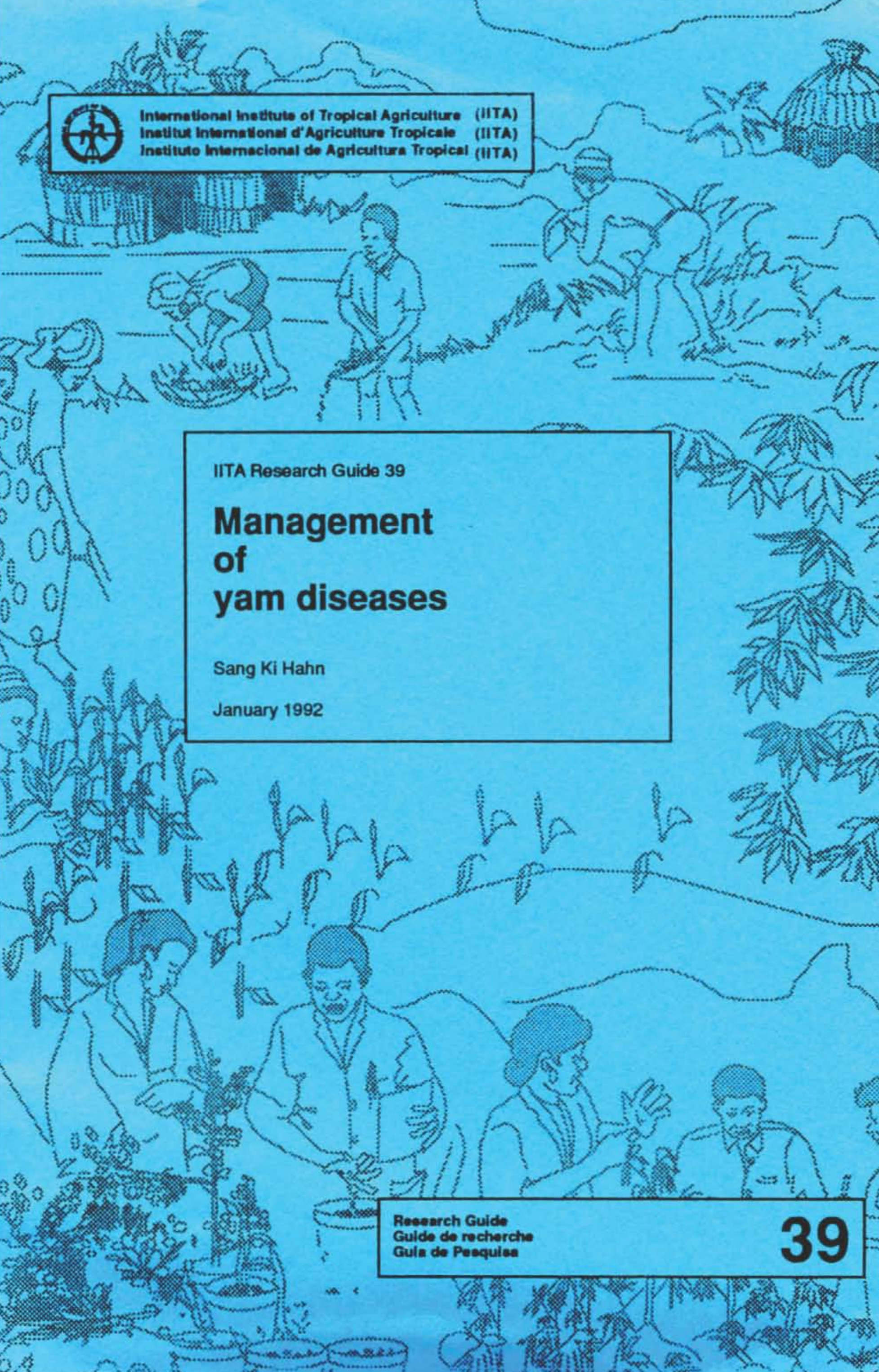

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IITA Research Guide 39

Management of yam diseases

Sang Ki Hahn

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39

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Management of yam diseases

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Management of yam diseases

Objectives. This guide is intended to enable you to:

- discuss the importance of yam diseases;
- describe foliage and tuber diseases of yams;
- control yam diseases.

Study materials

- Samples of different yam species and varieties.
- Diseased plants and tubers.
- Yam planting material.

Practicals

- Identify diseases in field and storage.
- Select healthy planting material.
- Select healthy yam tubers for storage.

Questionnaire

1. Where are yams cultivated?
2. What are the major cultivated yam species grown in West Africa?
3. What are climatic requirements for yam cultivation?
4. What is the effect of yam diseases?
5. What are the major foliage diseases of yams?
6. How is yam mosaic virus transmitted?
7. On what yam species is yam anthracnose disease particularly damaging?
8. On what yam species is yam fusarium wilt particularly damaging?
9. Which bacteria cause disease in yams?
10. What are the causes of invasion by fungi in the field?
11. Which fungus causes the most frequent storage rot?
12. On what conditions do storage rots depend?
13. Which nematodes are of primary importance in causing damage on yams?
14. In what parts of the tuber is the yam nematode found before and after harvest?
15. What are the symptoms and damage of root knot nematode?
16. To what other pathogenic organisms do the yam nematodes provide entrance to?
17. What factor determines greatly the health status of yam plants in the field?
18. What are the components of integrated control of yam diseases?
19. What are the agronomic practices that can reduce yam diseases?
20. How are most of the yam diseases transmitted?
21. What is the most effective, inexpensive, and practical control measure of yam diseases?

Management of yam diseases

Abstract. Different species of yams are grown in the "yam zone" of West Africa. In field and storage, yams are exposed to various diseases caused by viruses, bacteria, fungi, and nematodes. Yam diseases can be controlled by several integrated control practices.

1 Importance of yam diseases

Yams *(Dioscorea spp.)* are tuber crops and a major staple only in the "yam zone" of West Africa. They play a central role in the farming systems and they are an important part of traditional culture and religion (Hahn, 1984; Hahn et al. 1987). The economically important species grown in West Africa are white yam *(Dioscorea rotundata)*, yellow yam *(D. cayenensis)*, trifoliate yam *(D. dumetorum)* and water yam *(D. alata)*.

Yams are grown in relatively high rainfall areas with a wet period of more than four months. Since yams grow for five to ten months in the field, the shoots, roots and tubers of the yam plants can be exposed to attacks by various diseases. Tubers require storage for up to six months in an open area and can be further attacked by diseases in storage.

Yam diseases are classified into two groups:

- diseases occurring from emergence to senescence of plants in the field;
- diseases that affect the tubers and occur from harvest or during storage and shortly after emergence.

Yam diseases seriously reduce yield, shelf life, post-harvest quality characteristics and market value. Foliar diseases are primary factors that necessitate staking which is costly and labor intensive; often staking material is not easily available.

Diseases occurring from emergence to senescence of plants include:

- viruses diseases,
- yam anthracnose disease,
- yam fusarium wilt.

Yam mosaic virus (YMV). YMV occurs primarily in white yam and yellow yam in West Africa. This virus is transmitted by the cotton aphid *(Aphis gossypii)* and mechanical means (Terry, 1976). The causal organism of YMV was reported as a potyvirus (Rossel and Thottappilly, 1985).

Uncharacterized virus. Water yam virus has been reported but it has not yet been well characterized (Rossel and Thottappilly, 1985).

Yam anthracnose disease (YAD). YAD is caused by *Colletotrichum gloesporioides* resulting in serious damage to water yam in particular. Yield loss of 30-80 % of different cultivars due to YAD was reported in Nigeria (Iloka and Iwueke, 1983). Yield loss by YAD was reported in water yam by Mignucci et al (1986) to be as high as 79 % for total yield and 91 % for marketable yield in Puerto Rico. The etiology of the disease of water yam generally described as "anthracnose", "scorch" or "die back" has never been adequately and convincingly determined at IITA (IITA, 1981).

Yam fusarium wilt (YFW). YFW caused by *Fusarium oxysporum* is severe particularly in white yam. YFW was reported to cause yield reduction of white yam by 60-80 % in Nigeria (Iloka and Iwueke, 1983). Yield loss of 32-44 % due to YFW was reported for white yam in Puerto Rico (Mignucci et al. 1986).

Diseases that affect the tubers and that occur from harvest or during storage and shortly after emergence are caused by:

- bacteria,
- fungi,
- nematodes.

both before and after harvest.

Bacteria. Bacterial disease caused by *Corynebacterium* spp. *in the field* have been recorded only in Nigeria (Ikotun, 1989).

After harvest, three pathogenic bacteria have been associated with storage rots (Ikotun, 1981). *Erwinia carotovora* pathovar *carotovora*, a gram-negative bacterium, was reported by Theberge (1985) and Ikotun (1989) as causing storage rot in which the tissues of infected tubers were turned into water-soaked dirty to white pulp. High humidity and cooler temperature favour the development of disease (Theberge, 1985).

Fungi. Yam tubers that are unbruised and have intact periderm are hardly attacked by fungi *in the field*. Invasion by fungi into tubers is thus facilitated by accidental cutting and by bruising of tubers during weeding, harvesting, and transportation to stores.

A total of 13 fungi have been reported to be associated with pre-harvest disease problems in yam tubers (Ikotun, 1989).

After harvest, most fungi invade yam tuber tissues and cause rots. A total of 30 different fungi have been reported to be associated with the storage rots (Ikotun, 1989). *Penicillium oxalicum* is the most frequently encountered rot causing organism of yam tubers (Ikotun, 1989). The fungus caused 57 to 77 % of all rots of yam tubers in Nigeria, while in West Indies, it was responsible for 80 % of all rots (Ikotun, 1989).

Storage rots depend on storage conditions such as aeration, relative humidity, light intensity, and temperature. Recent study showed that temperature of 15 ^{o}C seems to be adequate for storage of tubers and that the relative humidity of 70 % in storage was still high, causing wet rots. The relative humidity regime of 55-65 % showed least storage rots. Storage rots also very much depended on origin or source and status of tubers (Osiru, personal communication, 1990).

Nematodes. Yam nematode *(Scutellonema bradys)* and root-knot nematode *(Meloidogyne spp.)* are of primary importance for the damage they cause to plants and tubers in field and storage. Root knot nematode mainly attacks roots, reducing growth and yield of yams in the field, while yam nematode causes damage primarily to tubers during storage.

Before harvest, yam nematode is found in the peridermal and sub-peridermal layers of tubers, rarely penetrating deeper than 1 to 2 cm during growth of the tubers. It does not cause marked yield reduction in the field but it does cause serious surface damage of tubers (Bridge, 1982).

Root-knot nematode causes galling of yam roots and gives rise to irregular knobby tubers if heavily attacked by the nematode. Marketing quality of the tubers can be affected by both nematodes.

After harvest, although both yam nematode and root knot nematode are associated with storage rots of yam tuber, the former is the primary pest of yam tubers in storage (Bridge, 1982). During storage, the yam nematode infecting the peridermal and sub-peridermal layers of tubers increase its population and can penetrate deeper in parts of the tubers, causing both dry rot and wet rot. This leads to serious storage losses of tubers.

Damage to tubers by yam nematode provides entry for pathogenic organisms, particularly fungi and bacteria, which gradually bring about wet rot during storage (Bridge, 1982). Yam nematode is not directly involved in the later stage of wet rot (Adesiyan et al. 1975). Yam nematode can cause 80 to 100 % loss of stored tubers in some parts of Nigeria (Adesiyan and Odihirin, 1978).

4 Integrated control

Since yams are normally planted with planting sets or seed yam, their health status greatly determines the health status of plants in the field which in turn determines the shelf life of tubers in storage. Therefore, integrated control of yam diseases should aim at healthier seed yam and plants and longer shelf life of tubers by preventing or reducing damage caused by the diseases to shoots, roots and tubers of yam plants in the field and to the tubers in storage. This can eventually lead to high and stable yield, improved shelf life, marketing and nutritive quality. Some components of integrated control of yam diseases are discussed below:

Agronomic practices. Agronomic practices play an important role in determining the extent of plant damage caused by yam diseases. Development of improved cropping systems that provide natural deterrents to disease build up are therefore essential for sustainable yam production by small holder yam farms in the humid and sub-humid ecologies in West Africa.

Agronomic practices include:

- use of healthy seed yam,
- crop rotation,
- cropping system,
- careful weeding, harvesting and handling.

Use of healthy seed yam. Most of the yam diseases, particularly nematodes and viruses, are transmitted through planting material. Therefore, the use of healthy and good quality planting material can lead to less disease problems of yam plants in the field and of tubers in storage. Healthier seed yam can be produced by use of improved seed yam production techniques (Otoo et al. 1985).

Crop rotation. Yam disease pressure can be reduced by keeping land fallow free of all host plants following harvest. Fallow and crop rotation are the most effective, inexpensive, and practical control measures of diseases, if enough land is available. Groundnuts, *Stylosanthes, Centrosema, Leuceana, Mucuna*, and nematode resistant cowpea varieties, reduce nematode population levels to a large extent in the field. Hydromorphic soils saturated for three to four months are almost free of parasitic nematodes. (Hahn et al. 1987). Well drained land reduces root and tuber diseases.

Cropping systems. Avoiding mixed cropping with other host crops of the yam diseases alongside yam vines will decrease disease pressure. A certain crop combination may reduce population of disease inoculum. This has not been well studied. Sparse population density and training of vines on stakes immediately after emergence reduces disease development. Early planting reduces damage caused by the foliage diseases; by escaping from peak disease pressure and prolonging the leaf area duration.

Careful weeding, harvesting and handling. Bruising and wounding of tubers during weeding, harvesting and post-harvest handling should be avoided in order not to open avenues for pathogens to enter tuber tissues.

Varieties resistant to diseases and nematodes. Varietal differences in resistance exist for YMV, YAD and nematodes. White yam varieties such as TDr 179, TDr 745, TDr 608 and TDr 747 are moderately resistant to YFW and YMV. Water yam varieties such as TDa 297, TDa 291 and TDa 310 show a fair level of resistance to YAD. Use of such resistant varieties are recommended.

Storage. More yam tubers are lost in storage than in the field. For good storage of yam tubers, selection of the tubers with least damage caused by nematodes and poor post harvest handling is of primary importance. Wood ash and lime wash are often used by farmers for the damaged parts of tubers to reduce storage rots.

Curing the tubers at 35 - 40 °C at relative humidity of 40 - 100 % for seven days after harvest has been effective in reducing storage losses (Ricci et al. 1979). Also, curing at temperature of 25 °C - 30 °C and at low humidity (between 55 and 62 %) for five days before storage has been found effective for controlling rots in stored yam tubers (Adesuyi 1973). The results of recent experiments on white yam storage seem to support the latter.

Chemical and physical control. Benomyl foliar sprays at rates of 600 -1100 g/ha at three week intervals were found as effective in controlling YAD of water yam (Mignucii et al. 1986). However, benomyl application at rates of 500 g/ha at 14 day intervals over a period of 90 days between June and August did not reduce the prevalence and severity of foliar necrosis including YAD in water yam at IITA (IITA 1981). Treatment of tubers with benomyl generally reduced the levels of fungal infection in stored white yam tubers (Ikotun, 1989).

Nemagon applied at 35.2 kg/ha considerably suppressed yam nematodes (Ikotun 1989) but is uneconomic.

Immersion of nematode infected tubers in hot water at 50 - 55 °C for 30-40 minutes was effective in controlling nematodes (Smith 1967; Bridge 1982; Fawole 1982). Heat treatment in water at 50 °C for 40 minutes or 55 °C for 30 minutes was used to control nematodes for seed yam production (Caveness and Otoo 1988). However, the effectiveness of hot water treatment of tubers for nematodes control of yam is questionable (IITA 1981).

Quarantine. Most yam diseases and nematodes are transmitted through planting materials. Therefore, there are risks of introduction of diseases and nematodes from foreign countries or other continents. Acceptable phytosanitary measures need to be applied when yam tubers are introduced. *In vitro* meristem tip culture followed by a sensitive and reliable virus indexing method reduces the risk of introducing undesirable diseases. Also micro-tubers produced *in vitro* are most useful for germplasm exchange.

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