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Key biotic stresses affecting tuber crops

Across the humid tropics, cassava, sweet potato, yams, taro, and elephant foot yam face intense biotic pressure. Insects, mites, weevils, fungi, viruses, nematodes, weeds, rodents and wild boar cause 20-90% yield losses, degrade tuber quality, and raise production costs. Vegetative propagation and vectors (whiteflies, aphids) hasten disease spread. Together with abiotic stresses, these factors are elevating the risk of emerging diseases, notably cassava stem/root and elephant foot yam leaf-pseudostem rot. An integrated IPM-IDM approach involving the use of clean seed systems, resistant/tolerant varieties, early surveillance, good drainage, community coordination, and rigorous post-harvest hygiene is central to safeguarding yield and income.

Keywords: Fungal disease, Insects, Plant virus,Vertebrate pest

TROPICAL tuber crops, including cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), yams (*Dioscorea* spp.), taro (*Colocasia esculenta*), and elephant foot yam (*Amorphophallus paeoniifolius*), are cornerstone crops for food security and livelihoods in the tropics and subtropics. Rich in carbohydrates and micronutrients, they supply daily calories and cash income for millions of people, particularly in Africa, Asia, and the Pacific. They are economic mainstays, supporting smallholder farmers and contributing to local and regional markets. However, their productivity and quality are severely constrained by biotic stresses, ranging from insects and mites to nematodes, fungi, bacteria, viruses, weeds, rodentsand wild boar, which cause significant yield losses, degrade tuber quality, and increase production costs, undermining sustainable agriculture.

The warm, humid and tropical climates favour the rapid build-up of pests and pathogens, making biotic stresses especially acute in tuber crops. Insects such as cassava mealybugs (*Paracoccus* spp., *Phenacoccus* spp.), sweet potato weevil (*Cylas formicarius*) and mites (*Tetranychus* spp., *Oligonychus* spp.) cause direct injury and enable secondary infections, while fungal diseases like taro leaf blight (*Phytophthora colocasiae*), collar rot of elephant foot yam (*Sclerotium rolfsii*), and yam anthracnose (*Colletotrichum gloeosporioides*) drive foliar damage and cause tuber rots. Viral diseases, such as cassava mosaic disease (CMD) and sweet potato virus disease (SPVD), are transmitted by whiteflies and aphids or through infected planting material, causing severe yield losses. Plant parasitic nematodes, root-knot nematodes (*Meloidogyne* spp.) and lesion nematodes (*Pratylenchus* spp.) impair roots and reduce vigour compounding losses, while weeds compete for light, water and nutrients, further depressing yield. Of late, driven by climate vagaries nad increased material transfer between places, emerging diseases including cassava stem and root rot and the leaf-pseudostem rot of elephant foot yam are on the rise.

The impact of these biotic stresses is profound, with yield losses commonly ranging from 20-90% depending on the crop, causal agent, and environment. Such losses threaten food security, especially where tuber crops are dietary staples, and reduce farmer incomes by lowering marketable yield. Vegetative propagation in cassava, sweet potato, and yam amplifies disease spread, as infected planting material perpetuates pathogen cycles. Additionally, vectors such as whiteflies and aphids further disseminate viruses and other pathogens, complicating management efforts.

This article aims to provide a comprehensive overview of the key biotic stresses affecting tropical tuber crops, focusing on their biology, transmission mechanisms, impacts, and management strategies. By exploring the interplay between pathogens, vectors, and host crops, it seeks to highlight sustainable approaches integrated approaches to bolster crop resilience and support global food security.

INSECTS

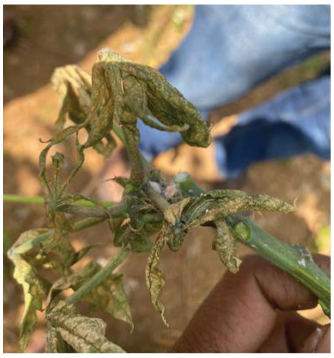
Mealybugs of cassava

Causative agent: *Paracoccus marginatus*, *Ferrisia virgata*, *Phenacoccus marginatus* and *Phenacoccus manihoti*

Symptoms: Mealybugs suck sap and make plants develop deformed terminal shoots, shortened internodes and stem distortion; honeydew and sooty mould further reduce photosynthesis. Severe infestations lead to stunting, chlorosis and heavy leaf/fruit drop.

Mode of spread: Infested planting material, susceptible varieties, proximity to infested field. Spread occurs via

Mealybug infestation on cassava



Mites damage in cassava

crawler movement locally and long distances by wind, vehicles, livestock, birds and clothing.

Impact: Mealybugs are a major constraint in cassava, capable of causing 60-80% yield loss. Integrated pest management, implemented through coordinated, community-wide action, can substantially reduce damage and protect yields.

Mites of cassava

Causative agent: *Tetranychus cinnabarinus*, *T. neocaledonicus*, *Eutetranychus orientalise* and *Oligonychus biharensis*

Symptoms: Infestation starts on mature lower leaves, especially in dry weather. *Tetranychus* spp. feed on the underside causing discolouration, weakening, drying and leaf drop. *Eutetranychus* sp. and *Oligonychus* sp. attack the upper surface, bleaching leaves to a rusted, leathery curl, often with webbing on shoots.

Mode of spread: Mainly through infected planting material. Dispersal also occurs through wind, irrigation water and through farm workers, tools and equipments.

Impact: Mites are major pests and cause substantial yield losses in cassava and late detection often leads to irreversible damage. Effective management requires early monitoring and community-wide approach by farmers.

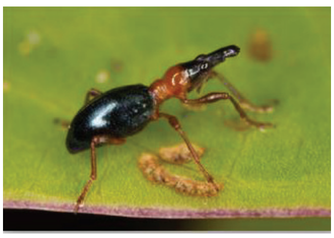
Weevil of sweet potato

Causative agent: *Cylas formicarius*

Symptoms: Adults and larvae bore into vines and make them swell, crack and wilt. Storage roots show holes and exudation followed by secondary rots.

Mode of spread: Mainly through infected planting material. Local spread by adult movement within fields and long distance through transport of tubers.

Impact: Sweet potato weevil causes major yield losses from 30-70% and up to 100% in severe/neglected situations. Tubers become unmarketable due to bitterness and decay. Using pheromone traps alongside cultural management and on-time harvests significantly reduces losses.



Adult sweet potato weevil

Weevil damage in vines

FUNGAL DISEASES

Leaf blight of taro

Causative agent: *Phytophthora colocasiae*

Symptoms: Taro leaf blight is one of the most destructive diseases of taro, characterized by water-soaked lesions on leaves that turn dark brown or black, often with a grayish-white center. Infected leaves collapse, reducing photosynthesis and corm yield by 30-50%. Severe infections can destroy entire fields.

Transmission: The pathogen spreads through sporangia carried by wind, rain, or irrigation water. Infected planting material and soil residues also serve as inoculum sources.

Impact: Taro leaf blight is a major constraint in tropical regions, particularly in the Pacific Islands and Southeast Asia, where taro is a cultural and dietary staple. Yield losses threaten food security and local economies.

Collar rot of elephant foot yam

Causative agent: *Sclerotium rolfsii*

Symptoms: Collar rot affects the base of elephant foot yam plants, causing water-soaked lesions, wilting, and stem collapse. White mycelial growth and small, brown sclerotia are visible at the collar region. Infected plants produce smaller corms, with yield losses of 20-40%.

Transmission: The soilborne fungus persists as sclerotia, infecting plants through wounds or at the soil-plant interface. High humidity and organic matter favour disease development.

Impact: Collar rot reduces the yield and quality of elephant foot yam, a key crop in South Asia and Africa. Losses affect farmer incomes and local markets, where corms are a valuable commodity.

Anthracnose of yams

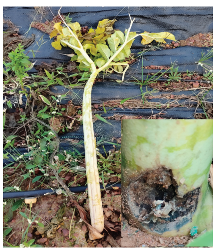
Causative agent: *Colletotrichum gloeosporioides*

Symptoms: Yam anthracnose presents as dark, sunken lesions on leaves, stems, and tubers, often with a grayish-white center. Severe infections cause defoliation, stem dieback, and tuber rot, leading to yield losses of 30-70%.

Transmission: The fungus spreads via spores dispersed by rain, wind, or infected planting material. Warm, wet conditions accelerate disease progression.

Impact: Anthracnose is a major constraint in yam-producing regions, particularly in West Africa, where yams are a staple and cultural crop. Reduced yields and tuber quality impact food security and market value.

Taro leaf blight



Collar rot of elephant foot yam

Yam anthracnose

SYMPTOMS OF FUNGAL DISEASES AFFECTING TROPICAL TUBER CROPS

PLANT VIRUSES

Cassava mosaic disease

Causative agent: *Indian cassava mosaic virus* (ICMV) and *Sri Lankan cassava mosaic virus* (SLCMV)

Symptoms: Cassava mosaic disease (CMD) is one of the most destructive diseases affecting cassava productions. In India, both viruses, ICMV) and SLCMV causes CMD. Infected cassava plants display symptoms such as mosaic patterns on the leaves, stunted growth, and reduced root yield. Severe infections can lead to complete crop loss.

Transmission: The virus is primarily transmitted by the whitefly (*Bemisia tabaci*), which feeds on infected plants and then transmits the virus to healthy ones.

Impact: CMD can cause substantial economic losses in cassava-producing regions, leading to food insecurity and reduced incomes for farmers. Farmers often resort to planting virus-resistant cassava varieties to mitigate the impact.

Sweet potato virus diseases

Causative agent: *Sweet Potato Feathery Mottle Virus* (SPFMV), *Sweet Potato Leaf Curl Virus* (SPLCV)

Symptoms: Sweet potato plants infected with various viruses, SPFMV and SPLCV, exhibit symptoms such as leaf curling, mosaic patterns, and yellowing of leaves. These symptoms can lead to reduced root quality and yield.

Transmission: Insects like aphids and whiteflies are common vectors for sweet potato viruses. Infected planting material can also spread the virus.

Impact: Sweet potato viruses pose a significant threat to food security, as this crop is a vital source of nutrition and income for many communities. Farmers often have to use virus-free planting material and adopt integrated pest management practices to control the spread of these viruses.

Sri Lankan Mosaic Disease

Sweet potato feathery mottle disease

Dasheen mosaic virus (Elephant foot yam)

Dasheen mosaic virus (Taro)

Dasheen mosaic

Causative agent: *Dasheen mosaic virus* (DsMV)

Symptoms: Dasheen mosaic primarily occurs in dasheen (also known as taro) and *Amorphophallus paeoniifolius* (elephant foot yam) and displays symptoms like yellow mosaic patterns on leaves, reduced plant vigor, and deformed corms.

Transmission: DsMV primarily transmitted by infected planting material, and through contaminated tools, and soil. Farmers must take strict sanitation measures to prevent its spread.

Impact: Dasheen is a crucial staple in many tropical diets, and DsMV can lead to reduced yields and poor crop quality. Farmers often need to source disease-free planting material and practice crop rotation to mitigate the impact.

SYMPTOMS OF VIRUS DISEASES AFFECTING TROPICAL TUBER CROPS

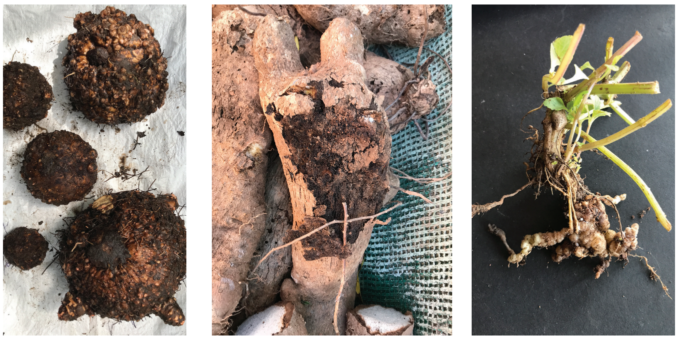
Nematodes of elephant foot yam, yams and Chinese potato

Causative agent: Root-knot nematode (*Meloidogyne incognita*), lesion nematode (*Pratylenchus* spp.), reniform nematode (*Rotylenchulus reniformis*) and yam nematode (*Scutellonema bradys*); mostly endoparasitic (reniform is semi-endoparasitic and yam nematode is ectoparasitic) with broad host ranges.

Symptoms: Patchy stunting and chlorosis; poor vine vigour, root/tuber galls and lesion; cracked tubers; yam tuber dry rot; weak response to fertilizer/irrigation.

Mode of spread: Spreads with infested planting material (seed tubers, setts), contaminated soils/ tools and irrigation water; resistant stages (egg masses) enable survival and multiple generations per season in warm soils.

Impact: Reduced root bulking; fewer/smaller tubers; greater susceptibility to secondary rots-together lowering marketable yield and increasing the cost of cultivation



Nematode infestation in elephant foot yam, yams and Chinese potato

Weeds of cassava, sweet potato, taro and elephant foot yam

Causative agent: A mixed weed flora dominated by hardy sedges, grasses, and broadleaves *viz.,* purple nutsedge (*Cyperus rotundus*), Bermuda grass (*Cynodon dactylon*), Torpedo grass (*Panicum repens*), Cock's comb (*Celosia argentea*) and barnyard grass (*Echinochloa crusgalli*)

Field indicators: Rapid early growth outcompetes seedlings and vine cuttings, while dense mats delay canopy closure and earthing-up. At harvest, their stolons and rhizomes tangle vines and leave tubers scarred.

Spread and persistence: Vegetative fragments (tuber, rhizome, stolon) are moved by tillage/hoeing, irrigation water, and contaminated planting material. Multiple flushes emerge after cultivation or rain.

Impact: Competition formoisture and nutrients depresses root bulking and smothering weakens vine vigour, raising weeding costs and reducing marketable yield, which increases the cost of cultivation.

Purple nutsedge

Torpedo grass

Barnyard grass

VERTEBRATE PESTS

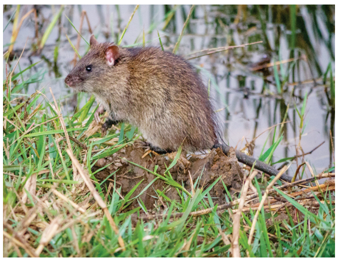
Rodent

Causative agent: Lesser bandicoot rat (Bandicota bengalensis), greater bandicoot (B. indica), field mice (Mus booduga) and house rat (Rattus rattus)

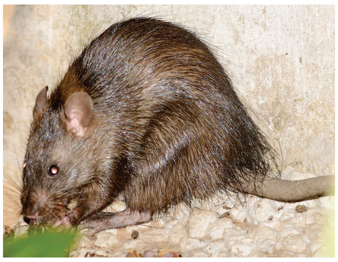
Field indicators: Fresh burrow mounds and active holes on ridges/bunds; narrow runways with smear marks; conical gnawing on tubers, cut setts/vines, missing tubers; droppings and tracks

Spread and persistence: Rapid breeding (multiple litters per year) enables quick population rebounds. Reinvasion from hedgerows, canal banks, and buildings; movement along bunds and drains and seasonal shift into fields during tuber bulking sustains infestations.

Impact: Stand losses from pulled or damaged setts, reduced root bulking from repeated gnawing, and storage losses/contamination are common; Feeding wounds act as entry points for rots, increasing post-harvest decay; together these effects lower marketable yield and raise cultivation costs due to extra labour and control inputs.



Lesser bandicoot rat



Greater bandicoot rat

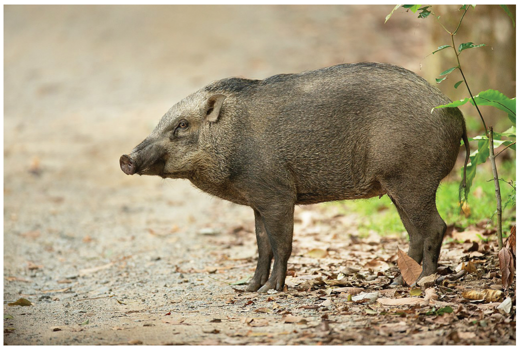
Wild boar

Causative agent: Wild boar (*Sus scrofa*)

Field indicators: Uprooted ridges/mounds; cloven hoofprints and wallows; tusk/gnaw marks on tubers, trampled vines, scattered half-eaten tubers; broken/undercut fence points, fresh dung and trails at field edges.

Spread and persistence: Powerful rooters, mostly nocturnal with high reproductive potential. Raids concentrate near forest fringes; animals learn routes and returns to profitable fields, moving along cover (bunds, canals, scrub); peak incursions often in family groups (sounders) during tuber bulking and post-harvest gleaning.

Impact: Stand loss and severe localised yield gaps from uprooting; tuber breakage/contamination cutting marketable grade; soil disturbance increases erosion and follow-on pest/rot risk; added guarding/fencing and replanting costs raise the cost of cultivation.



Wild boar

EMERGING DISEASES

Climate variability, intensified monocropping, and the movement of infected planting material are driving a surge in emerging diseases notably cassava stem and root rot and the leaf–pseudostem rot of elephant foot yam. These pressures let once minor or novel pathogens to extend their range and impact, jeopardizing yields and planting material quality.

Cassava stem and root rot disease

***Causative agent*:** Primarily caused by different species of *Fusarium* spp.

Symptoms: Cassava stem and root rot manifest as wilting leaves darkened and shrivelled stems, and soft, discoloured, or decayed roots. Infected plants may show stunted growth, and severe cases lead to plant death and tuber rot, causing yield losses of 20-80%.

***Transmission*:** The pathogens spread through infected planting material, soil, or water splashes. Warm, humid conditions and poor soil drainage favour disease development.

***Impact*:** Cassava planted only in wet land fields of Kerala have shown the disease which was up to 100% incidence and entire tuber loss based on the weather factors and soil moisture. Reduction in yield and poor tuber quality undermine food security and economic stability for farmers.

Leaf yellowing and wilting

Blackening of collar region

Fungal infection on the affected area

Leaf and pseudostem rot disease in elephant foot yam

***Causative agent*:** Primarily caused by fungi such as *Fusarium* spp. and *Colletotrichum* spp.

***Symptoms*:** Leaf and pseudostem rot in elephant foot yam manifests as chlorotic, stunted, or blighted leaves with tan to dark brown spots that may merge, causing complete leaf death. Pseudostems develop dark, necrotic lesions, often at the base or collar region, leading to wilting or plant collapse. Severe infections result in root and corm rot, with decayed, discolored tissue and reduced tuber quality

***Transmission*:** The pathogens spread through infected planting material, soil, or water splashes. Fusarium spp. are soil-borne, thriving in warm, moist conditions with poor drainage, while Colletotrichum spp. disperse spores via rain or wind, exacerbating disease spread in humid environments.

***Impact*:** Leaf and stem rot significantly affects elephant foot yam production in tropical regions like India and Southeast Asia, where it is a staple and cash crop. Reduced yield and poor corm quality threaten food security, farmer income, and availability of planting material for subsequent seasons.

Leaf and pseudostem rot in elephant foot yam

CONCLUSION

The biotic stresses, insects, mites fungi, viruses, nematodes, and vertebrate pests collectively erode yield, quality, and profit in tuber crops, especially under warm, humid conditions. Building resilience hinges on clean planting material, resistant, tolerant varieties, vigilant vector and weed management, and field sanitation. Integrated, ecology based tactics like crop rotation, soil health improvement, biologicals and pheromone traps should be timed to critical crop stages. Community coordination across field borders and good post-harvest hygiene further suppress reinfestation. Together, these measures form a practical, sustainable IPM pathway to safeguard food security and farmer incomes.

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