BASELINE SURVEY OF FOREST TREE DISEASESIN ETHIOPIA

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Forest protection, both as science and art, has not been developed to required level to curtail destruction of the indigenous as well as plantation forests in Ethiopia. Though 90%of forest development after seedling establishment involved protection, knowledge and intervention regarding the up-keeping and strengthening of forests have been given little attention in saving forests from injuries sustained by various agencies, such as, fire, diseases, pests, weeds, domestic animals, wildlife, pollution, and the most important actor, man himself.

Perhaps, because the extent of damage being so drastic, so pronounced and so great, forest fire might have commanded better attention than the other damaging agencies. However, in a given region, either insect pests or diseases may, and often do, cause more loss in a year than fires do. Their involvement in destruction is usually slower, less dramatic, and not as readily susceptible of quick control as fire. However, they are at work at all times, and no forest area is free of them.

Forests can be considered under several aspects according to their function, providing timber and other products, or for their different welfare effects which can scarcely be evaluated exactly. Diseases attacking a forest reduce their value to a very different degree; they may even destroy the forest as a whole. They may have a significant impact on forest productivity and hence also on forest management in general. Diseases brought about by one or several of the agents (fungi, bacteria, viruses, nematodes, etc.)can cause mortality of valuable timber, destruction of wood, reduction of growth increment and wood quality, deficiency on stocking, and delayed regeneration. This hazard must always be kept in mind and every effort has to be made in order to know beforehand what might happen to the forests if a new disease might appear from somewhere. In East Africa, thousands of hectares of *Pinusradiata,* a very fast growing pine, derived from California (U.S.A.), were killed by a needle disease (*Dothistroma* needle blight)and the species had to be replaced by another species of pine (*Pinuspatula*)which is

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more resistant to the disease but slower growing type; that reduces the yield by about one-quarter to one-third (Boyce, 1961).

The cypress species, *Cuppressusmacrocarpa*, formerly rich in prospect, was abandoned as a plantation in many areas of East Africa because of a disease known as *Monchaetia* canker (Boyce, 1961).

Two factors in forest management are of most significant influence on disease situation, the establishment of man-made monoculture, comparable with those of agricultural crops, and the worldwide distribution of fast growing exotics. Indeed, there is no principal difference of forest trees to fruit or ornamental trees. But fruit trees mostly command a higher value as compared to forest trees so that specialized and intensive protective measures can be used to combat their diseases. On the other hand, mode of cultivation, utilization, management of forest trees is very different and the forest areas are very extensive, the crop has rotations of many years, so that many epidemiological relations and the possibilities of prevention and control are very different.

Important Forest Diseases in International Scene

Tree diseases of various types had occurred in many parts of the world and some of them have caused devastating losses in timber.

Chestnut blight (*Endothiaparasitica*), which was introduced into U.S.A. from Asia, had commercially destroyed the American chestnut trees throughout its entire natural range in about 1910 (Beattie and Diller, 1914).

Dutch elm disease (*Ceratocystisulmi*)is another disease of historical importance of elm tree. Trees of all ages were killed and in some districts 60 to 70 percent of the trees had been destroyed in Europe and U.S.A. (Peace, 1960).

The first exotic tree to be extensively planted in continental Europe was eastern white pine introduced in 1705. At first,it was of great promise and hailed with enthusiasm; it finally encountered an unpredictable pathogenic factor, white pine blister rust, caused by the rust fungus, *Cronartiumribicola*Fisch, a migrant from Asia, resulting in the abandonment of the tree species throughout Europe (Gibson, 1979).

Douglas fir, another species, found high favour, and was extensively planted in Europe. The first pathogenic factor to threaten the tree was *Phomopsis*canker caused by a European fungus, *Phomopsispseudotsugae* Wilson and by *Rhabdocline* needle cast caused by *Rhabdoclinepseudotsugae*Sydow.

In southern Sweden, a flourishing plantation of 12-year old Jackpine (*Pinusbanksiana* Lam.) was ruined by a fungus (*Dasyscypha* species) which ordinarily occurs as a harmless saprophyte on the native Scots pine (causing canker on the main stem) (Boyce, 1961, Gibson, 1979).

Scots pine was attacked by a gall rust (*Peridemium* sp.), Himalayan pine (*Pinusexcelsa* Wall.) was damaged by a canker (*Valsasuperficialis*), Japanese red pine (*P. densiflora*Sieb. and Zucc.) was considerably affected by dieback of the leaders and branches, probably caused by *Cenangiumabietis* (Pers.) Rehm; Austrian pine was completely destroyed by sweet fern blister rust (*Cronartiumcomptoniae*Arth.)(Gibson, 1979).

Ornamental Austrian pine was susceptible to dieback of the twigs caused by *Sphaeropsisellisi*Sacc., also known as *Diplodiapinea* (Desm.) Kiekx (Gibson, 1979).

Monterey cypress (*Cupressusmacrocarpa*Gord.) in East Africa exemplifies two dangerous conditions to an exotic species:

1. A native fungus of no consequence becoming pathogenic on an exotic,
2. A fungus of no significance on the exotic in its native habitat causing loss to the tree in its new environment.

Monochaetiaunicornis (C.HE.)Sacc., found in a harmless form on a native juniper (*Juniperusprocera*Hochst.), apparently has become pathogenic on various cypresses, including Monterey, causing severe cankers on young trees in plantation.

Polystictusversicolor, a wood-destroying fungus relatively world-wide in its distribution, but confined to dead trees in the native habitat of Monterey cypress in California, causes a serious white rot of the wood of living trees in East Africa.

Type of Losses from Forest Diseases

When compared to forest fires, which are sudden and spectacular, diseases and insects work slowly and insidiously, but the loss is much higher in many regions.

Root, foliage, and stem diseases cause heavy losses by reducing increment for stands not yet reached merchantable size, by causing the lengthening of the rotation, and by actual killing of trees and by causing under-stocking. In general, all of which contribute to reduction in the future capital of timber (Boyce, 1961).

Sometimes, losses could be higher after timber is converted, much of it, in storage or in service. Its value is much lowered or destroyed by stain and decay, thus necessitating an increased annual cut for replacement, whose cost is significant and sometimes is greater than the value of the material destroyed (Boyce, 1961).

Disease Situation in Ethiopia's Forests

Forestry has a big impact on Ethiopia's economy. It is a source of income and employment to many farmers and contributes valuable resources to local industries and communities.

However, in spite of high demand for forest products various factors are known to contribute towards a decline in land under forest cover. Conversion of forestland into agricultural crop farms, destructive exploitation by man, forest fires, overgrazing, insect pests, are some of the causes. The consequence of this heavy exploitation is a general shortage of timber and firewood, a loss of valuable top soil and a reduction in the water supply.

In addition, forest tree diseases are also important factors that did not command much attention, but are highly involved in the gradual loss of growing stocks. The effect of these diseases is often not as striking as the other factors destroying the forest, but it is nevertheless of great importance. There has, however, been no constructive assessment of the magnitude and rate of loss due to diseases, especially in plantations of exotic and indigenous species. Very little research has been conducted on evaluation of

losses due to diseases in forest stands in Ethiopia. Thus, field surveillance of forest tree diseases was initiated to detect the existing and potential problem areas with the ultimate goal of preventing losses through carefully planned and executed disease management programmes.

Field Surveillance

General observation of plantation sites and natural forests were undertaken for the purpose of detecting all sorts of damages to trees by carefully inspecting those of more subtle nature, such as tip and shoot or stem injury. By walking through the forest any relevant symptom or indication of diseases was noted and their spread in the forest was assessed. Assessment procedures could either mean counting the number of trees damaged or evaluating them on severity scale. An attempt was made to collect specimens and identify the diseases at the spot or in a laboratory. If the diseases could not be identified immediately samples were collected for further confirmation by professionals at Commonwealth Mycological Institute, Kew Garden, Surrey, England.

The Forest Sites Visited Under this Survey

a. Menagesha – Suba forest
b. Jibat – Mute – Jegenfo forest
c. Chilimo – Gaje forest
d. Munessa – Shashamene forest
e. Bore – Jemjem forest
f. Megada forest
g. Jimma – Jiren Plantation
h. Bellete – Gera forest
i. Bonga forest
j. Mizan – Aman – Bebeka forest
k. Teppi Zone forest
l. Bedelle Zone forest
m. Babya – Fola forest
n. Sigmo – Gela forest
o. Boter – Becho forest

A large sample of trees of various species was assessed both at the indicated forest sites as well as the trees along the roads to the major forest zones.

Major Findings

Observationsin the forests of Southern and Eastern regions and in a number of lumber yards have indicated the presence of various types of diseases.

Root rots, wood rots, foliage diseases, die-backs and damping-off have often been observed at many locations. In forests over coffee plantations, *Armillariamellea* has been identified frequently. Reject logs left inside the forests showed the presence of fruiting bodies of many fungi. In stored logs, heart rot and deterioration of the sapwood has been seen in many instances. Die-back of *Cupressus, Eucalyptus* and *Acacia* spp. has frequently been observed. Foliage diseases, such as leaf spots, powdery mildews, and tar spots are common on trees of unthrifty growth. Infestations by an array of parasitic flowering plants have also been observed on some hardwoods (Table 1).

Table 1. List of Forest Tree Diseases Associated with each Tree Species within the surveyed Forest Zones

No	Indigenous Tree Species	Diseases Identified
1	*Acacia* spp. (Girar)	a. Powdery mildews b. [1]PFP – *Pharagmantheramacrosolea*
2	*Albizzia* spp. (Sesa)	a. PFP: 1. [2]*Viscum*aff. *Triflorum* DC Subsp. *nervosum* *2. Tapinanthusglobiferus* *3. Pharagmantheramacrosolea*
3	*Bersemeaabyssinica (Azamir)*	a. Rust b. Leaf spot (*Pestalotia* sp.)
4	*Celtiskraussiana (Kawit/Amalaka)*	a. Powdery mildews (*Oidium* sp.) b. PFP – 1. *Tapinanthusglobiferus* 2.*Viscumaff. Triflorum* Subsp. *nervosum*
5	*Combretum* spp. (avalo/Agalo)	PFP – *Viscumaff. Triflorum* Subsp. *nervosum*
6	*Cordiaafricana* (Wanza)	a. Powdery mildew (*Oidium* sp.) b. Tar spot (*Phyllachoracaffra*)

No	Indigenous Tree Species	Diseases Identified
		c. Leaf spot (*Macrophoma* spp.)
7	*Croton macrostachys* (Bissana)	*a. Viscumtuberculatum* *b. Leaf spots (pathogen not confirmed)*
8	*Ekerbergiacapensis (Sombo)*	PFP – *Englerina wood fordioides*
9	*Entadaabyssinica*	PFP – *Oncocalyxfischeri*
10	*Ficus* spp. (Shola)	PFP – *Phragmantheraregularis* Leaf spot – *Alternaria* spp.
11	*Hageniaabyssinica (Kosso)*	a. Tip die-back (unknown cause) b. PFP – *Phragmantherausuensis*
12	*Juniperusprocera (Tid)*	a. Needle blight (Pestalotia spp.) b. Seedling root rot (Fusarium spp.) c. Heart wood rot
13	*Milletiaferruginea (Birbira)*	Leaf spot (phlyctaena sp.)
14	*Maesialanceolata*	Leaf spot
15	*Morus lacteal (Shamgareza)*	Wood rot
16	*Oleaeuropea* subsp. *Africana (Woira)*	PFP – a. *Englerina wood fordioides* b. *Viscumtuberculatum*
17	*Phoenisreclinata (Zembaba)*	Leaf spot (Phlyctaena sp.)
18	*Podocarpusgracilior*(Zigba)	a. Podocarpus tar spot (*Coryneliauberata*) b. Powdery mildew (*Oidium* sp.)
19	*Pygeumafricanum (Tikur – Inchet)*	Powdery mildew (*Oidium* sp.)
20	*Sapiumellipticum (Bosoka)*	PFP – *Viscumtuberculatum*
21	*Seneciogigas*	Leaf spot (*Alternaria* sp.)
22	*Terminaliaglaucescens*	PFP – *Erianthemumdregei*
23	*Vernoniaamygdalina*	Wood rot

(EXOTIC TREE SPECIES

1	*Acacia decurrens (Mimoza)*	PFP –*Phragmantheraregularis*
2	*Acacia magnum*	Basal rot (*Phytophthora* sp.)
3	*Cidrellaodorata*	Butt rot (*Armillaria* sp.)
4	*Cordiaalliodora*	Butt rot (*Armillaria*sp.)
5	*Cupressuslusitanica*(Yeferenj-tid)	a. Die – back b. Butt rot (*Armillaria* sp.) c. Crown gall (*Agrobacterium sp.* d. Shoot blight (*Phomopsis* sp.) e. Stem crack (unknown cause)
6	*Cupressuspyramidalis (Shotata-tid)*	a. Tip die-back b. Shoot blight (*Phomopsis* sp.)
7	*Cupressustorulosa (Yeferenj-tid)*	Uprooting (unknown cause)
8	*Eucalyptus cladocalyx (Bahirzaf)*	Leaf spots (*Alternaria* sp.)
9	*Eucalyptus globules (Nech-*Bahrzaf*)*	a. Die-back b. Gall like growth at base of stem
10	*Eucalyptus cameldulensis (Key-Bahrzaf)*	a. Powdery mildews (*Oidium* sp.) b. Leaf spots (*Pestalotia* sp.)
11	*Eucalyptus saligna (Saligna-Bahrzaf)*	Leaf spots (*Pestalotia* sp.)
12	*Eucalyptus pilularis (Bahrzaf)*	Butt rot (*Armillaria* sp.)
13	*Eucalyptus grandis (bahrzaf)*	Leaf spots (*Pestalotia* sp.)
14	*Gmellianaarborea (Arborea)*	Butt rot (*Armillaria* sp.)
15	*Grevillearobusta (Grevilea)*	Leaf spots (Pstalotia sp.)
16	*Meliaazedarach (Melea)*	*a.* PFP – *Tapinanthusglobiferus* b. PFP – *Oncocalyxfischeri*
17	*Pinusradiata (Radiata pine)*	a. Needle cast (*Alternaria* sp.) b. Needle blight (*Pestalotia* sp.)
18	*Pinuspatula (Patula pine)*	a. Needle blight (*Pestalotia* sp.) b. Armillaria root rot (*Armillaria*sp.)

[1]PFP = Parasitic Flowering Plants, identified by The National Herbarium, Science Faculty, A.A. University;

[2] All fungi species and the corresponding diseases are mainly identified at DebreZeitAgr. Research Center. Confirmation has been rendered by Dr. Paul at AdetAgr. Research Center,and Commonwealth Mycological Institute, England.

The extensive introduction of exotic species may have exposed them to indigenous pathogens for which they have no natural resistance. Evaluation

of the status of pathogen population in exotic plantations is desirable to forestall any rapid development of attacks for whichno control measures have been prepared which could consequently have serious effects on forest yield.

Among the exotics, cypress, especially *Cupressuslusitanica* and pine (*Pinuspatula*) seemed to enjoy wide acceptance for large scale plantation by the Forest Service Department of the Ministry of Agriculture. These trees seemed to have adopted well on high rainfall areas where the survey work have been undertaken. In general, disease problem seemed to play a lesser role in hindering their development as compared to other factors, such as silvicultural or management problems.

The exotics seem to be suffering from several management problems:

a. Reforestation in many cases is widely practiced with cypress and pine species from among the conifers, and Eucalyptus species from the hardwoods. Species – site matching did not seem to be practiced in many instances, and as a result, some of them are exposed to drought or hydric stresses or other environmental effects.
b. At seedling stage, root pruning is sometimes practiced when conditions do not allow immediate field planting. This practice promoted the proliferation of more secondary roots and slow development of the tap root system. Unless the tap root develops fast it may not reach the lower water table during prolonged dry spell and eventually the trees may die.
c. When some of the dying trees or those in the process of wilting were uprooted and checked, in several instances the tap roots had crooked formation, bending upwards and then downwards which seemed to hinder development of the tap root.
d. Timely pruning and thinning in most of the exotics were not practiced as desired. In such instances growth was retarded, and the trees got weaker, which may expose them to attack by insects and diseases.
e. Timely weeding was not properly practiced in many plantation sites. The weeds, besides their competitive damage, serve as hiding place for rodents which girdle the basal stem of several tree species.

f. Pre-treatment of plantation sites, to clear the area from residual pests and diseases, seemed to have not occurred in many places prior to planting. In many instances, it has been observed that some exotics were suffering from diseases transmitted from the natural stand.
g. Seed-bed management against diseases is virtually nonexistent. As a result some root diseases were transmitted to the field.

When it comes to the natural forests, nothing seemed to be practiced in terms of managing the stand. Everything had been left to nature to take its own course. However, most natural forests have been disturbed through selective harvesting, in which case, the species composition is being gradually changing. Trees of undesired types or shrubs are replacing the elite species due to changes in the ecology.

Most of the indigenous forests in the areas visited have very little disease problems. However, the spreading of parasitic flowering plants on many of the broad-leaved trees deserves attention. Species, such as *Crotonmacrostachys*, *Albizzia* spp., and some of the *Acacia* spp., are being threatened by these parasites. The current survey has identified over ten species of parasitic flowering plants growing on trees in most of the visited forest sites. Other than these parasitic plants, heart wood rots on over mature trees and some foliage diseases were occasionally observed.

On the basis of the observations so far made, a number of diseases may pose greater problems if indeed the necessary measures are not taken in due time. Some of these steps may require adjustment of management and silvicultural practices to reduce unnecessary damages.

- Closer scrutiny must be made in the introduction of seeds of exotic species. Some of them may carry pathogenic fungi of destructive capacity. All seeds must pass through quarantine screening prior to introduction into the country.
- Prior to planting exotics, one must identify locations where the species can be adapted. In places where the trees are not adapted to grow luxuriantly, they tend to be unthrifty and become susceptible to diseases and insects.
- In some places, it has been observed that introduced species are planted right after the natural forests have been cleared. This practice

exposes the exotic trees to root-rotting fungi. For this reason one must expose the land to light and heat or until the land dries up to kill off some of the pathogenic microorganisms before replanting it. If possible, keep the land free of vegetation for at least one season.

- Proper seed-bed management is essential to ward-off damping-off or other seedling diseases. In addition, where there are problems, application of seed-dressing chemicals or soil treatment is highly advisable.
- As much as possible, root pruning must be avoided. Pruned roots have the capacity to slow down tap root development and create an opening for the entrance of organisms.
- Though not extensive, branch stub canker has been observed at many locations on Cypress. Wounding during pruning may promote the introduction of organisms. Under some conditions, it may be necessary to brush the cut portion with disinfectants.
- In some natural forests and in exotic plantations, trees were allowed to grow beyond their rotation age. Hollow trunks, due to heart wood rotting have been observed. One must harvest trees for proper utilization before exposing them to diseases.
- A national campaign should be conducted to minimize the danger by parasitic flowering plants. They seem to have spread all over the nation by birds and have threatened some of the indigenous as well as the exotic species. Pure removal of the infected branches and burning them would minimize the effect of the parasite.
- Reject logs must be removed from forest zones, as they are conducive for proliferation of many disease causing microorganisms.
- If conditions result in death of some trees or parts of a tree, they must be removed from the site immediately in order to protect others from transmitting infections. This practice has already been adopted at some locations.

Hopefully, the study would present a formidable background to understand the status of forest tree diseases under Ethiopia’s condition and serves as a good reference point to assess the current and the future developments of diseases.

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References

Beattie, R.K. and J.D. Diller. 1954. Fifty years of Chestnut blight in America. J. Forestry 52: 323 – 329.

Breitenbach, F.V. 1963. The indigenous trees of Ethiopia.Min.of Agriculture, Ethiopia.

Bloomberg, W.J. 1984. Surveying for root disease losses in British Columbia forests.Pages 359 – 371, in Proc. 6th Int. Conf. on root and butt rots o f forest trees. (IUFRO Working Party 52-06-01) CSIRO, Melbourne.

Boyce, J.S. 1961. Forest Pathology.McGraw –Hill Book Co. Inc., New York.pp. 572.

Central Statistics Office of Ethiopia. 1971. Statistical Abstract.

Forestry Association of Ethiopia. 1962. Ethiopia's Forestry Review, No. 344. Pp 86.

FAO. 1975. 2nd World Technical Consultation on Forest Diseases and Insects. World Consultation on Forest Diseases and Insects, Delhi, April 6 – 12, 1975.

Gibson, I.A.S. 1979. Diseases of forest trees widely planted as exotics in the tropics and southern hemisphere. Part II: The Genus Pinus. Commonwealth Mycological Institute, Kew, Surrey.

Heptig, G.H. and G.M. Jemison. 1958. Forest Protection: Timber resources for America's future. U.S. Dept. Agr.,Forest Service, Forest Resource Rept. 14: 185 – 220.

Houston, D.R. 1987. Forest tree declines of past and present: current understanding. Can. Jour. of Plant Pathology 9: 349 – 360.

Huffnagel, H.P. 1961. Agriculture in Ethiopia.Food and Agriculture Organization of the United Nations, Rome. Pp 393 – 424.

Imp. Ethiopian Govt., Min. of Pen. 1971. NegaritGazeta (31st year – No. 2), 12th Oct. 1971.

Logan, W.E.M. 1964. An introduction to the Forests of Central and Southern Ethiopia. Imp. Forestry Institute, Univ. of Oxford, Institute paper No. 24. 58p.

Peace, T.R. 1960. The status and development of Elm disease in Britain.Forestry Comm. Bull. 33: 1 – 44.

Powers, H.R., Jr. 1984. Control of fusiform rust of southern pines in the U.S.A. Eur. J. For.Pathol. 14: 426 – 431.

Pratt, J.E. 1979. *Fomesannosus* butt rot of Sitka spruce II – Losses in yield and value of timber in diseased trees and stands. Forestry 52: 113 – 127.

Rishbeth, J. 1987. Forest Pathology – present and future. Can. Jour. of Plant Pathology 9: 321 – 333.

SIDA. 1969. Forestry in Ethiopia. A Report.

Swain, E.H.F. 1952. Forestry possibilities in Ethiopia. UNASYLVA 6 (1): 15 – 20).

Walter, J.M. and C. May. 1943. Dutch elm disease and its control. U.S. Dept. Agr.Circ.677: 1- 12.