus the virulence of isolates collected as the disease appears at the beginning of September from wheat plants sown in the rainy season (end of June) was unsignificant. Virulent genes to Lr14 and Lr16 were found. Isolates collected from the end of October to November had very severe virulence. They infected almost all monogenic lines. This conclusion proves the dynamics of infection of monogenic lines sown at different times under field conditions of Ambo (Table 7).

It is possible to note that under Ambo conditions during the 1982 rainy season infection of monogenic lines to leaf rust was significantly high than during the rainy season of 1983. Recordings in the middle of October 1982 showed the presence of virulent genes in the population, namely Lr2c, Lr2d, Lr3, Lr4, Lr 10, Lr14a, Lr16, LrB, LrT. Recordings in the middle of October 1983 gave virulent genes in the population only to the highly susceptible lines Lr3, Lr4, Lr14a and Lr16.

In 1983 increase in the virulence of the population of leaf rust was recorded till the middle of November, when the virulent genes, Lr1, Lr2a, Lr2b, Lr2d, Lr3, Lr3Ka, Lr4, Lr10, Lr11, Lr14, Lr14a, Lr14b, Lr16, Lr17, Lr19, Lr24 and LrB were found.

In the last days of December 1983 sudden drop in the virulence of the population of leaf rust was observed. From January to the beginning of August 1983 weak infection level was noted on wheat from sparsely observed leaf rust symptoms. The reason for slight infection with leaf rust during this period (January - August) can be attributed to the unfavourable conditions for the development of leaf rust in the dry period and reduced of cultivated land under wheat during this time of the year.

Fields of monogenic lines in 1983 in different regions of Ethiopia with different natural climatic conditions permited to determine high virulence in the population of leaf rust at Holetta, Heraro, Diksis and Ambo with altitudes of 2500, 2350, 2650 and 2250 m respectively (Table 8).

Recordings in these places in the middle of September 1983 showed that the concentration of virulent genes were on Lr2b, Lr2c, Lr2d, Lr3, Lr4, Lr10, Lr11, Lr14a, Lr16, Lr24 and LrB. Monogenic lines Lr13, Lr17 and Lr18 were not affected. Monogenic lines Lr1, Lr2a, Lr3Ka, Lr9, Lr19 and LrT had very weak infection level (from 0 to 20MR).

It should be noted that the better favourable conditions for infection of varieties by leaf rust, the more concentration of virulent genes were found in the population.

<u>Conclusions</u>

1. For 10 years from 1974 to 1983, 57 races of leaf rust were identified, and from amongst these, race 1 was found every year, race 53 and 58 within 7 years, races 62 and 123 within 6 years, races 2, 6, 11, 15, 25, 61, 141, 167, within 5 years, races 14 and 38 within 3 years, races 3, 5, 36, 70, 74,92, 133, 139, 156, 179, 223 within 2 years and the remaining 26 races within 1 year. The highest frequency of occurence is observed for race 1.
2. Races 2, 6 and 15 which appeared in 1977 and race 3 in 1982 had high virulence to varieties of Kenyan origin namely Enkoy, Romany B.C. and Kenya nyoka and to a variety of Egyptian origin Giza 155. However, didn't infect Tobari 66, which actually is a variety of Mexican origin.
3. The least concentration of virulent genes on the population of leaf rust was to the genes Lr9, Lr19, Lr24, Lr3Ka (1,0, 9,8, 6,5, and 9,8% in 1983) accordingly and the highest was to the genes Lr16, Lr14a, Lr14b, (55,4, 54,3, 53,3 % in 1983) accordingly.

4. In respect with monogenic lines the virulence of the population of leaf rust increases in the rainy season till the middle of November and then becomes less till January. From January to the beginning of August very slight infection levels were observed. From the above mentioned statements, it is possible to make the following conclusion - it is necessary to sow on time promptly with the beginning of the rainy season being the optimum. For late sowings (September - October), it is necessary to use highly resistant varieties against leaf rust.

5. The population of leaf rust is characterized with large amount of genotypes (119 in 1980); high virulence of one of the genes (7, 7 in 1983); and by annual increase in the number of genotypes from 100 isolates.

The average virulence of single genotype of race 1 in 1983 equaled 2, 3; race = 13,4, and race 3 = 16,5. This means that in average one isolate of the 1st race had two genes of virulence; 13 virulent genes in 6 race in 16 virulent genes in race 3. They were able to attack varieties whose resistance is controlled with complementary genes.

Acknowledgement

A big technical assistance for fulfilling the job in respect with leaf rust race identification was rendered by the field assistant Tezazu Tafesse, to whom we forward our sincere thanks.

In our work we used materials related to race and genotypic composition of leaf rust report by Dr. Madumarov T.M. (7.8), for the period (1974-1977), Dr. Madumarov T.M. and Sorokina G.K. (9, 10) for the period 1978-1979; Dr. Jakutin B.I. (11, 12) for the period 1980-1981. All these materials were published in the respective progress reports of SPL. We forward our sincer thanks for the job fulfilled.

References

1. Annual Report IAR for 1968-1969

2. Annual Report IAR for 1969-1970

3. Annual Report IAR for 1970-1971

4. Green G.Y, 1965. Canadian Plant Disease Survey 45

5. Mihailova, vitko, 1970, Mycology and Phytopathology

6. Person C, Samborski D.Y., Forsyth F.P., 1957. Effect of benzimedosole on detached wheat leaves. Nature, 180.

7. Progress Report SPL for the Period January 1975 to December 1975

8. Progress Report SPL for the Period January 1977 to December 1977

9. Progress Report SPL for the Period January 1978 to December 1978

10. Progress Report SPL for the Period January 1979 to December 1979

11. Progress Report SPL for the Period January 1980 to December 1980

12. Progress Report SPL for the Period January 1981 to December 1981

13. Progress Report SPL for the Period January 1982 to December 1982

14. Voronkova A.A. 1980 "Genetiko-immunological osnowi selekcii pshenici na ustoichvost K rchavchine".

Table 1. Race composition of leaf rust population in Ethiopia (Shewa, Arsi, Bale) from 1974 to 1983

Years	No. of races	Races: 3 Regions (Shewa, Arsi, Bale) and other places	Races: Shewa	Races: Arsi	Races: Bale
1974*	15	1,11,12,14,38,51,53,58,62,66,74, 120,123,167,176	1,12,38,51,58,62, 74,123	1,11,14,53,66, 120,123	1,53,120,123,167,176
1975*	23	1,11,14,25,32,38,53,54,58,61,70, 76,120,123,133,141,156,164,167, 176,188,211,223	1,11,38,76, 141,223	11,14,32,38,54, 61,70,76,123, 141,156,167	1,11,14,61,120,123, 167
1976*	15	1,11,14,25,38,53,61,70,120,123, 133,141,156,167,76	1,14,38,61, 76,141,167	1,14,38,70,123	1,53,120,123,133, 141,167
1977*	14	1,2,6,15,25,26,38,61,62,76,141, 161,167,58	1,25,38,61,62 76,141,167	1,2,6,15,25,26, 58,61,62,141, 161,167	-
1978**	6	1,15,25,58,62,176	1,15,25,58,62,176	-	-
1979**	13	1,2,25,53,61,62,123,124,141,167, 168,169,179	1,2,25,53,61,62, 123,124,141,167, 168,169,179	-	-
1980***	12	1,2,6,21,53,58,61,62,124,141, 161,223	1,2,21,53,61,62, 124,141,161,223	6,58,61	-
1981***	20	1,5,11,12,15,33,58,61,84,92,137,139, 141,149,161,163,175,177,217,220	1,6,15,58,61,177	1,6,15,61,149	1,6,58,177
1982	20	1,2,3,5,6,11,15,36,38,42,53,63,74, 92,111,121,123,124,139,179	1,2,3,11,15,36,38, 53,63,74,92,111, 121,124,139,179	1,2,3,5,6,36,38, 53,74,92	2,3,5,6,15,42,53,92
1983	13	1,2,3,5,6,11,14,15,36,53,58,62,123	1,3,6,15	1,5,3,6,58	1,6,14,15,62,2,3

* Determination of races carried out by Dr. Madumarov T.M.

** " " " " " Sorokina G.K.

*** " " " " " Jakutkin B.I.

Table 2. Frequency of distribution of some races from 1974 to 1983 (%)

Years	1st place		2nd place		3rd place		4th place	
	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.
1974	1	29,2	120	19,5	14	13,9	53	12,1
1975	1	24,2	141	14,8	167	13,0	61	11,4
1976	1	33,7	141	19,4	167	13,2	61	8,0
1977	1	44,2	25	16,4	62	12,1	61	9,1
1978	25	75,6	1	16,9	15	4,7	176	1,4
1979	1	79,0	25	1,8	53	1,8	61	1,8
1980	1	41,6	62	20,6	61	8,8	58	5,9
1981	6	22,4	1	20,0	149	4,7	58,61	3,5
1982	1	31,7	36	9,3	6	8,8	3,53	8,3
1983*	1	32,1	6	8,7	3	8,6	36	7,6

* Determination of race composition and frequency of distribution is not finished yet

Table 5. Affection of monogenic lines of some leaf rust races distributed in Ethiopia 1976, 1980, 1981, 1983

Monogenic lines	Races								
	1	2	3	6	15	25	53	58	62
Lr 1	R86*/S14**	R	R40/S60	R67/S33	R	– –	R	R	R
Lr 2a	R95/S5	R	R60/S40	R83/S17	R	R	R	R66/S34	R
Lr 2b	R95/S5	R	R20/S80	R60/S40	R50/S50	S	R	R	R50/S50
Lr 2c	R77/S23	R50/S50	S	R40/S60	R50/S50	S	R	R50/S50	S
Lr 2d	R	S	R20/S80	R40/S60	R	–	R	S	R
Lr 3	R95/S5	S	S	S	R50/S50	S	R50/S50	S	S
Lr 3Ka	R95/S5	R	R60/S40	R	R	–	R	R	R
Lr 4	R95/S5	R	R20/S80	R20/S80	S	–	S	S	S
Lr 9	R	R	R	R	R	R90/S10	R	R	R
Lr 10	R73/S27	S	R40/S60	S	S	S	S	S	S
Lr 11	R95/S5	R	S	R20/S80	R	–	S	S	S
Lr 12	R91/S9	R	S	R40/S60	R	–	S	S	R
Lr 13	R77/S23	R	S	R40/S60	R	–	S	S	S
Lr 14	R86/S14	R	S	R20/S80	R	–	S	R	S
Lr 14a	R77/S23	R50/S50	S	S	S	S	S	S	S
Lr 14b	R86/S14	R50/S50	S	S	R50/S50	S	S	S	S
Lr 16	R86/S14	R50/S50	S	S	S	S	S	S	S
Lr 17	R95/S5	S	R40/S60	R60/S40	R50/S50	S	R	S	R50/S50
Lr 18	R91/S9	R50/S50	R40,S60	R60/S40	R50/S50	S	R	R50/S50	S
Lr 19	R95/S5	R	R	R83/S17	R	–	R	R	R
Lr 24	R	R50/S50	R80/S20	R71/S29	R67/S33	–	R	R50/S50	R50/S50
Lr B	R95/S5	R	S	R20/S80	R20/S80	–	R	S	S
Lr T	R77/S23	R	R60/S40	R40/S60	R	–	R	S	S

* Number of resistant biotypes (%)
** Number of suseeptible biotypes (%)

Table 6. Frequency of distribution of virulence genes in leaf rust populations in several regions of Ethiopia (Shewa, Arsi, Bale) in 1978, 1980, 1981, 1983 (%)

Code No.	Monogenic line	1978***	1980**	1981**	1983
1.	Lr 1	0,0	3,2	11,7	20,6
2.	LR 2a	0,8	6,3	11,7	17,4
3.	Lr 2b	14,3	11,3	34,3	30,4
4.	Lr 2c	67,5	26,8	37,8	31,5
5.	Lr 2d	–	51,5	21,9	18,5
6.	Lr 3	77,0	48,9	32,4	48,9
7.	LR 3Ka	–	41,1	14,4	9,8
8.	Lr 4	–	–	35,1	43,5
9.	Lr 9	3,2	15,8	0,9	0,0
10.	Lr 10	76,2	50,7	30,6	48,9
11.	Lr 11	–	9,7	35,0	35,9
12.	Lr 12	–	–	3,3*	47,8
13.	Lr 13	–	–	25,2	43,5
14.	Lr 14	–	–	26,6	41,3
15.	Lr 14a	51,6	38,9	0,2*	54,3
16.	Lr 14b	75,4	46,9	23,4	53,3
17.	Lr 16	76,2	35,8	31,5	55,4
18.	Lr 17	29,4	39,8	29,7	25,0
19.	Lr 18	68,3	43,8	20,7	38,0
20.	Lr 19	0,0	2,2	1,5	9,8
21.	Lr 21	–	0	0*	–
22.	Lr 24	–	29,8	24,3	6,5
23.	Lr B	–	60,5	22,5	42,4
24.	Lr T	–	–	26,6	45,6

* Virulence was estimated for isolates collected at Ambo

** Data collected by Dr. V.Jakutkin

*** Data collected by Dr. G.Sorokina, T.Madumarov

Table 7. Dynamic of affection of monogenic lines depending on sowing date plant development in field conditions at Ambo, SPL (1982 - 1983)

Monogenic lines	Sowing Date										
	21/06/82			6/12/82			8/06/83		17/09/83		
	Evaluation, 1982			Evaluation, 1983			Evaluation, 1983		Evaluation, 1983		
	20.9	7.10	25.10	1.1	11.2	10.4	17.09	16.10	31.10	16.11	20.12
Lr 1	0	0	0	0	0	0	0	0	0	TMS	0
Lr 2a	0	0	TR	0	0	0	0	TMR	TMS	30MS	0
Lr 2b	0	TMS	TR	0	0	0	10MR	10MR	10MS	40S	TS
Lr 2c	TMS	20MS	80S	0	0	0	TMR	TMR	TMR	10MR	30MS
Lr 2d	0	20MS	80S	0	0	0	0	0	10S	10MS	20MR
Lr 3	0	40S	80S	0	0	0	10MS	10MS	TMS	30MS	0
Lr 3ka	0	0	0	0	0	0	TMR	TMR	TMS	TMS	0
Lr 4	0	10S	80S	0	0	0	10S	10S	0	10S	0
Lr 9	0	0	0	0	0	0	0	0	TMR	0	0
Lr 10	0	10S	100S	0	0	0	TMR	TMR	20S	50S	0
Lr 11	0	TR	0	0	0	0	0	0	TMS	10MS	10MR
Lr 12	0	0	0	0	0	0	TR	TR	10MS	TMR	0
Lr 13	0	0	0	0	0	0	0	0	TMR	0	0
Lr 14	0	TMR	20MR	0	0	0	0	0	TS	10MS	0
Lr 14a	100S	100S	100S	0	0	0	TMS	TMS	TMS	60S	0
Lr 14b	0	0	0	0	0	0	0	0	TMS	10MS	0
Lr 16	50S	50S	100S	0	0	0	TMS	TMS	TMR	20MS	0
Lr 17	0	0	0	0	0	0	0	0	TMR	10MS	0
Lr 18	0	0	0	0	0	TMR	0	0	0	TMR	0
Lr 19	0	0	0	0	0	0	0	0	TMR	10S	0
Lr 24	0	0	0	0	0	0	0	0	0	TS	0
Lr B	50MS	50MS	100S	0	0	0	0	0	TMS	50S	0
Lr T	0	TMR	50S	0	0	0	0	0	10MR	10MR	0

Table 8. , Affection of monogenic lines in different regions of Ethiopia by leaf rust in September, 1983

Code	Monogenic line	Nazret	Bako	Debre Zeit	Kulumsa	Ambo	Herero	Holetta	Diksis	Sheno
		1500	1650	1850	2150	2250	2350	2500	2650	2850
1	Lr 1	0	0	0	0	0	0	TR	TR	0
2	Lr 2a	0	0	0	0	0	0	TMR	0	0
3	Lr 2b	0	0	TMS	0	10MR	0	60S	20MS	0
4	Lr 2c	0	0	0	0	TMR	10MS	10MR	TR	0
5	Lr 2d	0	0	0	0	0	80S	10MS	0	0
6	Lr 3	TMS	0	0	0	10MS	100S	100S	20MR	0
7	Lr 3Ka	0	0	0	0	TMR	0	0	0	0
8	Lr 4	TMS	0	0	0	10S	80S	TMS	40MS	0
9	Lr 9	0	0	0	0	0	0	TMR	0	0
10	Lr 10	0	10S	0	0	TMR	TS	TS	40MS	0
11	Lr 11	0	0	0	0	0	10S	TMS	10MS	0
12	Lr 12	0	0	0	0	TR	0	TMS	0	0
13	Lr 13	0	0	0	0	0	0	0	0	0
14	Lr 14	0	0	0	0	0	0	TMS	0	0
15	Lr 14a	TMS	10MS	0	0	TMS	TS	TMR	40MS	0
16	Lr 14b	0	0	0	0	0	0	TMS	0	0
17	Lr 16	0	0	0	0	TMS	20MS	TMS	TMR	0
18	Lr 17	0	0	0	0	0	0	0	0	0
19	Lr 18	0	0	0	0	0	0	0	0	0
20	Lr 19	0	0	0	0	0	0	0	20MR	0
21	Lr 24	0	0	0	0	0	TMS	0	40MS	0
22	Lr B	TMS	0	0	0	0	TMS	TS	20MS	0
23	Lr T	0	10MR	0	0	0	0	0	0	0

Rust Spore Trap Nursery (RSTN), 1983

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Introduction

Epidemic out break of rust diseases frequently occures in Ethiopia. For epidemic development of rust would require the following: cultivation of susceptible varieties, favourable weather condition for development of the pathogen, sufficient amount of inoculum. As it was well known the most important control measure is a cultivation of resistant varieties.

However, after a period of some years the pathogen adapts itself to the newly cultivated resistant varieties and overcome its resistance, as a result of this interaction new biotypes and races appear in the population. This brings the appearance of new epidemic outbreak. Due to this reason it is very important to study race composition and identification of virulent forms of the pathogen.

Materials and methods

For this purpose in 1983 at different locations special rust spore trap nursery was organized for monitoring and to defect new change in the virulence pattern. The nursery was composed of 17 varieties and lines, the following groups of wheat were included:

- Susceptible - for monitoring widely distributed races.
- Moderately resistant - for monitoring virulent races.
- Resistant - for monitoring new genotypes of virulence.

The following varieties and monogenic lines Einkorn, Vernal, Khapli, Sr6, Sr22, SrTtl, 181-5, Sonora64, Lerma Rojo64, Lee, Era, FKN(11-50-17) were used for monitoring stem and leaf rust spores.

Varieties and lines of Lr1; Lr9; Lr19; Kharkovskaya46, Dimitrovka5-12 were used for monitoring leaf and stripe rust spores. The main results obtained are presented in tables 1, 2, 3.

Results and discussions

Stem rust: In 1983 crop season at Ambo and Debre Zeit the heavy development of stem rust was recorded. At Holetta, Debre Zeit and Bako heavy rust infection was observed on separate cultivars. At Kulumsa, Bekoji, Meraro, Arsi Negele, Herero, Robe, Awasa and Sheno heavy development of stem rust was absent during the main crop season (1983). Heavy development of stem rust at Ambo was due to artificial inoculation pressure. In Shewa, Arsi and Bale Administrative Regions a depression of stem rust was observed. Wheat varieties Era, Dimitrovka 5-12, FKN (11-50-17) were found resistant in all locations to stem rust.

Leaf rust: The heavy development of leaf rust was observed at Ambo, Debre Zeit, Arsi Negele, Herero; moderate level - at Awasa and Debre Zeit; low development - at Holetta, Bako. The rust spores trap nurseries at Bekoji, Meraro and Sheno were found free from leaf rust. Monogenic lines Lr9; Lr 19 and wheat varieties Dimitrovka 5-12, FKN (11-50-17) have been found resistant in all locations where the trials were conducted.

Stripe rust: In 1983 heavy epidemic development of stripe rust was recorded in Shewa, Arsi, Bale, Gonder Administrative Regions. Heavy infection of stripe rust was observed at Bekoji, Meraro, Sheno, Holetta. At Awasa none of the varieties was affected by stripe rust. At Debre Zeit two monogenic lines of leaf rust were susceptible to stripe rust. Only one wheat variety Einkorn (T.monococcum) was found to be resistant in all locations.

Conclusion

In 1983 crop season heavy epidemic out break of stripe rust was recorded in Shewa, Arsi, Gonder and Bale Administrative Regions. In some regions there was leaf rust epidemic. Out of 17 varieties and lines tested not a single wheat variety or line was found to be resistant to the three types of rust diseases. Bekoji, Meraro and Sheno were found to be "hot spot" areas for selection of stripe rust resistant varieties. At Debre Zeit there is a favourable condition for selection of resistant varieties to stem and leaf rust diseases. At Ambo (SPL) there is a favourable condition for the formation of artificial heavy disease pressure for the three types of rust diseases.

It would be advisable to make a few changes in the setø of RSTN varieties. For example, variety 181-5 is very early maturing variety and it escapes the diseases. The Mexican varieties Sonora64 and Lerma Rojo64 are very close by their genotypes and only one of the varieties is sufficient.

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Table 1. Evaluation of RSTN to stem rust of wheat during 1983

Variety or line	Ambo	Holetta	Debre Zeit	Kulumsa	Bekoji	Meraro	Arsi Negele	Herero	Robe	Awasa	Bako	Sheno	Debre Tabor
Einkorn	100MS	0	80S	0	0	0	TS	0	0	0	0	0	80MS
Vernal	50MS	0	80S	0	0	0	0	TS	0	0	-	0	50S
Khapli	10MS	0	10MS	0	0	0	0	0	0	0	TS	0	-
Sr 6	80S	0	TS	0	0	0	0	0	0	0	0	0	MS
Sr 22	20MR	0	0	0	0	0	0	0	0	0	50MR	0	-
Sr Tt-1	30MS	TS	0	0	0	0	TS	0	0	0	0	0	-
Lr 1	100S	0	0	0	0	0	0	0	0	0	0	0	0-
Lr 9	100S	0	0	0	0	0	0	0	0	0	0	0	-
Lr 19	80MS	0	0	0	0	0	0	0	0	0	0	0	-
Lee	100S	TS	80S	0	0	0	0	0	0	0	80MS	0	50S
Kharkovs-kaya 46	100S	50S	100S	0	0	0	0	TS	0	0	100S	0	80S
181 - 5	100S	0	0	-	0	0	0	0	0	0	0	0	0
Sonora 64	80MS	0	0	0	0	0	0	0	0	0	0	0	0
Lerma Rojo	100S	0	0	0	0	0	0	0	0	0	0	0	0
Era	TS	0	0	0	0	0	0	0	0	0	0	0	-
Dimitrov-ka 5-12	0	0	0	0	0	0	0	0	0	0	0	0	-
EKN (11 - 50 - 17)	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. Evaluation of RSTN to leaf rust of wheat during 1983.

Variety or line	Ambo	Holetta	Debre Zeit	Kulumsa	Bekoji	Meraro	Arsi-Negele	Herero	Robe	Awasa	Bako	Sheno	Debre Tabor
Enkorn	80MS	0	0	0	0	0	0	0	0	0	0	0	-
Vernal	50MR	0	60MR	0	0	0	0	TS	0	0	0	0	-
Khapli	-	60S	50S	60MS	0	0	60S	-	0	20MR	-	0	-
Sr 6	50MS	0	90S	0	0	0	60S	40MS	0	60MS	100S	0	50MS
Sr 22	100MS	0	100S	0	0	0	50S	80MS	0	80S	-	0	50MS
Sr Tt-1	100S	0	80S	0	0	0	50S	20S	0	50S	70S	0	-
Lr 1	10S	0	80S	0	0	0	30MS	0	0	0	0	0	-
Lr 9	0	0	0	0	0	0	10MR	0	0	0	0	0	-
Lr 19	0	0	0	0	0	0	0	0	0	0	0	0	-
Lee	20MS	0	40S	0	0	0	10S	-	0	0	-	0	-
Kharkovskaya 46	50MS	0	20MR	0	0	0	0	30S	0	0	-	0	-
181 - 5	-	-	50S	-	0	0	-	40MS	0	TS	-	0	0
Sonora 64	-	-	-	-		0	0	-	0	0	-	0	0
Lerma Rojo	-	0	-	-	0	0	-	-	0	0	-	0	0
Era	0	0	0	0	0	0	0	0	0	0	0	0	-
Dimitrovka 5-12	20MS	0	0	0	0	0	0	40MS	0	0	0	0	MS
FKN (11-50-17)	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3. Evaluation of RSTN to stripe rust of wheat during 1983.

Variety or line	Ambo	Holetta	Debre Zeit	Kulumsa	Bekoji	Meraro	Arsi-Negele	Herero	Robe	Awasa	Bako	Sheno	Debre Tabor
Einkorn	0	0	0	0	TR	0	0	0	TS	0	–	TR	–
Vernal	0	0	0	0	10MR	0	TR	10S	TR	0	0	0	–
Khapli	–	0	0	30MS	30MS	TS	–	–	TR	0	–	80MS	80MS
Sr 6	0	5S	0	40MS	60MS	20S	TS	–	10MS	0	0	80S	50S
Sr 22	0	10S	0	50MS	80MS	60MS	+R	–	70S	0	–	80S	50MS
Sr Tt 1	30S	70S	TS	70S	100S	80S	60S	30MS	50S	0	–	100S	100S
Lr 1	80S	60S	20MS	30MS	80S	50S	50S	100S	10MS	0	0	100S	100S
Lr 9	80S	80S	80S	60MS	80S	50MS	20S	–	50S	0	0	100S	100S
Lr 19	100S	80S	TS	70MS	100S	80S	60S	100S	50S	0	0	100S	100S
Lee	50S	60S	TR	30MS	100S	70MS	40S	100S	70S	0	–	100S	–
Kharkovskaya 46	TS	10MS	0	TR	80S	30MS	10MR	–	0	0	–	100S	50MS
181 - 5	–	–	–	–	0	0	–	–	10MR	TR	–	–	0
Sonora 64	–	10MS	–	–	60S	10S	–	–	30MS	0	–	100S	0
Lerma Rojo 64	–	10MS	–	–	50S	10MS	–	–	30S	0	–	100S	0
Era	20MS	TR	0	0	20MR	20MS	0	20S	50S	0	0	100MS	80MS
Dimitrovka 5-12	80S	50S	0	TR	60S	70S	10S	100S	TR	0	–	100S	80S
FKN (11-50-17)	20MS	TR	0	TR	30MR	TR	TR	10S	0	0	0	50S	0

Mz/STB 24.1 (78) Screening of Maize Varieties Resistant to Stalk Borer (Busseola fusca)

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Introduction

Stalk borer (*Busseola fusca*) is a major insect pest problem on maize in mountainous area of Ethiopia. Finding out maize varieties which are resistant to stalk borer is the main objective of selection work and varieties screening.

Materials and Methods

- Season - 1979-1983
- Location - Ambo, SPL
- Design - RCB three replications. Each replication included 30-40 plants per certain variety
- Plot size : $6.75 m^2$
- Spacing : 0.75 x 0.3 m
- Seed rate : two seeds per each planting hole
- Sowing date : May-June
- Harvest : December-January
- Variety : Sent from Alemaya and Bako
- Cultural practice - fertilizers : N_{50}, P_{50} per ha were applied before planting and before the first cultivation; weeding : Primagram after sowing at the rate of 3 kg a.i. per ha.
- Treatments - in accordance with method by Shapiro (1980) the design included three variants (under field condition)

1. Artificial infestation with stalk borer;
2. Natural infestation background;
3. Pesticides treatment to avoid the natural background of infestation (check).

- Time, intervals, dosage - artificial infestation with larvae of stalk borer Busseola fusca (4-5 larvae per plant) was carried out starting from the stage tassel of emergence by reproduction the larvae in laboratory conditions.
- Scoring of infection intensity - recording stalk borer infestation was carried out on each plant individually in two periods in accordance with Guthrie W., 1960.
  1. Before flowering at the stage of 8-10 leaves by recording the damage of leaves (0-5 shortened scale);
  2. During harvest by recording the damage of maize cobs, and also by scoring the number of stalk borers larvae, number of holes on stalk and length of tunnel (cavities) inside the stalks.

Assessment of infested stalks was carried out by dissecting the stalks, Resistance of varieties was evaluated considering the relatively integrated index of resistance (Shapiro, 1971, 1980). Yield estimation was carried out on each plant separately. Dispersional analysis was done after getting the results.

Results and discussion

In 1978-1980 years ninteen varieties from Bako and Alemaya were tested with artificial inoculation (5 first instar stalk borer larvae per plant) under open air cage condition (poultry good):

1978	1979	1980
1. Bako Composite	1. Eto Tuxpeno	1. Alemaya Composite
2. Jima Bako	2. Mezella Amarilla	2. Al.7660
3. KCB	3. ETO Illinois B	3. Al. 7655
4. KCC	4. ETO Blanco	4. EAH-75
5. HSR 52	5. ECE-3C (Comp.B)	5. Ca 5 (M)
6. OP 512	6. Ba F_2 (comp.B)	
	7. 1-1a (comp.B)	
	8. Ba-D-late (comp.)	

There was no significant difference in damage between varieties. Number of attacked plants accounted from 32 to 52%. There were from 2 to 5 holes per one plant. Average length of cavities into stems was 8-13 cm. All the above mentioned varieties were not resistant to stalk borer (see SPL Annual Report for 1978, 1979, 1980: Dr.A.Kuzin; Dr.V.Matsuk, Dr.S.Chekmenev). In 1981 and 1982 screening of maize varieties resistant to stalk borer was conducted with artificial inoculation method also, but under field condition.

Only under natural background of infestation field assessment of varieties was conducted in 1978 (Table 1). Due to the high amount of rainfalls (Ambo region) during vegetating period (1983) the level of population density of stalk borer was very low 3% of damaged plants). On this reason there were no favourable conditions for artificial inoculation and sufficient data were not obtained (Table 2). It is necessary to note that weather condition (especially rainfalls) influenced greatly on the results of artificial inoculation of plants in the field. Stalk borer larvae of first instar are always susceptible to overwetting. Most of the larvae become dead when they were in the water drops which indicates the decrease of artificial inoculation effectiveness.

On the results of many years field trials we can make a conclusion that none of these varieties were sufficiently resistant to stalk borer (the same in the trial under open air cage condition).

The varieties which were relatively resistant under field condition in 1978 (HSR 52, ETO Illinois, ETO Blanco B)didn't confirm resistance in the trial under open air cage condition. The varieties which were relatively resistant in 1981 trial: TZPB x Ba. Comp. IV; Ba. comp. IV and some others were highly damaged during the second trial (1982).

In our opinion in future for the screening of maize varieties resistant to stalk borer it is necessary to use the breeding material directively. The use of wellknown varieties and varieties from other countries also will not be profitable. The stalk borer Busseola fusca is widely distributed in many African countries and appearance of new resistant variety is usually recorded in corresponding literature.

Table 1. Evaluation of ressitant of maize sample varieties against stalk borer - Busseola fusca (under field coniition)

Varieties	% of damaged plants			The average length of cavities /plant	
	1978	1981	1982	1981	1982
1	2	3	4	5	6
1. HSR 52	2.0				
2. ETO x Blanco B	4.3				
3. ETO x Jinois	5.8				
4. Amarilla Cristalino	7.6				
5. HGAA	7.8				
6. Blanco Cristalino	8.1				
7. ETO x Tixpeno	8.2				
8. Antiqua x Veracruz 181	8.6				
9. UCB x V 30	9.3				
10. Amarillo de Bajio	9.7				
11. UCA x V 301	10.4				
12. Blanco Subtropical	10.6				
13. A 512	10.9				
14. Mezela Amarilla	10.9				
15. Local check	11.2				
16. AED x Tixpeno	11.8				
17. Amarillo dentatos	11.9				
18. Braquitico	13.1				
19. Kitale Syn.	13.4				
20. Ag 32	15.0				
21. Amarillo Subtropical	15.2				
22. Mezela Tropical Blanco	15.9				
23. Jima Bako	16.0				
24. Tixpeno	16.4				
25. ETO Blanco FR	18.4				
26. Tixpeno Caribe	19.0				
27. Awasa 511	9.8	-	67.5	-	9.6
28. Ba composite	11.7	18.4	-	6.9	-
29. Al. composite	9.2	29.7	81.7	8.5	32.4
30. Alamora med. x Ba comp. IV		32.4	73.4	2.6	9.4

Table 1 continued

1	2	3	4	5	6
31. Ba.comp. IV		14.5	62.5	0.9	7.4
32. Local check-Katumani		22.9	60.4	5.6	11.7
33. TZSR		15.9	83.2	2.0	13.9
34. Sidamo x Ba.comp. IV		21.5	62.2	2.1	10.1
35. TZPB x Ba.comp. IV		16.9	76.9	1.7	9.05
36. TZSR x Ba.comp. IV		24.7	64.4	3.8	9.2
37. Alamora short x Ba.comp. IV		23.5	45.2	2.4	3.2
38. Ca 5 (M)-check 2		29.3	85.6	4.5	14.2
39. Al.7660-check 3		42.2	63.3	3.9	10.6
40. UCA		26.2	68.1	7.1	13.7
41. Ca 5 (M)		44.1	87.4	2.8	13.5
42. EAH-75		33.2	74.3	12.5	21.6
43. TZE x Ba.comp. IV		41.7		3.7	
44. Borer rest. 137		28.9		3.4	
45. F from 3233		29.7		2.8	
46. Alamora short		27.2		2.4	
47. TZE 4		23.8		4.7	
48. Sidamo		28.5		5.3	
49. TZB x Ba.comp. IV		27.9		4.3	
50. Borer rest 136 x Ba.comp. IV		29.3		2.6	
51. Local yellow x Ba.comp. IV		29.1		1.3	
52. Alamora fall x Ba.comp. IV		42.8		3.7	
53. Katumani-check 1		29.9		3.0	
54. Local yellow-check 4		36.5		1.8	
55. UCB		35.1		7.5	
56. Ca 6		36.9		4.8	
57. Al 7655		50.5		4.3	
58. Al 7660		43.3		7.6	
LSD 5%		17.7	19.3	6.2	13.8

Besides, it is advisable to conduct preliminary screening on resistance under natural background infestation in the regions with high population density of stalk borer (for example Awasa and others). Unfortunately, in Ambo region (SPL field) natural background infestation level by stalk borer ranged from 3 to 20% only.

Only after that it will be profitable to include varieties which showed preliminary resistance into the screening by such labour consuming method as artificial inoculation of plants.

Table 2. Evaluation of resistant sample varieties of maize against stalk borer (under field contition), Ambo, 1983

	Varieties	% of damaged plants	The average number of holes/plant	The total average length of cavities on plant
1.	Awasa 511	0	0	0
2.	Ca 5(M)	0	0	0
3.	Local check (Katumani)	0.87	0.02	0.25
4.	UCA	2.45	0.16	0.48
5.	Al.composite	0	0	0
6.	EAH-75	3.16	0.14	0.36
7.	KCB	1.82	0.23	0.51
8.	TZSR	0	0	0
9.	KCC	0	0	0
10.	Ba.comp. IV	1.65	0.04	0.23
11.	Al.7660	2.24	0.02	0.25
12.	Ca 5(M)-check	2.72	0.06	0.58
	LSD 5%	NS*	NS*	NS*

* - not significantly different

Conclusion and recommendations

1. Thus, during the period of 1978-1983 under open air cage condition and field condition with artificial inoculation of plants and on natural background of infestation 77 sample varieties of maize were evaluated to stalk borer resistance. None of them was sufficiently resistant to stalk borer *Busseola fusca*.

2. In future the trial on screening of maize varieties resistant to stalk borer will be carried out on new breeding materials in accordance with agreement achieved with breeders.

Preliminary notes on natural predatory enemies of the main maize and sorghum pests

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Mulugeta Negeri, SPL, Ambo

Introduction

In modern integrated system of plant protection certain attention is payed to natural enemies (predators and parasitoides) as one of the biological factors in pest control. In order to use this factor more rationally, complete information on entomophages is needed. Thus, the first step in entomophages study should be clarification of species composition(5).

Up to now in Ethiopia more attention is payed to the studying of parasitic entomofauna of sorghum, maize and other cereals pests, than to predatory entomophages. Parasitic entomofauna of stalk borers is described in the works of Mohyuddin A., Greuthead (6) and Assefa G.Amlak (3). In Ambo (SPL) ~~the studying~~ of parasites species composition has been started in 1977 (4:1). This work was conducted in other research stations of Ethiopia also. However, the data available on species composition of natural predatory enemies of sorghum and maize pests are still rather limited. Through the role of predators in controlling population density of some insect pests is greater than that of parasites (7). The objective of this investigation was to widen reliable information on species composition of natural predatory enemies of maize and sorghum pests in Ethiopia.

Materials and methods

In 1982/83 investigations were carried out in Ambo region (Alt. 2250). Maize and sorghum fields (3-5 hectares) untreated by insecticides were observed. Insects were collected directly from maize and sorghum plants as well as from soil nearby the plants and from wild uncultivated plants around this field. One of the methods used for collection is by shaking examined plant parts so that the possible insect pests and associated predators do fall in to the collection trap. The rectangular butterfly-net (40 x 50 cm) modified by SPL specialists was used for that purpose. It is made of close nylon textile and has detachable glass container. At the botoon of this butterfly-net a glass funnel partly palced into glass container is fastened. Contacting surfaces of glass container and funnel form acute angle inside the container that makes impossible for collected insects to leave the container.

For the collection of pests from soil the method of pittraps was used (2). Collected larvae and nymphes of insects were reared in laboratory conditions up to imago. Stalk borer larvae, aphids and spider mites were used as a food. Abundance of predatory insects on maize was estimated visually. Maize cobs and leaves from plants affected by aphids were observed monthly on 10-15 plants in 3-4 replications.

Insects were sent for identification to British Commonwealth Institute of Entomology. Taxonomic collections of IAR stations and Alemaya Agricultural College were also used for identification.

The sowing and harvesting of maize and sorghum was carried out at the beginning of May and at the end of December respectively.. The last rain in 1983 season was indicated in the first decade of October. Intensive increment of aphids population (Rhopalosiphum sp.) on maize coincided with the end of the rainy season. 40% of plants with 0.6-0.9 degree on infestation (i.e. up to 100-180 insects per plant) were affected by aphids. The infestation of maize by stalk borer Busseola fusca was 5-15%.

Results and discussion

At present time the 22 following species of predatory insects were identified:

I Order Coleoptera

Fam. Coccinellidae

1. Adalia intermedia
2. Adalia signifera (R)
3. Adalia 6-areata
4. Adonia variegata (Gre) Spp. tredecimsignata
5. Cheilomenes lunata F*
6. Cheilomenes literata*
7. Cheilomenes vicina (Cydonia vittata)
8. Henosepilachna reticulata
9. Hyperaspis senegalensis
10. Scymnus sp.*
11. Thea bisectonotata var. tricineata (Sic)

Fam. Carabidae

1. Calosoma rugosum Dag.
2. Chlaenius spp.
3. Carabus sp.

II Order Hemiptera

Fam. Anthocoridae

1. Orius sp.*

Fam. Reduvidae

1. Pirates aurigens (Dist)
2. Rhinocoris rapax (Stal) (Rh.Picturates Dist)
3. Rhinocoris segmentarius (Germ)

III Order Neuroptera

Fam. Chrysopidae

1. Chrysopa carnea (Steph)*
2. Chrysopa sp.

IV Order Diptera

Fam. Syrphydae

1. Sphaerophoria ruppolii
2. Syrophus adligatus Weid*
3. Syrphus sp.

* - abundant species (in comparison with others)

Two species of predatory mites from Order Acariformes were collected from wild plants (around 310 mites). One of them is presumably from Fam. Anistidae. In rare instances these mites were monitored on maize plants too.

Among identified groups of above mentioned entomophages some species of predators dominated quantitatively in comparison with others. Thus, in 1982-1983 Scymnus sp. population was found to be the largest among Fam. Coccinellidae and accounted for 41% of total number of collected insects. From other species of lady-bird three were found to be dominant, i.e. Ch. Lunata, Ch. Literata and Adonia variegata and accounted for 29% from total amount of collected lady-bird insects. Among the collected bugs Orius sp. accounted for 83% of total population. Among goldeneyes Chrysipa Carnea accounted for 87%. Syrphus adligatus was dominant among syrphid flies and accounted for 46%.

The results of predators density of population are presented in Table 1 and figure 2. As we can see, different species of entomophages started to invade maize plantations at the end of September and the beginning of October and reached maximum of density population before harvesting, i.e. the end of November. Prevalent predators were insects from

Fam. Coccinellidae and Anthocoridae. At this time more than 5 predatory insects were found on each maize plant attacked by aphids. Taking into account that around 40% of plants were affected by aphids, it is easy to calculate at the same time on the area of one hectare 80 thousand of useful predatory entomophages were actively working in favour of man. Inspite of favourable conditions for multiplication of aphids after rainy season their spreading was controlled by the activity of entomophages. Up to the end of maize harvesting population density of of aphids was not more than 1.0 degree. During observation of wild

Table 1. Abundence of predatory arthropods population on maize affected by aphids. (visual observation, Ambo, 1983)

Date of observation	Average number of predators (image and larvae stage) per 10 plants				
	Coccinellidae	Anthocoridae	Syrphidae	Neuroptera	Total
1. September	1.3±0.6	0.3±0.3	0.3±0.3	0.0±0.0	1.9
2. October	0.0±1.7	1.5±0.4	3.5±1.0	1.2±0.5	14.2
3. November	33.2±3.7	12.0±1.3	5.0±0.9	4.5±1.0	54.7
4. December	5.3±0.9	1.0±0.7	0.7±0.3	0.7±0.3	7.7
LSD 5%	1.98	0.71	1.1	1.17	

plants, grasses, bushes and trees the same tendency in seasonal abundance of predatory arthropods was indicated. The greatest amount of predatory arthropods from Fam. Anthocoridae, Coccinellidae and Order Acariformes was indicated on the trees Coroton macrostehus and Acacia spp. Thus, these plants could be considered as reservation place for these natural enemies.

Conclusion

The data collected at Ambo region shows that there is a great amount of natural predatory entomophages in Ethiopia, both in species composition and their number.

Taking the above into account, it is advisable to widen research investigations of predatory entomofauna, including species composition, their biology, seasonal abundance and their sensitiveness to pesticides. This will help to use more effectively this natural factor of biological control in plant protection in Ethiopia.

Acknowledgement

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References

1. Abdulhafiz Ahmed, D.Titov, 1983. Parasitoids and predators of the main maize and sorghum insect-pests. Fifteenth Annual Meeting of National Crop Improvement Conference (NCIC). Cereal section.

2. Archet T.L. and G.Musick, 1977. Evaluation of sampling methods for black cutworm larvae in field corn. J.econ. entomol. 70:447-449.

3. Assefa G.Amlak, 1983. Maize stalk borer, Busseola fusca, as a pest of maize and sorghum in Ethiopia. CMF newsletter, Vol. 2; No. 2; P. 5-9

4. Chekmenev S., 1981. Biological control study on maize stalk borer and other pests. Progress report for the period January 1980 to December 1980. Scientific Phytopathological Laboratory, Ambo, Ethiopia, P. 152-153.

5. Harry G.Coppel, James W.Mertinn, 1977. Biological insect pest suppression. New-York-Berlin, Springer P. 328-338.

6. Mohyuddin A.I., Greathead D.I., 1970. An annotated list of the parasites of Graminaceous stem borers in East Africa with a discussion of their potential on biological control. Entomofauna 15 (3), P.241-274.

7. Paul De Bach, 1964. Biological control of insect pest and weeds. New-York-London-Toronto, Reinhold, pp. 105-107.

8. Tessema Megenasa, Taddese Gebre Medhin, Tsedeke Abate, 1980. A Review of the State of Agriculture Pesticides use in Ethiopia. Ethiopian Journal of Agricultural Science, V.11, No. 1, pp.29-38.

Chemical control of Damping-off on tef

Dr. Evmenenko A., SPL, Ambo

Introduction

Fungi genus Drechslera and rust fungi have been reported to be associated with tef, which cause diseases at various stages of crop growth. Therefore, studies were undertaken to find out effective fungicides for the control of the diseases by seed treatment and foliar sprays. In previous years the trials of fungicides Benlate, Aphos and Ceresan were carried out in SPL by Dr. Gorshkov. The best result was achieved in Benlate applioation, then Aphos and Ceresan. From 1981 the trials on new fungicides - Campogran, Brassicol, Rizolex, Bronopol were carried out. These fungicides have shown high effect against soil and seed-borne infection. It is necessary to continue tests and screening of the most effective fungicides. It is important, in the first place, to replace the high toxicity Ceresan, and, secondly, it is necessary to apply the fungicide rotation in order to avoid the fungicides resistance.

Materials and methods

Green-house and field trials were conducted in 1981-1983 growing seasons. The trials were carried out in randomized complete block design with four replications and consisted of two treatments - inoculated and protected. Species of Drechslera, originally isolated from naturally infected tef plants, were used throughout the experiment. All strains were tested in greenhouse and were found to be pathogenic on tef. Methods for virulent estimation were described by Benken (1) and Miller (3) and these were modified to be used for tef (2). Seed dressing by campogran, Brassicol, Rizolex and Bronopol with the rate of 2.5 g/kg was conducted. Spraying by Calixin in field trials was used against leaf diseases, first spraying at the beginning of infection, further treatments - in 10 days intervals. Scoring of diseases development at tillering stage was conducted. Crop stand (0-9), Damping-off (0-9), leaf-spot (0-9) were determined. Disease data were recorded for all the plants in the inoculated and protected plots, summarized and averaged. The data were analysed statistically.

Results and discussion

The preliminary trial in laboratory condition have shown that Ceresan as compared with Campogran, Brassicol, Rizolex and Bronopol had considerable phytotoxicity of tef's seedlings (Table 1).

Table 1. Phytotoxicity of tested fungicides

Treatment	Root length*	Stem length*
Check	1.5 - 2.0	1.0 - 1.2
Ceresan	0	0.2 - 0.4
Campogran	1.5 - 2.2	0.8 - 1.0
Brassicol	1.5 - 2.4	0.7 - 0.9
Rizolex	1.4 - 2.0	0.8 - 1.2
Bronopol	1.5 - 2.0	0.7 - 1.1

* - average mean between 200 seedlings.
estimation was done 5th day after germination

The results of greenhouse and field trials are presented on Table 2. A comparison of different fungicides showed that all the treatments protected seedlings from seed and soil-borne infections. Minimum germination was recorded with untreated control (35% in greenhouse, 20% in field). Maximum germination was recorded with Campogran (99-85%) and Rizolex (98-84%), followed by Bronopol (98-83%), Brassicol (95-81%), Ceresan (85-74%). All tests indicated that fungicides reduced the number of early infections, delayed disease progress and decreases final diseases severity. Calixin was found effective against foliar diseases as foliar sprays. Four times treatment by Calixin decreased Drechslera leaf-spot affection from 25-30% to 1-2%, and rust from 75S-80S to 5S-TS.

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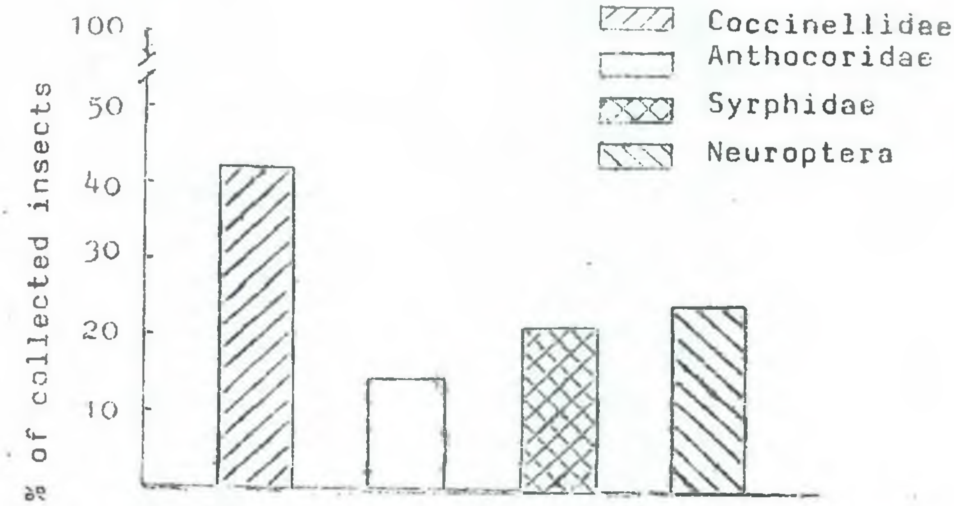

Fig.1 Quantitative ratio of groups of predatory insects collected from maize plants at Ambo, 1983.

Conclusion and Recommendations

Tested fungicides: Campogran, Brassicol, Rizolex, Bronopol can be recommended for protection of tef crop against seed and soil-borne infections as seed dressers, and Calixin against foliar diseases as foliar sprays. We must have to replace the high toxicity Ceresan, and secondly, it is necessary to apply the fungicide rotation in order to avoid the fungicides resistance.

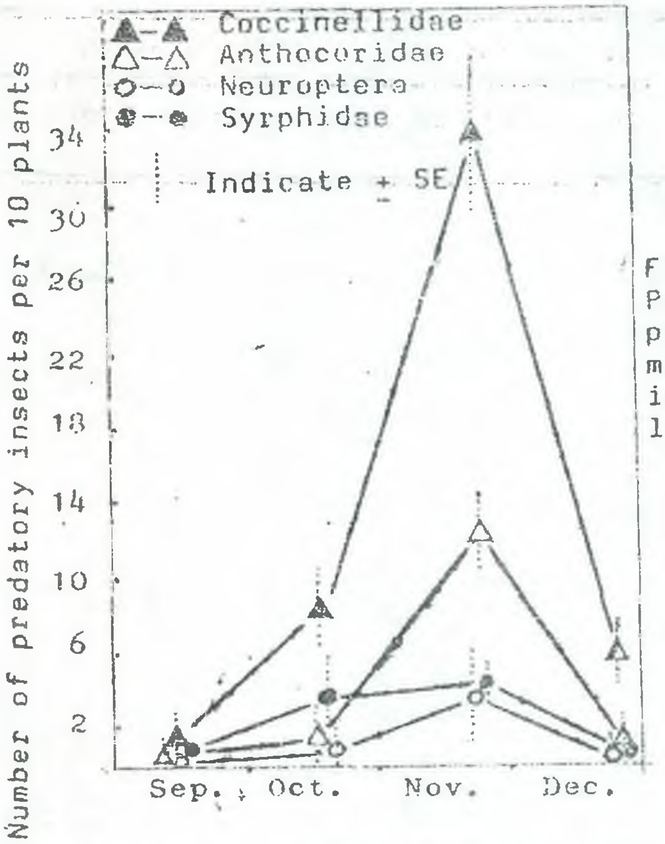

Fig.2 .
Population dynamics of predatory natural insects maize pest on the plants infected by aphids (Rhopalosiphum sp.)

Table 2. Fungicides effect in damping-off in tef

	Green-house trials		Field trials	
	Germination %	Damping-off %	Germination %	Damping-off %
Infected soil, nontreated seeds	35	64	20	45
Infected soil, Ceresan seed treated	85	8	74	12
Infected soil, Campogran seed treated	99	0	85	4
Infected soil, Brassicol seed treated	95	0	81	4
Infected soil Rizolex seed treated	98	1	84	5
Infected soil, Bronopol seed treated	98	2	83	5
LSD (05)	2.84	1.08	2.93	1.06
LSD (01)	4.53	1.21	4.75	1.32

Variety - DZ-01-1377

Design - RCB 4

Green-house trial

100 seeds in each replication

estimation was done 10^{th} day after germination

Field trial

Sowing date : August 1, 1983

Estimated : September 28, 1983

Plot size : 2 x 3 = $6m^2$

References

1. Benken A.A. 1980. Estimation of plant resistance to soil plant pathogen. Mycology and Phytopathology. 14.6:531-38

2. Evmenenko A.F. 1982. *Damping-off virulent of tef:* artificial inoculation methods for virulent estimation of Damping-off pathogens. EPC News letter, 1982, 17:15-16.

3. Miller D.K. 1980. Predisposition of Bean Roots to attack by the pea pathogens, Fusarium solani f, sp. pisi. Phytopathology 70:1221-26.

Identification of pathogens causing Damping-off on tef using serological method

Dr. Evmenenko A., SPL, Ambo

Introduction

Main pathogens of tef diseases are the species of Drechslera. Many criteria have been used in identifying plant pathogens, such as their chemical, physiological, parasite and morphological characteristics. However, it is very difficult to identify species of genus Drechslera using morphological differences and host range. Using serological method we can exactly identify some species. The objective of this study was to determine the inner antigen structure of strains and to find out serological relationship between species of genus Drechslera.

Materials and methods

Fungal strains

Sixteen strains of Drechslera from various habitats and location in Ethiopia were tested in the greenhouse and were found to be pathogenic on tef plants. The strains were maintained between study on slants of tef extract Agar (TEA).

Antesera production: Four strains (20, 24, 43) were used to immunize rabbits to produce antisera. The strains were grown in petri plats on TEA medium for 15 days at 25c. Conidial masses were suspended in saline (5.10^6 per ml of 1.85% NaCl) and the resulting suspension was adjusted to PH 6.5 with 1N NaOH before autoclaving at 120C for 20 min. The autoclaved suspension was centrifuged for 20 min at 2000 rpm. Eight rabbits were immunized (two for each tested strain), one immunization schedule was used. The dose of antigen was increased by 0.5 ml for each next immunization. Test bleeding was made on alternate days starting 10 days after the final injection. The blood was refrigerated overnight and fractionated by centrifugation at rpm for 10 min. The antisera were collected, recentrifuged for 5 min to eliminate the blood cells, and stored at 8C until used.

Serology technique: Microagglutination (MA), and Ouchterlony double diffusion (ODD) methods were used. MA rests were conducted by mixing equal amounts(one drop to one drop) of serial dilutions (rating from 1:50 to 1:12800) of each antiserum and fungal suspension. Prepared slides were incubated for 20-30 min at 25C, and the drops were observed with a binocular microscope for an agglutination reaction. The greatest dilution at which agglutination occured was considered to be the titer of the antiserum for the strain involved (Table 2). Gellpatterns (ODD tests) consisted of a center well and peripheral wells (5mm in diameter) 5mm from the center well. Antisera were placed in the center well and antigens were placed in the peripheral wells. Plated were kept at 20C and examined daily of 10 days. In ODD studies heated fractions (were obtained by autoclaving at 120C for 20 min) were used to react with the antiserum.

Results and discussion

ODD tests demonstrated antigenic variation among the 16 strains of four species genus Drechslera (Table 3). All strains gave a different reaction and could not be reasonably placed in either seroval based on the ODD tests with homologous and heterologous antiserum. Each of the tested four species Drechslera reacted not only to its own specific antiserum. ODD tests showed that Drech. miyakei is serologically related to the following species; Drech. poae, Drech. setaria, Drech. frumentacei. Antiserum for Drech. poae and Drech. setaria also reacted specifilally with antigens of Drech. miyakei, Drech. frumentacei.

The results indicate that Drech. Miyakei antigens are probably similar to the antigens of other Drechslera species.

Conclusion

The results of ODD tests indicted that this method could not be used to serologicallyv separate species genus Drechslera.

Table 1. Origin of strains of Drechslera used in tests to determine serological variation

Strain number	Species Drechslera	Isolated from	Location
20 x	miyakei	seedling lodging	Ambo, SPL
24 x	poae	leaf-spot	Ambo, SPL
30	poae	stem rot	Nekemte
31	miyakei	leaf-spot	state farm Didesa
32	setaria	seedling lodging	28 km from Nekemte to Ambo
33	poae	leaf-spot	40 km from Nekemte to Ambo
34	frumentacei	stem rot	state farm - Wama
35	miyakei	leaf rot	state farm - Wama
36	poae	root rot	107 km from Nekemte to Ambo
37	frumentacei	seedling lodging	131 km from Nekemte to Ambo
38	poae	seedling lodging	156 km from Nekemte to Ambo
39	setaria	seedling lodging	184 km from Nekemte to Ambo
40	poae	leaf spot	Nazret Research Station
41	setaria	leaf spot	Debre Zeit, Research Station
42	poae	root rot	state farm - Djirma
43 x	setaria	leaf spot	Holetta Research Station

x - These three tested strains were used to induce antibody formation in rabbits

Table 2. Microagglutination titers[x] of rabbit antisera prepared against autoclaved fungal cells

Antigen/ Antisera		range of delutions								
		50	100	200	400	800	1600	3200	6400	12800
20/20AS	I	+	+	+	+	+	+	+	±	−
	II	+	+	+	+	+	+	±	−	−
24/24AS	I	+	+	+	+	+	±	−	−	−
	II	+	+	+	+	+	+	±	−	−
43/43AS	I	+	+	+	+	+	+	±	−	−
	II	+	+	+	+	+	+	±	−	−

x - Titer of last observable agglutination of fungal cells

Table 3. Ouchterlony double diffusion reaction (ODD) of antigens of strains tested against antisera

Species Drechslera	Antigen	Antisera Dr. miyakei 20 AS	Dr. poae 24AS	Dr. setaria 43AS
miyakei	20	+	+	-
miyakei	31	+	-	-
miyakei	35	+	+	+
poae	24	-	+	-
poae	33	+	+	+
poae	36	-	+	+
poae	38	+	+	+
poae	40	+	+	+
poae	42	+	+	+
poae	30	+	+	+
setaria	32	+	+	+
setaria	39	-	+	+
setaria	41	+	+	+
setaria	43	-	-	+

Crop loss assessment study due to Damping-off on tef

Dr. Evmenenko A.F., SPL, Ambo

Introduction

The fungi of genus Drechslera are the principal pathogens involved in common seed decay, preemergence and postemergence Damping-off of tef(1). During a survey trip to some of tef growing regions in Ethiopia it was observed that Damping-off was found to be very severe and one of the most important tef diseases. Up to now there was no exact information about the degree of tef's damping-off harmfulness. Therefore, investigations were carried out to assess the losses in yield of tef due to varying levels of disease severity.

Materials and methods

Field trials were conducted in 1981-1983 growing seasons. The trials were carried out in a randomized complete block design with four replications and consisted of two treatments - inoculated and protected plots. In the former, artificial inoculation with special propagated inoculum was made (2). The protected plots were kept Damping-off - free by presowing soil treatment and seed dressing applications of Brassicol and Campogran respectively. Species of Drechslera, originally isolated from naturally infected tef plants, were used throughout the experiment. All strains were tested in greenhouse and were found to be pathogenic on tef plants. In addition, special experiment in field condition was conducted. The removal of plants from 10 to 80 percent on disease-free plots before tillering stage was made. The yield differences betweer plots of each entry were worked out for calculating the yield loss. Yield data were recorded for all the plants in the inoculated and protected plots, summarized and averaged. Grain yields were computed on per hectare basis at 12.5 percent moisture level. Also detailed yield component analysis could give on insight into the problem by indicating the component that greatly affects and therby influences yield. The data were analysed statistically. For quantifying the amount of indection in each plot two parameters were used, i.e. the percentage of plants infected (PPI) and percentage disease index (PDI). Infected plants were graded by adopting 0-9 scale. PDI was worked out by the formula:

$$PDI = \frac{\text{of raiting of the plants infected}}{\text{number of plants observed x 9}} \times 100$$

$$\text{Coefficient of disease index (CODEX)} = \frac{\text{PDI x PPI}}{100}$$

The yield differences between protected and inoculated plots of each entry were worked out for calculating the loss percentage on "potential" yield. This difference was added to the yield of the protected plots and the percentage loss was computed by the formula:

$$\%\ \text{loss} = \frac{\text{Yield difference}}{\text{yield protected plot + yield difference}} \times 100$$

Results and discussion

Application of inoculum in various treatment (from 10g to 200g per plot) created disease development of different severities. Lowest CODEX (0.12%) was observed in protected plots. Treated plots registred from 1.08 to 4.7% CODEX (Table 1). Highest CODEX (5.5%) was observed in treated plots by 100g inoculum per plot. On inoculated plots maximum (44.2Q/ha) yield was recorded when maximum (5.5% CODEX) of plants were affected in seedling stage whereas a minimum yield (33.4Q/ha) was found when minimum (1.08% CODEX) of plants were affected. These corelated with data which were obtained in experiment with removed plants (Table 2). Inverse relationship between number of plant and tillering intensity as well as individual plant productivity was observed. These parameters on plots with 80% of removed plants were higher than on check plots. due to these, on plots with high level of removing plants there was no significant decrease of yield loss. Removal of 30% didn't cause loss. Removal of 40% leads to loss of 1.1%. In both cases we can explain this phenomenon by compensation of yield due to increased tillering capacity and productivity of remaining healthy plants. The data shows that the Damping-off reduces the yield only when disease severity is more than 40%. During a survey trips to some of tef growing regions in Ethiopia in previous years as well as this year it was observed that severity of Damping-off was no more 20-25%.

Conclusions and recommendations

Based on the above statements it is suggested that immediate steps for increase of tef yield should be taken to improve farming practices and also to evolve cultivars resistant to water lodging on early stage and lodging before maturing as the main agents of yield loss.

Table 1. Yield losses at different levels of applied inoculum, 1981, 1982, 1983

Treatment by inoculum g/plot	PPI				PDI				CODEX				1000 gr/wt				Yield			
	81	82	83	av.	81	82	83	av.	81	82	83	av.	81	82	83	av.	81	82	83	av.
Protected	7	5	6	6	2	2	2	2	0.12	0.10	0.14	0.12	0.274	0.285	0.299	0.286	35.1	35.8	35.9	35.6
10 g/plot	18	17	13	16	7	7	7	7	1.1	1.06	1.08	1.08	0.271	0.273	0.272	0.272	33.0	33.6	33.6	33.4
30 g/plot	17	21	16	18	7	7	8	7	1.3	1.3	1.6	1.4	0.298	0.304	0.293	0.301	40.1	39.8	44.0	41.3
70 g/plot	24	26	25	25	11	12	11	11	2.8	2.7	2.9	2.8	0.283	0.281	0.294	0.286	39.1	39.3	40.7	39.7
100 g/plot	36	32	34	34	16	16	16	16	5.3	5.6	5.6	5.5	0.291	0.299	0.304	0.298	44.1	44.3	44.2	44.2
150 g/plot	28	31	31	30	10	10	10	10	2.9	2.7	3.1	2.9	0.290	0.296	0.290	0.292	36.6	36.1	36.5	36.4
200 g/plot	32	34	30	32	14	15	15	15	4.5	4.6	5.0	4.7	0.301	0.308	0.309	0.306	41.0	41.9	42.5	41.8
LSD (05)											0.9					0.09				3.12
LSD (01)											1.3					0.012				4.21

Table 2. Yield losses at different levels of removed plants

Plants per plots, %	Tillering intensity				Ind. plant productivity				1000 grain Wt.				Yield, Q/ha				% loss
	81	82	83	av	81	82	83	av	81	82	83	av	81	82	83	av	av
100	3	3	3	3	.18	.16	.26	.2	271	281	282	278	44.0	44.6	44.9	44.5	-
90	3	4	5	4	.24	.22	.14	.2	280	285	284	283	44.3	44.1	43.6	44.0	1.1
80	4	4	4	4	.31	.28	.31	.3	276	279	282	279	42.1	42.9	43.4	42.8	3.8
70	3	4	5	4	.35	.39	.46	.4	291	296	295	294	44.4	44.3	44.8	44.5	0.0
60	6	5	4	5	.51	.46	.53	.5	295	293	294	294	44.1	43.3	43.6	44.0	1.1
50	6	6	6	6	.56	.61	.63	.6	290	298	300	296	39.1	39.6	40.1	39.6	9.9
40	7	6	5	6	.64	.59	.57	.6	290	295	291	292	30.8	30.4	30.9	30.7	23.6
30	6	5	7	6	.68	.71	.71	.7	280	287	288	285	26.4	26.1	26.1	26.2	29.1
20	7	7	7	7	.79	.83	.78	.8	280	284	279	281	27.6	27.9	27.9	27.8	27.2
LSD (05)												0.01				3.16	1.1
LSD (01)												0.018				4.28	1.9

References

1. Awgichew Kidane and Mathur S.B. 1978. Seed transmission of _Drechslera miyakei_ on _Eragrostis tef_ from Ethiopia. Plant disease reporter, 1978.

2. Evmenenko A. 1982. Damping-off of tef: artificial inoculation methods for virulent estimation of Damping-off pathogens. EPC Newsletter, 1982, 17:15-16.

Study on the development of Damping-off in connection with the tef cultivation methods

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Introduction

In previous years the number of Damping-off of development ecological factors were determined in different regions. Phytopathological analysis displayed severe infection of tef seeds and heading by Helminthosporium sp., Fusarium sp., Alternaria sp., Cladosporium sp. The fungi of genus Drechslera are highly virulent in attacking tef. Based on the analysis of the literature sources available in the laboratory (1), the virulent strains, isolated from damaged plants were identified as species genus Drechslera (Drech. miyakei, Drech. poae, Drech.setaria, Drech. frumentacei). During these years were investigated symptoms, microflora of tef panicles, seeds, and headings. The optimum system of crop cultivation is the most effective method for plant protection against main diseases. Therefore, it is necessary to carry out the investigation to the indication of diseases character, depending on the tef's technology.

Materials and methods

Field trials were conducted in 1982-1983 growing seasons. During observation at Debre-Zeit Research Station and Ambo SPL crop stand (0-9), Damping-off (0-9), leaf-spot diseases (0-9) development were recorded. Investigation were conducted on the fields, where works on the improvement of various agrotechnical tef's cultivation methods, according to the research programme of IAR. At the same time the samples for phytopathological analysis were collected.

Results and discussion

The study of Damping-off development in connection with the tef cultivation methods was continued. All data are presented in tables 1, 2. In this year as well as in previous year tef was more damaged by Damping-off on plots with early sowing date. Tef plants was more damaged by Damping-off on plots with high level of seed rate. In additior, the study of rust development in connection with tef cultivation methods was carried out. In this year as well as in previous year tef was less affected by rust on plots with early sowing date. At the same time there were no differences between rust development and seed rate.

Conclusion and recommendation

Based on the information about crop loss assessment it was determieed that correlation between Damping-off severity and yield loss was not observed. Based on the above information it is suggested that immediate steps for increase of tef yield should be taken to improve farming practices and also to evolve cultivars resistant to water lodging at early staae and lodging before maturing as the main agents of yield loss on tef.

Table 1. Correlation between sowing date and tef's diseases development

Sowin date	Crop stand (0-9)	Damping-off (0-9)	Helm. leaf-spot (0-9)	Sept. leaf-spot (0-9)	Rust %
			Debre-Zeit		
July 2	9	2	2	1	TS
July 12	9	2	3	0	5S
July 22	8	3	2	1	25S
August 2	8	0	1	0	10S
August 12	9	0	0	0	30S
			Ambo		
June 10	7	2	3	2	TS
June 20	8	1	3	1	5S
June 30	6	2	3	2	10S
July 10	7	2	2	1	20S
July 20	8	1	1	1	25S
July 30	8	1	1	0	30S
August 20	8	1	1	0	40S

Table 2. Correlation between seed rate and tef's diseases development

Seed rate Kg/ha	Crop stand (09)	Damping-off (09)	Helm. leaf-spot (09)	Sept. leaf-spot (09)	Rust %
20	8	1	2	0	10S
25	8	1	2	1	15S
30	8	1	1	0	10S
35	8	2	2	0	20S
40	9	3	3	0	10S
45	9	3	2	1	10S
50	9	3	3	0	15S

References

1. Awgichew Kidane and Mathur S.B. 1978. Seed transmission of *Drechslera miyakei* on *Eragrostis tef* from Ethiopia. Plant diseases reporter, 1978, 62:70-71.

Distribution of physiological races of wheat stripe rust in Ethiopia during 197[illegible]-1983

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Introduction

Stripe rust (Puccinia striiformis West f.sp.tritici Eriks et.Henn) appears every year and causes heavy epidemic on wheat cultivated in Ethiopia. Stripe rust is distributed on highland regions at an altitude of 2300m in Administrative Regions of Arsi, Bale, Shewa, Gojam. Heavy development of stripe rust was observed at State Farms and local wheat varieties cultivated by farmers. It was well known that cultivation of resistant varieties is one of the most important method of controlling rust diseases. Breeding of new resistant varieties needs certain amount of effort from both breeders and plant pathologists. For this goal it is necessary to know the race composition of the pathogen in the population and watch closely the appearance of new virulent race of rust diseases. However the races composition analysis of stripe rust in Ethiopia was not conducted until 1974. It was only known that in 1968 E. Fuchs identified race 6E0 from rust supplies samples collected from Holetta Research Station. Regular race composition analysis of stripe rust was started in 1974 at Scientific Phytopathological Laboratory (SPL), Ambo. In this article we present the results of stripe rust races analysis during 1974-1983.

Materials and methods

Stripe rust samples collected from State Farms fields, Research Stations, farmers fields, Rust Spors Trap Nursery and sent by cooperators were established for race analysis in greenhouse. The greenhouse conditions were strictly regulated. The day temperature - 23°C, the night temperature - 13°C and an illumination of 16 hours, these parameters were strictly established in greenhouse for the trial. After inoculation the plants were kept in a saturated humid chamber for 18-20 hrs.

Scoring of the types of reactions were carried out on 17-18 days after inoculation by internationally accepted scale. International standard identification of stripe rust races. For determination of genotype virulence supplemental monogenic varieties were used. Race designation was done accordingly, Johnson R. et. al., 1972.

Results and discussion

Epidemics of stripe rust were observed in 1976, 1977, 1980, 1981, 1982, 1983 crop seasons in the Administrative Regions of Arsi, Bale in some areas in Administrative Regions at Shewa and Gonder. In 1980 Mamba variety was highly attacked by stripe rust at Diksis State Farm. In 1981 symptom of stripe rust was observed on Enkoy variety. Particularly heavy epidemics out break of stripe rust was observed in 1981-83 at State Farm. In 1981 symptom of stripe rust was observed on Enkoy variety. Particularly heavy epidemics out break of stripe rust was observed in 1981-83 at State Farms in the Administrative Regions of Arsi and Bale.

During 1974-1983 in Ethiopia 72 races of stripe rust were identified:

OEO, OE1, OE2, OE4, OE16, 1EO, 2EO, 2E2, 2E4, 2E16, 2E45, 2E128, 3EO, 3E8, 4EO, 4E16, 4E18, 5E2, 6EO, 6E1, 6E4, 6E6, 6E18, 7E1, 8EO, 8E8, 16E160, 17EO, 32EO, 32E2, 32E61, 33E29, 34EO, 34E16, 34E33, 35E37, 36E16, 38E18, 40E4, 40E9, 40E61, 41E49, 41E57, 41E120, 41E165, 42E15, 42E61, 43E59, 47E163, 48EO, 64EO, 64E189, 65E63, 68E16, 70EO, 70E80, 86E2, 89E96, 91E251, 96E41, 99E253, 105E253, 109E253, 111E255, 113E253, 114E255, 121E249, 121E251, 121E253, 121E255, 126E121, 127E255.

The most widely distributed races were OEO, 2EO, 4EO and 6EO.

In 1974 crop season races 1EO, 2EO were identified.

In 1974-76 rust samples collected from Ambo, Holetta, Sheno, Sodo as the result of analysis races 2EO, 6EO were identified. Race 6EO was found to be prevalent.

In 1977 rust samples were collected from Sheno and additionally race 6E6 was identified. In 1978-79 races analysis was not carried out.

Starting from 1980 the race analysis have been widened. From 1980 to 1983 more than 200 isolates were established in greenhouse. In 1980 crop season 41 races of stripe rust were identified. Majority of the races identified were from Holetta and Diksis State Farm. The same year a highly virulent races and biotypes which attack the established variety Mamba was identified.

Race OEO which does not attack the differential sets was identified. However two biotypes of race OEO which are virulent on Enkoy were identified. After 1980 race OEO was constantly identified from samples collected every year. In relation to this information one has to be careful, the mistake in methods of identification of races might bring for a constantly identification of race OEO.

In 1982 crop season 15 race were identified. In 1983 as the result of races analysis 18 races were identified. Races OEO, 2EO, 4EO, 6EO were prevalent.

The average virulence ability of the population was not very high, 0.92-3.2. It means that averagly one isolate of the pathogen possesses three virulent genes. The genotype of virulence is represented by the formula:

Y_r 3,4,5,9,10/1,2,6,7,8,SU 92

However these reces are highly virulent to local and established varieties cultivated by farmers. It can be noted that stripe rust races under tropical conditions of Ethiopia were not virulent in comparison with Europian conditions.

Conclusion

In Ethiopia in recent years constant epidemics of stripe rust was observed in major wheat growing regions. Majority of the cultivated varieties are moderately susceptible or susceptible to stripe rust.

During 1971-1983 in Ethiopia 72 races were identified. Races 2EO, OEO, 4EO, 6EO were prevalent. The average virulence ability of the population was not very high.

In 1980-81 crop season biotypes of race OEO and 121E255 which overcome the resistance established varieties Mamba, Enkoy, Romany B.C. were identified in Arsi Administrative Region.

Table 1. Distribution of physiological races of wheat stripe rust in Ethiopia during 1974-1983

Location	Before 1974	1974	1975	1976	1977	1980	1981	1982	1983
Ambo, SPL	-	-	-	2E0, 6E0	2E0, 6E0	0E0	-	0E0,0E2,0E16, 2E0,2E2,2E4, 2E16,4E0, 6E0,70E0, 86E2	2E0,3E0,4E0, 5E2,6E0,6E4 32E0,40E4, 32E2,4E16
Holetta Research Station	6E0	-	2E0, 6E0	2E0,6E0	-	2E45,32E61,40E61,42E15,42E61, 41E49,43E59,65E63,64E189, 96E41,99E253,113E253, 113E253,121E249,121E253, 121E255	0E0,0E16, 2E0,4E0, 36E16	0E0,4E0,4E16, 64E0,70E0	1E0,2E0,6E0, 68E16,70E16, 70E80
Sheno	-	1E0, 2E0	2E0 6E0	-	2E0,6E0, 6E6	8E8	-	0E0	6E0,7E1
Kulumsa Ex. Station	-	-	-	-	-	0E0,0E4,16E160,34E33,35E37, 41E165,48E0,89E96	0E0	0E0,2E0, 64E0	2E16,38E18
Diksis State Farm	-	-	-	-	-	0E1,0E16,32E0,33E29,34E0, 40E9,41E57,41E120,47E163, 91E251,105E253,109E253, 111E255,114E255,121E251, 121E255,126E121,127E255	0E0 0E16,2E0,4E0, 4E18,6E0, 36E16	0E0,0E2,2E0, 2E2,6E1, 2E128	2E0,7E1

Table 1 continued

Location	Before 1974	1974	1975	1976	1977	1980	1981	1982	1983
Herere State Farm	-	-	-	-	-	-	-	0E0, 2E0, 4E0, 6E0	6E0
Assasa	-	-	-	-	-	-	-	0E0	-
Bekoji	-	-	-	-	-	-	-	-	3E0, 6E0, 6E16
Meraro	-	-	-	-	-	-	-	-	2E16, 3E8, 8E0
Debre Birhan	-	-	-	-	-	-	-	-	17E0
Sodo	-	-	6E0	2E0, 6E0	-	-	-	-	-

Distribution of physiological races of wheat stem rust in Ethiopia during 1982-1983

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Introduction

Wheat is one of the main cereal crops in Ethiopia. The total wheat hectarage in Ethiopia is estimated to be 0.55 million. Though, published information is scanty, about 60% of the wheat area is occupied by tetraploid wheats (wheat research programme, 1982).

At present wheat yields are very low in Ethiopia: from 7 to 8 quintals per ha as compared with about 15Q/ha for the world average. Diseases are the major contributing factors to the low yield, in addition to low yielding varieties, poor cultural practices and lack of fertilizers (Dagnachew, 1967).

Among the important diseases that limit the production of wheat in Ethiopia is stem (or black) rust. This disease generally causes heavy damage at altitudes below 2300m (Dagnachew, 1967; SPL Progress Reports, 1975; 1978). Currently it can effectively be controlled by growing resistant varieties. However, the development of improved high yielding, rust resistant varieties requires knowledges of the race composition and distribution in a particular zone and the country as a whole. (Singh et al, 1978). In general, phisiological races are investigated for the following reasons: to study evolutionary trends in the parasites, to search for sources of resistance (parent selection) which will facilitate breeding resistant varieties and to search for resistant genes or combinations of genes for which the corresponding gene(s) for virulence do not exist (Roelfs et al., 1983 ; Plant Sciences Annual Research Report, 1973).

In Ethiopia physiological races of wheat stem rust have been investigated in the Scientific Phytopathological Laboratory(SPL) at Ambo, Ethiopia, since 1974. Since then race survey results have been published annually in SPL Progress Report.

This paper presents partial results of race survey of wheat stem rust in the main wheat growing regions (Shewa, Arsi and Bale) of Ethiopia during 1982-1983 crop season.

Materials and methods

Rust samples were collected from farmer's fields, state farms, nurseries including Rust Spore Trap Nursery (RSTN), research and experimental stations in Shewa, Arsi and Bale Administrative Regions. A few samples were also sent by cooperators from different agro-climatic zones in the above mentioned regions. The collection consisted of varying number of stems or leaves bearing uredia from an individual plant, cultivar or mixtures of cultivars.

Greenhouse cultures were established from the uredial collections. Susceptible wheat varieties Little Club, Michigan Amber, Stephaya 135 and Capelle Desprez were used for the maintenance of the uredospres and preparation of monosporic lines (or isolates). Seven-day-old seedlings of these varieties were inoculated with the uredial samples and incubated in a dew chamber at about 15-20°c and 100% relative humidity for 16-18 hours. The dew period was approximately 14 hours. After incubation the plants were placed on greenhouse benches under controlled environment. After 12 to 14 days up to 5 leaves bearing or pruned to bear a single uredium were saved from each sample and isolated using an ordinary lamp glass. Uredospores were collected separately from the uredia every two days until each uredium provided enough spores to inoculate differential host series. If enough spores were not obtained isolates were multiplied on susceptible varieties. Each isolate was analysed on sets of standard international differentials (Stakman et. al., 1962) and the cultivar lee to identify races. Races were described by the key of Roelfs(1977). In addition, wheat lines with the single gene for Sr6, Sr7b, Sr8, Sr9b, Sr9d, Sr9e, Sr10, Sr11, Sr13, Sr15, Sr16, Sr17, Sr21, SrTt1 were evaluated for their response to each rust isolate. The "universally" resistant series-lines with the host genes Sr22, Sr23, Sr24, Sr25, Sr26, Sr27, Sr29, Sr30, SrTt2 and SrGt were also inoculated with each isolate (Roelfs et. al., 1983). For designating the virulence pattern of a culture (isolate) on the selected Sr. genes, Green's "formula method" was used (Green, 1965).

Results and discussion

A total of 70 isolates obtained from wheat stem rust collection have been analysed during 1982-1983 crop season up to now. Several of the remaining isolates will be analysed in the nearest future. The results of the present analysis are presented in Table I.

As a result of the analysis of the 70 isolates the following 15 races were identified: 9, 11, 15, 21, 34, 40, 53, 83, 86, 89, 117, 122, 131, 143 and 179. Races 131 and 143 are new records for Ethiopia. In the population races 15, 53, 86, 89 and 117 were most prevalent. In the previous years 15, 40, 53 and 117 were prevalent in the population. This indicates no sudden shift in the race composition. From the widely cultivated local wheat species Triticum aethiopicum race 117 only was identified indicating adaptation of this race to the local varieties or cultivars.

From the samples collected at Ambo 10 races were identified with the races 15, 86 and 143 being the most prevalent. In addition it was supposed that there could be race 15B in the population because the cultivar Lee was attacked by a few isolates of race 15.

The analysis of the genotypical structure of this pathogen on monogenic lines and "universally" resistant series revealed high concentration of virulence genes P_5, P_6, P_{10}, P_{17}, P_{25}, P_{Tt-1} and P_{Tt-2}.

Resistant genes Sr7, Sr8, Sr9b, Sr11, Sr22, Sr26, Sr29, Sr30 and SrGt confer resistance to most isolates but no single gene confers resistance to all the isolates.

Table 1. Distribution and frequency of physiological races of wheat stem rust in Ethiopia during 1982-83

Location	Races	% of frequency
Ambo, SPL	15, 86, 143, 34, 11, 9, 21, 40, 83, 122	7.1, 7.1, 7.1, 2.9, 2.9, 1.4, 1.4, 1.4, 1.4, 1.4
Debre Zeit	53, 117, 86, 89, 9, 15	17.1, 5.7, 2.9, 2.9, 1.4, 1.4
Holetta	89, 83	4.3, 1.4
Bako	117, 86, 122	8.6, 1.4, 1.4
Kulumsa	86, 131, 179	1.4, 1.4, 1.4
Herero	86, 89	4.3, 1.4
Arsi Negele	15, 179	1.4, 4.3
Sheno	89	1.4
Addis Alem	86	2.9
Races presence in the total population	9, 11, 15, 21, 34, 40 53, 83, 86, 89, 117, 122, 131, 143, 179	2.9, 2.9, 10.0, 1.4, 2.9, 1.4, 17.1, 1.4, 20.0, 10.0, 15.7, 1.4, 1.4, 7.1, 4.3

Conclusions

Race analysis of collections of wheat stem rust (Puccinia graminis Pers. f. Sp. tritici Eriks and Henn.) were made during 1982-1983 crop season. During the period 15 races of stem rust 9, 11, 15, 21, 34, 53, 83, 86, 89, 117, 122, 131, 143 and 179 were identified up to now and the study is in the progress to search for more races. Races 131 and 143 are new records for Ethiopia. Races 15, 40, 53, 86, 89 and 117 were more prevalent. The rest of the races were of frequent occurence.

Resistant genes Sr7, Sr8, Sr9b, Sr11, Sr13, Sr21, Sr22, Sr26, Sr30 and SrGt chofer resistance to most of isolates but no single gene confers resistance to all of the isolates. Analysis of the genetic structure of the pathogen population indicated the presence of high concentration of virulent genes P_5, P_6, P_{10}, P_{17}, P_{25}, P_{Tt-1} and P_{Tt-2}.

References

1. Dagnachew Y., 1967, Plant Diseases of Economic Importance in Ethiopia, HSIU Univ., College of Agric., Expt. Station Bull., 50:30.

2. Ethiopian Bread Wheat Research Programme, 1982.

3. Green J.G., 1965, Stem Rust of Wheat, Barley and Rye in Canada in 1964, Can. Plant Dis. Surv. 45:23-29.

4. Plant Science Annual Research Report, 1973, HSIU, College of Agric., Dept. of Plant Sciences, 3:135-142.

5. Rolfs A.P. and McVey G.V., 1979, Low infection types produced by Puccinia graminis f. sp. tritici and wheat lines with designating genes for resistance, phytopathology, 69:722-730.

6. Rolfs, A.F. 1977, Mean infection types produced by physiological races of Puccinia graminis f. sp. tritici on the standard differential varieties of Triticum sp. as of April 21, 1977 4 unnumbered pages.

7. Rolfs A.F., Long D.L., Casper D.H., 1983, Races of Puccinia graminisf. sp. tritici in the United States and Mexico in 1981, Plant Diseases, 67:82-84.

8. Singh, S., Goel L.B., Nayar,S. R., Sharma S,K. and Chattorjec S.C., 1979, Prevalence and distribution of physiological races of wheat rusts in India during 1976-1978 crop seasons, Indian Phytopath., 32:417-420.

9. Stakman E.C., Stewart D.M., Loegering W.Q., 1962, Identification of physiological races of Puccinia graminis var.tritici, U.S. Dept. of Agric. Agric. Res. Serv. Tech. Bull. E 617 (Revised 1962), 53 p.

10. SFL Progress Reports, 1975, 1978.

Influence of altitude on rust diseases of wheat in different agroclimatic zones

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Introduction

In this article we present data connected with wheat varieties resistance to major small grains diseases with increasing agroclimatic stress for developing broadly adapted materials as well as enhanced stability of yield when grown under stress situations in three Administrative Regions of Ethiopia (Shewa, Arsi, Bale) for the period of four years (1980-1983).

The main objective of the trial was to evaluate resistant varieties of wheat to rust diseases with increasing agroclimatic stress in major wheat growing regions of Ethiopia.

It was estimated that conditions for development of different types of rust diseases were more favourable in zones with the following altitudes:

Stem rust	-	1600m (Bako) - 2500m (Holetta);
Leaf rust	-	1850m (Debre Zeit) - 2600m (Diksis)
Stripe rust	-	2150m (Kulumsa) - 2850m (Sheno) above sea level.

The highest affection of wheat by stem rust was registered in 1980. In 1981 and 1982 it was relatively lower than in 1980. The lowest incidence occured in 1983.

The highest affection of wheat by leaf rust was registered in 1982. In 1980, 1981 and 1983 it was relatively lower than in 1982.

The highest affection of wheat by stripe rust was registered in 1981. In 1982 and 1983 it was relatively lower than in 1981. The lowest incidence occured in 1980.

Based on the results of trials for three consecutive years, respectively, in different regions of Ethiopia the following varieties were found resistant to three types of rust diseases:

1. Veery "S" CM33027-F15M-500Y-OM (Veery 1);
2. Au-Tob x Grota CM30833-N-2Y-2M-2Y-2M;
3. CCX Cal - Sr;
4. Cno-Chriskon/Nar 59-on Se454-115-2S-1S 05;
5. K. Paa.

Materials and Methods

During 1980-1983 crop seasons 32 wheat varieties were included into the Ethiopian wheat rust trap nursery(EWRTN) and evaluated in typical wheat growing regions with different altitudes (high, medium, low), temperature and humidity.

Classification of characteristics of altitude and average temperature according to Gemachew D., 1977 (1) was given below:

Class name (traditional)	Altitude	Average temperature
Qolla	800-1500m	20-28°C
Weina Dega	1500-2300m	18-22°C
Dega	2300-3000m	14.5-18°C

The trial was conducted in the following locations:

Shewa : Ambo (2250m), Nazret (1500m)
Bako (1600m), Debre Zeit (1850m)
Holetta (2500m), Sheno (2850m)

Arsi : Kulumsa (2150m), Diksis (2600m)

Bale : Herero (2350m).

Evaluation of trap nursery and formation of EWRTN in 1980 was conducted by Dr. Tesfaye Tesema, Dr. A. Dmitriev, Terefe Deisa; in 1981 - by Dr. Kingma, Dr. V. Jakutkin, Temam Hussein; in 1982 - by Dr. A. Kuzmichev, Dr. D. Solomatin, Temam Hussein, Masresha Aklilu; in 1983 - by Dr. A. Kuzmichev (2, 5, 6, 7).

In all locations the nursery was sown at a recommended sowing date for every region by agronomists. All varieties were sown in one day. Each variety was sown in one row of 1-2, 5m length with inter row spacing of 20-40 cm. Seed rate was 125 Kg/ha. During vegetative period 1-2 scorings of rust incidence were conducted by lodging scale (3). For the estimation of average coefficient of infection the scales R-0.2; MR-0.4; MS-0.8 and S-1.0 were used.

The coefficient of infection of rust diseases is calculated from the multiplication of a resistance rating by the severity expressed as a percentage of the plant tissue covered by the disease.

Mean average coefficient of infection (A.C.I.) can be calculated for the observation in a given geographical or epidemological zones. The average coefficient of infection was calculated on the results of evaluation of 32 bread and durum wheat varieties. Among them 7 varieties of Ethiopia and 7 varieties of Kenian origin, 1 variety of Mexican cross with Giza 139 of Egyptian origin; 5 varieties of Mexican cross with Russian varieties Aurora and Kaukaz and 6 varieties of Mexican cross with local varieties of durum wheat. Among all varieties tested the following groups of wheat varieties were included also:

- Established varieties (Enkoy, Romany B.C., K6290 Bulk)
- Newly released varieties (K6295-4A, ET-13A2, Dereselign)
- Advanced pipelines (Veery 1, Veery 15, KKBB NZ x Kal-bb), Bobwhite 7, Peregrine 1, Giza 139 x GB 1860.

Results and discussion

Characteristics of maximum affection by three types of rust of 32 varieties tested in all locations are presented in Table 1.

The data of bread and durum wheat affection by stem rust showed that the highest infection was in 1980, when 72% of varieties were infected; the average coefficient of infection reached 28.4. In 1981-1983 decrease of infection by stem rust and low coefficient of infection was registered.

The highest affection of wheat by leaf rust was observed in 1982. Percentage of infection reached 59.4 and the average coefficient of infection reached 14. In 1980, 1981 and 1983 it was relatively lower than in 1982.

The stripe rust average coefficient of infection recorded 71.9 (1981), 31.4 (1982), 28.3 (1983), 1.9 (1980), percentage of infection ranged from 21.9 (1980) to 87.5 (1982).

If one compares the results of our trial difference can also be noted depending on where these varieties are grown. The amount of infection will vary in different locations (tables 2, 3, 4, 5).

Stem rust development during the period 1980-1983, the highest percentage of infected varieties and the highest average coefficient of infection were recorded at the following locations:

1980 - Ambo, Holetta
1981 - Debre Zeit, Ambo
1982 - Debre Zeit, Herero
1983 - Bako, Ambo, Debre Zeit

Bread and durum wheat varieties were infected by stem rust at the altitudes from 1500 m (Nazret) to 2600m (Diksis). The highest stem rust infection was indicated in Weina Dega agro-climatic zone at the altitudes from 1600m (Bako) to 2500m (Holetta).

<u>Leaf rust</u> development during the period 1980-1983, the highest percentage of infected varieties and the highest average coefficient of infection were recorded at the following locations:

1981 - Herero, Debre -Zeit, Diksis
1982 - Kulumsa, Debre-Zeit, Diksis
1983 - Herero, Holetta, Diksis

Wheat varieties were affected leaf rust at the altitudes from 1500, (Nazret) to 2850m (Sheno). The highest amount of infected varieties and the highest average coefficient of infection were indicated in Weina Dega and Dega agro-climatic zones at the altitude from 1850m (Debre Zeit) to 2600m (Diksis).

<u>Stripe rust</u> development during the period 1981 to 1983 the highest percentage of infected varieties and the hgihest average coefficient of infection were recorded at the following locations:

1981 - Diksis, Kulumsa, Herero
1982 - Herero, Diksis, Kulumsa
1983 - Ambo, Sheno, Herero

Wheat varieties were affected by stripe rust at the altitudes from 1600m (Bako) to 2850m (Sheno). The highest amount of infected varieties and the highest average coefficient of infection were indicated in Weina Dega agro-climatic zones at the altitude from 2150 (Kulumda) to 2850m (Sheno).

The above mentioned variations in development of three types of rust diseases in different agro-climatic zones can be explained by the presence of favourable conditions (temperature, relative humidity and illumination). For example, optimum conditions for development of stem, leaf and stripe rust according to Peresipkin V. is as follows:

	Temperature °C			
	Optimum	Maximum	Minimum	Illumination (in luxes)
Stem rust	18-28	30	1	5-7 thousand
Leaf rust	15-25	31	2.5	5-7 thousand
Stripe rust	11-13	25	1	30-40 thousand

100% humidity and water drops presence are considered to be optimum conditions for the germination of uredospores and osidiospores as well as for rust infestation. Taking into account results abtained, high infection by the three types of rust (stem, leaf, stripe) can be expected in the agroclimatic zones with altitudes from 2150m to 2500m. In view of the above results it is recommended to distribute varieties with different resistance to three types of rust in relevant agro-climatic zones of Ethiopia. Thus, at the altitude of 2150m it is recommended to cultivate in the first place commercial varieties resistant to stem rust.

For the cultivation of production varieties in agro-climatic zones at the altitudes from 2150m to 2500m varieties resistant to three types of rust should be used, while the sites situated at the altitudes of 2500m and above it is recommended to use varieties resistant to stripe rust. It should be noted that the above division into agro-climatic zones should be considered as flexible, because conditions for high affection of wheat by rusts can differ even within one season.

As a result of evaluation conducted during three years (1981-1983) the following varieties were not affected by three types of rust:

1. Veery"S"CM33027-F-15M-500Y-0M
2. Au-Tob x Grofa CM30833-N-2Y-2M-2Y-2M-0Y
3. CCoCal-Sr
4. Cno-Chries x On/Nar 59-ON SE/5/-115-2S-1S-0S
5. K.Paa.

Conclusion and recommendation

1. The relationship between altitudes of the growing sites and infection of wheat rust of different varieties were significantly interrelated. Under tropical conditions of Ethiopia the influence of altitude on the development of wheat rust diseases was highly marked. For example:

   - Infection of wheat by stem rust wss registered in Qolla, Weina Dega and Dega agro-climatic zones at the altitudes from 1500m (Nazret) to 2600m (Diksis) above sea level. The highest infection was recorded in zones with the altitudes from 1600m (Bako) to 2500m (Holetta).

   - Infection of wheat by leaf rust was registered also in Qolla, Weina Dega and Dega agro-climatic zones with the altitudes from 1500m (Nazret) to 2850m (Sheno). The highest infection was recorded at the altitudes from 1850m (Debre Zeit) to 2600m (Diksis).

   - Infection of wheat by stripe rust was indicated in Weina Dega and Dega agro-climatic zones with altitudes from 1600m (Bako) to 2850m (Sheno). The highest infection was recorded at the altitudes from 2150m (Kulumsa) to 2850m (Sheno).

2. In some wheat growing seasons wheat cultivation of susceptible varieties in separate agro-climatic zones a serious risk in the incidence of wheat rust diseases can be encountered. Due to the above reason a strategy based on the research findings of varietal zonation is of major importance.

   It would be advisable:

   - to use in the first place varieties resistant to stem rust at the altitude up to 2150m (Qolla, Weina Dega)

   - in the regions with altitudes from 2150 up to 2500m varieties resistant to the three types rust (stripe, stem and leaf) should be used.

- in the regions with altitude of 2500m above sea level (Dega) varieties resistant to stripe rust should be cultivated.

3. Based on the results of trials for three consecutive years in different regions of Ethiopia the following varieties were found resistant to the three types of rust diseases:

   1. Veery"S" CM33027-F15M-500Y-OM (Veery 1)
   2. Au-Tob x Grota CM30833-N-2Y-2M-2Y-2M
   3. CCx Cal-Sr
   4. Cno-Chriskon/Nar 59-onSe454-115-2S-1S-OS
   5. K.Paa.

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Table 1. Characteristics of maximum affection by the three types of rust of wheat varieties in all locations

Code	Variety or cross	Stem Rust				Leaf Rust				Stripe Rust(Yellow Rust)			
		1980	1981	1982	1983	1980	1981	1982	1983	1980	1981	1982	1983
1	2	3	4	5	6	7	8	9	10	11	12	13	14
							Bread Wheat						
1.	ET51.A.L-A.L	0	0	0	TMR	0	TS	0	TR	0	100S	80MS	10MR
2.	CgNxKal-Bb CM15133-1M-3Y-6M-OY	0	0	0	0	0	0	0	0	0	100S	TR	20MS
3.	Gizal39xGb1360 3316 PI 243064	0	TS	0	10MR	0	5S	30MS	60S	0	0	0	0
4.	PF 70354+IAS 55IAS 20	10MS	0	TS	10MS	0	0	TR	TS	0	100S	60S	20S
5.	Wepit62xTob66CM8287-1Y-3M-1Y-OM	45MS	0	TS	0	0	0	0	0	0	100S	100S	80S
6.	ET 51.A.L.B.L	25R	0	0	10MS	0	0	0	0	0	100S	100MS	60S
7.	ET 12-C-4-L-5-L	35S	0	0	0	0	0	TR	TMR	TS	100S	100S	60S
8.	Kavkaz x Kal-Bb	65S	TS	0	20S	TMR	TS	50S	TS	TS	100S	TR	10MR
9.	K6410-2	TMR	0	0	0	0	0	TR	TMS	0	100S	100S	40S
10.	ET 30.K3-L-5B (FS) 5H	0	0	0	TMR	0	5MS	TR	0	0	100S	100S	10MR
11.	AuroraxKal-BbSWN-1703-L-2-A-6H	100MS	0	0	0	0	0	TR	0	0	100S	TS	50S
12.	ET30-K-3-L-3-A(F5) 5H	25MS	0	0	10MS	0	TS	10S	10MR	0	100S	10S	60MS
13.	ET30-K-3-L-3-B (F5) 3H	0	0	0	0	0	TS	40S	10MS	0	100S	TR	0
14.	LT 1100-C-H1-H1-4-A-13H	65S	0	TS	0	0	0	0	0	10MS	100S	30S	60S
15.	Man"S"NimrodxKal-BbSWM1629-L-A-1H	65S	5S	0	0	25MS	0	TS	0	0	0	0	20MS
16.	KVZ-TC71/Maya"S"xBb-IniaCM-33089-W-3M-11Y-OM	5S	0	10MS	0	0	0	0	0	0	0	TR	40S
17.	AuxKal-Bb/Wop"S"CM33203-G-9M-4Y-M	45MS	0	0	0	TR	0	0	0	10S	100S	80MS	10MS
18.	Desconocido Fricor-EII 7753-2e-100E+OY	25MS	0	0	0	0	0	0	0	0	0	0	0
19.	AuxKal-Bb/Wop"S"CM33203-N/M.2y-OM	25MS	0	0	0	0	0	0	0	TS	0	0	0

Table 1 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14
20.	Enkoy	TS	0	0	10MS	0	5S	30S	40S	0	0	TR	10MR
21.	Mamba	0	0	0	0	0	0	TMR	TMS	0	100S	TR	20MR
22.	K-6290 Bulk	0	0	0	0	0	TMS	0	TMR	0	100S	30S	20MS
23.	Bobito"S"	25MS	0	0	0	0	0	0	0	0	100S	30S	80S
24.	K 6295-4A	0	0	0	TMS	0	TS	5MS	10MS	0	100S	10S	10MR
25.	ET 13	TR	0	0	0	0	0	0	0	0	100S	TR	80MS
26.	Romany B.C.	0	TR	0	10MS	0	0	0	0	0	100S	50S	30S
							Durum Wheat						
1.	Illumillo	100MS	5MS	0	0	TMR	TS	50MS	10MS	0	100S	80S	80MS
2.	Reichenbachii	40S	5MS	0	0	TMS	TMS	TR	TMS	40S	100S	80S	80S
3.	Egypt Local No. 8	25MS	TR	TS	0	100MS	5S	10MS	10MR	0	100S	5S	50S
4.	D 87	100S	TMS	TS	0	10S	25MS	100S	60MR	0	0	TR	0
5.	Local Ejere	100S	100S	0	5S	100S	100S	100S	60S	TR	0	20MR	0
6.	Cr-GsxPg, CM13434-5Y-1M-4Y-0Y	100S	100MS	30S	0	65MS	100MS	50MS	20MS	0	0	TR	0
	Average coefficient of infect.	28.4	6.1	1.3	2.2	8.2	7.8	14.0	7.5	1.9	71.9	31.4	28.3
	Number of infected varieties %	72	31	22	34	28	47	59	56	22	72	87	75

Note: In the tables 2, 3, 4, 5 numbers of varieties coincided with numbers and names of varieties of Table 1.

Table 2. Results of evaluation of 32 wheat varieties tested in major wheat growing regions (Data from EWRTN, 1980)

Code	Nazret			Bako			Debre Zeit			Kulumsa			Ambo			Herero			Holetta			Diksis			Sheno		
	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
													Bread Wheat														
1.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
2.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
3.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
4.	-	-	-	-	-	-	0	-	-	0	-	0	10MS	0	0	-	-	-	0	-	0	-	-	-	0	0	0
5.	-	-	-	-	-	-	0	-	-	0	-	0	40MS	0	0	-	-	-	0	-	0	-	-	-	0	0	0
6.	-	-	-	-	-	-	0	-	-	0	-	0	25R	0	0	-	-	-	0	-	0	-	-	-	0	0	0
7.	-	-	-	-	-	-	0	-	-	0	-	0	35S	0	0	-	-	-	0	-	TS	-	-	-	0	0	0
8.	-	-	-	-	-	-	0	-	-	10MS	-	0	25S	TMR	0	-	-	-	65S	-	TS	-	-	-	0	0	0
9.	-	-	-	-	-	-	0	-	-	0	-	0	TMR	0	0	-	-	-	0	-	0	-	-	-	0	0	0
10.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
11.	-	-	-	-	-	-	0	-	-	0	-	0	100MS	0	0	-	-	-	0	-	0	-	-	-	0	0	0
12.	-	-	-	-	-	-	0	-	-	0	-	0	TR	0	0	-	-	-	25MS	-	0	-	-	-	0	0	0
13.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
14.	-	-	-	-	-	-	0	-	-	0	-	0	65S	0	0	-	-	-	0	-	10MS	-	-	-	0	0	0
15.	-	-	-	-	-	-	0	-	-	0	-	0	65S	25MS	0	-	-	-	5MS	-	0	-	-	-	0	0	0
16.	-	-	-	-	-	-	0	-	-	0	-	0	5S	0	0	-	-	-	0	-	0	-	-	-	0	0	0
17.	-	-	-	-	-	-	0	-	-	0	-	0	25S	TR	0	-	-	-	45MS	-	10S	-	-	-	0	0	0
18.	-	-	-	-	-	-	0	-	-	0	-	0	25MS	0	0	-	-	-	5MS	-	0	-	-	-	0	0	0
19.	-	-	-	-	-	-	0	-	-	0	-	0	25MS	0	0	-	-	-	15MR	-	TS	-	-	-	0	0	0
20.	-	-	-	-	-	-	0	-	-	TS	-	0	0	0	0	-	-	-	5MR	-	0	-	-	-	0	0	0

Table 2 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
21.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
22.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
23.	-	-	-	-	-	-	0	-	-	0	-	0	25MS	0	0	-	-	-	0	-	0	-	-	-	0	0	0
24.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
25.	-	-	-	-	-	-	0	-	-	0	-	0	TR	0	0	-	-	-	0	-	0	-	-	-	0	0	0
26.	-	-	-	-	-	-	0	-	-	0	-	0	0	0	0	-	-	-	0	-	0	-	-	-	0	0	0
Durum Wheat																											
1.	-	-	-	-	-	-	0	0	-	0	-	0	100MS	TMR	0	-	-	-	70MR	-	0	-	-	-	0	0	0
2.	-	-	-	-	-	-	0	0	-	0	-	0	TR	TMS	0	-	-	-	40S	-	40S	-	-	-	0	0	0
3.	-	-	-	-	-	-	TMS	5MR	-	0	-	0	25MS	100MS	0	-	-	-	TR	-	0	-	-	-	0	0	0
4.	-	-	-	-	-	-	TMS	5S	-	5S	-	0	100S	10S	0	-	-	-	80S	-	0	-	-	-	0	0	0
5.	-	-	-	-	-	-	TMS	65S	-	70S	-	0	100S	100S	0	-	-	-	90S	-	TR	-	-	-	5S	TMS	0
6.	-	-	-	-	-	-	TMS	10MS	-	30S	-	0	100S	65MS	0	-	-	-	90S	-	0	-	-	-	0	TMS	0
Average coefficient of infection							0,1	13,3	-	3,6	-	0,0	25,2	7,9	0,0	-	-	-	14,5	-	1,9	-	-	-	0,2	0,05	0
Number of infected varieties %							12,5	66,7	-	15,6	-	0,0	68,8	28,1	0,0	-	-	-	40,6	-	21,9	-	-	-	3,1	6,2	0

Table 3. Results of evaluation of 32 wheat varieties tested in major wheat growing regions (Data from EWRTN, 1981)

Code	Nazret			Bako			Debre Zeit			Kulumsa			Ambo			Herero			Holetta			Diksis			Sheno		
	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
																Bread Wheat											
1.	–	–	–	–	–	–	0	TS	0	0	TS	5S	0	0	0	0	TS	100S	0	0	0	0	0	100S	–	–	–
2.	–	–	–	–	–	–	0	0	0	0	0	10S	0	0	0	0	0	100S	0	0	0	0	0	100S	–	–	–
3.	–	–	–	–	–	–	0	0	0	0	TMS	0	0	0	0	0	5S	0	0	0	0	TS	TS	0	–	–	–
4.	–	–	–	–	–	–	0	0	0	0	0	15MS	0	0	0	0	0	100S	0	0	0	0	0	100S	–	–	–
5.	–	–	–	–	–	–	0	0	0	0	0	50S	0	0	0	0	0	100S	0	0	0	0	0	100S	–	–	–
6.	–	–	–	–	–	–	0	0	0	0	0	50S	0	0	0	0	0	100S	0	0	0	0	0	100S	–	–	–
7.	–	–	–	–	–	–	0	0	0	0	0	100S	0	0	0	0	0	100S	0	0	0	0	0	100S	–	–	–
8.	–	–	–	–	–	–	0	TMR	0	TS	TS	0	0	0	0	0	10MS	100S	0	0	0	0	0	TMS	–	–	–
9.	–	–	–	–	–	–	0	0	0	0	0	50S	0	0	0	0	0	100S	0	0	0	0	0	100S	–	–	–
10.	–	–	–	–	–	–	0	0	0	0	0	100MS	0	0	0	0	5MS	0	0	0	0	0	0	100S	–	–	–
11.	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100S	–	–	–
12.	–	–	–	–	–	–	0	TMS	0	0	TMS	0	0	0	0	0	TS	100S	0	0	0	0	0	100S	–	–	–
13.	–	–	–	–	–	–	0	TMS	0	0	TS	0	0	0	0	0	TS	100S	0	0	0	0	0	100S	–	–	–
14.	–	–	–	–	–	–	0	0	0	0	0	20S	0	0	0	0	0	5S	0	0	0	0	0	100S	–	–	–
15.	–	–	–	–	–	–	0	0	0	5S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	–	–
16.	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	–	–
17.	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100S	–	–	–
18.	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	–	–

Table 3 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
19.	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-
20.	-	-	-	-	-	-	0	0	0	0	TMS	0	0	0	0	0	5S	0	0	0	0	0	0	0	-	-	-
21.	-	-	-	-	-	-	0	0	0	0	0	25MS	0	0	0	0	0	5S	0	0	0	0	0	100S	-	-	-
22.	-	-	-	-	-	-	0	0	0	0	0	100S	0	0	0	0	TMS	100S	0	0	0	0	0	100S	-	-	-
23.	-	-	-	-	-	-	0	0	0	0	0	100S	0	0	0	0	0	100S	0	0	0	0	0	100S	-	-	-
24.	-	-	-	-	-	-	0	0	0	0	0	100S	0	0	0	0	TMS	100S	0	0	0	0	TS	100S	-	-	-
25.	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	100S	0	0	0	0	0	10MS	-	-	-
26.	-	-	-	-	-	-	0	0	0	0	0	50S	0	0	0	TR	0	100S	0	0	0	0	0	100S	-	-	-
																Durum Wheat											
1.	-	-	-	-	-	-	5MS	0	0	0	TMS	100MS	5MS	30MS	0	0	TMS	10MS	0	0	0	0	TS	100S	-	-	-
2.	-	-	-	-	-	-	5MS	0	0	0	0	50MS	0	0	0	0	0	100S	0	0	0	0	TMS	100S	-	-	-
3.	-	-	-	-	-	-	TR	5S	0	0	TMS	100MS	0	0	0	0	0	100S	0	0	0	0	TMS	100S	-	-	-
4.	-	-	-	-	-	-	0	TMS	0	0	TMS	0	TMS	25MS	0	0	5MS	0	0	0	0	0	20MS	0	-	-	-
5.	-	-	-	-	-	-	10S	80S	0	100S	25S	0	0	100S	0	100MS	60S	0	0	0	0	50MS	100S	0	-	-	-
6.	-	-	-	-	-	-	TMS	0	0	0	TMR	0	25MS	10MS	0	5MS	0	0	0	0	0	100MS	100MS	0	-	-	-
Average coefficient of infection							0,6	2,7	0	3,3	1,0	29,6	0,8	4,6	0	2,6	2,8	53,7	0	0	0	3,8	6,2	65,9			
Number of infected varieties							15,6	22	0	9,4	34	53,1	9,4	12	0	9,4	37	62	0	0	0	9,4	25	72			

Table 4. Results of evaluation of 32 wheat varieties tested in major wheat growing regions (Date from EWRTN, 1982)
Data from EWRTN, 1982

Code	Nazret			Bako			Debre Zeit			Kulumsa			Ambo			Herero			Holetta			Diksis			Sheno		
	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
													Bread Wheat														
1	–	–	–	–	–	–	0	0	0	0	0	5MS	0	0	0	0	0	TR	0	0	0	0	0	80MS	–	–	–
2	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	TR	0	0	0	0	0	TR	–	–	–
3	–	–	–	–	–	–	0	0	0	0	5MS	0	0	0	0	0	10MR	0	0	0	0	0	30MS	0	–	–	–
4	–	–	–	–	–	–	TS	0	TS	0	0	0	0	0	0	0	TR	50S	0	0	0	0	0	60S	–	–	–
5	–	–	–	–	–	–	TS	0	0	0	0	10MS	0	0	0	0	0	100S	0	0	0	0	0	80MS	–	–	–
6	–	–	–	–	–	–	0	0	0	0	0	TR	0	0	0	0	0	TR	0	0	0	0	0	100MS	–	–	–
7	–	–	–	–	–	–	0	0	0	0	0	20S	0	TR	100S	0	0	80S	0	0	0	0	0	100S	–	–	–
8	–	–	–	–	–	–	0	50S	TR	0	TR	TR	0	0	0	0	0	0	0	0	0	0	0	0	–	–	–
9	–	–	–	–	–	–	0	0	0	0	TR	20MS	0	0	0	0	TR	100S	0	0	0	0	0	80S	–	–	–
10	–	–	–	–	–	–	0	TR	0	0	0	0	0	0	0	0	0	TS	0	0	0	0	TR	100S	–	–	–
11	–	–	–	–	–	–	0	0	0	0	TR	0	0	0	0	0	0	TS	0	0	0	0	0	0	–	–	–
12	–	–	–	–	–	–	0	10S	0	0	10MS	0	0	0	0	0	0	10S	0	0	0	0	0	0	–	–	–
13	–	–	–	–	–	–	0	40S	0	0	40MS	0	0	0	0	0	0	TS	0	0	0	0	0	0	–	–	–
14	–	–	–	–	–	–	0	0	0	0	0	5MS	0	0	0	0	0	30S	0	0	0	0	0	50MR	–	–	–
15	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	TS	0	–	–	–
16	–	–	–	–	–	–	10MS	0	0	TS	0	0	0	0	0	0	0	TR	0	0	0	0	0	0	–	–	–
17	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80MS	–	–	–
18	–	–	–	–	–	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	–	–	–

Table 4 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
19	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	-
20	-	-	-	-	-	-	0	5S	0	0	5MR	0	0	0	0	0	30S	TR	0	0	0	0	5MS	0	-	-	-
21.	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	TR	0	0	0	0	TMR	0	-	-	-
22	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	30S	0	0	TR	0	0	10MR	-	-	-
23	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	30S	0	0	0	0	0	30MS	-	-	-
24	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	10S	0	0	0	0	5MS	20MS	-	-	-
25	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	TR	-	-	-
26	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0	50S	0	0	0	0	0	30S	-	-	-
																	Durum Wheat										
1	-	-	-	-	-	-	0	0	0	0	TR	0	0	50MS	0	0	0	10S	0	10MS	0	0	0	80S	-	-	-
2	-	-	-	-	-	-	0	0	0	0	0	0	0	TR	10S	0	0	TR	0	TR	0	0	0	80S	-	-	-
3	-	-	-	-	-	-	TR	TR	0	TS	0	0	0	10MS	20MS	0	TR	5S	0	0	0	0	TR	80MS	-	-	-
4	-	-	-	-	-	-	TR	TR	0	0	10MR	0	0	15MS	0	TS	30MR	0	TS	100S	0	0	5MS	TR	-	-	-
5	-	-	-	-	-	-	0	80S	0	0	40MS	0	0	100S	0	0	100S	0	0	100S	TR	0	80S	20MS	-	-	-
6	-	-	-	-	-	-	30S	TR	0	TS	20MR	0	0	20MR	TR	20S	10MR	0	0	30MR	0	TS	50MS	0	-	-	-
Average coefficient of infection							1,3	5,6	0,04		0,1	2,8	1,6	0,5,1	4,1	0,7	4,6	15,9	0,03	6,7	0,01	0,03	4,8	29,6			
Number of inf. varitties %							19	28	6		34	22	22	0 22	12	6	25	69	3	16	6	3	31	62			

Table 5 Results of evaluation of 32 wheat varieties tested in major wheat growing regions (Data from EWRTN, 1983)

Code	Nazret			Bako			Debre Zeit			Kulumsa			Ambo			Herero			Holetta			Diksis			Sheno		
	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR	SR	LR	YR
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	0	0	0	0	0	0	0	0	0	0	0	0	TMR	0	10MR	0	0	0	0	0	0	0	TR	0	0	0	5R
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20MS	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	10MR	0	0	0	60S	0	0	TMS	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	10MR	10MS	TS	10MR	0	0	0	0	0	0	0	0	0	0	0	20S
5	0	0	0	0	0	0	0	0	0	0	0	20MR	0	0	80S	0	0	0	0	0	0	0	0	0	0	0	60MS
6	0	0	0	0	0	0	0	0	0	0	0	50MS	10MS	0	60S	0	0	0	0	0	0	0	0	0	0	0	20S
7	0	0	0	0	0	0	0	0	0	0	TMR	60S	0	0	0	0	0	0	0	0	TR	0	0	20MS	0	0	40S
8	0	0	0	0	0	0	0	0	0	0	0	0	2aS	TS	10MR	10MS	10MR	10MS	0	0	TR	0	0	0	0	0	TMR
9	0	0	0	0	TMS	40MS	0	0	0	0	0	60MS	TR	TMS	20MR	0	0	0	0	0	40S	0	0	0	0	0	20S
10	0	0	0	10R	0	C	0	0	0	0	0	0	TMR	TMR	10MR	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50S	0	0	0	0	0	0	0	0	0	0	0	30S
12	0	0	0	0	0	0	0	0	0	0	10MR	0	10MS	10MR	60MS	0	0	0	0	TMR	0	0	0	0	0	0	5MS
13	0	0	0	0	0	0	0	0	0	0	0	0	TMR	TMS	0	0	TMR	0	0	10MS	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	TR	0	60S	0	0	0	0	0	TR	0	0	0	0	0	40S
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20MS	0	0	TR	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	TMS	10S	0	0	0	0	0	0	0	0	0	0	0	40S
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10MS	0	0	0	0	0	TR	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 5 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
20	0	0	0	TR	10MR	0	0	0	0	0	0	0	10MS	TS	10MR	0	40S	0	0	10MS	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20MR	0	TMS	0	0	0	0	0	0	0	0	0	5R
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20MS	0	0	0	0	TMR	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	20MR	0	0	80S	0	0	0	0	0	10MR	0	0	0	0	0	40S
24	0	0	0	10MR	0	0	0	0	0	0	0	0	TMS	TMS	10MR	0	10MS	0	0	TS	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	80MS	0	0	20MR	0	0	0	0	0	0	0	0	0	0	0	5MR
26	0	0	0	10R	0	0	0	0	0	0	0	0	10MS	0	10MS	0	0	20MR	0	0	TMS	0	0	0	0	0	30S
														Durum Wheat													
1	0	0	0	0	0	0	0	0	0	0	0	0	TR	0	50S	0	0	80MS	0	0	0	0	10MS	0	0	0	40S
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50MS	0	0	60MS	0	TMS	10MR	0	0	0	0	0	80S
3	0	0	0	0	0	0	0	0	0	0	0	0	10R	10MR	80S	0	10MR	50MS	0	10MR	0	0	10MR	0	0	0	50S
4	0	0	0	10R	0	0	0	TMR	0	0	0	0	10MR	10MR	0	0	60MR	0	0	10MR	0	0	10S	0	0	0	0
5	5MS	10M[illegible]	0	TR	70MS	0	5S	40MS	0	0	0	0	10MS	10MS	0	0	60S	0	0	20MS	0	0	40S	0	0	0	0
6	0	0	0	0	0	0	0	TS	0	0	0	0	10MS	10MS	0	0	20S	0	0	20MS	0	0	TMS	0	0	0	0
A.C.I.	0,1	0,1	0	0,3	1,8	[illegible]	0,2	2,1	0	0	0,1	7,3	2,8	1,0	22,3	0,3	6,7	5,8	0	1,8	1,6	0	1,9	0,5	0	0	15,8
N.I.V. %	3	3	0	19	9	3	3	9	0	0	6	22	56	41	75	3	3	22	0	81	25	0	22	3	0	0	56

Role of insects in the transmission of enset wilt Pathogen Xanthomonas musacearum in Welayita, Ethiopia

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Introduction

Enset wilt is the most destructive disease currently encountered in Welayita Awraja. The initial symptom of the disease is wilting of the heart leaf or one of the inner leaves. Yirgu and Bradbury (1968), described that the causative agent of enset wilt was Xanthomonas musacearum sp.n. The same organism causing enset wilt was also reported to cause a naturally occuring wilt to banana in Ethiopia (Yirgu and Bradbury, 1974).

The probable speead of the disease and possible control measures were suggested by Yirgu and Bradbury (1968. But suspecting the presence of an unknown vector to enset wilt bacteria this study was initiated in Welayita.

Objectives: a) To determine the major types of insects associated with enset plant.

b) To test the suspected insects in the dissemination and inoculation of the pathogen Xanthomonas musacearu .

Materials and Methods

Forty one sets of enset plantations in twenty six peasant associations (PAS) and a Crop and Pasture Section (CPS) enset plantation at Soddo were examined.

An attempt was made to isolate the bacterium from three insect species collected from diseased and/or healthy enset plants (poecilocarda nigrinervis Stal; Pentalonia nigrinervosa Coquerel; Planococcus ficus Signoret).

The insects were placed in two groups, surface sterilized and non-sterilized. Two groups of insects were then crushed in 2 ml sterile water on sterilized mortar with a pestle.

A pure culture of bacteria that resembeed typical to Xanthomonas sp. were tested for hypersensitivity on Nicotiana glutinosa L (Klement, 1963) and on Vicia faba (Starr and Dye, 1963). The bacterial isolates that gave HR reaction on V.faba and N.glutinosa were tested on enset plants in field condition. Ten milliliters of cloudly visible suspension of bacterial cells were injected into petioles of healthy enset plants in five replications.

Biochemical analysis were done by the methods described in Beltukova et.al (1968), Chumakov (1974),(Israelsky (1960), Sierra (1957) and the guides in the manual of Microbiological Methods by the Society of American Bacteriologists (1957).

These were 4 pathogenic isolates from insects, one from naturally wilting enset and one non-pathogenic isolate from banana aphid.

Results and Discussion

Three most frequently observed insect speci s in association with enset plants were determined. These are: Poecilocarda nigrinervis, Pentalonia nigronervosa and Planococcus ficus.

Isolating pathogenic bacteria from the three species, collected from wilting enset plants, yielded positive results for P. nigrinervis and P. nigronervosa both surface sterilized and non-sterilized (table 1). Colonies of bacteria resembling typical Xanthomonas sp. were also obtained from non-surface sterilized P.ficus collected from wilting enset plant. P.ficus, P.nigrinervis and P. nigronervosa collected from healthy enset plants did not yield pathogenic isolates to enset.

The bacterial colonies that resembled typical Xanthomonas sp. from all three species produced necrosis on Nicotiana glutinosa L Vicia faba L leaves.

Pathogenicity test of bacterial isolates on enset plants were positive for P. nigrinervis both surface sterilized and non-sterilized, collected from wilting enset. Reactions were also positive in part for surface sterilized P. nigronervosa and non-sterilized P.ficus, collected from wilting enset.

The bacterial isolates from the test insects in their biochemical properties belong to the species *Xanthomonas musacearum*.

Conclusion

From the overall results we may conclude that P.ficus although observed to be surface contaminated, it is considered as unimportant carrier. P. nigronervosa seem to be a potential carrier, but restricted to the winged forms only which may limit their importance as vector. The agility of the adult as well as nymph of the insects, and the high effect in the pathogenicity test on enset (table 2), which resulted from a high accumulation of the pathogen in the insects, gives us basis to put P.nigrinervis as the main vector of enset wilt pathogen in Wolayita.

Table 1. Isolation of Xanthomonas sp. from insects.

Insect	Source of insect			
	Healthy enset Plant		Wilting enset Plant	
Species	Surface sterilized	Non-sterilized	Surface sterilized	Non-sterilized
Poecilocarda nigrinervis Stal	-	-	+	+
Pentalonia nigronervosa Coquerel	-	(+)	+	+
Planococcus ficus Signoret	-	-	-	-

Key:
+ Positive results
- Negative results
(+) Proved to be non-pathogenic to enset

Table 2. Percentage of Positive and Negative Reactions in the Pathogenicity Test of the Bacterial Isolates on Enset, under Field Condition

Isolates number	Sources of Isolates	Reactions		Days after inoculation
		Positive	Negative	
613	Planococcus ficus, non-sterilized, from wilting enset	20	80	29
541b	P.nigrinervis, non-sterilized, from wilting enset	100	-	18
504	P.nigrinervis surface sterilized, from wilting enset	100	-	47
630	P.nigronervosa, non-sterilized, from healthy enset	-	100	30
637	P.nigronervosa, surface sterilized from wilting enset	20	80	29

* Test enset plants found with discolored vessels under tissue examination and that yielded Xanthomonas musacearum Yirgu and Bradbury, 1968 upon reisolation were considered positive, for P.ficus and P.nigronervosa, while the wilt symptom was observed on the whole plant and the injected leaf died in the case of P.nigrinervis in the indicated period.

COMPLETE RESEARCH ACTIVITIES

CI/BLS 23.282 Serological relationships among isolates of xanthomonas vesicatoria isolated from crops and weeds

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Alemneh Zenaie SPL, Ambo

Introduction

Various isolates of *Xanthomonas vesicatoria* (Doidge) Dowson obtained from Chilli (*Capsicum annum L*) and tomato (*Lycopersicon esculentum* Mill) were differentiated based on host of origin pathological and biological reactions, phage sensitivity and serological tests (Dye et.al 1964). Lovrekovich and Klement (1965) found 11 pepper isolates quite different from 22 tomato isolates on the basis of serological reactions. Charudattan et.al. (1973) differentiated 72 isolates of *Xanthomonas vesicatoria* from Chilli and tomato into 2 serotypes which however could not be correlated with pathotypes.

In our present work attempts are made to find similarities or differences between Ethiopian isolates of *Xanthomonas vesicatoria* obtained from Chilli, tomato and *Galinsoga parviflora*. The experiment was conducted in the 1982-83 crop season under laboratory conditions.

Materials and methods

We used isolates of *Xanthomonas vesicatoria* viz. from Chilli, tomato and Galinsoga. All the cultures were maintained on potato dextrose agar slants in refregerator and all the isolates were pathogenic to their respective hosts.

- location - Ambo, SPL
- duration - 1982-83.

<u>Preparation of antigens</u>: Fourty-eight hours old cultures of the separate isolates to be studied were washed from PDA slants in to other tubes with saline solution (0.85%) and were and killed by heating on a water bath for a period of 1 hr. at 56-60°C. The resulting bacterial solutions were centrifuged for 20 min. at 4000 RPM (Revolution per minute). Then the supermetant saline solution was discharged while bacterial pelets were redisolved in the solution. Then after 3-4 washings pellets finally were suspended in saline solution to serve as antigens at the rate of $5 \times 10^8 - 16 \times 10^9$ cells/ml.

<u>Immunization of rabits</u>: Rabits were inoculated with prepared antigens from the respective isolates for six times, $5 \times 10^8 - 16 \times 10^9$ cells/ml.

<u>Preparation of antiserum</u>: A week after final injection rabits were kept without food for 24 hrs. and then were bled. The blood was allowed to clot and the serum decanted. Mertiolate at a concentration of 0.01% was used as preservative of the blood. For control normal serum was obtained from a rabit which hadn't been inoculated with any antigen.

<u>Serological tests</u>: For test tube agglutination the antisera obtained were serially diluted with saline solution in two fold in small test tubes. Equal amounts of antigen were mixed into each tube and into a control test tube containing only saline solution. Test tubes were then incubated at 37°C for 24 hrs. For slide agglutination test, single drops of antigens and diluted antisera (1:50) were mixed on a glass slide and agglutination was observed. Character of agglutiration was scored as follows:

++++ clear supernatant fluid on sediment

+++ same as above but same opalesconse of suspension

++ 50% bacterial cells sediment. Others remain cloudy in the supernatant fluid

\+ very slight sediment

± ambigious reaction

\- no reaction

Results and discussion

With the presence of agglutination an opalescent suspension gave way to flask like appearance depending on the type of antigen involved. The in vitro reaction between antisera and homologous antigens was positive in all cases. At lower dilution rates of antisera sedimentation occurs leaving a clear supernatant fluid (Antisera to isolates 559 and 547). The highest dilution rate at which the potential antisera of 559 and 547 could form agglutination with antigens was 1:6400 and 1:1600 for 317-c. Comparative checks were made both with mixtures of the antigens and saline solution and the antigens and normal (non immune) serum to check for non specific agglutination. As a result no reaction was observed. All the three antigens under observation diluted at the rate of 1:50 gave the same type of agglutination both with their homologous and heterogenous antigens, when tested on slide for agglutination. This is considered as a preliminary indication of the close relationship of isolates of *Xanthomonas vesicatoria* obtained from the three host plants, though the difference in titration point between 317-c and the others still leaves doubt for further tests in future to see if there is basic difference between the Galinsoga isolate and the others from pepper and tomato. Thus, as a conclusion it is possible to say that these isolates from pepper, tomato and Galinsoga most probably possess antigens of the same nature in their respective bacterial cells.

Table 1. Origin of antigens

Isolates of X. vesicatoria	Host plant	Origin of specimen	Pathogenicity on	
			Pepper	Tomato
1. 559	pepper	Awasa	HV	SV
2. 547	tomato	Awasa	HV	HV
3. 317-c	Galinsoga parviflora	Gudder	V	HV

S - slightly virulent

V - virulent

HV - highly virulent

Table 2. Results of cross reaction (slide agglutination)

Antisera (dilution 1:50)	Antigens			Saline solution
	559	547	317-c	
1. 559	+++	+++	+++	-
2. 547	+++	+++	+++	-
3. 317-c	+++	+++	+++	-
4. Normal (non immune)	-	-	-	-

Table 3. Results of tube agglutination test

Antigen (isolate)	Replications	Dilutions of antisera 1:50	1:100	1:200	1:400	1:800	1:1600	1:3200	1:6400	1:12800	1:25600	Normal serum
1. 559	1	++	++	++	++	++	+	±	±	±	-	-
	2	++++	+++	++	++	++	+	+	+	±	-	-
2. 547	1	+++	+++	+++	++	+	-	-	-	-	-	-
	2	++++	+++	++	++	++	++	+	+	-	-	-
3. 317-c	1	++	++	++	++	+	+	±	-	-	-	-
	2	+++	+++	+++	+++	++	++	±	±	-	-	-

Conclusions and recommendations

As a conclusion it is possible to say that the isolates from pepper, tomato and galinsoga posses antigens of the same nature in their respective bacterial cells because all the three antisera under observation diluted at the rate of 1:50 gave the same type of agglutination both with their homologous and heterogenous antigens when tested on slide for agglutination.

There was a difference in titration point between the galinsoga isolate 317-c and the other two isolates from pepper and tomato. Thus, this difference and cross inoculation tests for phytopathogenicity on the host plants per se will be the challenge awaiting future activities in this line.

The farming community should be aware of the possibility that weeds such as gallinsoga can be alternate hosts for bacterial pathogens, which under favourable conditions can damage field crops such as pepper and other solanaceous crops. In addition to this, a rotation of solanaceous crops such as pepper should not follow other solanaceous crops such as tomato, since these crops can be infected by the same types of phytopathogens.

Virus diseases of pepper in Ethiopia

Dr. A.A. Agranovsky

Introduction

In this brief review the data on viral disease in Ethiopia obtained by the SPL virologists, are summarized. The studies have been conducted since 1977 by Dr. A. Gordeichuk, Ato Abdulrazak Yusuf, Dr. Y. Kalashian, Dr. V. Knjazev and Ato Yaynu **Hiskias**.

Viral diseases of pepper represnnt an international problem of the crop production. Pepper is highly susceptible to many viruses causing sometimes great yield losses; about 36 viral diseases of the crop have been described (1). Some of these pathogens are specific for pepper (2), while the others possess rather wide host ranges including many species from both Solanaceae and other families (3, 4, 5). The most widely distributed viruses affecting pepper are TMV, TRSV, PMV, TEV, PVY and CMV (1). Some of these pathogens have been indexed in Ethiopia (6), but more detailed studies was not conducted.

Materials and methods

The study of viruses infecting pepper was performed by the following scheme: visual observation of pepper crops with checking of plants having visual sumptoms of virual infection (mosaics, chloroses, leaf distortions, dwarfing and stunting); collection of samples; inoculation of samples to the test plants in greenhouse for virus maintenance and identification; electron microscopy and serological analysis. The appropriate methods have been described and details given previously (for review see (7)).

Abbreviations used: TMV, tobacco mosaic virus; TRSV, tobacco ringspot virus; PMV, pepper mottle virus; TEV, tobacco etch virus; PVY, potato virus Y; CMV, cucumber mosaic virus; AMV, alfalfa mosaic virus; PVMV, pepper veinal mottle virus; Prog. Rep. SPL (1977), Progress Report of the SPL for the period of 1977.

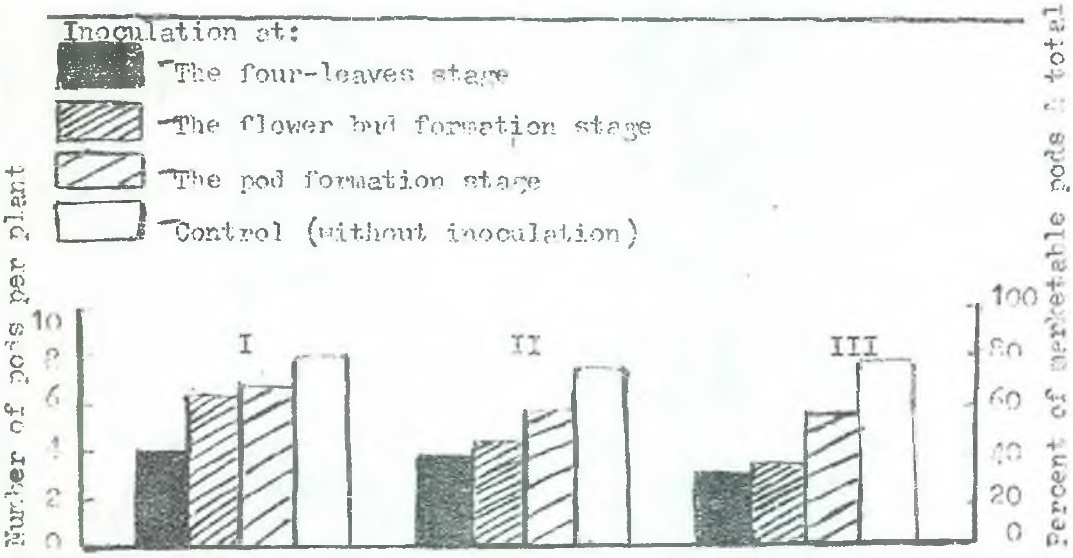

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Fig. No. 4. The influence of TMV infection at different growth stages of plants on the pepper pods yield. I, number of pods; II, weight of pods; III, percent of markotable pods. The average numbers from 4 repetitons, 20 plants each, are represented.

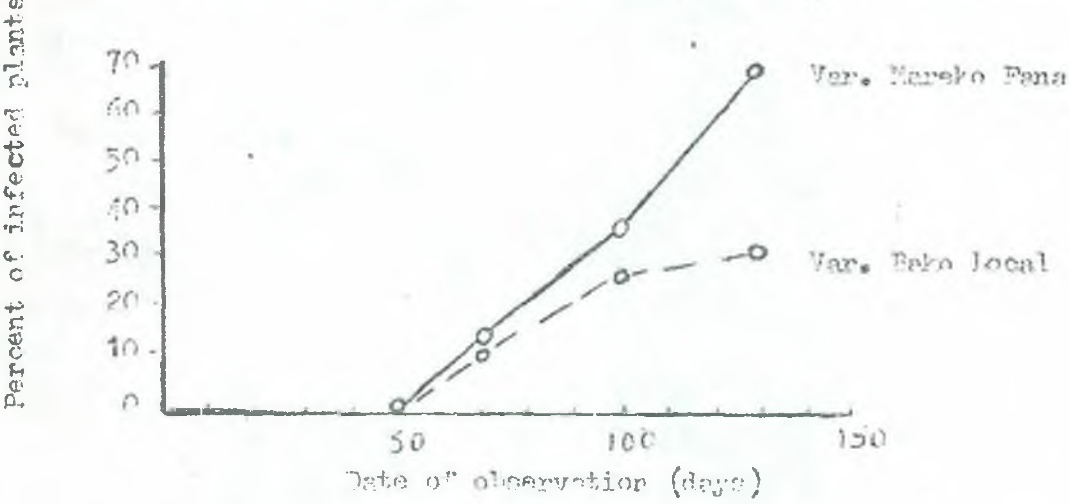

Fig. No. 5. Dynamics of TMV spreading on pepper in field conditions. The average percent of infected plants from 4 repetitions, 100 plants each, is presented.

Results and discussion

The surveys have been conducted since 1977 at different locations in major pepper growing areas. The presence of PVY on pepper crops was observed in 1977 in Shewa and Sidamo Administrative Regions , at Bako, Didesa, Shashemene, Sodo, Tendaho, Debre Zeit, Melkawerer, and Nazret (8). In accordance with the previous results (1), the evaluation of the percents of infestation and yield losses gave values of 100% and 50%, respectively.

In 1978 the infestation of TMV on pepper has been revealed in Ambo and Guder regions(9).

The three virus diseases were described in Shewa Administrative Region in 1979 at Ambo, Guder, Ziway and Awasa. The causal agents were identified as PVY, TMV, and CMV (10).

In 1980, TEV was found in pepper samples from Guder state farm. Pepper crops at Tibilla and Awasa-Melkasa were shown to be infested with AMV and PVMV, respectively (11). The latter virus has previously been described only in Ghana, where the PVMV disease causes significant yield losses in naturally infected Capsicum annum and C. frutescens (2). In 1981 the presence of TMV was observed in Welega Administrative Regions (pepper crops at the state farms Didesa, Beredar, and Anger). The infestation at the time of the survey was relatively low (9-10%). At the same time, pepper in Kefa (state farm Godjab) and Sidamo (Awasa Research Station) appeared to be highly infested with CMV. Thus, up to 30% of plants in the field contained the symptoms of virus infection (12).

In the last years severe infestations (up to 70-100%) have been reported for the state farms Didesa, Anger and Uke in Welega Administrative Region, and for Guder, Gibe, and Mareko regions in Shewa Administrative Region (13). Besides the common TMV strain, two other strains, namely ribgrass and tomato streak, were identified by serological and indicator host methods. Some thread-like virus particles were also observed under electron microscope upon the sample analysis. The same results were obtained this year upon electron microscopy of the pepper samples obtained from Guder. The further separation and identification of viruses will be continued.

The other direction of SPL research activities was the development of the control measures against seed-transmittable virus infection of pepper. It has been reported previously that TMV can be absor ed on the pepper seeds surface and thus transmitted through seeds (14). The solutions of HCI, $KMnO_4$, Na_3PO_4 and NaOH were used at different concentrations and application times for elimination of TMV from seeds (10-13). The trials has been conducted at Ambo and Didesa. The best results (70-100% decrease of infection as compared with water-treated control) were obtained for treatments with 10% Na_3PO_4 solutions for 30 min.

This year the work on control measures against viruses affecting pepper will be continued in view of applying of rapid and valid methods for their diagnostics, including the ELISA test.

The data of the studies of pepper virus diseases obtained in 1983, are summarized in the next chapter.

Survey

The survey was conducted at Bako Research Station and Mareko areas. Samples were collected from farmer's fields located along the road from Butajira to Ziway. These samples have shown the systemic mosaic and vein clearing upon the inoculation of indicator host *Datura stramonium*. The reaction was shown to be the same for all three samples. The samples from Bako produced local lesions upon the *Nicotiana glutinosa* inoculation. These data are in a good agreement with the results of last year.

Control measures against virus diseases in hot pepper

Some novel data on tobacco mosaic virus (TMV) infection in pepper were obtained from the two trials layed out at Ambo greenhouse (vegetation pots variant) and in field conditions.

Green-house trial

The influence of TMV infection at different stages of pepper growth on the yield of pods was evaluated both quantitatively and qualitatively. The data of this study are summarized in Fig. 4.

Thus, the infection of pepper plants with TMV at all the vegetation stages leads to the loss of yield both quantitatively and qualitatively. It should be noted that the virus infection at the earlier stages causes the most drastic loss of pod yield.

Field trial

The dynamics of TMV spreading from the infected pepper plants to the healthy ones were studied. The experiments were started in January 6, 1983 and conducted upto June 2, 1983. Four repetitive plots, 100 plants each, were used for pepper varieties, Mareko Fana and Bako Local, respectively. One TMV-infected plant was spaced with four healthy ones. The plots were cultiveted manually. The occurence of TMV was monitored by serological and incator-plant tests. The results of these experiments are summarized in Fig. No. 5.

The spread of TMV was observed after 2 months from the sowing date. The number of infected plants significantly increased upon the vegetation of pepper. Taking into account the requirements in cultivation during the whole vegetation period, the high level of TMV distribution could be explained by the continued contacts between infected and healthy plants through the field workers.

Therefore, the systemic screening of plants with the visual symptoms of virus diseases appears to be the most effective control on the field.

Chemical control of virus vectors

Evaluation of effectiveness of three insecticides (temic, Furadan and Astelic) against the TMV vectors (aphids) was conducted in greenhouse conditions.

All the pesticides were found to be extremely effective (up tc 95-100%, see Table 1).

Table 1. Chemical control of virus vectors

Treatment	Rates Kg a.i./ha	Mortality of aphids (%) with correction for the check after treatment			
		in 5 days	in 10 days	in 30 days	in 60 days
1. Furadan 10G	4.0	94.3	100	100	100
2. Temik 15G	3.4	95.1	100	100	100
3. Actellik 50EC	1.0	96.0	100	-*	-*

* Not tested

References

1. Villalon B. 1980. Breeding Peppers to Resist Virus Diseases. Plant Disease V.65, N7, 557-567.

2. Brunt A.A. and Kenten R.H. 1972. Pepper Veinal Mottle Virus. Descr. Plant Viruses N104.

3. Gibbs A.J. and Harrison B.D. 1970. Cucumber Mosaic Virus. Descr. Plant Viruses N 1.

4. Shepherd R.J. and Purcifull D.E. 1971. Tobacco Etch Virus. Descr. Plant Viruses N 55.

5. Zaitlin M. and Izrael H.W. 1975. Tobacco Mosaic Virus. Descr. Plant Viruses N 151.

6. Stewart R.B. and Dagnatchew Yirgou 1968. Index of Plant Diseases in Ethiopia.

7. Gibbs A.J. and Harrison B.D. 1976. Plant Virology. The Principles. Edward Arnold, London.

8. Progr. Rep. SPL, 1977, pp 52-62.

9. Progr. Rep. SPL 1978, pp 106-121.

10. Progr. Rep. SPL 1979, pp 19-24.

11. Progr. Rep. SPL 1980, pp 106-112.

12. Progr. Rep. SPL 1981, pp 64-68.

13. Progr. Rep. SPL 1982, pp 102-106.

14. Tosic M. et al. 1981. Transmission of Tobacco Mosaic Virus through seeds of pepper (capsicum annum L.). Phytopathol. Zeitschrift. v. 97, N 1, 10-13.

PC/WS 21.5.82 Survey of weed infestation on major cereals growing in Ambo area

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Introduction:

Determination of weed species composition and level of infestation of crops plays a great role for working out the most effective methods of weed control (the pepper choice of herbicides, times, rates and methods of their application, optimum tillage, crop rotation, etc). At the same time the survey data are necessary for definition of herbicides requirements and for their rational distribution in different regions of the country. Therefore, SPL has been carrying out survey of weed infestation in the major cereals during last year.

Materials and methods:

- Season - rain seasons, 1980-1983
- Location - production fields of the SPL, Guder State Farm, Ambo Agricultural College, co-operative and peasant farms of Ambo region.

Results and Disuussion:

Wheat

In October broad leaved weeds, mainly, Guizotia scabra, Medicago fulcata, polygonum nepalense, Plantago lanceolata, and Sinapis arvensis were prevalent in all observed fields, except Ambo. Among grasses Phalaris paradoxa, Snowdenia polystachya and Setaria pallide-fusca were the most spread. Around Ambo grasses accounted for more than 50%. With rise of the altitude Galinsoga parviflora, P. lanceolata, S. pallide-fusca and Lolium temulentum completely disappeared and, on contrary, frequency of P. nepalense, Bidens pilosa and Avena spp. increased (Table 1). The infestation of farmer's plots was 3-5 degrees, fields of SPL and Agricultural College were invaded by weeds significantly less.

Barley

More than 20 main weed species were found in barley fields. Dicotyledonous were predominant over grasses independently upon the region of barley production. Weed flora composition was the same as in wheat.

In dry season (October) the total amount of grasses increased, because a great number of broad leaved weeds finshed their vegetation, whereas L. temulentum, Ph.padoxa, S.polystachya, Avena spp. and Setaria spp. continued to grow.

Hard eradicated weed Cyperus rotundus (15-20%) was observed near from Guder (Table 2).

Tef

Tef fields were highly infested by G.scabra, P.nepalense, G.parviflora, M.fulcata, P.lanceolata, Ph.paradoxa, Digitaria scalarum, S.pallide-fusca and S.polystachya. Cyperus rotundus occured in fields around Guder and Worka very frequently. Relative quantity of grasses increased here in comparison with other crops. Any general correlation between distribution of weed species and altitude has not been revealed. (Table 3).

Maize and sorghum

Broad leaved weeds were predominant in maize and sorghum fields as well as in other crops. Among them P.nepalense, G.parvoflora, Commelina benghalensis, M. fulcata, G.scabra, Trifolium spp. and P. lanceolata were prevailed. From grasses only Ph. paradoxa and S.polystachya were presented. Maize in surroundings of Bako was infested to a great extent by C.rotundus (Table 4).

Parasitic weeds from Striga and Cuscuta genuses were not discovered. However, Orobanche minor occured sometimes on the SPL experimental fields.

For these years some new weed species such as Achiranthus aspera, Neslia paniculatum, Rhynchelytrum repens, Alchemilla fisheri, Brachiaria birantha, Medicago polymorpha, Plectranthus spp. and Erlandia cardiofolia were collected and identified to supplement SPL herbarium which includes 326 species.

Conclusion and Recommendation

More than 30 main weed species were found in cereals of Ambo region. In the first part of the vegetative period broad leaved weeds, especially, Galinsoga parviflora, Polygonum nepalense, Sinapis arvensis, Commelina benghalensis, Bidens pilosa, Plantago lanceolata and Trifolium spp. were the most spread and harmful in cereals. In the second part of the field season Guizotia scabra, Medicago fulcata, Phalaris paradoxa, Setaria pallide-fusca and Snowdenia polystachya grew very intensively and created a great problem in crop production. They produce high biomass and being good competitors supress small cereals, such as tef, wheat and barley to a great extent. Therefore, it is necessary to apply nonselective herbicides with long action, their mixtures and combinations to control weeds in crops.

Table 1. Weed infestation of wheat in Ambo region, frequency, % (time of observation - October)

	Weed species	Guder 2000 m	Worka 2250 m	Ambo 2300 m	Gedo 2500 m	Ginchi 2800 m	Dendy 2800 m
1.	Polygonum nepalense	-	-	7-12	5-10	15-20	5-10
2.	Plantago lanceolata	5-10	10-15	5-10	5-10	-	-
3.	Medicago fulcata	5-10	10-15	5-10	5-10	5-10	5-10
4.	Rumex abyss	5	-	-	5	-	5
5.	Cynodon dactylon	5-10	-	-	-	-	-
6.	Sonchus spp.	5-10	-	5	5	-	-
7.	Bidens pilosa	5-10	-	-	-	20-25	5-10
8.	Galinsoga parviflora	5-10	5-10	5	5-10	-	-
9.	Digitaria scalarum	5-10	-	-	5-10	-	-
10.	Setaria pallidefusca	-510	5-10	5-10	5-10	-	-
11.	Sinapis arvensis	5-10	-	5-10	-	5	5-10
12.	Andropogon abyss	5	-	5-10	5	-	-
13.	Euphorbia hirta	-	5-10	-	-	-	5-10
14.	Guizotia scabra	5-10	10-15	10-15	5-10	5-10	5-10
15.	Gallium spurium	-	5-10	-	-	-	5-10
16.	Lolium temulentum	-	10-15	7-12	5-10	-	-
17.	Phalaris paradoxa	10-15	5-10	15-20	5-10	15-20	5-10
18.	Avena spp.	-	-	-	-	10-15	5-10
19.	Snowdenia polystachya	5	5-10	10-15	10-15	5-10	5-10

Table 2. Weed infestation of barley in Ambo region, frequency, %

	Weed Species	Guder 2000 July	Guder 2000 October	Metty 2250 July	Ambo 2300 July	Ambo 2300 October	Galisa 2950 October
1.	Galinsoga parviflora	15-20	-	10-15	5-10	5-10	-
2.	Cyperus rotundus	15-20	-	-	-	-	-
3.	Trifolium spp.	5-10	-	10-15	5-10	-	5-10
4.	Medicago fulcata	5-10	10-15	-	5	10-15	-
5.	Polygonum nepalense	15-20	10-15	5-10	10-15	10-15	10-15
6.	Guizotia scabra	5-10	10-15	-	-	5-10	5-10
7.	Datura stramonium	10-15	-	5-10	-	-	-
8.	Amaranthus retroflexus	10-15	-	5-10	5-10	-	-
9.	Nicandra physaloides	5-10	-	-	5-10	-	-
10.	Commelina benghalensis	5	-	-	5-10	-	-
11.	Scorpiurus sulcata	-	-	-	-	-	-
12.	Plantago lanceolata	5	5-10	-	5-10	5-10	-
13.	Sonchus spp.	-	-	10-15	-	5-10	-
14.	Lolium temulentum	-	5-10	10-15	-	5	5-10
15.	Phalaris paradoxa	-	5-10	10-15	5-10	5-10	5-10
16.	Euphorbia hirta	-	-	10-15	-	-	10-15
17.	Brassica spp.	-	5	-	5-10	5-10	5
18.	Bidens pilosa	-	5-10	-	-	5-10	5-10
19.	Matricaria spp.	-	5-10	-	-	-	-
20.	Snowdenia polystachya	-	5-10	-	5-10	10-15	5-10
21.	Avena spp.	-	-	-	-	-	10-15
22.	Setaria spp.	-	-	-	-	-	5-10
23.	Rumex abyss	-	-	-	-	-	5-10

Table 3. Weed infestation of tef in Ambo region, frequency, %

	Weed Species	Guder 2000 August	Guder 2000 October	Worka 2250 October	Metty 2250 October	Ambo 2300 October	Gedo 2500 October	Dendy 2800 September
1.	Phalaris paradoxa	5-10	5-10	15-20	10-15	10-15	10-15	15-20
2.	Galinsoga parviflora	13-18	15-20	-	-	5	5-10	10-15
3.	Cyperus rotundus	13-18	-	20-25	-	-	-	-
4.	Guizotia scabra	13-18	5-10	15-20	10-15	10-15	10-15	10-15
5.	Cynodon dactylon	10-15	5-10	-	-	-	-	-
6.	Polygonum nepalense	13-18	5-10	20-25	-	13-18	13-18	10-15
7.	Digitaria scalarum	13-18	5-10	-	10-15	-	5-10	5-10
8.	Commelina benghalensis	-	10-15	-	5-10	5-10	-	-
9.	Plantago lanceolata	-	5-10	-	-	5-10	5	10-15
10.	Setaria pallidefusca	-	10-15	-	5-10	5-10	5-10	-
11.	Medicago fulcata	-	-	10-15	5-10	8-13	5-10	-
12.	Trifolium spp.	-	-	5-10	-	-	5-10	-
13.	Brassica spp.	-	-	-	5-10	-	-	-
14.	Andropogon abyss.	-	-	-	-	5-10	5-10	-
15.	Snowdenia polystachya	-	-	5-10	5-10	5-10	5-10	-
16.	Ageratum conizoides	-	-	-	10-15	-	-	-
17.	Rumex abyss.	-	-	-	-	-	-	15-20

Table 4. Weed infestation of maize in Ambo region, frequency, %

	Weed Species	Ijaji 1800 October	Guder 2000 August	Worka 2250 October	Ambo 2300 June	Ambo 2300 October	Bako 1650 June
1.	Commelina benghalensis	10-15	10-15	-	5-10	-	15-20
2.	Amaranthus spp.	5	5	-	5-10	-	-
3.	Galinsoga parviflora	5-10	10-15	-	10-15	5-10	15-20
4.	Cyperus rotundus	5-10	5-10	-	-	-	15-20
5.	Polygonum nepalense	10-15	10-15	-	10-15	5-10	5-10
6.	Trifolium spp.	-	5-10	10-15	5	-	-
7.	Medicago fulcata	5-10	5-10	15-20	-	5-10	-
8.	Phalaris paradoxa	5-10	5-10	25-30	-	10-15	-
9.	Guizotia scabra	10-15	5-10	20-25	-	15-20	10-15
10.	Plantago lanceolata	-	5-10	5-10	10-15	5-10	5-10
11.	Sonchus spp.	-	5	-	5-10	5-10	-
12.	Snowdenia polystachya	10-15	5-10	5-10	-	15-20	-
13.	Nicandra physaloides	-	-	-	5-10	-	5-10
14.	Scorpiurus sulcata	-	-	-	5-10	-	5-10
15.	Sinapis arvensis	-	-	-	5-10	5-10	-
16.	Convolvulus arvensis	-	-	-	10-15	-	-

Ba/WS 26 (82) Studying effectiveness of different herbicides and their mixtures to control weeds in barley

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Introduction

Research findings in testing different herbicides and their mixtures to control weeds in barley fields have been carried out by Ethiopian research stations. Optimum rates, time and methods of herbicides application were determined for some climatic zones of the country. However, it is very important to continue similar investigations in other climatic conditions, since every region is characterized by specific weed composition, level of infestation, nature of interaction between weeds and agricultural crops. Therefore, the effectiveness of applied herbicides will be different, also.

In this connection in 1981 SPL started to test some herbicides in barley trial with the aim to determine the new promising chemicals, to ascertain rates, times and selectivity of recommended herbicides and to evaluate their profitability in Ambo region.

Materials and methods

- Season - 1981-1983
- Location - SPL experimental field, Ambo
- Design - 4 replications, randomized plots.
  Plot size - 20 m
  Seed rate - 3.0 mln of grains per ha.
  Sowing date - June
  Variety - IAR (H) 485
  Harvest - October - November
- Treatments - different rates and times of application of 7 herbicides (Terbutrine, U-46, Blefit, Basagran, Tribunil, Metoxuron, Fluorodifen) were tested. Barley seedlings were sprayed by Dimecron against barley fly two times.

- Observations - score of plant density, visual score of herbicides effectiveness after 2 and 5 weeks, using EWRC scale; quantity
- weight assessment of weeds on plots $0.25m^2$ in 4 replications.

Results and discussion

In 1981-1982 weed infestation of barley crop was relatively low, about 1000g of fresh mass per m^2. Broad leaved weeds prevailed significantly over grasses. In 1983 the level of infestation was very high, 99 plants or 2277g per m^2. Dicotiledonous accounted for 50% (Table 1).

For three years observations *Phalaris paradoxa*, *Polygonum nepalense*, *Snowdenia polystachya*, *Guizotia scabra*, *sinapis arvensis*, *Amaranthus retroflexus* and *Nicandra physaloides* were the most spread and harmful weeds.

The effectiveness of studied herbicides was in great dependence with weed composition. The best results were obtained at the treatments of nonselective chemicals, such as Terbutrine and Fluorodifen applied pre-emergence. Treated plots were clean during 5 weeks after herbicides application, and in three months weeds quantity was less by 70 and 80% respectively, in comparison with the untreated control (Table 2).

Table 2. Effectiveness of herbicides application

Herbicides	Weed control, %								
	2 weeks after application (visual score)			5 weeks after application (visual score)			3 months after application (quantity Wt. assess.)		
	1981	1982	1983	1981	1982	1983	1981	1982	1983
Terbutrine, pre-emergence	100	100	100	90	90	100	46	56	70
Terbutrine, 3 leaf stage	95	90	95	60	50	75	46	50	67
Blefit	60	20	70	50	0	60	50	0	54
Fluorodifen	-	100	100		95	100	-	79	80
Tribunil	-	-	80		-	60	-	-	59
Metoxuron	-	-	75	-	-	60	-	-	55

Broad leaved weeds as well as grasses were well controlled. However, the latest and largest wild plants Ph.paradoxa, S.Polystachya and G.scabra proved to be resistant to these herbicides. Cyanotis spp.,P.nepalense and Scorpiurus sulcata regrew fast in the case of Terbutrine application. Blefit, Basagran, U-46, Tribunil and Metoxuron showed a weak heribcidal action.

All tested herbicides, except Terbutrine, were safe for barley plants. Blefit, U-46, Basagran, Metoxuron and Tribunil had no negative influence on barley. After Fluorodifen application white necrotic spots in the middle of low leaves and wilting took place. These signs dissapeared to the end of tillering stage. Terbutrine applied just after sowing induced plant dying off on flat places and slopes by 5% and on microdepressions more than 50%. At the post-emergence application of Terbutrine the total mortality of crops ranged from 5 to 40%.

Terbutrine and especially, Fluorodifen, applied pre-emergence provided the best yield increaments in comparison with other herbicides, even under conditions of 1983. This year very low yield of barley due to heavy water-logging and high level of infestation was obtained(Table 3).

Table 3. Barley yield, Q/ha

Treatments	Yield, Q/ha		
	1981	1982	1983
1. Control	18.7	21.4	4.5
2. Two hand weedings	28.2	25.9	7.5
3. Terbutrine, 0.75 - 1.0 Kg a.i./ha pre-emergence	27.9	28.5	8.5
4. Terbutrine, 0.75 Kg a.i./ha, 3 leaves stage	was scrap	29.7	5.2
5. Blefit, 1.5 kg a.i./ha, tillering	28.9	22.0	-
6. Blefit, 2.0 kg a.i./ha tillering	27.1	22.8	4.4
7. Fluorodifen, 2.5 kg a.i./ha, pre-emergence	-	28.9	16.7
8. Tribunil, 2.0 kg a.i. /ha 3 leave stage	-	-	7.2
9. Metoxuron, 1.5 kg a.i. /ha 3 leaves stage	-	-	5.0
LSD (5%)	3.8	4.4	0.7

Two handweedings reduced the general infestation by 50-60% and provided significant yield increaments. However, it is not possible to recommend handweedings to weed control, as a main control measure, because in this case where is very low recoupment and profitableness of additional expenditures.

Conclusion and recommendations

Phalaris paradoxa, *Polygonum nepalense*, *Snowdenia polystachya*, *Guizotia scabra*, *Sinapis arvensis*, *Amaranthus retroflexus* and *Nicandra physaloides* were the ~~most~~ spread and harmfull weeds in barley fields.

Among tested herbicides Terbutrine at the rate of 0.75 - 1.00 kg a.i./ha. Pre-emergence and Fluorodifen at the rate of 2.5 kg a.i./ha, pre-emergence were the most effective. They provided good weed control and the significant increaments of barley yield. Handweedings were less effective.

The latest and largest weeds, such as *Ph.paradoxa*, *S.polystachya* and *G.scabra* proved to be resistant to these herbicides. Therefore, it is necessary to continue testing new chemicals and, especially, different mixtures and combinations (split-application) in barley fields.

Table 1. Weed composition and level of weed infestation in 1981 - 1983

Weed species	Weight of fresh biomass, g/m^2					
	1981		1982		1983	
	g	%	g	%	g	%
Total weeds	1036	100	1020	100	2277	100
Broad leaved weeds	650	63	894	88	1147	50
Polygonum nepalense	218	21	371	36	201	9
Plantago lanceolata	120	12	6	1	45	2
Scorpiurus sulcata	138	13	5	-	44	2
Commelina benghalensis	40	4	-	-	9	-
Sonchus spp.	28	3	-	-	11	-
Trifolium spp.	24	2	24	2	16	-
Amaranthus retroflexus	-	-	135	13	100	4
Nicandra physaloides	-	-	133	13	99	4
Sinapis arvensis	14	1	108	11	124	5
Galinsoga parviflora	-	-	104	10	59	3
Medicago fulcata	-	-	-	-	103	5
Guizotia scabra	66	6	8	1	321	14
Other dicotiledonous	2	-	-	-	15	-
Grasses	386	37	126	12	1130	50
Snowdenia polystachya	-	-	103	10	350	15
Phalaris paradoxa	386	37	23	2	669	30
Setaria pallidefusca	-	-	-	-	111	5

Sericulture programme in Ethiopia

Introduction

Mulberry (MORUS) leaf, the food material for silk worms is the agricultural part of sericulture which plays a significant role in determining the production cost of cocoons and fruits which are also very important for making citric acid jam & Jelly.

Belli (1947) reported that mulberry cultivation had been carredd out at 30 localities between altitudes 1600-2000m. distributed from Harer, Jima(Mizan) Nekemte, Asmera to Gonder. Among the eleven mulberry experimental sites Adi Ugri, Keren, Kobo, Mizan Teferi, Addis Abeba and a much better nursery was prepared at Indibir and was planted with the best Italian, Japanese and Chinese varieties. Breeding of silk worms was carried out at Addis Abeba, Adwa, Adi Ugri and Mizan. Eventhough, the experiment was intrupted by the World War II Belli concluded that:-

- Mulberry grows in all parts of Ethiopia
- Favourable areas for sericulture vary from altitudes 1400-1900m above sea level and 1600-2000 mm rainfall.
- Breeding is posssible if worms are protected against night cold. At various areas peasants had shown nterest in cocoon production. Results of these experiments were considered satisfactory.

The potential for the production and improvement of sericulture in Ethiopia is great, and the resources are untouched. Today, the IAR is the only institution in the country to conduct a modest sericulture programme on the breeding of silk worms and analyzing silk fibre on scientific lines since 1980.

Silk is a highly profitable cash crop that can produce a very big return from small unit area of land. A peasant family can produce its cash requirements from small portion of the farm releasing most of it for other food crops. Demand for silk is world wide. it is highly liked from the local weavers to top fashion designers for its sheen, granular, beauty and class. Silk cocoons can be sold as a raw material or it can also be processed into a silk garment, creating jobs, also serving as a source of a revenue fromsale of bulk garments.

A sound raw silk cottage industry involves mulberry production, silk worm rearing and silk processing not only creates badly needed jobs but plays as much enough to keep the industry running.

From our practical point of view many Ethiopians are already familiar with spinning of other fabrics so that they can adopt the necessary skills of spinning silk very easily.

The objective

To introduce sericulture/silk production/to Ethiopia where the country has high potential in cocoon production as follows:-

- To apply proper agronomical practices to mulberry plants so that leaf alatability to worms will be increased and the ratio of cocoon produced could be determined

- To start a modest programme on silk worm breeding to produce a reliable source superior quality and disease free layings/seeds.

- To produce reeled and spun silk materials for weaving into fabrics.

- To train technicians at various levels of sericulture.

Methodology

Various farm implements and practical methods have been used to maximize mulberry leaf yield and besides those, the required laboratory equipment have been arranged for silk worm rearing section to produce healthy seeds. Indian standard method is used in silk processing.

Results and discussion

As it is stated earlier, the first silk worm rearing was conducted in 1980 with Polish Polyhybrid seed which produces superior quality silk but it consumes more leaf and also requires more care. In the same year, rearing was conducted with Indian bivoltine seed which produces quality cocoons and is also completely adapting to Ethiopian climatical conditions. Mass selection method is used for breeding the first four generations. No break of the lines were observed. For further investigation rearing on line has been continued to 13^{th} generation and for the new breed NB_{18} X NB_7 rearing has been continued to 7^{th} generation, were imported in March 1983.

Effect of various agronomical practices have been studied on mulberry plant at NRS to determine leaf yield per unit area of land and also to see its effect on cocoon production. With the application of proper cultural practices upto 28,000 kgs. of leaf was harvested with mean harvest of 5 to 6 crops. During the first year of plantation 15,000 kgs. of leaf was harvested which produced 930 kgs. of cocoons.

The basic fibre tests and recordings have been made in silk processing section onsmall hand operated reeling machines locally constructed by WADU. The tests show that the qualitative and eveness of the fibre remains in its original performance and can be made into any desired fabrics or designed fashions.

Status of research on sericulture & identified problems

Recognizing the great importance of sericulture in general, the progress in the research is not as satisfactory as it was expected to be. Sericulture was established during 1980/81 budget year, and there are certain problems which have remained important constraints to the rapid expansion of research activities on sericulture. (Basic problems mainly are:-)

1. Shortage of experienced staff in (a) silk worm breeding and seed production. (b) silk processing section.

2. Shortage of grainage (silk worm breeding equipment).

3. Relying on imported silk worm eggs.

4. Insufficient varieties of mulberry leaf. (One variety only)

Comparison of results obtained at CSR & TI (Mysore) & NRS

Table 1. Rearing performance of NB$_{18}$ X NB$_7$ at Mysore

Race NB$_{18}$	No. of eggs per laying	% hatching	Wt. of 10 larvae (gms)	Larval period		Yield per 10,000 larvae brushed		Single cocoon Wt. (gm)	Single shell Wt. (gm)	Silk ratio %
				Day	Hours	#	Wt. (kg)			
"	525	93.7	43.3	24	06	6734	10.306	1.567	0.349	22.3
"	415	88.8	38.9	25	08	4972	7.978	1.706	0.365	21.3
"	582	93.8	43.1	26	13	6603	11.867	1.737	0.366	21.1
"	587	94.5	38.1	32	00	7726	9.899	1.284	0.272	21.0
"	498	95.6	53.6	27	20	7108	15.11	2.193	0.487	22.4
NB$_7$	523	88	42.3	25	06	8006	11.139	1.570	0.361	22.9
"	421	85.7	39.2	25	00	5096	7.506	1.567	0.292	18.6
"	518	90	42	26	18	6710	11.77	1.805	0.396	22.0

Source CSR and TI, progress report 1981/82

Table 2. Rearing performance of NB $_{18}$ X NB$_7$ at NRS (1st-6th generations)

Race NB$_{18}$ x D$_7$	No. of eggs per laying	% hatching	Wt. of 10 larvae (gms)	Larval period		Yield per 10, 000 larvae brushed		Single cocoon Wt. (gm)	Single shell Wt. (gm)	Silk ratio %
				Day	Hours	#	Wt. (kg)			
Origin	502	90	49.05	28	10	7816	14.00	1.36	0.46	21.6
1st crop	519	86	39.4	30	9	8101	11.00	1.40	0.35	20.0
2nd "	480	85	46.4	29	20	7909	13.69	1.39	0.41	21.4
3rd "	491	88	47.4	31	18	8608	11.36	1.78	0.45	21.3
4th "	538	91	43.0	30	23	8400	13.60	1.88	0.42	21.0
5th "	508	84	39.0	29	19	7400	10.16	1.30	0.35	18.0
6th "	513	93	43.5	28	12	7711	11.23	1.72	0.40	20.9

Table 3. Rearing performance of NB_{18} X NB_7 at NRS 7^{th} - 10^{th} (generation)

Race NB_{18} X D_7	No. of eggs per laying	% hatching	Wt. of 10 larvae(gms)	Larval period		Yield per 10,000 larvae brushed		Single cocoon Wt. (gm)	Single shell Wt. (gm)	Silk ratio %
				Day	Hours	No.	Wt. (kg)			
7^{th} crop	485	80	41	30	20	-	-	1.604	0.36	21.42
8^{th} crop	495	75	30	31	00	9370	15.8	1.621	0.36	22.20
9^{th} crop	519	82	47	31	15	8500	10.0	2.00	0.400	20.00
10^{th} crop	417	88	39	30	18	8601	11.20	1.680	0.340	21.18

Future plans

1) To establish cottage industries, the return is very big per unit area of land.

2) To establish settlement schemes, either by the Government or co-operatives. Old age, disabled and even children can be engaged in the work.

3) To establish the programme to farmers training centers like ARDU, Agarfa, Gegnooh Amba, Ministry of Agriculture etc....through proper channels.

4) To explore the possibility of using sericulture in diversification.

Conclusion

From our experience of planning period and preparation stages the data collected during the course of sericulture programmes at Nazret Research Station are highly encouraging to establish sericulture industry in Ethiopia at various ecological conditions.

Kirishnaswami (1978) reported that inorder to encourage and popularize cottage industry on this line, and to increase the net profit earned per unit area of land from sericulture and compete with some other agricultural or commercial crops like coffee and cotton in developing countries like Ethiopia where the average income is low.

Hugues (1982) reported that sericulture research activities require more investment interms of:-

1) Training research personnel at various levels of sericulture technology as early as possible.

2) Improving sericulture research facilities

3) Extension of the research work at various Government Institutions, like training centers, ARDU and WADU.... etc.

BACKGROUND

It is now six years since the first effective step to organize the Editorial Board (EB) of the Ethiopian Journal of Agricultural Sciences (EJAS) was taken by the Eleventh National Crop Improvement Conference (NCIC), 25-27 April, 1978, and five years since the first historic issue of the EJAS was published in January, 1979. In this brief report attempts would be made to recapture some of the accomplishments of the EJAS in general, and that of the EB for the 1983/84 period, in particular. (The major activities of the EB for the 1982/83 period were reported during the Fifteenth NCIC (April 1, 1983).

The first EB which consisted of:-

Editor	Brhane G/Kidane	- Plant Breeding	-A.A.U.*
Assoc. Editor	Taye Bezuneh	- Horticulture	- "
Secretary	Lakew Birke	- Agr.Economics	-E.S.T.C.
Treasurer	Asrat Tefera	- "	-M.C.T.D.
Members	Dereje Ashagari	- Plant Pathology	-M.S.F.D.
	Hailu Kassa	- Animal Science	-M.O.A.
	Mesfin Abebe	- Soil Science	-I.A.R.
	Solomon H/Mariam	- Veterinary Science	-M.O.A.

reached agreement on the name, objectives, content, organization and frequency of publication of the Journal, Finally after three years of outstanding service and having published three issues of the EJAS, the first EB left office on April 2, 1982, at the Fourteenth NCIC, which elected the current members of the Board. These included:-

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*A.A.U Addis Abeba University
E.S.T.C. Ethiopian Science and Technology Commission
I.A.R. Institute of Agricultural Research
M.C.T.D. Ministry of Coffee and Tea Development
M.O.A. Ministry of Agriculture
M.S.F.D. Ministry of State Farms Development

Editor	Mesfin Abebe	-Soil Science	-I.A.R.
Assoc. Editor	Feseha Gebre-Ab	-Veterinary Science	-A.A.U.
Secretary	Mulugetta Mekuria	-Socio-Economics	-I.A.R.
Treasurer	Asfaw Zeleke	-Horticulture	-A.A.U.
Distrib.Officer	Tessema Megenassa	-Crop Protection	-A.A.U.
Members	Beyene Chichaibelu	-Animal Science	-A.A.U.
	Biru Abebe	-Field Crops	-I.A.R.
	Desta Hamito	-Biometrics	-M.C.T.D.
	Mesfin Ameha	-Coffee Breeding	-I.A.R.
	Tesfaye Tessema	-Field Crops	-A.A.U.

As in the past, attempts were made to have a wide spectrum of disciplines represented in the EB and because of the felt need for a biometrican and a publication and distribution officer, the number of the EB was raised from eight to ten.

HIGHLIGHTS OF ACTIVITIES

During the 1983/84 period, the EB through its monthly meetings, has deliberated and acted upon a number of important issues and the following constitute the salient activities.

MEETINGS

Consistent with past tradition, the EB met once every month to:-

a) evaluate and screen manuscripts that are submitted for possible publication in the EJAS;

b) suggest reviewers for those manuscripts which the EB felt might merit closer professional serutiny·

c) determine a manuscript's prospects of publication once it is received from the reviewers. This involves either acceptance or rejection of the paper, which is duely communicated to the author(s). In the case of divergent decisions by the reviewers,

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the paper is sent to another reviewer or scrutinized by one or more of the EB members who have the competence in the discipline. Finally, the comments of the reviewers and the marked copies are sent to the author(s) for inclusion in the final manuscript;

d) follow-up the status of manuscripts that are with reviewers and/or the printers. Reminders are sent to reviewers to return the article within eight weeks after receipt should they feel incompetent or are unable to review the paper within the set dead-line;

e) augment the funds obtained from the co-sponsors- the Addis Abeba University (AAU) and the Institute of Agricultural Research (IAR). As a result, a number of government and international organizations were approached. Complimentary copies of the hitherto published issues of the Journal were provided so that potential donors could appraise the contents and importance of the EJAS.

MANUSCRIPTS

Through the relentless effort of the EB, a few dedicated reviewers, and an appreciation by a small sector of the agricultural community of the impact that a scientific agricultural journal has on agricultural development, the EJAS is almost up-to-date with the present publication of Vol.V (1983). Enough articles are now with the EB and/or reviewers for the forthcoming Vol. VI (1984). This is rather encouraging when one views the short history of the EJAS which was beleaguered from its birth with an array of seemingly insurmountable problems. Among these were the lack of sponsor(s) and hence finance, abscence of a home base, secretarial support and the yet undeveloped culture and/or lack of incentive (renumeration, promotion etc..) of publishing in a scientific journal.

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Out of a total of 69 articles published so far the current EB has received 63 articles out of which 30 are awaiting publication subject to reviewers professional comments and approval of the EB, while two are with the authors for modification and six are rejected. Out of the 63 total, 34 were submitted by the staff of the AAU, 21 by the IAR and 8 by others.

Of the total 63 manuscripts published by the EJAS, 10 (14.4%) are in field crops, 19(27.4%) in crop protection, 5(7.2%) in soil science, 18(25.9%) in animal sciences, 5(7.2%) in socio-economics, 6(8.7%) in horticulture and the rest constitute about 10%. From this one can discern the lopsided disciplinary distribution of the manuscripts published in the EJAS.

The reiterate our previous report, more research is conducted in field crops, horticulture, etc.. than in animal sciences, socio-economics, etc.. That the NCIC has been convening for the last fifteen years is a measure of their strength and testimony to the wealth of research findings generated by this group. Surprisingly, however, fewer papers were published in these fields and the major contribution to the EJAS was made in the areas of animal sciences and crop protection. While we laud these active groups, we urge the others to play a more vigorous role in documenting their findings in the EJAS for use by the agricultural community at large.

Of the manuscripts published so far, 60% originated from the Addis Abeba University, a predominantly teaching institution, and only 40% from the Institute of Agricultural Research, the national institution with a mandate on agricultural research. The EB commends the prolific publication of the AAU staff and wishes to alert the IAR staff, of the ever-increasing need to make their findings available to users through the EJAS. The EB realizes that a number of sound justifications could be cited for the present predicament. Nonetheless, it is difficult to reconcile the fact that many valuable research findings on which so much manpower and financial outlay have been expended remain unpublished. This would only be an excercise in futility.

The EJAS continues to be among the top accredited and recognized reputable journal by the Academic Senate Standing Committee for Research and Publication of the AAU. As a consequence, many are the AAU staff who have been promoted by publishing in the EJAS. Had such a policy been strictly adhered to by other research institutions, the above stumble-block would have been removed and the flow of publishable material would have increased as a result of such an incentive.

FUND SOLICITING

The EJAS continues to receive enthusiastic support and generous financial contributions from both sponsors; the IAR. However, to minimize the uncertainities associated with finance and to reduce undue leaning on the co-sponors, a vigorous drive was made to solicit funds both from national and international organizations.

Prominent among these were· The Ministries of Agriculture: State Farms Development, Coffee and Tea Development· Education; Commission for Higher Education; the Agricultural and Industrial Development Bank; College of Agriculture (Alemaya) and the Junior Colleges of Agriculture (Awasa, Ambo, Debre Zeit and Jima). While substantial grants have been received from some, there are indications that assistance could be forthcoming from the others in the near future.

Assistance sought from the International Development Research Center (IDRC) did not materialize due to the precondition by the Center that EJAS be amalgamated with the East African Agriculture and

Forestry Journal and that it publishes IDRC financed project reports. This was found unacceptable to the EB, because the former implies loss of the EJAS' identity and the latter, since it would be a violation of the EJAS' policy of publishing a manuscript subject to professional review. Efforts to use ILCA's facilities have so far not been successful.

When the current EB took office, not more than ten birr was left in the account of the EJAS. However, through the unreserved support of institutions such as the Ministry of State Farms Development which donated Birr 10,500.00; the Awasa Junior College of Agriculture Birr 2,000.00; and the Horticultural Development Department US $100.00; and pledged to earmark an annual contribution of US $100.00; the EJAS though in small measures, is now in a position to alleviate some of the financial burden from the AAU and IAR by publishing one or two issues, intermittently. Through such funds, the EB published both issues of Volumes III and V, while Volume IV was funded by the AAU and the IAR.

This would not have been possible were it not for the untiring efforts of Dr. Seme Debela, Head of Research and Advisory Department of MSFD, Dr. Geremew Haile, Dean of the Awasa Junior College of Agriculture and Dr. Semu Negus Haile Mariam, Head of the Horticultural Development Department of the MSFD. Thus, the EB wishes to express its appreciation and gratitude to them, and to the co-sponsors, the AAU and the IAR who are always forefront in supporting the EJAS. We hope that such support would continue and other organizations would follow suit to keep the only scientific agricultural journal of the nation viable.

DISTRIBUTION

Sales were made at the NCIC, on various seminars, workshops etc... by members of the EB and through mail

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from Debre Zeit JCA and RC. Substantial amounts of the hitterto published issues were given to the AAU, IAR, MSFD, HDD, and Awasa JCA as a compliment and a token of our appreciation for the financial contributions they made towards promoting the EJAS.

GUIDLINES

1. Statute of operation· The EB has been handling the affairs of the Journal on the implied tocit understanding of what its duties and responsibilities ought to be. However, cognizant of the need for a statute of operation, one was prepared detailing the terms of reference of each executive and other members, and in an aticipation of a Business Manager, the number of the EB is raised from ten to eleven.

2. Declaration Form: The EB has come across a few cases of plagiarism. While some were unintention. others were deliberate. To safeguard against such acts, the EB has prepared a format in which a) the institution under which the research was conducted would either vouch or disclaim the autenticity and authorship of a manuscript submitted to the EJAS and b) authors would declare as to the originality of the work and attes that the data was generated by them.

PROBLEMS FACED AND RECOMMENDATIONS

When one reflects on the short history of the EJAS, albeit the major strides it has made, it is faced with numerous and varied problems. Prominent among these were:-

MANUSCRIPTS

Despite some improvements from the past, the number of manuscripts received are not of the expected

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high standard. This particularly is disturbing when one notes the long history of agricultural research (though not by developed countries standard) and that the scientific agricultural community is perhaps the largest in the country.

Many are the authors who do not heed the "Information to Contributors" which not only is published in every issue of the EJAS but is also mailed to them along with the corrected manuscript and the professional comments of the reviewers. This by necessity has led the EB to make repeated proof-freading, and hence a delay in printing. Articles dispatched to authors are returned "corrected" with seemingly every unending and new waves of errors. What is more exasperating is that at times the required number of the articles (three) are not submitted. Addresses, tables (it is appalling and grotesque to find simple means miscalculated.) and references are not properly written, thus leading to a major overhaul of the papers by reviewers and members of the EB. The problem is compounded by the slow response of authors in returning the corrected manuscripts thereby causing further unnecessary delay in printing. To miniminize such delays. the EB was forced to shoulder the added responsibility of proofreading the gally, which normally is the responsibility of the authors.

This situation has been tolerated for fear of discouraging the yet inexperienced but potential contributors, however, the ill-practice appears to be rampant among experienced senior scientists as well. Nevertheless, with the evergrowing appreciation of the EJAS and increasing flow of manuscripts, this trend should not be allowed to continue. This would mean an outright rejection of a manuscripts by the EB prior to review, if it doesn't have proper scientific write-up and fails to conform to "Information to Contributors".

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While the right of individuals to publish in a journal of their choice should be respected, the practice of publishing in foreign journals limits the access of such information to users in the country as a whole. This not only deprives usable information but it also erodes the EJAS indirectly. Thus, in the interest of availing research findings within the country and hence enriching the EJAS, institutions involved in research should examine their publication policies vis-a-vis data generated by them.

REVIEWERS

The EJAS duely acknowledges the great service rendered by a handful of reviewers. Had it not been for their unreserved contribution, the journal would have flaundered long ago. All the sames the chronic problem of getting qualified reviewers is still with us. Even when competent reviewers are found, there has always been the unavoidable but understandable delay in returning the reviewed manuscript. Despite this, the EJAS which has been behind schedule in printing is now catching up with the publication of both issues of Volume V (1983). Even then, we urge members of the NCIC and others to play a greater role in revieweing articles, suggesting possible reviewers within and outside the country etc. In the abscence of any renumeration, we suggest that complimentary copies of the Journal be provided to reviewers, at least for the interime period until such a time that the EB in consultation with the sponsors could arrive at a workable solution.

OFFICE AND SECRETARIAL SUPPORT

The Journal, at present, is at the mercy of the few individuals who constitute the EB. Despite repeated requests for a budget and office space, the

EJAS continues to have no office, secretarial or logistic support of any kind. As a consequence the monthly meetings are held in the E.S.T.C. through the kind assistance of Dr. Lakew Birkie. and the EB duely acknowledges his contribution. Equally, due to the lack of a store, unsold copies of the Journal are kept either at the Debre Zeit JCA or in one of the offices of the Socio-Economics Department through the assistance of Ato Mulugetta Mekuria.

Having the Journal typed is beset with a host of problems which are numerous to mention. Yet, when one views EJAS, the only national journal in agriculture, in juxtaposition to some faculty journals of the AAU (Sinet, etc..) the comparison ends there. Such journals not only have full time secretaries, but possess the necessary paraphernalia such as IBM composers, IBM typewriters, office, store, filing cabinets etc. But, the EJAS thrives on the perseverance of the EB members, who not only have added institutional responsibilities, but who had to travel to Addis Abeba from such far away places as Alemaya, Bako, Debre Zeit. and Jima for monthly meetings and for executing specific assignments. Needless to say, the abscence of office, store, logistics, supportive staff has made it difficult to follow-up correspondence, typing of manuscripts, printing, sales, distribution etc. Since the distribution of the Journal is no less important than the publication, and because the arrangement instituted by the EB leaves little to be desired, we suggest that a business manager be assigned to follow up the chain of activities from typing to distribution.

The present EB has miraculously survived these stumble-blocks: however unless corrective measures are taken soon, these would in the long run be detrimental and possibly lead to the demise of the

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EJAS. Thus, the present ad-hoc arrangement which is based on good will need to be re-examined and concrete commitment made by both the AAU and the IAR.

PRODUCTION, SALES AND DISTRIBUTION

This has been handled, for the most part, by members of the EB. Due to the lack of well constituted mechanism and the limited subscription, sales have not proceeded in sufficiently vigorous pace. As a result, income from sales are not yet large enough to keep the Journal viable. This means that the Journal has to continue being subsidized and thus remain under the tutelage of the AAU and the IAR until such a time that ESAS is formed. We, therefore, recommend that this be accomplished through established institutional channel(s) and that either one of the sponsors designate an appropriate person(s) to handle this important aspect of the EJAS.

LACK OF ADEQUATE PARTICIPATION OF EB MEMBERS

Because the Journal is deficient in experience and tradition and aware of the need of close follow-up, the EB agreed to meet once every month. However, since some EB members consider service in the EJAS of low priority compared to the commitment they have to their respective institutions, it was not possible to get the full participation and involvement of all members. As a consequence, some meetings had to be cancelled despite the fact that some members come from such remote places as Alemaya, Bako and Jima.

That certain assignments are either relinquished or relegated to only a few members has aggravated the chain of problems. Therefore, it is imperative that only those individuals who are commited to serve the best interest of the Journal be elected to the EB.

It must also be borne in mind that proximity plays a vital role since constant communication has to be maintained, and this has been a hinderance in the affairs of the current EB.

Conscious of the fact that the recommendation made by the out-going EB became an issue in the 14th NCIC (April, 1982), the now out-going EB refrains from making such a recommendation of possible incoming EB members, and leaves the decision to the NCIC. However, should our advice and suggestion be sought we would only be glad to comply. The EB, however, feels that future elections be held at the Ethiopian Agricultural Research Conference (EARC) where agricultural scientists other than members of the NCIC would participate.

TERM OF OFFICE

From the experience it has acquired and that of other countries, the EB feels that two years of service is too short a time to get ones bearing and make a meaningfull contribution to the development of the Journal. Further such a rapid turnover of the EB members does not warrant lack of discontinuity and timely publication of the EJAS. Thus, we recommend that the term of office be five years, beginning with the incoming EB members.

In a final note, the EB would like to take this opportunity to thank those who, directly and/or indirectly have contributed towards the growth, development and reputability of the EJAS.

Reported By:

Mesfin Abebe

Editor

ANNEX

1.	Number of Articles Submitted to EJAS (1982-84)		63
2.	Articles with Reviewers	30	
3.	Articles Accepted for Publication	25	
4.	Articles Rejected	6	
5.	Articles with Authors for Modification	2	
		63	

DISTRIBUTION OF ARTICLES SUBMITTED BY DISCIPLINES (1982/84)

1.	Animal Sciences	13
2.	Crop Protection	13
3.	Field Crops	10
4.	Soil Science	7
5.	Veterinary Medicine	6
6.	Forage Pasture	4
7.	Germplasm Collection	2
8.	Coffee	2
9.	Oil Crops	2
10.	Agric. and the Nation	2
11.	Socio-Economics	1
12.	Agric. Engineering	1
	TOTAL	63

DISTRIBUTION OF ARTICLES BY INSTITUTIONS (1982-84)

1.	Addis Abeba University	34
2.	Institute of Agricultural Research	21
3.	Others	8
	TOTAL	63

ETHIOPIAN JOURNAL OF AGRICULTURAL SCIENCES

Statute of Operation

Draft

PREAMBLE

The Ethiopian Journal of Agricultural Sciences should have been the organ of the Ethiopian Society of Agricultural Sciences. (ESAS), which, had it been established, would have its own constitution, by-laws etc. In the abscence of ESAS it was deemed necessary to draft the following Statute of Operation for ESAS.

NAME: The Ethiopian Journal of Agricultural Sciences.

ABBREVIATION: E J A S.

ESTABLISHED April 1978 by the 11th session of the National Crop Improvement Conference.

SPONSORS: Institute of Agricultural Research and Addis Ababa University

AIMS AND OBJECTIVES:

1) Establish professional communication among agricultural scientists.
2) Orderly dissemination of agricultural research information to the forming community as a whole, and
3) Promote application of research findings and development experience in the teaching process in all fields of agriculture.

ORGANIZATION:

1) The editorial board is totally responsible for the affairs of the journal.
2) The board shall comprise of 11 members.
3) The officers of the board shall comprise of

   Editor
   Associate editor
   Secretary
   Financial Officer
   Distribution officer
   Internal Auditor
   and 5 regular members.

4) The editorial board shall have a paid business manager, subordinated to the distribution officer.
5) The members of the board shall be elected for a period of 5 years by the Ethiopian Agricultural Research Conference.
6) The members elected to form the Editorial board shall appoint the editor, asso. editor, secretary, treasurer, distribution officer, internal auditor etc... . The appointment to the various posts by election shall be done under the chairmanship of the outgoing editor.
7) At least two members of the outgoing Editorial board shall be elected to form part of the new Editorial board.
8) A member can be elected to the Editorial board not more than 3 times.
9) The board has the right to select and put a replacement to a post vacated and of re-shuffling members to various posts during a given term of office.

DUTIES AND RESPONSIBILITIES:

The outgoing editor shall be an advisor to EJAS Editorial board for one term of office.

EDITOR

1) is responsible for the affairs pertaining to the journal.
2) presides over all meetings concerning the journal.
3) calls meetings at regular intervals and when ever deemed necessary.
4) sees that the journal is regularly published.

5) assigns responsibilities to the members of the editorial board.
6) represents the Editorial board of EJAS.
7) Approves payments, countersigns check with the financial officer for payments of services rendered to EJAS.
8) Communicates final status of the manuscript to authors.

Associate Editor

1. Acts as an editor in the absence of the latter
2. Performs all functions upon the delegation of Editorial Board
3. Would be responsible for popularizing EJAS fund raising and soliciting other help for the development and growth of the journal
4. Prepares the annual budget of EJAS

SECRETARY

1) Handles all correspondences pertaining to the journal.
2) Prepares and distributes agenda of meetings in advance.
3) Writes minutes, keeps file and record of EJAS.
4) Receives manuscripts form authors, presents to the Editorial Board meeting and sends the manuscript to the relevant body on the basis of the Editorial Board decisions. Communicate on the preliminary status of articles to authors.
5) Helps the editor in all other matters.

Financial Officer

1) Handles financial and related resources of EJAS.
2) Settles payments of EJAS with the approval of the editor.
3) Countersigns checks of payment for services rendered to EJAS.
4) Prepares and presents financial and other related reports to Editorial Board and other bodies when requested.

INTERNAL AUDITOR

1) Conducts regular auditing of finance and related resources of EJAS.
2) Prepares and submits report every six month on the finance and related resources of EJAS.

PUBLICATION AND DISTRIBUTION OFFICER

1) Distributes journals to subscribers on time.
2) Responsible for keeping the journal.
3) Maintains records of sold and unsold copies of EJAS.
4) Reminds subscribers to renew subscriptions.
5) Recruits new subscribers together with the asso. editor.
6) Searchs for better methods that enhance wide distribution of EJAS.
7) Submits financial reports on the status of distribution regularly.

BUSINESS MANAGER

1) Is responsible for all matters concerning the printing, sales and distribution of the journal and is accountable to the distribution and financial officer.

2) Assists the editor, asso. editor, secretary, distribution officer in their respective responsibilities.
3) Makes sure that the secretariat of the journal is properly maintained.
4) Attends all matters pertaining to general procurement.
5) Executes functions given by the Editorial Board of EJAS.

MEMBERS

1) Attend regular and other meetings of EJAS
2) Participate in the initial professional screening of manuscripts before despatch to reviewers and in the identification of reviewers.
3) Generate and implement ideas for the growth and development of EJAS.
4) Work for the popularization and dessimenation of EJAS.
5) Make certain that the standard and quality of EJAS is maintained and upgraded.
6) Represent EJAS Editorial Board whenever delegated.

APRIL, 1984

COMMITTEE REPORT

ON

DOCUMENTATION OF RESEARCH

OF

THE INSTITUTE OF AGRICULTURAL RESEARCH

ADDIS ABEBA

APRIL 27, 1984

BACKGROUND

During the 1983/84 Project Review Meeting a steering committee was formed to streamline some of the prevailing discrepancies in: research coding, progress report, the kinds and format of IAR publications etc.

The committee which was formed on October 20, 1983 (Ref. No. 416/76/90/2) was composed of:-

*	W/t Abrehet Habtemariam	- Documentation
	Ato Beyene Kebede	- Coordinator, Dept. of Animal Science
	Ato Demise Chanyalew	- A/Head, Planning and Programming
	Dr. Desta Beyene	- Coordinator, Dept. of Soil Science
	Dr. Hailu Gebremariam	- Chairman of Team Leaders
	Dr. Mesfin Abebe	- Research & Extension (Chairman)
	Ato Mulugetta Mekuria	- Coordinator, Dept. of Socio-Economics
**	Ato Seifu Gebremariam	- Coordinator, Dept. of Horticulture
	Ato Tsedeke Abate	- Coordinator, Dept. of Crop Protection
	Ato Tsegaye Beru	- Head, Liaison & Publication Dept. (Secretary)

The committee met on several occasions, and by its ad-hoc sub-committee contacted both the AAU and ILCA to learn from their experiences. In its deliberation it has extensively referred to various IAR documents and, especially exhausted a previous IAR committee report (August 26, 1982) which addressed itself to:-

1. Preview procedures and guidelines
2. NCIC formats and guidelines
3. Review procedure, and

***4. Annual research conference regulations.

The present report includes the highlights of the committee's decision, and is by no means exhaustive. The basic concepts laid in the previous report have not been attered and we feel that they can be used for a long time to come.

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* Joined the committee on her return from England

** Later replaced by Ato Lemma Dessalegne due to work pressure

*** Officially know as Ethiopian Agricultural Research Conference (EARC)

Due to other commitments, the committee has yet to have subsequent meetings to finalize its recommendation. Until then, the salient points are here presented in the hope of getting feedbacks for possible incorporation in the write-up of the final guidelines. In the interim period, we urge that recommendations suggested here be adhered to.

THE PRESENT PRACTICE

The present coding system is considered to be neither flexible nor hospitable. Some of its shortcomings are:-

1. It does not include all the past projects and therefore these are not documented.
2. There have been cases where project codes have been changed in subsequent years thus leading to confusion.
3. Projects which were initiated in previous years are resubmitted in subsequent years.
4. Because of inadequate communication between the Liaison and Publication Department and researchers, there have been changes in titles, codes and years of project initiation.
5. The coding system does not go hand in hand with the progress reports.
6. Researchers that, for various reasons, are not involved in a specific research are listed in the program, etc.

Although developing a new coding system is certainly time consuming and necessitates additional manpower, it was agreed that a new system be developed. The new system should embrace trials conducted prior to the institution of the present system.

There is also a felt need to have a registration book, accession numbers, a guideline, codes, titles and carding system. This tentative suggestion would be further pursued by an ad-hoc committee.

PROGRESS REPORTS

A progress report basically is intended to indicate the development of a project for the specified period of time. Thus, reports that are long overdue can, by no extent of imagination be considered progress reports. So far the IAR publishes twelve "annual" progress reports (8 Teams and 4 Departments). Such reports should be timely, concise but provide as much factual information as possible such that continuity could be maintained in the abscence of the initiator.

Progress reports may not be easily comprehended by the general public but are of importance to researchers. They contain technical information, give tentative recommendation, suggest trends on future lines of investigation etc. However, there have been cases where non-technical problems encountered have been reported. Needless to say, this could have direct and /or indirect bearing on the trial; but evoking the problems of vehicles, lack of fertilizers, insecticides etc. would provide no usable information. But citing meterological changes, frost, etc. as "problems" might shade some light on the outcome of the investigation. Problems of logistics, supplies, manpower, etc. should appropriately be included in the biannual report (formely quarterly report) and possibly at the preview and review meetings.

The lack of format or guidelines on the write-up of progress report has led to:-

1. Lack of clear definition of the stipulated objective and led to a conglomeration of data that follows no systematic pattern or design.
2. Disorganized and unsystematic reporting often is observed. This might arise because some staff are, unwittingly or by design, overloaded with research or administrative work thus devoting less time to research. This has been the major contributing factor for delay of reports. This must be rectified by either limiting the number of activities one should handle -eg. new trials may be proposed only when the previous ones are completed or provide more assistance or limit the number of committees one should serve in.

3. Incomplete information or lack of comprehensiveness despite the availability of a wealth of data is rampant. Some just do not seem to have the ability to report their results in a meaningful manner despite the fact that they initiated it in the first place. Others seem to be plain careless or negligent. No step was taken to rectify the situation. Had the name of the reporter been indicated at the time due stept could have been taken and the culprit discredited. Conversely, appropriate credit was not given to those who submitted well documented and scientifically written reports.

4. In the abscence of an effective publication committee there could be prospects of plagiarism.

To ameliorate the prevailing sad situation the following are suggested:

1. The Liaison and Publication Department through the IAR management urge Teams, and Departments to submit reports on time. Failure to comply should result in serious administrative measures. (This would be treated later).

2. For reports that are long over due their information of three or four years could be compiled (summarized) and presented as one publication.

3. To insure against the loss of information, raw data should be kept with a) the Officer-in-Charge, b) the Liaison and Publication Department and c) Team Leader and/or Department Coordinator.

4. As it pertains to the crop teams, the Chairman of the Team Leaders ascertains that a) raw data are sent by cooperators, etc. to respective teams on schedule, and b) there is a systematic reporting of data and proper interpretation of results i.e tables, etc.

5. The cooperators or station representatives should send all processed data from stations to crop/department coordinators who after checking the authenticity and proper presentation would forward the final report to the Liaison and Publication Department.

6. Reports must have the final approval of the Publication Committee which by and large is composed of Department Coordinators.

GENERAL CONTENTS OF PROGRESS REPORTS

1. All progress reports must bear the address of the Institution and year of publication.
2. All progress reports must contain a staff list (Department or Team).
3. All teams will have separate publications under their respective departments. The contributions of all disciplines should be memtioned. Such a report could have the following title with appropriate changes for other departments such as Animal, Soil, etc.

   eg. Institute of Agricultural Research.
   Department of Field Crops.
   Progress Report of Tef Team (Sci. name) for the Period

4. The inside cover would be the same as the front cover which bears the address of the IAR and ~~time~~ . of release.
5. The write-up would be quasi-scientific since a final write-up of the completed trial is presumed. However it must ~~have~~:-

   a) Abstract - This gives the essence of the major findings and normally does not exceed 200 - 300 words.

   b) Introduction - Here some background information is given by indicating clearly the objective of the trial. Effort should be made to back it with references.

   c) Materials and Methods - includes only the essence of the materials used and the methods employed. Mention of day-to-day items like use of vehicles, beakors etc is not a normal practice.

d) Results and Discussion - covers the highlights of the findings. It should not be cluttered but concise. Charts and tables can be used to better advantage. Please note that figures are more eye catching and convey meanings fast. As in introduction literature citation (where possible) should be done to coraborate the findings.

e) Tentative Recommendation - If the work is of long-term (eg. research on tree crops, livestock) attempts should be made but it can be optional if the research has not yet matured.

f) References -- This includes not a bibliography of suggested reading but the actual citation made in the text, if any. It should be included where appropriate and possible.

6. As the case may be completed, on-going, discontinued, and modified projects would be reported. PNYT and NYT are also included. However, since information about NYT can be found in the NCIC proceedings it need only be summarized in a few paragraphs without tables.

7. The code, title and year of initiation should be included for any kind of report.

8. Name of the initiator and/or reporter must be indicated. It could be the same person except under rapid turnover of staff.

9. If a project is reinitiated with major modifications, then the name of the initiator need to be included.

10. Due recognition should be given to cooperators who in the abscence of the initiator do the write-up.

SPECIFIC CONTENT AND THEIR SEQUENCE

All progress reports must contain the following:

1. Table of contents
2. General introduction
3. Metreological data

4. Technical report which includes:
   a) Code, title, initiator whose title would be indicated with an asterisks at the bottom of the first page.
   b) Abstract
   c) Introduction
   d) Materials and methods
   e) Results and discussion
   f) Tentative recommendation (where possible)
   g) References (where possible)

5. List of staff among which are:
   a) Name
   b) Academic qualification
   c) Disciplines (soils, protection, etc.)
   d) Stations/substations

DEADLINE FOR SUBMISSION

1. Progress reports should come out without delay.
2. The report should be submitted by the end of August. To maintain the tempo and insure timely publication, reports submitted beyond the deadline would not be considered. Such reports would be defered for subsequent issue.
3. If reports are not submitted by the end of August the management should take serious action. The suggested alternatives are:

   a) delay academic promotion
   b) deprive scholarship, seminar, etc. opportunities
   c) deprive a forum for the presentation of such findings on NCIC, Review, etc.

   d) other punitive measures as deemed necessary by the management.
4. In the case of cooperators outside the IAR, one possibility could be curtailing funds earmarked to them through the IAR.

PROCEEDING

Proceedings contain a compilation of scientific reports (papers) presented at symposia, workshops, conferences, seminars, etc.

At present two kinds of proceedings are published by the IAR. These are:

The National Crop Improvement Conference (NCIC) and
The Ethiopian Agricultural Research Conference (EARC)

The following general guidelines are suggested:

1. It is not mandatory that a researcher presents papers at EARC but at the NCIC. This is provided that the investigation is complete and contains recommendable information.

2. Each report in a proceeding must have scientific write-up This means each must have 1) Abstract 2) Introduction 3) Materials and Methods 4) Results and Discussion 5) 5) Reference and where applicable appendices or attachement such as list of participants.

3. The proceedings have titles and indicate the date and place of venue. They come out in series.

   eg. a) Institute of Agricultural Research
   Proceedings of the Sixteenth National Crop Improvement Conference

   April 16 - 18, 1983
   Addis Abeba

   b) Institute of Agricultural Research
   Proceedings of the Second Ethiopian Agricultural Research Conference

   April 19 - 20, 1983
   Addis Abeba

4. The code of the project, and title, the professional title of the author(s) or reporters or cooperators or compilors and their institutional affiliation is indicated as a footnote on the first page of each article.

5. Should the research be initiated by ~~someone else but~~ data compiled or reported by another, this should so be indicated.

6. Papers presented at any conference, after scrutiny by the Publication Committee, could be submitted for publication to a scientific journal. However, it should be indicated in a footnote as to where the article was first presented.

7. The content of the proceedings is subject to review by the Publication Committee.

NATIONAL CROP IMPROVEMENT CONFERENCE (NCIC)

The NCIC, held annually or three days consists of:

I. Plenary session (day 1) in which keynote address, research highlights and reports by various agencies are presented.

II. Group session (day 2) in which major findings of:- a) cereals, b) oil and fiber crops, c) horticulture and coffee, and d) pulses are presented.

III. Plenary session (day 3) in which reports from group rapporteurs on recommended technology or completed projects with usable results would be delivered.

1. Information to be presented at the NCIC would be left to the joint discretion of the teams/departments, the author(s) and Publication Committee. This means a researcher suggests to the team that his findings be presented at the NCIC, and the team should it approve it passes the report to the Publication Committee.

2. The reports will have codes, title, name of author(s)/reportors/ cooperators, institutional affiliation of author(s), the last one as a footnote with asterisks.

3. Though it should have scientific write-up completed trials should be presented in such a way that the findings are easily understood by users - i.e. it should not be too technical.

4. The deadline for submitting reports to the Liaison and Publication Department is February 15 of each year. Since the NCIC is held on later part of March, enough provision must be given for review, typing, publication etc. The reports should not exceed ten pages.

5. The reports would be screened by the Publication Committee.

PRESENTATION OF PAPERS

Research Institutions (IAR, College of Agriculture, etc.)
- highlights on pressing research problems
- the progress of research projects
- completed research projects

State Farms, RRC
- highlights on progress in crop production
- production problems and expected solutions from research
- impact of variety and other recommendations on crop production
- suitability and problems of imported chemicals and seeds

Development Agencies (ARDU, WADU, etc.)
- highlights of results of demonstration trials
- impact of varieties and other recommendations
- progress and problems related to crop production
- envisaged changes of programmes

Ethiopian Seed Corporation
- progress and problems
- highlights of future plans related to seed production

Agricultural Marketing Corporation
- Status and types of imports of agricultural inputs
- distribution of agricultural inputs
- progress and problems

Ethiopian Grain Agency, Ethiopian Oil Seeds and Pulses Export Corporation
- status of grain import and export
- priority crops for export market
- problems of meeting quality standards for export of agricultural commodities

Horticulture Corporation
- status of import and export of horticultural produce
- priority crops for export market
- problems of meeting quality standards for export

Ministry of Coffee and Tea Development

- status of coffee export and import.
- problems of meeting quality standards for export
- suitability and problems of imported chemicals

All Ethiopian Farmer's Association

- Problems of crop production
- impact of varieties and other recommendations on crop production
- cooperation with research institutions and extension in the transfer of agricultural research results

Special papers would be presented on invitation as appropriate.

THE ETHIOPIAN AGRICULTURAL RESEARCH CONFERENCE

1. The proceedings of the EARC will contain authored research articles, review articles (by team, department or individuals of high professional competence), and short communications. These could be completed or incomplete projects that suggest trends and areas of possible investigation. The papers which must be of high technical standard must have a scientific, write-up similar to the EJAS.

2. Potential papers would be reviewed by the Publication Committee.

3. The EARC will convene annually right after the NCIC. This is in divergence to the previous committee report. The suggested change is due to a) the inevitable loss of momentum if convened every two years b) logistcs. If EARC is held every two years in October as previously suggested, it would mean unnecessary disruption of stations'activities at a critical time of harvest and repeated trips to Addis Abeba. This, we believe, could be avoided if the EARC is held just after the NCIC. Further, October being a time prior to harvest, information which otherwise would be incorporated at EARC is not yet available.

4. During the 1982 EARC, separate but simultaneous meetings were held in crops and animal sciences for one day only. In

future EARC, however, all agricultural scientists would meet together for two days. This, it is believed, would promote cross-transfere of information.

5. To allow enough time for communication with authors, review articles, etc. the deadline for submitting papers is no later than the end of December.

6. Manuscripts submitted to international journals must first be presented at NCIC or EARC and be published in one of the IAR publications. This would allow easy access by the Ethiopian Agricultural Community. Equally, efforts must be made to strengthen the EJAS rather than enrich external journals.

7. The abstracts of approved papers would be distributed during the conference. The discussion at the conference would be recorded and would be included in the proceedings.

SEMINARS, WORKSHOPS, SYMPOSIA...

1. These would follow the format of EARC and would have scientific write-up.

2. Should be authored and have series, where applicable.

3. If edited or compiled by an individual (s), this should be indicated.

4. Due acknowledgment should be given.

5. Should be approved by the Publication Committee.

INTERNATIONAL CONFERENCE PAPERS

The details are similar to proceeding. However, the following should be observed.

1. Such papers should get prior approval of the Publication Committee.

2. They must first be delivered in EARC.

3. The abstract of the paper may be sent to the organizers prior to the approval of the Publication Committee so that the

author(s) could meet the deadline. However, should the paper be rejected by the Publication Committee, it shall not be presented in the international conference.

4. If the conference is held in the interim period, the article should be presented in the forthcoming EARC but copies or reprints should be given to the Liaison and Publication Department for compilation.

TECHNICAL MANUAL

This does not fall within the scope of a handbook and contains information on matters like laboratory methodology, (laboratory manual) field record books, etc.

1. It can be authored by an individual(s), department, a team, etc. and should have series.
2. Will include the name of the Institute, date of publication, acknowledgment, if any, and references.
3. The Publication Committee will ascertain whether it carries all the pertinent information.

HANDBOOK

It contains transferable information and covers a specific area. It is of higher standard than a technical manual or extension bulletin but lesser than a book though it meets the standard of a book.

1. It will have a scientific write-up with a title, tables of contents, introduction, acknowledgement, main text, reference and an index. The name of the institution and date of release would be included.
2. The name of the author(s) or editor(s) would be indicated. In the event that the handbook is revised, the original author(s) or editor(s) would be retained, but the revisor would be indicated as "Revised by..." However, prior approval of the Publication Committee should be sought.

3. In the event that major changes are made and substantial amount of new material or information is incorporated, the names of the original writers should only be indicated in the "forward or "introduction" and the person who made the major overhaul will now be the legitimate author.

TECHNICAL BULLETIN

It contains original findings on a given area. It could be a compilation of finished projects or review of several years' research activities.

1. It should have a scientific write-up.
2. Should bear the author(s) name and must come out in series.
3. The salient points should be reported in EARC prior to the release of the bulletin.
4. The highlights could also be published in a scientific journal with the code, title and institution indicated as a footnote.
5. Conversely, should the technical bulletin be released after publication in a journal or EARC proceeding, this should be indicated in the forward to the technical bulletin.
6. Due acknowledgement should be given and the forum it had come out be indicated.

EXTENSION BULLETIN

1. It contains non-technical but usable information or technology which is easily transferable. It may include a bibliography depending on the subject treated and comes out in series.
2. The Liaison and Publication Department is responsible for such a publication. But until such a time that the Department is strengthened individual researchers should be encouraged. Under this condition authorship right is given but not if the Liaison and Publication Department releases it.

3. If edited or compiled or prepared by an individual this should also be noted.

4. It is subject to the approval of the Publication Committee.

NEWSLETTER

The newsletter that used to come out irregularly is discontinued altogether. Thus, the Liaison and Publication Department should reactivate it immediately.

The newsletter published in series is envisaged to contain:-

1. View point would replace editorial
2. International visits, promotions, departures, appointment, etc.
3. Announcement of conferences
4. Highlights of Preview, Review, NCIC, EARC and other IAR workshops, seminars, etc.
5. History of stations, new developments, etc.
6. Such a publication may or may not have authorship.

LEAFLET

1. It is non-technical and contains highlights of research recommendation.
2. It would be prepared by the Liaison and Publication Department. However, until it is strengthened, individuals, teams, etc. should be encouraged to produce it under their authorship, though , it should be handed the Liaison and Publication Department for publication.
3. Should have series, name of the institution and needs the Publication Committee's approval.

RESEARCH ABSTRACT

1. It is a compilation of pertinent research findings in about hundred words. The abstract would indicate the code, title of project, date of initiation and completion.

2. It is suggested that one research abstract which would embrace all teams and departments be published.

3. The abstract would read:-

   Institute of Agricultural Research
   Research Abstract for the Period _____ to _____
   Date Issued

ANNUAL REPORT

It will contain financial statement (budget), research highlights i.e. the number of approved and completed projects, future trends of research, I.A.R. - vis-a-vis station and manpower development, different committees within the IAR, conferences, training, released or forthcoming publications etc. for that year.

Such a publication would include no author but would be released in series bearing the name of the Institute and date of publication.

JOURNAL

Presently the IAR does not publish a Journal, nor would this be entertained in the near future. However, as a co-sponsor of the EJAS, it must continue to give its unreserved full support while at the same time strengthening the existing or proposed publications.

Because its staff publish in both EJAS and international journals, some of the tenets should be established. Thus, a manuscript submitted to a journal should meet:

1. The article must first be screened and approved by the concerned department or team before it is passed on to the Publication Committee.

2. Prior to submission to a journal, it must be approved by the Publication Committee.

3. The paper must have a scientific writeup similar to that of the EJAS.

4. It must contain the code, title, institution, author(s) or cooperators name and due acknowledgement where appropriate.

CODE AND FORMAT

The committee has not yet thouroughly deliberated on this point. However, it has felt that:

1. The present coding system which seems incomprehensive need to be evaluated with modification or institution of a new one in mind.

2. The current format for research proposal is found to be deficient. It does not leave enough room for sufficient analysis of the project. It does not demand that a proposal be backed with sufficient background information and extensive literature review. To this end an ad-hoc committee composed of W/t Abrehet Habtemariam, Ato Demise Chanyalew and Ato Tsegaye Beru has been formed to produce a draft working document.

Finally thanks are in order to all members of the committee who worked relentlessly to produce this working document and I trust that their zeal would be kept up to see it become the "bible" of the IAR on documentation of research. Our appreciation also goes to those who would carefully examine the document and send their positive feed backs and criticisms. This could be mailed to either Ato Tsegaye Beru or I.

Reported by: Mesfin Abebe