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MINISTRY OF AGRICULTURE

E P I D



EPID Agents Handbook

for

Agronomy Crops

Revised April, 1975

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Agricultural Research and  
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E P I D

Extension Agents Handbook

First Edition, Feb. 1974

This is an advanced release of the Extension Agents Handbook. The handbook will eventually and hopefully be published in bound book form with a soft cover and of a size that will fit into the agents pocket. The book is meant to be used in the field by the agent to answer farmers questions on the spot. It is not intended to replace publications which present a more thorough discussion of agronomic subjects.

The subject matter for this book has been developed and reviewed by members of the Institute of Agriculture Research and the EPID staff. It is hoped that all who use this handbook will inform the EPID Headquarters in Addis Ababa of any comments errors, omissions or changes required before final publication.

More crops will be added to this handbook as more information is developed. Most crops grown in Ethiopia will eventually be included.

Second Edition April 1975

A decision has been made to restrict this handbook to Agronomic Crops only. Handbooks will be published to meet other needs of the Extension Agents.

## 1975 Fertilizer Recommendations

The 1975 fertilizer recommendations have been based upon the results from the field trials of 1973 and adjusted to the current price of fertilizer. These recommendations should be used as guideline by EPID agents when advising farmers.

To obtain maximum benefit from the use of fertilizer, the fertilizers must be applied properly. The following methods of application are recommended.

<u>C r o p</u>	<u>Method of Fertilizer use</u>
Barley	Broadcast fertilizer and seed. Work both into the soil with harrow or by shallow ploughing.
Field peas	Banding in the planting row below the seed. No seed should touch the fertilizer. Broadcasting fertilizer will reduce the effect considerably.
Maize	Apply DAP in a band in the planting row below the seed. Apply Urea or a topdressing when the maize is kneehigh. Band urea in a small furrow 10 to 15 cm away from the planting row and cover with soil.
Rape seed	Broadcast fertilizer and seed. However, row planting and banding fertilizer in the planting row will increase yield.
Sorghum	Apply DAP in a band in the planting row below the seed.
Teff	Broadcast fertilizer and harrow. Where no harrow is available drive cattle over the field or work fertilizer into soil by tramping.

<u>C r o p</u>	<u>Method of Fertilizer use</u>
Wheat	Broadcast fertilizer and seed. Work both in the soil with harrow or by shallow ploughing.

### 1975 Recommendations

Fertilizer recommendations have been made for crops by Zones in Ethiopia. Regions in each of the four zones are given in the following tables.

#### Zone I

Logemder, Eritrea, Tigre and Wollo.

<u>C r o p</u>	<u>Soil</u>	<u>Fertilizer kg/ha</u>	<u>Remarks</u>
1. Teff	Red & Brown Soils	100 DAP	No nitrogen if teff lodges
	Black soils	No fertilizer	Fertilizer does not pay
2. Maize	All Soils	100 DAP	
3. Sorghum	All Soils	100 DAP	No fertilizer in dry areas
4. Wheat	Red Soils	100 DAP + 50 Urea	
	Black soils	100 DAP	
Barley	Red soils	100 Compound or 50 DAP + 50 Urea	
	Black Soils	100 DAP	
6. Chickpeas	All soils	No fertilizer	
Horse bean	" "		
7. F. Peas	All Soils	100 DAP	
8. Rape Seed	All soils	150 DAP	
9. Noug	All "	No fertilizer	

Zone II

4.

Gojjam and Shoa

C r o p	Soil	Fertilizer kg/ha	Remarks
1 Teff	Red & Brown Soils	100 DAP	No DAP if Teff Lodges
	Black Soils	100 Compound + 100 Urea	No Urea if teff Lodges
2 Maize	All Soils	100 DAP	
3 Sorghum	All soils	100 DAP	
4 Wheat	Red Soils	100 DAP	
	Black Soils	100 compound + 50 Urea	
5 Barley	Red Soils	100 Compound or 50 DAP + 50 Urea	
	Black Soils	150 DAP	
6 Chick peas & H.beans	All soils	No fertilizer	
7 Field Peas	All soils	100 DAP	
8 Rape Seed	All soils	150 DAP	
9 Noug	All soils	No fertilizer	



Zone III

Gemu Goffa, Illubabor, Kaffa and Wollega.

C r o p	Soil	Fertilizer	Remarks
1. Teff	Red Soil, High rainfall	100 TSP	Where Teff Lodges
	Red + brown soil	100 DAP	Where teff does not lodge
	Black soils	No fertilizer	Fertilizer does not pay.
2. Maize(hyb)	All soils	100 DAP + 50 Urea	
	" (local) " "	100 DAP	
3. Sorghum	All soils	100 DAP	
4. Wheat	All soils	100 DAP	
5. Barley	All soils	100 compound or 50 Urea + 50 DAP	
6. Chickpeas and H.beans	All soils	100 DAP	
7. F. Peas	All soils	100 DAP	
8. Rape seed	All soils	150 DAP	
9. Noug	All soils	No fertilizer	

Zone IV.

Arussi, Bale, Hararghe and Sidamo

C r o p	S o i l	Fertilizer	Remarks
1. Teff	Red & brown Soil	100 DAP	
	Black Soils	No fertilizer	Fertilizer does not pay
2. Maize	All soils	50 DAP + 50 Urea	
3 Sorghum	All soils	100 DAP	
4 Wheat	All soils	100 DAP	
5 Barley	Red soils	100 compound or 50 DAP + 50 Urea	
6 Chickpeas & H.beans	All soils	No fertilizer	
7 Field peas	All soils	100 DAP	
8 Rape seed	All soils	150 DAP	
9 Noug	All soils	No fertilizer	

Note:

The amount of each nutrient (nitrogen or phosphate) to be applied by the fertilizers recommended can be calculated as follows:-

$$\text{kg/ha of nutrient} = \frac{\text{kg of fertilizer} \times \% \text{ nutrient in fertilizer}}{100}$$

<u>Fertilizer</u>	% N(Nitrogen)	% P <sub>2</sub> O <sub>5</sub> (Phosphate)
Compound (23-23-0)	23	23
DAP (18-46-0)	18	46
TSP (Triple Super Phosphate) (0-46-0)	0	46
Urea (46-0-0)	46	0

Example: Find the kg/ha of N and P<sub>2</sub>O<sub>5</sub> applied when 150 kg of DAP is applied per hectare.

$$\text{Kg of N applied} = \frac{150 \times 18}{100} = 27 \text{ kg N/ha}$$

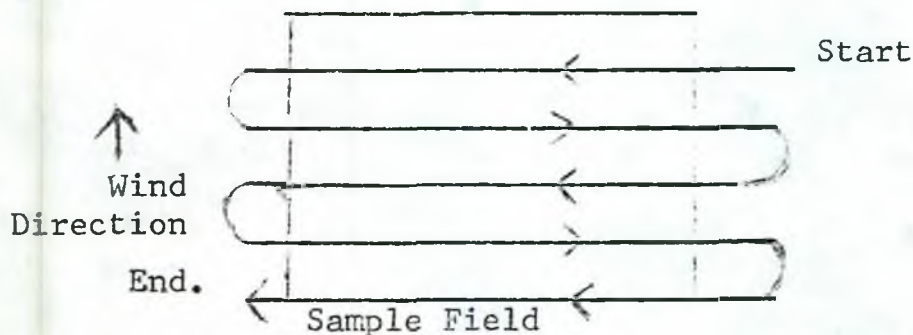
$$\text{Kg of P}_2\text{O}_5 \text{ applied} = \frac{150 \times 46}{100} = 68 \text{ kg/P}_2\text{O}_5\text{/ha}$$



### Instructions for Using Dust on field Crops

If Dusters are not available, the farmer can apply dust by placing 5 - 10 kilos of dust in a loosely woven bag or sack which will allow dust to freely pass through when the bag is shook or hit with a stick.

To treat a field, start on the down wind side and let the dust drift 2 - 3 meters across the crop. Move at right angles to the wind dusting a 2 - 3 meter strip at each trip. Repeat until field is dusted (see diagram below)



Caution: Dust are insecticides and as such are poisonings. Sacks or bags used for applying dust must not be used for any other purpose. (See safty Precautions for insecticides).

### Safty Precaution for Using Pesticides

Pesticides are Toxic (Poison) to man and domestic animal. Some more so than others. EPID tries to select the safest pesticide possible, however, agents and farmers must be aware of the following precautions when using pesticides.

1. Don't dust or spray yourself
2. Don't dust or spray other people
3. Don't eat, drink or smoke while dusting or spraying
4. Store pesticides out of the reach of children and animals preferably under lock & key.
5. Lable all pesticides so that they will not be used or mistaken for somethingelse.

6. Wash with soap and water after using pesticides.
7. Don't use pesticides containers as storage.  
Containers must be destroyed by burying or burning or Agent should tell farmer to return container to Agent office.
8. Treated seeds are not to be used for food by man or animals.

### Barley (Hordeum spp.)

#### 1. Conditions of Growth

##### 1.1 Altitude and Temperature Range

above 1800 m. Optimum 2200 m.

Prefers cool climate. Can tolerate frost better than wheat or teff (especially the local types).

##### 1.2 Rainfall

At least 250 mm distributed over growing season can stand more drought than wheat or teff.

##### 1.3 Soils

Fertile well drained soils best. Does poorly on wet clay soils and can tolerate some degree of soil acidity or alkalinity. (especially the local types).

#### 2. Varieties:

##### 2.1 Food-barley (1975 recommendations)

The variety composite 29 is recommended for all altitudes while C-63 is recommended for areas above 2300m. (All seeds must be treated with aldrin before sowing).

## 2.2 Malting-Barley (1973 recommendations)

- (a) above 2200: Beka, Kenya Research and Proctor (seeds must be dusted with aldrin for protection against barley-fly).

## 3. Cultural Practices

### 3.1 Land Preparation

Ploughed to form a uniform smooth seed bed. Use of mouldboard plough and harrow is advisable.

### 3.2 Planting Methods

Barley may be broadcasted but does better when planted in rows spaced 20cm apart. Seeds should not be deeper than 5 cm.

### 3.3 Sowing Date

- a. Food barley: between 15 June and 5 July.
- b. Malting barley: between 15 June and 25 June. for best quality malting barley.

### 3.4 Plant Population

- a. Broadcasting: 100 to 120 kg/ha
- b. Planted in rows: 85 to 100 kg/ha (175 - 225 plants/sq. meter).

### 3.5 Fertilizers

- a. Use EPID recommendations for your area (see front of book)
- b. Apply at time of seed sowing.

### 3.6 Weeding

- a. Hand weed until dense foliage is established
- b. Herbicides are available for broad-leafed weeds. EPID agents will make recommendations for their area.

#### 4. Diseases

##### 4.1 Scald (*Rhynchosporium secalis*)

Major foliar diseases recognized by large white (dry) areas surrounded by dark brown regions on the leaves. May attack head and could reduce yield to 50% or more.

No method of control

Prevent by using (1) resistant varieties.

(2) crop rotation (3) burn previous barley residue

(4) delay planting two or three weeks, provided the barley variety to be used is as an early maturing type.

##### 4.2 Leaf Rust (*Puccinia hordei*)

Foliar disease recognized by light orange or yellow spots on leaf surface.

Heavy infestation can reduce yield 20% or more

Prevent by using resistant varieties

##### 4.3 Smuts and mildews also infect barley to a lesser extent.

#### 5. Pests

##### 5.1 Barley Fly (*Hylemya arambourge*)

Prevent attack by treating seed with 60 grams of 40% aldrin for every 10 kgm of seed.

##### 5.2 Worms can be a problem

Treat with 10kg/ha DDT 10% dust when an average of 5 worms per square meter occur. (See instructions for using dust and safety precautions).

Chick Pea (Cicer arienyum)

1. Conditions of Growth

1.1 Altitude and Temperature Range

Generally grown between 1800 and 2200 m.

1.2 Rainfall

Chick peas are grown in areas with at least 400 mm rainfall but are sown late and mature on residual soil moisture. They can tolerate moisture stress.

1.3 Soils

Chick peas are often planted in clay soils after the water logging season. They can tolerate low soil fertility.

2. Varieties

No general recommended varieties at this time. EPID agents or the experiment station near you can recommend varieties for your area.

3. Cultural Practices

3.1 Land Preparation:

Chick peas prefer a rough seed bed; a rough plowing is adequate.

3.2 Planting Method

Chick peas may be broadcast but do better if planted in rows 20 - 25 cm apart. Seed should be planted not deeper than 5 cm.

3.3 Sowing Date

Under existing cultural methods, the optimum sowing date is about mid September.

### 3.4 Plant Population

Use 75 - 100 kg Seed/ha

### 3.5 Fertilizers

Use EPID recommendation for your area (see front of the book)

### 3.6 Weeding

Hand weed until dense foliage is established.

## 4. Diseases

- 4.1 Root Rot (*Sclerotium rolfsii*) is the most serious problem. Plants turn pale green to reddish brown and die. Tap root and base stem are rotted. Yield reduction can exceed 50%. Prevent by pre-treating seed with the fungicide Thiram before planting. Do not plant in soils which remain waterlogged for long periods after planting.

## 5. Pests

American Bollworm is the only reported pest. Control by dusting with 10% DDT dust at 8 - 10kg/ha. When an average of 5 worms per 1 square meter are present, (see Instructions for using dust and safety precautions).

## Dagussa (Finger Millet)

### 1. Conditions of Growth

#### 1.1 Altitude

Usually grown from 900 to 2500m

#### 1.2 Rainfall

At least 500 mm distributed throughout growing season.

### 1.3 Soils

A wide variety of soil condition are suitable  
Waterlogged or very acid soils are not desirable.

## 2. Varieties

No general recommendations. The following varieties have proved the best, local Bishoftu, IE Badubindana, IE 786, and IE 788 MS9270.

## 3. Cultural Practices

### 3.1 Land Preparation

Plough to form a smooth level seed bed. Use of a mouldboard plough and harrow is recommended.

### 3.2 Planting Method

The usual method is to broadcast seed but seed planted in rows is easier to weed, plants grow better and yields are usually higher.

### 3.3 Sowing Date

Plant as soon as after the first rains but not later than mid July.

### 3.4 Plant Population

(a) Broadcast; 35 to 40 kg of seed/ha. Some thinning may be necessary.

(b) Row planting: 30 kg/ha at a spacing of 20 or 30 cm between rows.

### 3.5 Fertilizers

Use EPID recommendation for your area.

### 3.6 Weeding

Hand weed until a dense foliage is developed.

## 4. Diseased

No diseases of economic importance

## 5. Pests

No pests of economic importance

## Field Peas (Pisum spp.)

The field peas grown in Ethiopia appear to be of two types: Pisum sativum subsp. arvense and Pisum sativum subsp. abyssinicum. The arvense type have coloured flowers usually purplish and angular seeds normally brownish grey or variegated in colour. The abyssinicum type has small 30 - 40 cm tall vines with only one pair of leaflets. The seeds are pale green, in some areas also black, fully pouch-like resembling large soya beans. Some mixtures and crossings also occur. The abyssinicum type matures in a shorter time than the arvense.

### 1. Conditions of Growth

#### 1.1 Altitudes

1700 m - 3200 m

Peas require a cool, relatively humid climate. They do not grow well in hot dry climates at lower altitudes where the seed setting is poor and mildew more of a problem. They are less sensitive to frost than horse beans.

#### 1.2 Rainfall

As the field peas take four to five months to mature depending on type and altitude they require a fairly long rainy season with 400 - 700 mm of rain.

#### 1.3 Soils

Field peas can be grown on most soils with a reasonable level of fertility. They do not do well on very acid soils and do not tolerate water-logging.



## 2. Varieties

Some introduced varieties have shown promise in recent trials but it is too early to recommend any for general use.

## 3. Cultural Practices

### 3.1 Land Preparation

The field peas do not require a fine seedbed; 2 - 3 ploughings with the local plough or one disc ploughing followed by 2 disc harrowings should be sufficient. It is an advantage if land preparation can start early to encourage weed seeds to germinate so that they can be destroyed in subsequent cultivations.

### 3.2 Sowing Method

Normally broadcast but row sowing will be advantageous for easier weeding. If broadcast, the seed is covered by ploughing with the local plough or harrowing by disc or spike harrow.

### 3.3 Sowing Date

The best results have been obtained if the peas are sown on red soils, as soon as the main rain starts and the soil is workable and on black soils about two weeks later.

### 3.4 Plant Populations

A seed rate of 100 - 150 kg per ha is recommended. A high seed rate will enable the peas to compete better with the weeds. If row sowing is used a spacing of 20 cm between the rows and 6 cm between the seeds in the row will give a seed rate of 100-150 kg depending on seed size and a plant population of 450,000 - 700,000 plants per ha depending on field germination.

### 3.5 Weeding

If the seed is broadcast, weeding is difficult but one hand weeding is recommended. If sown in rows weeding will be easier.

### 3.6 Crop Rotation

Peas should normally be sown after cereals and not more often than every 5 to 6 years on the same land.

### 3.7 Harvesting Methods

When ripe the peas are harvested by pulling the plants and stacking them until they are dry. The threshing is done by driving oxen or a tractor over the plants. They are cleaned by hand winnowing or by a winnowing machine.

### 3.8 Clean - Up After the Crop

Especially in areas where Ascochyta blights are serious (see below under Main Diseases) the crop residues should be disposed of by ploughing under the remains in the field and feeding the residues at the threshing ground to cattle or burning it.

## 4. Main Diseases

### 4.1 Ascochyta Blights

In wet areas with high rainfall Ascochyta blights are the most important diseases of peas. They cause purple brownish spots on leaves, stems, and pods. Blights are carried over to the next season in infected seed or residues in the field.

Control: There is no practical resistance to blights in peas. Therefore, they are best controlled by the use of disease-free seed (originating from drier regions with low rainfall) and by sound crop rotation

(use 3.7). Residues in pea fields should be ploughed under as soon as the crop is harvested. Seed treatment is only of little value to control blights.

#### 4.2 Powdery Mildew

The disease is recognized by the white or grayish covering on all parts of the plant. It tends to be more severe at lower altitudes.

Control: Infected pea residues should be turned under as soon as possible after harvest.

#### 4.3 Root rots

They cause chlorosis, wilting, stunting or dying of plants. Infection takes place through the soil by different soilborne fungi. The damage may vary from year to year with the weather conditions and the causal organisms present.

Control: Control of the root rot complex is difficult. Good crop rotation (see 3.7) would be the most important measure. Using healthy seed, seed treatment and good management of soil (drainage) and crops should help to reduce the damage.

### 5. Pests

#### 5.1 Worms

Treat worms with 10 kg/ha 10% DDT Dust when an average of 5 worms per square meter occur (see dusting Instructions and Safety Precautions).

## Haricot Beans (Phaseolus vulgaris)

### 1. Conditions of Growth

#### 1.1 Altitudes and temperature range

Between 600 and 2200 m

Beans do not grow well at low altitudes because fruit set is poor at high temperatures. At high altitudes growth is slow and beans are sensitive to frost.

#### 1.2 Rainfall

Medium rainfall (400 - 700mm)

A dry season at harvest time is best.

Rain is required at flowering period.

Very high rainfall causes flower drop and increases incidence of disease.

#### 1.3 Soils

Well drained fertile soil with pH above 5. Beans are damaged in waterlogged soil.

### 2. Varieties (1973 Recommendations)

#### 2.1 White haricot pea beans

Ethiopia 10, Tengeru 10, Mexican 142

#### 2.2 Red Kidney

Canadian Wonder, Ethiopia Red

#### 2.3 Colored flat

Red Wollamo Sodd, Black Dessie (Highly recommended for local use)

#### 2.4 Speckled kidney beans

Brown speckled

### 3. Cultural Practices

#### 3.1 Land Preparation

Plough to form uniform seed bed free of weeds. Use of mould board plough and harrow is recommended.

#### 3.2 Crop Rotation

Beans should not be grown more often than every 3rd or 4th year on the same land (see Diseases)

#### 3.3 Planting Methods

Beans can be broadcasted and covered by harrow or plough. Beans will grow better and produce higher yields if planted in rows. Seeds should be planted at least 3 cm. deep but not deeper than 8 cm.

#### 3.4 Sowing Date

Beans should be planted so that they will mature in the dry season. They mature in 85 to 95 days at medium altitudes (100 to 1700m) and 110 days at high altitudes (1800 to 2200m). Yields will be lower if planted too late.

#### 3.5 Plant Population

##### a) Broadcast planted

Use 60 - 70 kg/ha of pea beans and 90 to 130 kg/ha of large seeded bean.

##### b) Row planted

Use 45 - 55 kg/ha of pea bean and 70 to 80kgm/ha of large seeded beans. The following spacings required to provide 250,000 plants/ha.

<u>Space Between Rows</u>	<u>Between seed in rows</u>
40 cm	7 cm
50 cm	6 cm
60 cm	5 cm

### 3.6 Fertilizers

Use EPID recommendation for your area (see front of book).

### 3.7 Weeding

Hand weed, starting 2 to 3 weeks after sowing and finish before flowering starts. With proper weeding yields will be increased over 50%.

Chemical weed killers are available for pre and post emergent weed control. The experiment station can provide recommendations.

## 4. Disease

### 4.1 Bacterial Blight

Control: Blights are spread by infected seed, by infected trash in soil and rain splash. Use healthy seed; Do not grow beans after beans use 3 - 4 years rotation; keep fields free of infected beans straw. Canadian Wonder is more susceptible than other varieties recommended.

### 4.2 Anthracnose

Control: Use healthy seed; rotation of 3 - 4 years; keep fields clean of infected straw. Use of zineb on high value seed crops.

### 4.3 Bean Rust

Control: Grow resistant varieties especially Ethiopia 10, Tengeru 16 and Mexican 142 and Black Dessie.

4.4 Virus disease

Control: Use healthy seed

4.5 Root Rots

Control: Do not grow beans or pulses often than every 3 to 4 years.

5. Pests5.1 American Bollworm

Treat field with 10 kg/ha carbaryl 10% dust when an average of 5 worms per square meter occur, (see Instruction for Dusting and safety precautions).

## Horse (Broad) Beans (Vicia Faba)

### 1. Conditions of Growth

#### 1.1 Altitudes and Temperature Range

1700 - 2800 m

At lower altitudes the diseases especially rust and mildew tend to reduce yields too much. In hot climate the podset also tends to be poor. At very high altitudes they can be damaged by frost.

#### 1.2 Rainfall

As the horse beans take 4 - 5 months to mature a fairly long rainy season with 400 - 700 mm rainfall is needed for good yield.

#### 1.3 Soils

Horse beans do best on deep well drained fertile soils. They do not grow well on acid soils but do well on drained clay soils.

### 2. Varieties

No general recommendation. Use clean healthy seed from plants which do well in area.

### 3. Cultural Practices

#### 3.1 Land Preparation

The Horse bean does not require a fine seed bed so that ploughing 2 - 3 times is sufficient. The soil cultivation should start as early as possible to encourage weed seeds to germinate so that they are then destroyed in subsequent cultivations.

#### 3.2 Planting Method

Sow if possible in rows for easier weeding. This can be done by hand or by a grain or maize drill. If broadcasting is used a better coverage of the



seed is obtained if a furrow is made with local plough, the seed sown in the furrow and covered with soil from the next furrow, compared with first broadcasting the seed and then cover it by one ploughing or harrowing.

### 3.3 Sowing Date

Late June to early July seem to be the best sowing time. The sowings could be done somewhat earlier on red soils (late June) than on black soils (early July).

### 3.4 Plant Populations

Seed rates of 200 to 275 kg per ha. The higher rate for more large seeded beans the lower for small seeded ones. If sown in rows a close spacing between the rows (20 cm) seems to give better yields than wider spacing (40 cm).

### 3.5 Fertilizer

No fertilizer recommended.

### 3.6 Weeding

No suitable herbicides for weed control in horse beans are available. Hand weeding once is normally sufficient if the weeding is done well but if the weed infestation is very heavy two hand weedings can be necessary. If the beans are sown in rows the weeding will be easier and take less time.

### 3.7 Crop Rotation

The horse beans should be grown after cereals and not more often than every three to four years on the same land.

#### 4. Main diseases

The most serious diseases on horse beans are chocolate spot and rust. At lower altitudes they are also sometimes attacked by mildew. No resistant varieties are as yet available and no control measure can as yet be recommended.

#### 5. Pests

##### 5.1 Worms

Treat beans when an average of 5 worms per square meter occur. Treat with 10% DDT dust at a rate of 10kg/ha (see instructions for dusting and safety precautions).

## Lentils (Lens esculenta)

### 1. Conditions of Growth

#### 1.1 Altitude and Temperature Range

Generally grown between 1800 and 2200 m but are widely adapted and can be grown at altitudes of 2800 m or more.

Lentils are not suited to the hot wet tropics.

#### 1.2 Rainfall

Generally planted late in the rainy season and mature on residual soil moisture.

#### 1.3 Soils

Grown on wide range of soils but do well when planted late in black clay soils.

### 2. Varieties

No generally recommended varieties. Use good local seed.

### 3. Cultural Practices

#### 3.1 Land Preparation

Lentils grow best in well prepared seed bed.

#### 3.2 Planting Method

Lentils may be broadcast but do better when planted in rows 20 cm apart. Seed should not be planted deeper than 3 to 4 cm.

#### 3.3 Sowing date

Under present management conditions the optimum sowing date is first two weeks of September.

#### 3.4 Plant Population

Optimum seeding rate is 15 to 20 kg/ha.

3.5 Fertilizers

Use EPID recommendation for your area  
(see front of book).

3.6 Weeding

Hand weed until dense foliage is established

4. Diseases

4.1 No diseases of economic importance

5. Pests

No pests of economic importance

Linseed (Linnum usitatissimum)

1. Conditions of Growth

1.1 Altitude and Temperature Range

Above 1800 m

Optimum between 2200 and 2800 m

Below 1800 m. with irrigation

Hot and very moist areas are unsuitable for this crop.

1.2 Rainfall

450 mm distributed over the growing season.

1.3 Soils

Well drained fertile clay loam to clay soils best.

Coarse textured soils are unsuitable.

2. Varieties

No general recommendation.

EPID agent or experiment station can make recommendations for specific areas, but the varieties Victory and Concurrent have done well at most research stations.

3. Cultural Practices

3.1 Land Preparation

Ploughed to form a uniform smooth seed bed. Use of mould board plough and harrow are recommended.

3.2 Planting Method

May be broadcast but is best planted in rows spaced 20 cm apart. Seeds should not be sown deeper than 1 - 2 cm.

3.3 Sowing Date

Between mid June and end of June. Late sowing could be damaged by frost.

3.4 Plant Population

a) Broadcast

30 to 50 kg/ha

b) Row planting

25 to 35 kg/ha

Use higher rate for large seeded varieties.

3.5 Fertilizer

No fertilizer recommended.

3.6 Weeding

Hand weed until dense foliage is established

4. Disease

None of major economic importance

5. Pests

No pest of economic importance.

## Maize (Zea Mays)

### 1. Conditions of growth

#### 1.1 Altitude and temperature range

Below 2200 cm but in low elevations where rainfall is low irrigation is necessary.

#### 1.2 Rainfall

Average rainfall above 500 mm is required for good yield. Irrigation is required in areas with lower rainfall.

#### 1.3 Soil

Well drained, fertile, medium textured soils are best. Maize does not grow well in waterlogged soils.

### 2. Varieties (1975 recommendations)

#### (a) Long growing season

H632, H613B, H611 and SRS2

#### (b) Short growing season

H511

#### (c) Composites

Kitale and Ukiriguru

### 3. Cultural Practices

#### 3.1 Land Preparation

Plowed to form uniform smooth seed bed. Use of mold board plough and harrow is advisable.

#### 3.2 Planting Method

The usual method is to broadcast seed on a rough seed bed but Maize grows best and produces higher yields when planted in rows 75 cm apart. Seed

should be planted at least 2 cm deep but not more than 5 cm deep and 20 to 30 cm apart in the row.

### 3.3 Sowing Date:

It is essential to plant early at the beginning of the rainy season (after receiving about 50cm of rain).

### 3.4 Plant Population

- (a) Broadcast planting requires about 30 kg seed/ha.
- (b) Seed planted in row 75 cm apart and 20 - 30cm in the row requires about 20 kg seed/ha.
- (c) Thinning may be required when broadcasting or when planted too close in the row.

### 3.5 Fertilizer

Use EPID recommendations for your area. (see front of book).

For best results the fertilizer should be banded 5 cm to the side and 5 cm below the seed at time of planting.

### 3.6 Weeding

Hand weed until a dense folage is established. With proper weeding yields can be increased as much as 50%.

## 4. Diseases

Principal diseases are corn leaf Blight (*Helminthosporium* sp) and Rust (*Puccinia* sp.) These diseases are prevented by selecting diseases resistant varieties. Varieties from USA and Europe are more suseptible than those from South America and Kenya.



## 5. Pests

- 5.1 Stalk Borers are a serious pest. They are controlled by destroying previous crop residue. Plowing under crop residue soon after harvesting or burning the fields will reduce infestation. Dust plants with 10% DDT by placing a pinch (amount held between the thumb and forefinger) in the whorle (centre) of plant when the plants are 15 - 20 cm high.
- 5.2 Army worm (*haphyema jugiperda*) can also be a serious pest. Treat with 10% DDT dust at 10 kg/ha when an average of 5 worms per square meter occur (see Instructions for Dusting and safty Precautions).

Noug (Guizotia Abyssinima)

1. Conditions of Growth

1.1 Altitude and temperature range

Between 1700 and 2500 m

Optimum between 1800 and 2200 m.

1.2 Rainfall

Will grow and produce a crop with less than 300m rainfall during growing season. Often planted late and crop maturing on residual soil moisture.

1.3 Soil

Nough is grown in wet clay soils. It grows well in waterlogged soils and on soils with a low fertility level.

2. Varieties

No improved varieties at present. Use good seed from local varieties.

3. Cultural Practices

3.1 Land Preparation

Noug will do well in a reasonable well prepared seed bed.

3.2 Planting Method

Broadcast.

3.3 Sowing Date

In well drained soils nough should be planted between 25 June and 7 July. In waterlogged soils planting can be delayed until end of August.

3.4 Plant Population

Broadcast 20 to 30 kg/ha.

3.5 Fertilizers

No fertilizer recommended.

3.6 Weeding

Hand weed until dense foliage is established.

4. Disease

No disease of economic importance

5. Pests

No serious pests

## PIGEON PEAS (Cajanus Cajan)

### 1. Conditions of Growth

#### 1.1 Altitude and Temperature Range

Usually grown below 1800 m. They are sensitive to frost.

#### 1.2 Rainfall

They are drought resistant due to deep root system. Well suited to areas with less than 600 mm rainfall.

#### 1.3 Soils

A well drained soils is most important because pigeon peas will not tolerate poor drainage.

### 2. Varieties

Two varieties are recognized.

1. Short (1 to 2 meter) early maturing and usually grown as an annual. (Tur cultivars of India)
2. Tall 2 - 3 meters late maturing and usually grown a perennial (2 to 3 years)(Arhar cultivars of India).

### 3. Cultural Practices

#### 3.1 Land Preparation

Minimum cultivation is required. It is important to eliminate the weeds during establishment to conserve moisture. This is very important in areas a low rainfall.

#### 3.2 Planting Method

Row planting is recommended

- a. Short varieties spacing of 50 x 20 cm is recommended.

- b. Tall varieties spacing of 1.5 x 1.2 m is recommended. Seed should be planted about 5 cm deep.
- c. Soaking the seed a few hours (2-3 hours) before planting will speed up germination.

### 3.3 Sowing Date

Seeds can be planted after the first rains in March or June.

### 3.4 Plant Population

Two or three seeds to a hill is adequate because germination is usually very good.

### 35. Fertilizer

No fertilizers are recommended.

### 3.6 Weeding

It is very important to keep weeds out of planting at all times particularly during the first 3 months but at all time for good production.

## 4. Diseases

No diseases of economic importance

## 5. Pests:

No pests of economic importance at present, but pod borers are a problem in some areas.

Rape Seed (Brassica napus)

1. Conditions of Growth

1.1 Altitude and Temperature Range above 1650

Optimum between 1800 and 2600 m.

Does best in cool moist climates. Not suited to hot humid climates.

1.2 Rainfall

Above 400 mm distributed over growing season

1.3 Soils

Well drained, fertile, medium textured soils are best.

Poor growth on poorly drained clay soils

2. Varieties

No general recommended variety; EPID agent or experiment station can make recommendations for specific areas.

3. Cultural Practices

3.1 Land Preparation

Ploughed to form smooth uniform seed bed.

Mould board plough and harrow are recommended

3.2 Planting Method

Broadcast

3.3 Sowing Date

Between early and mid June is optimum time for sowing. Later planting may result in loss due to frost at harvest time.

3.4 Plant Populations

Broadcast                    12 - 18 kg/ha

### 3.5 Fertilizers

Use EPID recommendations for your area (see front of book)

### 3.6 Weeding

Hand weed until dense foliage is established.

#### Diseases:

No disease of economic importance except rust on some varieties.

## 5. Pests

The diamond back moth & Plusa worms may reach damaging levels. Control by dusting with 10% DDT dust at a rate of 10 kg/ha. Dust when an average of 5 worms per square meter occur. (See dusting Instruction and Safty Instruction).

## Sorghum (Sorghum Spp)

### 1. Conditions of Growth

#### 1.1 Altitude and Temperature

Usually below 2,000 m but in low rainfall areas irrigation is necessary.

#### 1.2 Rainfall

Average rainfall above 400 mm during growing season for good yields. In areas less than 600 mm sorghum may be grown more profitable than maize.

#### 1.3 Soils

Well drained fertile medium textured soils are best. Usually sorghum does better than maize on less fertile soils. Warm soils are essential.

### 2. Varieties (1975 recommendations)

Tall set varieties such as Hirna, Alemaya 70 and Erwegere and short set varieties such as Gato 994 and Didessa 1057 are most adaptable.

### 3. Cultural Practices

#### 3.1 Land Preparations

Ploughed to form a uniform smooth seed bed. Use of mould board plough and harrow is advisable.

#### 3.2 Planting Method

The usual method is to broadcast seed on a rough seed bed but sorghum grows best and produces higher yields when planted in rows 75 mm apart. Seed should be planted at least 2 cm deep but not more than 5 cm deep and 20 to 30 cm apart in the row.



### 3.3 Sowing Date:

It is essential to plant as early as possible at the beginning of the rainy season, usually after receiving about 50 mm of rain.

### 3.4 Plant Population

Recommended seeding rate for varieties suggested is 8 - 10 kg/ha. High seed rate is recommended because sorghum is susceptible to seed decay and seedling blight. Thinning may be necessary to give approximately 133,000 plants/ha. In areas where moisture is short more plants should be thinned out.

### 3.5 Fertilizer:

Use EPID recommendations for your area (See front of book)

### 3.6 Weeding:

Hand weed until dense foliage is established. With proper weeding yields can be increased as much as 50%.

Striga: A good fertilizer program and hand weeding are most effective. Striga should not be allowed to go to seed. Weed when plants start to bloom.

## 4. Disease - No disease of economic importance

## 5. Pest

5.1 Beetle - (*Pachnods interrupta*) may be controlled by dusting with 10% DDT. Place dust in bag tied to a pole and shake over the heads. Treat when an average of one beetle per head is present.

5.2 Stock Borers - Dust plants with 10 kg/ha of 10% DDT when plants are 15 - 20 cm tall.

- 5.3 American Boll Worm - Dust with 10 kg/ha of 10% DDT when an average of one worm per head is present. (See Instructions for Dusting and Safty Precaution)

Teff (Eragrostis tef)

1. Conditions of growth

1.1 Altitude and temperature range

Between 1,500 and 2,800 m

Optimum between 1,800 and 2,200 m

1.2 Rainfall

Above 200 mm distributed over growing season.

Optimum growth is in areas with 400 mm rain during growing season.

1.3 Soils

Teff does well on clay loam and clay soils which retain moisture during the growing seasons. It does well on soils with a moderate fertility level and can tolerate moderate waterlogged conditions.

2. Varieties

No general recommendation at present time. EPID agents or experiment station can recommended varieties for areas.

3. Cultural Practives

3.1 Land Preparation

Teff requires a very smooth and well prepared seed bed for optimum yield. The seed bed should be compacted before seeding.

3. 3.2 Planting Method

Broadcast

3.3 Sowing Date:

Optimum sowing date is the first two weeks of July. Planting may be delayed if rainfall has not been enough to wet and compact the soil.

3.4 Plant Population

Use 30 kg seed/ha

### 3.5 Fertilizers

Use EPID recommendations for your area (See front of book)

### 3.6 Weeding

Teff requires clean weeding for good yields. Hand weed until dense foliage in established. Chemical weed killers are available for the control of broad leaf weeds, EPID agents can make recommendations for the area.

## 4. Diseases

The most important diseases reported on teff are rust (Uromyces ergrostides) and head smudge (Helminthosporum miyakei) No control available for these disease at present.

## 5. Pests

- 5.1 Worms: have been reported on teff and can be controlled by dusting with 10% DDT at a rate of 10 kg/ha. When an average of 5 worms per square meter occur. (See Instructions for Dusting and Safty Precautions)
- 5.2 Teff Fly - Treat seed at a rate of 50 gm of aldrin 40% W.P. to 10 kg of seed (See Instructions for Dusting and Safty Precautions)

Wheat (Triticum Spp.)

1. Conditions of Growth

1.1 Altitude and Temperature Range

Between 1,700 and 2,800 m.

Optimum 1,800 and 2,400 mm.

Below 1,700 m as an irrigated winter crop

Grown in areas with cool night temp.

Frost can damage plants and reduce yield.

1.2 Rainfall

Above 300 mm distributed over growing season.

High rainfall and high temperatures reduce growth and yields.

1.3 Soils

Well drained fertile soils best; camber beds improve growth on wet clay soils.

2. Varieties: (1975 recommendations)

(a) above 2,000 m, Kanga (FW68), Mamba, Roman BC, K4500 L6A4, and K4135

(b) below 2,000 m, Kanga (FW68), Laketch (8156 W), K4500L6A4 and CI8152 Fr<sup>2</sup>

3. Cultural Practices:

3.1 Land Preparation:

Ploughed to form smooth, uniform seed bed.

Mould board plough and harrow are recommended.

3.2 Planting method

Wheat may be broadcast but does better when planted in rows 20 cm apart. Seed should not be deeper than 5 cm.

3.3 Sowing Date:

Between mid June and early July.

### 3.4 Plant Population

125 - 150 kg/ha

150 kg/ha for broadcast seeding and 125 kg/ha when drilled in rows 20 cm apart

100 kg/ha for weak straw varieties

### 3.5 Fertilizers

Use EPID recommendations for your area (See front of book)

Apply at time of seed sowing

### 3.6 Weeding

(a) Hand weed until dense foliage is established

(b) Herbicides are available for broad-leaf weed control; EPID agents will make recommendations for their area.

## 4. Diseases:

### 4.1 Leaf Blotch (Septoria Tritici)

Major foliar disease

Light-green to yellow spots between veins of leaves which spread rapidly to form light brown irregular blotch with speckled appearance.

Yield reduction can exceed 40%. Prevent by

- (1) Use resistant varieties
- (2) crop rotation
- (3) burning previous crop residues
- (4) plowing under volunteer wheat

### 4.2 Rusts (Puccinia spp.)

Leaf rust (P. recondita), strip rust (P. Struiformis) and stem rust (P. Graminis)

Orange or yellow spores on leaves stems and/or heads, neat rows on surface of affected plant part.

Yield loss substantial with leaf and stripe rusts and complete with stem rust, Prevent by using resistant varieties.

## 5. Pests

Plusia worms and armyworms but usually not serious. Control by dusting with 10 kg/ha of 10% of DDT when an average of 5 worms per square meter occur. (See Instructions for Dusting and Safty Precautions).

## SEED AND GRAIN STORAGE

### I SEED STORAGE FOR FARMER USE

As seed grain is specially selected or bought at great expense, it is important to take special care in storage. The following method of storage is strongly recommended.

Seed grain must be well-dried in the sun so that the moisture content is as low as possible (Pulses 7-9%, cereals 10%, sorghum, maize 11-12%). The seed grain should then be threshed and put into an airtight metal drum together with the correct number of phosphine-producing tablets, bags or pellets. (See relevant section). The drum must not be opened until the grain is needed. The drum should be kept in a shaded place and, if possible, inside a building where it will be safe from thieves.

If the drum is left open for more than one or two days, it should be re-treated with phosphine before it is re-sealed.

Before the seed is planted, it should be treated with a suitable seed-dressing.

Many peasant farmers traditionally store their unthreshed seed grain in the eaves of their houses above the fireplace. Here the grain is protected by the smoke from the fire so this practice is recommended as long as the grain is not too near the heat of the fire where it could become "cooked".

## II Grain Storage Treatment For Farm Use

### A. Dust Treatment

Grain can be protected against insect infestation by mixing it with an insecticidal dust when it is put into store. Grain which is to be stored for any length of time must first be thoroughly dried. Damp grain is soft and is more likely to become mouldy and attacked by insects.

Whichever insecticide is used, to obtain the maximum protection it is important that the insecticide is thoroughly mixed with the grain. When treating small quantities of grain the measured amount of insecticide can be sprinkled over the grain as it is put into store. For larger quantities it is best done by heaping the grain on the floor indoors, protected from the wind,

and then turning the grain with a shovel or piece of wood while the insecticide is applied over the heap from a tin with a perforated lid. Alternatively large amounts of grain may be treated quite quickly using a "Fuffle".

The inert carrier dusts used in the various formulations available also change from time to time. Every time the dust is changed, its weight changes, causing the volume to weight ratio of the insecticide to change. If, therefore, extension agents are teaching farmers to use a known volume (e.g. matchbox-fulls) on their grain, they should carefully weigh a matchbox-full before recommending how many of each should be mixed with a given quantity of grain.

#### For example

An agent is supplied with 0.5% Lindane dust. He knows that the recommended dose for cob maize is:-

100 gms of dust for every 100 kilos of grain

1 matchbox-full is found to contain 10 gms of dust

Therefore,

10 matchbox-fulls is needed to treat every 100 kilos of grain.



A new formulation of the same insecticide is given to the agent. When he weighs it he finds that:

1 match-box-full contains 15 gms of insecticidal dust.

Therefore,

7 matchbox-fulls will treat 100 kilos of maize cobs.

#### W A R N I N G

Some storage pesticides are also used for controlling insects in the field, but only those formulations specifically recommended for use on harvested grain should be used on the stored crop. Other formulations are available for cleaning the store or protecting the grain by surface spraying of stocks. Do not use these directly on the grain itself.

All grain treated with dust should be washed or sieved before it is cooked. Although safe, large amounts of dust do not improve the taste of the food.

(1) Dust Formulation Recommended For Farmer UseLindane (gamma B.H.C.)

This insecticide is sold under a variety of trade names, Gammexane, Geolingex, Calandrin, Fito Gamma, Blue Cross, Red Triangle.

It may be used on cob maize and sorghum heads or on shelled maize, threshed sorghum and cereal grains. It should not be recommended for use on Haricot beans destined for export. It is also used on the surface of bags and for sprinkling around stores to treat residual infestations prior to the during storage.

Dosage rates are as follows

On Unthreshed Cereals, Cob Maize, Sorghum Heads Using

a. 0.5% dust.

0.5% dust	mix	100	gms	with	every	100	kilos	grain
1.0% dust	"	50	"	"	"	"	"	"
2.0% dust	"	25	"	"	"	"	"	"
3.0% dust	"	17	"	"	"	"	"	"

The cost of treatment with Lindane varies from 8 cents to 20 cents per quintal. It is effective against adult Sitotraga moths and Sitophilus weavils. Lindane will remain effective for 4-8 months.

## (2) How to apply Lindane dust to grain

The chemical can only be insecticidal when it comes into direct contact with the insects. Thus it is necessary to distribute the dust where the pests will make this contact. Ideally, this is achieved by mixing the insecticide evenly throughout the threshed grain by one of the two methods described below or by sandwich application in unthreshed grain.

### i. Threshed Grain

#### Shovel mixing

The threshed grain is placed on the ground in a heap and the correct quantity of insecticide is added. Then the whole pile is mixed together using a shovel or a flat piece of wood, until all the commodity appears to be treated with the dust. This method can only be effective if performed correctly. However, the quality of shovel mixing can vary depending on the operator and how much effort he is prepared to put into the task. If the quantity to be treated is only a few bags, then this method usually suffices.

Care should be taken that the mixing is sheltered from the wind and takes place on dry ground free from debris, or ideally on a stone or tarpaulin surface to avoid any contamination of the grain.

#### Use of the Fuffle

This is a device consisting of a funnel incorporating several baffles; hence the name "Fuffle". It is designed to mix threshed grain and insecticide together uniformly and quickly, i.e. 10 bags in half an hour.

The fuffle has three sockets on the side into which are fitted wooden poles to act as legs. The legs themselves should be strong wood, approx. 10 cms in diameter and 1.3 meters long. The ends which are to be fitted into the fuffle should be tapered to ensure a tight fit. Hooks are present at the base of the fuffle for the attachment

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of a sack, and the legs should be adjusted so that the bottom of the sack just touches the ground.

A container which will hold about 20 kilos of grain, often a bucket, is filled with the commodity. The appropriate quantity of insecticide dust for the volume is measured out and placed in a small heap on top of the grain. The container is then quickly emptied into the fuffle in one action. This procedure is repeated until the sacks are full. The movement of the dust and the grain through the different parts of the machine ensure a thorough mixing.

In the case of pit stores the fuffle can be used without legs since the apparatus may be placed in the mouth of the pit.

Use of this apparatus is simple, quick and efficient. The grain is treated and bagged in one operation, and the quality of the mixing is constant. As there are no moving parts in the fuffle, there is nothing to malfunction or wear out.

ii) Unthreshed GrainSandwich Application

If it is not possible to utilise either of the methods described above, then a reasonable degree of control can be achieved by putting part of the grain into the pit or store and then sprinkling a covering of insecticide dust over the surface before more of the commodity is added. This method is continued until all the grain is in store, creating a sandwich effect. Care should be taken to ensure that the correct amount of dust is added to the quantity of produce being stored, no matter how many layers are incorporated. It is recommended that each layer of grain be 20 - 25 cms deep. This method can be used for unthreshed grain as it is being put into cribs.

Conversion Tables

<u>Length</u> <u>to convert</u>	<u>To</u>	<u>Multiply by</u>
Centimeters	Meters	.01
"	Millimeter	10.00
"	Inches	.394
"	Feet	.033
Meters	Centimeter	100.00
"	Millimeters	1000.
"	Kilometers	.001
"	Inches	39.37
"	Feet	3.28
"	Yards	1.094
Kilometer	Meters	1000.
"	Miles	.621
"	Feet	32 1
Inches	Millimeter	25.4
"	Centimeter	2.54
Feet	Inches	12.
"	Centimeter	30.48
"	Meter	.305
Mile	Feet	5280.
"	Kilometer	1.61
 <u>Area</u>		
Square Meter	Square centimeter	. 10,000
"    Kilometer	"    meter	1,000,000
"    "	Hectares	100
"    "	Gasha	2.5
"    "	Acres	247
Hectares	Square meter	10,000 (100m x 100m)
"	Acres	2.47
Gasha	Hectares	40
Acres	Hectares	.4047
"	Sq. feet	43,560
 <u>Weight</u>		
Gram	Kilo Gram	0.001
"	Ounce (oz)	0.0353
Kilogram	gram	1,000
"	Ounce (oz)	35.27
"	Pound	2.205

<u>Weight to convert</u>	<u>To</u>	<u>Multiply by</u>
Ounce (oz)	Gram	28.35
"	Pound	0.0625
Pound	Gram	453.6
"	Kilo gram	0.454
"	Ounce (oz)	16
Quintal	Kilo gram	100
"	Ton (metric)	.1
"	Pound	220.5
Ton (Metric)	Kilogram	1000
"	Quintals	10
"	Pounds	2204.6
Ton (short)	Pound	200
"	Kilo grams	907.2
"	Tons (long)	.89
Cubic foot water	Pounds	62.43
Gallon of water	Pounds	8.345
Liter of water	Kilograms	1
" " "	grams	1000

Volume

Cubic centimeter	Litres	0.001
" "	Cubic inches	0.061
Litres	Cubic centimeter	1,000
"	Cubic meters	0.001
"	Gallons (U.S.)	0.264
Hectare centimeter	Litres	100,000
" "	Gallons (U.S.)	26,496
" "	Acre inch	1.026
Cubic feet	Cubic centimeter	28,326
" "	Cubic meters	0.028
" "	Liters	28.32
" "	Gallons (U.S.)	7.48
Gallons (U.S.)	Liters	3.785
"	Gallons (Imp.)	.833
"	Cubic feet	.134
"	Pints	8.
"	Quarts	4
Acre inches	Gallons (U.S.)	27,120
" "	Hectare Centimeter	.975



Volume of Tank

Square Tank

$$\text{Volume (Liters)} = \text{Length (m)} \times \text{Width (m)} \times \text{height (m)} \\ \times 1000$$

Round Tank

$$\text{Volume (lts.)} = \text{Diameter (m)} \times \text{Diameter (m)} \times \text{height} \\ \text{(m)} \times 785$$

Weighth-Volume Characteristic of Certain Materials

<u>Material</u>	<u>kg/Cubic meter</u>	<u>Cubic meter/ton metric</u>
Cement	1510	0.66
Concrete	2410	0.44
Gravel	1925	0.52
Lime	850	1.18
Sand	1605	0.62
Soil	1605	0.62
Water	1000	1.00
Wood (Tidh)	348	2.61
Wood (Zigba)	640	1.61

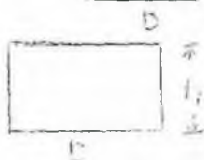
Area of A Plain

Triangle



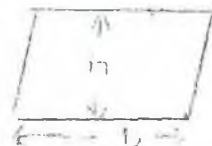
$$\text{Area} = \frac{bh}{2}$$

Rectangle



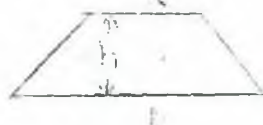
$$\text{Area} = bh$$

Parallelogram



$$\text{Area} = bh$$

Trapezoid



$$\text{Area} = \frac{(a + b)}{2} h$$

Circle



$$\text{Area} = r^2$$

Irrigular Plain

$$\text{Area} = d \left( \frac{w_1 + w_4}{2} + w_2 + w_3 \right)$$

b = Base

a = top

d = distance

h = height

r = radius

w = width

Concrete Mixes and Materials

Approximate amount of material for

10 Square meters of Concrete

<u>Thickness of Concrete</u>	<u>Concrete (Cu.M.)</u>	<u>Sacks of Cement</u>	<u>Sand (Cu.M)</u>	<u>Gravel (Cu.M.)</u>
10 cm	1.0	8	0.5	0.7
15 cm	1.5	12	1.0	1.0
20 cm	2.0	16	1.5	1.4
25 cm	2.5	20	2.0	1.75

Water Tight Concrete

Cement -- 1 part by volume  
 Sand -- 2 " " "  
 Gravel -- 3 " " "  
 Hydrated lime 13 liters per 50 kg cement

Recommended Proportions of Water of Cement for

Different Kind of Work

	Litre of Water to add to each sack of cement if sand is			Suggested mixture for a batch			Material per cu. Meter of Concrete		
	V.Wet	Wet	Damp	50kg sack of cement	Sand Cu.m.	Gravel Cu.m.	50 kg sacks of cem.	Sand Cu.m.	Gravel Cu.m.
Subjected to severe conditions (dairy floors etc.)	16	18	20	1	0.06	0.07	9	0.5	0.6*
Subjected to moderate conditions (water tight floors, walkways, storage tanks etc.)	19	22	24	1	0.07	0.10	8	0.5	0.7+
Subjected to slight wear (foundations, walls, mass concrete etc.)	21	24	27	1	0.09	0.13	6½	0.5	0.75+

\* maximum size of aggregate 20 mm  
 + " " " " 40 mm

White Wash that Sticks

1. Slowly add boiling water to 8 liters of lime stirring constantly.
2. Add 2 liters of salt to lime paste and stir thoroughly. Add water to bring to proper thickness for brushing.
3. Just before using add one hand full of cement and a teaspoon of ultramarine bluing to each bucketfull of white wash.

Cement makes white wash adhere strongly to any surface and bluing gives the white wash-cement mixture a snow-white appearance.

Amounts of Paint Required for Wood Surface

Divide the number of square meters of surface by 5.  
This gives the number of liters of paint required for 2 coats of paint.

Note: Cement mixes, white wash and paint required taken from.

"Handbooks of weight and measure, Conversion tables and other data often needed in Agriculture."

Exp. St. Mic. Pub . No. 29 April 1968, HSIU College of Agr.