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Fungal Diseases of Yam (*Dioscorea* spp.)

*Swostika Padhi, R. Arutselvan, Honey Pattanayak,

Ankita Senapati and Bidya Bharati Das

ICAR-Central Tuber Crop Research Institute, Regional Station,

Bhubaneswar-751019, Odisha, India

*Corresponding Author's email: swosti2212@gmail.com

Yam (*Dioscorea* spp.) is an important tropical tuber crop cultivated for its starchy tubers, contributing to food security, nutrition and farmers' income. In India, greater yam (*Dioscorea alata*) is the main species grown. However, yam production and tuber quality are affected by several fungal diseases that damage the vines in the field and the tubers during storage. Anthracnose, also known as dieback and caused by *Colletotrichum* species, is regarded as the most destructive field disease of yam, particularly under warm, humid and rainy conditions, and can cause leaf blackening, vine death and heavy yield losses in susceptible varieties. Other important problems include leaf spots, dry rot and soft or mouldy storage rots, which reduce photosynthesis, damage tubers and cause post-harvest losses. Effective disease management requires an integrated approach involving healthy planting material, resistant or tolerant varieties, field sanitation, crop rotation, suitable planting time, careful harvesting and clean storage. Biological control options and registered plant protection products may also be used when appropriate and in accordance with local recommendations. Accurate diagnosis is essential because similar symptoms may be associated with different pathogens and require different management measures. This article describes the major fungal diseases of yam, their characteristic symptoms, favourable environmental conditions and practical management strategies to support healthier crops and sustainable yam production.

Keywords: Yam, Fungal disease, Anthracnose, *Colletotrichum*

Introduction

Yam (*Dioscorea* spp.) is an important tropical tuber crop cultivated for its starchy underground tubers, which are valued as a source of energy, dietary fibre and minerals and as a source of food and income for farming communities. Greater yam (*Dioscorea alata*), also called water yam, is the most important edible yam in India and is grown in states such as Kerala, West Bengal, Bihar, Odisha, Assam, Gujarat and Maharashtra, where it is used mainly as a vegetable (Jeeva *et al.*, 2005). Despite its importance, yam production is affected by several diseases caused by fungi. These diseases damage leaves, vines and tubers, reducing crop growth, yield and market quality. Among them, anthracnose, caused by *Colletotrichum* species, is the most widespread and damaging field disease, and *D. alata* is the most susceptible of the cultivated yams (Ntui *et al.*, 2021). After harvest, storage rots such as dry rot can cause further serious losses (Amusa *et al.*, 2003). The occurrence and severity of these diseases depend on several factors, including the pathogen, weather conditions, yam variety, planting material and field and storage management practices. Therefore, understanding disease symptoms and adopting preventive measures are essential for successful yam cultivation.

Major fungal diseases of Yam

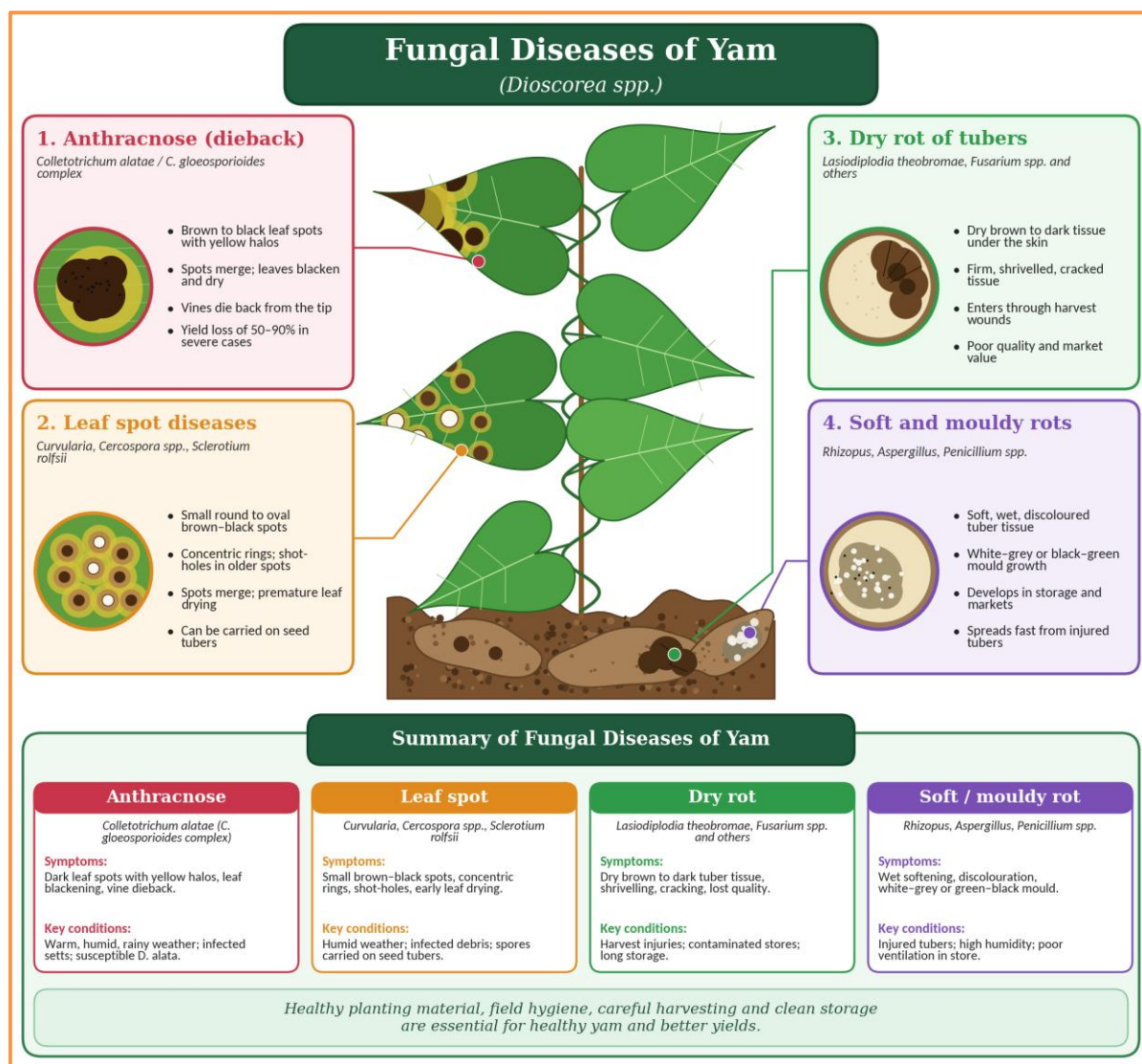


Figure 1. Major fungal diseases of yam: symptoms, causal fungi and key conditions.

1. Anthracnose (yam dieback)

Anthracnose, also called yam dieback, is the most widespread and damaging field disease of yam. It is caused by *Colletotrichum* fungi belonging to the *C. gloeosporioides* species complex, and the yam-specialised species *C. alatae* is now considered the predominant cause (Fuentes-Aponte *et al.*, 2021; Ntui *et al.*, 2021). The disease starts as small necrotic spots on the leaves that enlarge into reddish to dark brown lesions, often surrounded by yellow haloes. The spots join together, leaves turn black and dry, and the infection moves to petioles and vines, causing dieback from the tip. In some varieties the blackening is so sudden that farmers say the plants have been struck by lightning. When the disease strikes early, plants may die without forming tubers or may produce only small tubers, and yield losses of 50–90% have been reported in severe cases (Ntui *et al.*, 2021). The fungus can attack all parts of the plant at all growth stages, and other crops and weeds may act as additional sources of infection.

2. Leaf spot diseases

Several fungi cause leaf spots on yam, including *Curvularia* species (*C. eragrostidis* and *C. geniculata*), *Cercospora* species and *Sclerotium rolfsii* (Torres-López *et al.*, 1986; Mignucci *et al.*, 1988; Jeeva *et al.*, 2005). *Curvularia* leaf spots appear as round to oval brown to black spots with irregular margins scattered over the foliage. The fungus can be carried inside the tuber, in both the outer and inner tissues, so infected planting material may introduce the disease into new fields (Torres-López *et al.*, 1986). In Kerala, *S. rolfsii* has been reported to

cause black, circular, concentric spots 5–10 mm across on *D. alata* leaves; the centres of older spots dry and fall out, giving a shot-hole appearance, and fluffy white mycelium may develop on the spots in humid conditions (Jeeva et al., 2005). As spots enlarge and merge, affected tissues dry prematurely, reducing the green leaf area available for photosynthesis and tuber development.

3. Dry rot of tubers

Dry rot is regarded as one of the most devastating storage diseases of yam. It markedly reduces the quantity, marketable value and edible portion of tubers, and the losses are more severe in stored tubers (Amusa et al., 2003). Affected tubers show dry, brown to dark discolouration of the tissue beneath the skin, and the tissue may become firm, shrivelled or cracked as the rot advances. Because the skin may look normal at the beginning, infected tubers can be missed at harvest and deteriorate gradually in store. Fungi such as *Lasiodiplodia theobromae* (syn. *Botryodiplodia theobromae*), *Fusarium* species, *Penicillium oxalicum* and *Aspergillus niger* have been isolated from rotting yam tubers (Aboagye-Nuamah et al., 2005; Dania et al., 2016). Nematodes can produce similar dry-rot symptoms, so the cause should not be assumed without diagnosis. Infection often enters through cuts and bruises made at harvest or during handling; in Ghana, rots were found more often in the upper part of the tuber, which was linked to insect damage and harvest cuts at the point where the vine was attached (Bancroft et al., 2005).

4. Soft and mouldy storage rots

Besides dry rot, yam tubers may develop soft, wet and mouldy rots during storage and marketing. In a study of yam barns and markets in Ghana, *Rhizopus stolonifer*, *Botryodiplodia theobromae* and *Fusarium oxysporum* were the most frequently encountered rot organisms, along with *Aspergillus* and *Penicillium* species, and all of them produced rots that progressed through the tuber over 28 days of storage (Aboagye-Nuamah et al., 2005). Affected tissue becomes soft, wet and discoloured, and white–grey or black–green mould may appear on the surface. *Sclerotium rolfii* and *Rhizoctonia solani* have also been isolated from rotten yam tubers in Nigeria (Dania et al., 2016). Injured tubers, high humidity and poor ventilation in stores increase the risk of such losses.

Table 1. Important fungal diseases of yam, their symptoms and management

Disease	Causal organism	Symptoms	Management Practices
Anthraxnose (dieback)	<i>Colletotrichum alatae</i> and other species of the <i>C. gloeosporioides</i> complex	Brown to black leaf spots with yellow haloes, leaf blackening, vine dieback and poor tuber formation	Healthy planting material, resistant or tolerant varieties, suitable planting time, field sanitation, crop rotation and recommended disease-specific treatment
Leaf spot	<i>Curvularia</i> , <i>Cercospora</i> species and <i>Sclerotium rolfii</i>	Small round to oval brown–black spots, concentric rings, shot-holes and premature drying	Disease-free planting tubers, removal of diseased debris, crop monitoring and correct diagnosis
Dry rot	<i>Lasiodiplodia theobromae</i> , <i>Fusarium</i> species and other fungi	Dry brown to dark tissue under the skin, shrivelling, cracking and reduced tuber quality	Careful harvesting, curing, rejection of damaged tubers, clean handling and suitable storage
Soft and mouldy rots	<i>Rhizopus stolonifer</i> , <i>Aspergillus</i> , <i>Penicillium</i> species and others	Soft, wet, discoloured tissue with white–grey or black–green mould	Avoiding wounds, sorting out rotten tubers, clean and ventilated stores, biological or approved treatments

Epidemiology: Why do yam diseases become severe?

Disease development in yam depends on the interaction between the host, pathogen and environment. Anthracnose is favoured by warm, humid and rainy weather, and the choice of planting date can strongly influence its severity. In a trial at Ibadan, Nigeria, planting date accounted for about 72% of the variation in anthracnose severity, with August planting showing the least disease, although the best date depends on local weather conditions (Egesi et al., 2007). Planting material is an important carrier of infection, because fungi such as *Curvularia* can be present inside tubers (Torres-López et al., 1986), and other crops and weeds can act as additional sources of *Colletotrichum*. Storage rots are promoted by wounds made at harvest, contaminated stores and poor storage conditions. Understanding these factors helps farmers adopt preventive measures and reduce disease losses.

Integrated management of yam diseases:

- 1. Selection of healthy planting material:** Use healthy, disease-free tubers or setts from reliable sources. Avoid planting material showing cuts, rot, discolouration or disease symptoms, and treat planting material with recommended protective products where advised.
- 2. Field sanitation:** Inspect crops regularly, remove severely infected leaves and vines and dispose of diseased residues safely. Control weeds that may harbour *Colletotrichum* and avoid moving contaminated soil or plant material to healthy fields.
- 3. Resistant varieties and planting time:** Grow less susceptible varieties recommended for your region, because yam genotypes differ widely in their reaction to anthracnose (Egesi et al., 2007). Where the local weather pattern is known, adjust the planting time to avoid the period of peak disease pressure.
- 4. Water, staking and field management:** Ensure good drainage and avoid water stagnation. Stake the vines and maintain proper spacing so that air can circulate and the foliage dries quickly. Apply nutrients according to soil-test results and avoid excessive nitrogen fertilisation.
- 5. Crop rotation and fallowing:** Rotate yam with suitable non-host crops and allow fallow periods to reduce disease carry-over in the field (Amusa et al., 2003).
- 6. Biological approaches:** Beneficial microorganisms such as *Trichoderma* species, *Bacillus subtilis* and *Pseudomonas fluorescens* have reduced post-harvest rot in stored yam, with *B. subtilis* giving 47.8–81.2% rot inhibition in one study (Dania et al., 2016). Use only products with proven effectiveness against the target pathogen and in line with local recommendations.
- 7. Careful harvesting, curing and storage:** Harvest at maturity and avoid cuts and bruises, since wounds allow fungi to enter the tubers. Cure tubers where recommended, store them in clean, well-ventilated places and remove rotten tubers regularly (Bancroft et al., 2005).
- 8. Responsible use of fungicides:** Use only registered products recommended for the specific disease. Follow label instructions, safety precautions and pre-harvest intervals, and rotate modes of action to reduce the risk of resistance. Fungicides alone have not given lasting control of anthracnose, so they should be combined with the preventive practices above (Ntui et al., 2021).
- 9. Regular monitoring and expert diagnosis:** Inspect crops and stored tubers frequently for disease symptoms. Seek advice from plant pathology laboratories or agricultural extension specialists when symptoms are severe or uncertain.

Conclusion

Fungal diseases are important constraints to yam cultivation because they can damage leaves and vines, reduce tuber development and cause heavy losses during storage. Anthracnose is particularly destructive under warm, humid and rainy conditions, while leaf spots, dry rot and other storage rots can further reduce crop quality and productivity. Effective management begins with the use of healthy planting material, resistant or tolerant varieties, regular crop inspection, good sanitation and suitable field management, followed by careful harvesting and clean storage. Accurate diagnosis is essential because different pathogens may produce similar symptoms but require different control measures. The judicious use of locally

recommended plant protection products, combined with preventive cultural practices, can help minimise disease losses and support sustainable yam production.

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