Part I
Preventing the Long-Distance Spread of Parasitic Weeds in Ethiopia

Part II
Recommendations to MOA Quarantine Service Concerning Parasitic Weeds

Chris Parker
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Technical Manual No. 2

ETHIOPIAN WEED SCIENCE COMMITTEE
WEED QUARANTINE AND NOXIOUS WEED ACTIVITIES

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ETHIOPIAN WEED SCIENCE COMMITTEE
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The Ethiopian Weed Science Committee (EWSC) was established on 23 November 1982. EWSC is a non-profit, nation wide scientific and educational organization, open to all who are interested in weeds and their control.

EWSC has the following objectives:

- encouraging and promoting the development of knowledge concerning weed science
- promoting unity in research, extension, education, legislation, regulation and other matters pertaining to weeds.
- facilitating and assisting professional contacts between individuals and organizations
- publishing and documenting weed science research results and making information available to users.

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PREFACE

In Ethiopia, the efficacy of quarantine regulation regarding the introduction of exotic weeds is severely limited. Ethiopia issues the first plant quarantine law in 1971 "Plant Protection Decree (PPD) No. 56 of 1971". Very recently the Ministry of Agriculture started implementing the PPD of 1971, as it is empowered by the same decree to control the movement of plant and plant products with the intentions of avoiding the entry of exotic injurious pests into the country.

In anticipation of these regulations and in order to generate more generally acceptable quarantine procedures, the following set of guidelines on "Weed quarantine and Noxious Weed Activities: have been prepared on the basis of the recommendation given by the Second Ethiopian Weed Science Workshop "Problems and Control of Parasitic Weeds in Ethiopia" during 29-30 September 1988.
Preventing the Long-Distance Spread of Parasitic Weeds in Ethiopia

1. Introduction

Parasitic weeds are already a serious problem in many parts of Ethiopia, but there is still enormous potential for them to spread to further new areas and cause even greater losses. For instance, in the past 30 years, *Striga hermonthica* has spread to new areas in northern Shewa and has also made a long distance jump into Hararghe where it was not previously known. Other parts of Hararghe and southern Ethiopia and the major maize growing areas of Welega could also be at risk if care is not taken to prevent further spread. There are similar risks of the further spread of *Orobanche*, *Alectra*, *Cuscuta* and Mistletoe species.

The Ethiopian Weed Science Committee in which all the major agricultural institutions are represented (MOA, IAR, MSFD, MCTD, AUA etc) has, since 1984, taken a special interest in the problem of parasitic weed in Ethiopia and has had a sub-committee monitoring their importance and seeking ways of reducing their impact. One of the most important actions has been to arrange a Workshop on Parasitic Weeds in Ethiopia, held at the MOA Sholla Laboratory in September 1988. At this Workshop, concern was expressed about the risk of further spread, and the need for cooperative effort to prevent it. In a special discussion period, it was proposed that the EWSC sub-committee should draft guide lines for the prevention of Introduction and Spread of Parasitic Weeds. After several meetings and preparation of draft proposals, two documents have been prepared. One of these is concerned with prevention of introduction, and is addressed specifically to the MOA Quarantine Service. This second document concerns the question of long-distance spread and is addressed to all relevant institutions who could cooperate in reducing the risks of transfer of parasitic weeds around the country.

The problem of local, short-distance spread has been also considered and suitable recommendations will be incorporated into MOA Extension advice.

2. The Main Areas of Long-distance Spread

The main means by which long-distance spread may occur include:

a) contaminated crop produce-seed, planting material, forage, crop residues, animals, etc.

b) contaminated containers, bags, etc.

c) contaminated vehicles and agricultural machinery such as combines.

As with quarantine at the national level there are serious problems of detecting or being aware of contamination, especially with the very small seeded root parasites (*Striga*, *Orobanche* and *Alectra species*), and methods of prevention must depend mainly on minimizing the risks of transfer, from infested to uninfected areas rather than on any physical quarantine physical quarantine or inspection system. With regard to mistletoes physical quarantine should be possible. Although seed is largely dispersed by birds, it should be possible to prevent spread through stem cuttings and other propagating materials.
3. Responsibility for Prevention of Spread

Responsibility for seeing that risk of long-distance spread is minimized will fall on the major institutions responsible for movement of produce and equipment around the country. Hence, this document is being circulated to:

- MOA including Agricultural Mechanization Corporation,
- MSFD including the Seed Corporation and HDC
- IAR
- MCTD
- AMC (Agricultural Marketing Corporation)
- RRC
- PPRC
- Awasa college of Agriculture
- AUA
- ILCA
- NGOs

Each of these organizations is requested to circulate copies to take all possible steps to ensure implementation of the simple procedures that are recommended below.

4. Recognising the Major Problems

The serious parasite species that are already in the country and for which precautions should be taken are relatively few. The main ones are indicated below, together with the main areas in which they are present (or absent):

4.1 Striga hermonthica

Widespread in Gondar, Gojam, Eritrea, Tigray and Welø. Also in Selale and Yifat & Timuga awrajas of Shewa, Habro awraja of Hararghe, Asosa awraja of Welega.

Important Sorghum and Miaze growing areas in which it is so far not present, include:

- all Welega other than parts of Asosa awraja;
- all Shewa, other than Selale and Yifat & Timuga;
- all Hararghe other than Habro awraja; all Kefa;
- all Illubabor (except parts of Gambella awraja);
- all Gamu Gofa, Bale, Sidamo and Arsi.

4.2 Striga asiatica

In the forms which attack crops it is restricted so far to Habro, Gursum and Harer-Zuriya awrajas of Hararghe, Yifat & awraja of Shewa (near Shewa Robi), Gamu and Gardula awraja of Gamu Gofa.

4.3 Striga aspera

Restricted, so far as is known to the State Farms as Upper Birr (Gojam) and Fincha (Welega).

4.4 Alectra vogelii

Restricted so far to the Gursum awraja of Hararghe, where it attacks groundnut and cowpea.
4.5 *Orobanche ramosa*

Widespread but sporadic in most provinces, known to be locally severe in tomatoes etc. in the Horticulture State Farms of the Upper Awash (Shewa/Arsi border), also in tomatoes and flower crops at Zeway (Shewa) etc.

No large areas are known for sure to be free, but care is needed wherever tomatoes, tobacco or eggplant are to be major crops.

4.6 *Orobanche cernua*

The only locality where this species is so far a problem is in the Horticulture State Farms of the Upper Awash (Shewa/Arsi border), attacking tomato, tobacco and eggplant. It is also recorded, however, from Bale (Mendeyu awraja) and Hararghe (Jijiga awraja).

4.7 *Cuscuta campestris*

This introduced species is already present in most provinces, but is still localised in most of them. Detailed distribution has not yet been defined, but noug-growing areas where it is certainly present include: Welega, Gojam, Gonder, Gamu Gofa and Welo (Ambassel). It is also present on coffee on the State Farms at Bebeka (Illubabor) and Tepi (Kefa) and on various other crop or wild hosts in Eritrea, Arsi, Tigray, Shewa, Hararghe and Sidamo. It is especially well-established in Kefa.

4.8 *Cuscuta epilinum*

This introduced species only attacks linseed and is so far known only from scattered localities including the following awrajas. Inderta (Tigray), Menagesha and Jibat & Mecha (Shewa), Mendoyu and Genale (Bale) and Chilalo (Arsi).

4.9 *Englerina woodfordioides*

This species appears to be fairly wide spread in the south and south-western parts of the country (Welega, Illubabor, Kefa, Sidamo and Bale). It is reported as a problem in peach from Western Shewa and Debre Markos (Gojam).

4.10 *Phragmanthera regularis*

Wide spread but sporadic in many provinces. It is a considerable problem on shade and fruit trees in Bahr Dar (Gojam), Menagesha (Shewa) and Sidama (Sidamo) awrajas.

4.11 *Tapinanthis globiferus*

This species is known to occur in almost all provinces but it is particularly serious problem in Welo, Welega and Hararghe.
4.12 *Viscum triflorum*

This species is reported from Eritrea, Tigray, Harerghhe, Sidamo, Arsi, Shewa, Kefa Gojam and Bale. It is reported from Ambasel (Welo) as a parasite on coffee.

N.B.

An identification manual is in the course of preparation by EWSC until that is available, help in identification of the above and their parasitic weeds should be sought from relevant units such as IAR, MOA (Sholla Laboratory) and the National Herbarium).

5. Designating Infested and Uninfested Areas

Each organization should consider the region for which they are responsible and with the help of the above and all other available information, consider the designation of INFESTED AND UNINFESTED areas at the awraja (or equivalent) level. If a new infestation is found we recommend that the finder collect sample and contact the Quarantine Section of MOA.

6. Methods to Prevent Spread

6.1 Movement of Crop Produce

Do not convey or permit to be conveyed, any crop seed or other crop produce, including straw etc. which could be contaminated with parasite seed, from INFESTED TO UNINFESTED districts. This may apply to crop species other than those that are normally attacked, if there is any risk that they are contaminated with infested soil, eg by being threshed on the ground, or carrying soil naturally, eg. potato, carrots, groundnut etc., or transplants or tree or fruit crops or ornamentals.

Cleaning of crop seed or produce to remove the inute seeds of root parasites (*Striga, Orobanche* or *Alectra* species) will not normally be feasible, but where absolutely necessary, risks could be greatly reduced by very thorough washing, (after first removing the shells in the case of groundnut). Cleaning of linseed can be achieved by careful sieving using sieves with mesh dimensions of 25 microns. Cleaning seed of noug is virtually impossible without very sophisticated equipment and should not be attempted for the purposes of transfer from INFESTED TO UNINFESTED areas.

6.2 Movement of Contaminated Bags and Containers

Any bag or other container that is known to have been contaminated with any of the fine-seeded root parasites and which cannot be very thoroughly and simply cleaned (eg. by washing) should not be used to convey any crop seed for planting, from INFESTED TO UNINFESTED areas. Metal or wooden containers can probably be cleaned satisfactorily, but bags of jute, hessian, sisal or synthetic fiber must be regarded as uncleanable, unless sophisticated bag cleaning equipment is available. Where necessary, new bags must be used for conveyance from INFESTED to UNINFESTED areas.

6.3 Movement of Vehicles, Combines and Agricultural Implements

Risks of spread on vehicles cannot be completely eliminated without very rigorous and impractical precautions, but the risks can be very much reduced by e.g.:

Scheduling field visits to go via UNINFESTED areas to INFESTED rather than vice versa. Scheduling combines to harvest UNINFESTED crops before INFESTED.
Where necessary, facilities should be developed for thorough washing of vehicles and implements before they move from a seriously INFESTED areas to go to an UNINFESTED area. If this is not practicable in the infested area, then it may be safely done at a suitable intermediate center where there is no risk of the washings reaching land in which the parasite could develop.

7. Conclusion

It is not envisaged that the above precautions be made mandatory in the immediate future, but the recipient institutions are requested to do all they can to promote the relatively simple procedures and advice given. Wherever they feel they need more advice or information, they should not hesitate to contact the Quarantine Service of MOA for further help.
Recommendations to MOA Quarantine Service
Concerning Parasitic Weeds

1. Introduction

Parasitic weeds are already a serious problem in many regions of Ethiopia and in a variety of crops. They have been the subject of intensive research by the Institute of Agricultural Research, and of study by Ministry of State Farms Development and Ministry of Agriculture. The later has prepared extension advice for farmers and conducted campaigns for the destruction of \textit{Striga} in affected areas. The Ethiopian Weed Science Committee comprising representatives from the above institutions and others, formed a sub-committee in 1984 with the express purpose of monitoring the problem of parasitic weeds in Ethiopia and considering ways in which their impact could be reduced. One of the most important actions of this committee was to arrange a Discussion Workshop on Parasitic Weeds in Ethiopia, held at the MOA Sholla Laboratory, Addis Ababa, in September 1988. In the course of discussions at this Workshop, there was repeated reference to the need to limit the further introduction and spread of parasitic weeds, and the EWSC Parasitic Weeds sub-Committee was charged with responsibility for developing guidelines for the prevention of such further introduction and spread. After several meetings and deliberation over draft proposals, it was agreed that the question of preventing new introduction from outside Ethiopia should be the topic of a document making recommendations to the MOA Quarantine Service, and giving advice on the identifications to the interception of parasitic weed species.

2. Prevention of Introduction

2.1. Species to be Subject to Restriction of Entry

Although many of the most important parasitic weed species are already present in Ethiopia, it is recommended that the range of prohibited species should include many of these on the following grounds:

a) that there is significant variation among different populations or 'races' of parasitic plant in terms of their ability to attack different hosts, and in the virulence of their attack. Hence, exotic population of indigenous parasite specie's could pose a new threat to crops not yet parasitised in Ethiopia, or that of even greater virulence and damage on the crops already attacked. A particular example is \textit{Striga gesnerioides} which already occurs in Ethiopia, but only in the form of races attacking wild hosts (and sweet potato in one small locality). In West Africa a different 'race' of this species causes severe losses of cowpea, and this race should certainly be excluded.

b) that there is as yet no certain means of distinguishing the seed of various closely related species within the most important genera of \textit{Striga}, \textit{Orobanche} or \textit{Cuscuta}.

Hence, it is recommended weed species to be excluded under any new Quarantine regulations should include:

\textbf{All Species of the Genus \textit{Striga} (Scrophulariaceae)}

Species already occurring as widespread problems in Ethiopia include \textit{S. hermonthica} and \textit{S. asiatica}, which \textit{S. aspera} and \textit{S. latericea} occur locally on crops, and \textit{S. forbesii} and \textit{S. gesnerioides} also occur
in the country mainly without attacking crops although they are known to do so elsewhere in Africa. Species not yet recorded in Ethiopia, which are known to cause problems elsewhere include *S. densiflora* and *S. euphrasioides (= S. angustifolia)* both occurring on sorghum, maize and millets, mainly in India.

**All species of the genus Orobanche (Orobanchaceae)**

Species already occurring in Ethiopia as weed problems are *O. minor*, *O. ramosa* and *O. cernua*. Species important elsewhere, and not yet recorded in Ethiopia include *O. aegyptiaca*, *O. crenata* and *O. cumana*. *O. aegyptiaca* is closely related to *O. ramosa* and attacks a similar range of crops but is large and possibly more damaging. *O. crenata* occurs all around the Mediterranean and is a particularly serious pest of faba bean. *O. cumana* is sometimes regarded as con-specific with *O. cernua*, but it may also be regarded as a distinct species, differing in being a special problem on sunflowers in E. Europe and USSR.

**All Species of the Genus Cuscuta (Convolvulaceae)**

Several *Cuscuta* species are indigenous to Ethiopia including *C. Kilimanjari*, but these rarely attack any crop. Two exotic species have already been introduced to Ethiopia at some time in the past are now widely distributed and troublesome. These are *C. campestris*, especially serious on noug, and *C. epilinum*, restricted to linseed. Species not recorded yet in Ethiopia but important elsewhere, include *C. chinensis* and *C. australis* (Asia).

**All Species of the Genus Alectra (Scrophulariaceae)**

At least two species of *Alectra* are apparently indigenous in Ethiopia and occur quite widely. *A. sessiliflora* occurs mainly on wild compositae, but may occasionally parasitize noug. *A. parasitics* has not been recorded on any crop. The exotic *A. vogelii* has only recently been discovered in the Gursum awraja of Hararghe where it damages groundnut and cowpea. It is presumed to have been introduced from west Africa where it is quite widespread on these two crops. This is the most requiring regulation, but one other, *A. orobanchoides* damages sunflower occasionally in Southern Africa.

**Mistletoes (Loranthaceae and Viscaceae)**

More than 30 mistletoe species do occur in Ethiopia, however, only 4 species namely: Englerina wood fordioides, Phragmanthera regularis, *Tapinanthus globiferus* (Loranthaceae) and *Viscum triflorium* (Viscaceae) have so far been recorded on trees of economic importance. These species are wide spread within the country, mainly in the natural vegetation. They can potentially be serious problem on tree crops including coffee and citrus.

**2.2 Methods of Interception**

Detection of the seeds of the root-parasite species (*Striga*, *Orobanche* and *Alectra*) will be extremely difficult by routine quarantine methods, but should be possible for spot-checking occasional suspect samples, using a wet-sieving process such as that used for separating *Striga* and *Orobanche* seeds from soil. The technique involves the washing of suspect seed or soil samples and passing the washings through standard soil sieves. Seeds of all species will pass through an 80 mesh (per inch) sieve with apertures approximately 25 micron, but be retained by a 120 mesh with apertures about 100 micron. Each genus has quite distinctive seed morphology (as well as characteristic small size of 0.2 - 0.5 mm) which can readily be recognized by a suitably training technician. The stem parasit, *Cuscuta* species, have larger seeds, 1-2 mm across which can be separated by suitable sieve sizes and recognized by their characteristically irregular surface. Mistletoe species
have more bigger seeds, that can be easily identified, but it is unlikely that means of spread could be seed. Emphasis should rather be given to inspection of stem cuttings and similar propagating materials to prevent introduction of more virulent forms and/or currently non-existent species.

While these techniques can be applied on a selective basis, main reliance will have to be placed on the requirement for a declaration of freedom from the specified species on phytosanitary certificates and/or perhaps prohibition of importation from certain seriously infested countries or regions.

3. Monitoring Initial Planting Sites

The IAR system of designating certain very limited sites for the initial growing of introduced crop seed materials under their own quarantine system includes the inspection of samples from imported seed material by growing them in isolation, fenced and away from crops areas, before dispatching to users. This procedure allows systematic monitoring for the possible accidental introduction of exotic weed species, including parasitic weeds.

MOA Quarantine Service should consider making strong recommendation to other seed importing institutions to follow a similar practice though it may not be practical for seed lots which are introduced as emergency supplies for immediate planting on large numbers of individual farms. If such importation and immediate distribution continues to be unavoidable, then particular care should be taken that the supplies come from non-infested regions/countries and/or are very thoroughly inspected for contamination before distribution.

The Quarantine Service should strongly urge all importing institutions to routinely examine all new planting sites for the presence of unusual weed species (not only parasitic). For purposes of educating field staff of these institutions in the identification of the main parasitic weeds, EWSC is intending to publish an identification manual on parasitic Weeds in Ethiopia. Until this is available, it may be necessary to arrange specialized training courses at which colour slides and specimens can be demonstrated. EWSC will be pleased to offer advice and assistance in the conduct of such training courses, on request.
For more detailed speckles that can be easily identified, but it is unlikely that means of spreading could
be detected on a regular basis, the use of video surveillance may be necessary. The potential for
species-specific impacts on biotic and abiotic components of the ecosystem requires
prevention of spread. The impacts of these species would depend on the interaction of various factors,
including the environmental conditions, host susceptibility, and the biological traits of the
species. It is important to consider the potential impacts of these species on biodiversity and
ecosystem function.

To prevent the spread of exotic species, it is important to implement measures that help
mitigate the risk of introduction. This includes the implementation of early detection and
response strategies, as well as the development of effective management plans. The use of
monitoring and surveillance techniques can help identify the presence of exotic species and
allow for timely interventions to prevent further spread. Additionally, public awareness
campaigns and educational programs can help increase public understanding of the risks associated
with exotic species and encourage proactive actions to prevent their introduction.

In conclusion, the spread of exotic species can have significant impacts on biodiversity and
ecosystem function. It is crucial to implement effective measures to prevent their introduction
and mitigate their potential impacts. This includes the implementation of early detection and
response strategies, as well as the development of effective management plans. Public awareness
campaigns and educational programs can also play a crucial role in raising awareness of the risks
associated with exotic species and encouraging proactive actions to prevent their introduction.