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Pests and diseases guide of sorghum, pearl millet and sesame



Pests and diseases guide of sorghum, pearl millet and sesame

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Foreword

The Food and Agriculture Organization of the United Nations (FAO) technically supports the Ministry of Environment, Water and Agriculture (MEWA) and Saudi REEF in the implementation of the project “*Strengthening MEWA's capacity to implement its Sustainable Rural Agricultural Development (SRAD) Programme*” (2019–2025). This strategic initiative aims to enhance institutional capacities, boost agricultural productivity, strengthen rural institutions, generate employment, and empower youth and women-led enterprises – all while promoting the sustainable management of land, water, and other vital natural resources.

As part of these efforts, FAO, in collaboration with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), the National Center for Vegetation Cover Development and Combating Desertification (NCVC), MEWA, and Saudi REEF, has placed special emphasis on promoting rainfed cereal cultivation in southwestern Saudi Arabia. This region, rich in agricultural heritage, faces unique challenges, particularly in managing pests and diseases that affect crop yields.

This publication, “*Pests and diseases guide of sorghum, pearl millet and sesame*”, has been developed under the SRAD project to provide practical, field-oriented knowledge for farmers, extension workers, and researchers. It aims to address biotic constraints in crop production and support informed decision-making in pest and disease management.

The guide documents experiences, shares lessons learned and presents preliminary findings. It serves as a valuable reference to raise awareness and strengthen resilience in rainfed farming systems.

As the project progresses into its next phase, this guide will continue to evolve – incorporating new insights, innovations, and the ongoing commitment of all partners to advancing sustainable rural livelihoods and agricultural development in Saudi Arabia.

Dr Nizar Haddad

FAO Saudi Arabia Programme Director



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The *“Pests and diseases guide of sorghum, pearl millet and sesame”* underwent a comprehensive review process and benefited from the expertise of specialists from ICRISAT, FAO, and MEWA. We also acknowledge the valuable and timely insights provided by colleagues at FAO Headquarters in Rome, which greatly contributed to the quality and relevance of this work.

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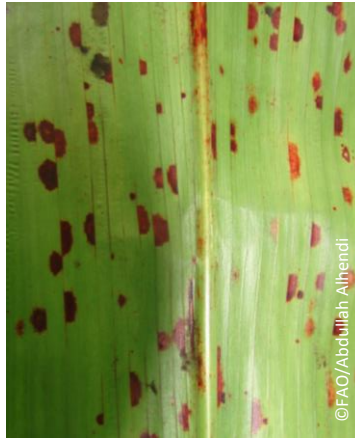
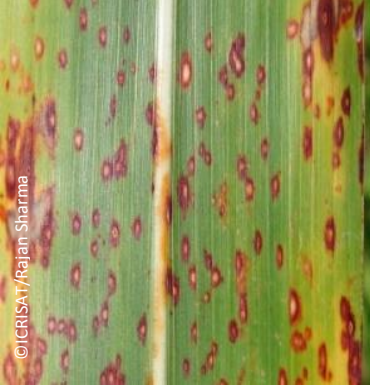


Abbreviations

a.i.	active ingredient
DAE	Days After Emergence
EC	Emulsifiable Concentrate
GR	Granules
MHM	Millet Head Miner
MMV	Maize Mosaic Virus
OD	Oil Dispersion
SC	Suspension Concentrate
SD	Seed Dressing
SG	Soluble Granules
SL	Soluble Liquid
SP	Soluble Powder
WCA	West and Central Africa
WDG	Water-Dispersible Granules
WG	Water-Dispersible Granules
WS	Water-Soluble







Pests and diseases guide of sorghum

Sorghum (*Sorghum bicolor* (L.) Moench) is an important millet crop in the semi-arid tropics which is the fifth major staple cereal globally, after rice, wheat, maize and barley. Grain yields sorghum in farmers' fields in Asia and Africa is generally low (1.0 t/ha) mainly due to crop losses caused by insect pests and diseases. On a global scale, sorghum suffers 25 – 40 percent average yield loss annually due to the combined effects of insect pests and diseases. These diseases can be classified according to the plant parts on which they occur, such as seedling diseases, foliar diseases, root and stalk diseases, leaf sheath diseases, panicle and grain diseases, and storage diseases. Diseases are also classified according to the symptoms they produce on plants and are called seedling blight, root and stalk rots, leaf blight, leaf spot, rust, smut, ergot, wilt, downy mildew, grain mold, leaf stripe, leaf streak, leaf mosaic, and other related diseases. Nearly 150 insect species and over 50 diseases have been reported as pests of sorghum, though only a

few are economically important globally, several others are regionally and locally important in specific agroecosystems. Among insect pests, shoot fly (*Atherigona soccata*), armyworm (*Mythimna separata*), sorghum midge (*Stenodiplosis sorghicola*), head bug (*Calocoris angustatus*), and head caterpillars (*Helicoverpa*, *Eublemma* and *Pyroderces*) and recent invasive pest fall armyworm (*Spodoptera frugiperda*) are the major pests of sorghum. Sorghum is grown in the South-West of Saudi Arabia mainly in Al Baha, Aseer, Makkah and Jazan provinces. Jazan region grows more than 40 000 ha which span around 80 percent of all sorghum grown in the country. The insect pests and diseases observed in the region are—Chinch bugs, aphids, stem borers, fall armyworms, smuts, grey leaf spots, downy mildew, sooty stripes, anthracnose. This digital guide provides detailed pest/disease description, pictorial representation of damage symptoms of insect pests and diagnostic signs and symptoms of diseases, and integrated pest/disease management options in sorghum.



Diseases of sorghum

Anthracnose, caused by *Colletotrichum sublineola* (syn. *C. graminicola*)

Pathogen/disease description

The disease is more prevalent and severe in warm and humid environments where it causes substantial economic losses. The disease has been observed in the Jazan region of Saudi Arabia. Anthracnose appears on several plant parts. The pathogen causes seedling blight, leaf blight, stalk rot, head blight and grain mold, and thus limits both grain and forage production. Among these, foliar anthracnose is the most pronounced and devastating on the forage and grain sorghum cultivars. Yield losses of 50 percent or more can occur under severe conditions (Chen *et al.*, 2024)

Disease symptoms

- The foliar symptoms appear 30–40 days after emergence. Typical symptoms are small, circular, elliptical or elongated spots, usually about 5 mm in diameter. These spots develop grey to straw-coloured centres with wide margins that may be tan, red, or blackish purple. In some cultivars that develop low levels of foliar infection, midrib infection occurs more prominently.
- On the centres of the spots, few to numerous small, circular, erumpent black dots develop; these are acervuli of the fungus.
- Elliptical to elongated lesions of straw colour, with red purple or black embedded acervuli are seen on the midrib.



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Management

- Host plant resistance: Several resistant accessions and some tolerant hybrid seed parents, such as ICSA/B 260 to ICSA/B 295 are available at ICRISAT that can be tested in Saudi Arabia.
- Planting disease free seeds, removal of crop residues and alternate hosts (wild sorghum), weed management, and crop rotation can serve in controlling the disease.
- *Chaetomium globosum* and *Trichoderma harzianum* are effective biocontrol agents that can be tested.
- Fungicides difenoconazole and propiconazole can be tested in Saudi Arabia for the control anthracnose.

Leaf blight, caused by *Setosphaeria turcica* (anamorph: *Exserohilum turcicum*)

Pathogen/disease description

Leaf blight is an economically important and widespread disease of sorghum in highly humid areas of Asia, Africa and the Americas. The disease has been observed in the Jazan region of Saudi Arabia. When infection occurs at pre-flowering stage in susceptible cultivars, grain yield losses of up to 50 percent may occur (Kumar *et al.*, 2013). The pathogen can also infect maize, Johnson grass, teosinte and Sudan grass. However, there are some host-specific races/pathotypes known that do not infect other crop species. The pathogen survives in the field in crop debris as mycelia and conidia in the tropics and as chlamydospores in temperate climate. Minimum temperatures between 14 and 16°C, mean temperatures of 20–22°C and high humidity or heavy dew are most favourable for disease development.

Disease symptoms

- Symptoms are visible from the seedling stage to the crop maturity stage. Small, reddish or tan spots develop on seedlings, the spots later enlarge and coalesce resulting in wilting of young leaves.
- On mature plants, long, elliptical, reddish purple or yellowish lesions develop, first on lower leaves and later progress to the upper leaves and stem as well.
- Lesion size varies depending on resistance levels of the host genotypes, virulence levels of pathogen isolates and prevailing weather conditions.
- In humid weather, numerous greyish black spores are produced in the lesions in concentric zones.



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Management

- Host plant resistance: Several resistant accessions and some leaf blight tolerant hybrid seed parents, such as ICSA/B 296 to ICSA/B 328 were developed during 1989 to 1998 and are available at ICRISAT which can be tested and deployed in Saudi Arabia.
- Fungicides registered in Saudi Arabia for sorghum need to be tested for their efficacy against leaf blight.



Loose kernel smut, caused by *Sporisorium cruentum* (syn: *Sphacelotheca cruenta*)

Pathogen/disease description

Loose kernel smut is common in most sorghum growing regions except Australia and some parts of Asia. The disease has been observed in the Jazan region of Saudi Arabia. Loose kernel smut attacks all groups of sorghums, including Johnson grass, although certain varieties in some groups are immune or highly resistant. However, the percent infection under field conditions is usually relatively low, often less than 10 percent.

Disease symptoms

- Normally, all kernels in an infected panicle are smutted. Individual infected kernels are replaced by small smut sori that are 2.5 cm or longer, pointed and surrounded by a thin grey membrane.
- This membrane usually ruptures soon after the panicle emerges from the boot to release powdery, dark brown to black teliospores.
- These teliospores can be blown away by wind leaving a long, black, pointed, conical, often curved structure (columella) in the centre of the gall.
- Infected plants are stunted, panicles on them appear earlier than the healthy plants.

Management

- Smutted panicles are to be burnt or buried in the soil as and when they are observed to prevent the spread of the disease.
- Seed treatment with carboxin @ 2 g/kg seed is effective for the management of loose smut.



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Covered kernel smut, caused by *Sporisorium sorghi* (syn. *Sphacelotheca sorghi*)

Pathogen/disease description

Covered kernel smut is a widespread disease in all sorghum growing regions and was also observed in Jazan region of Saudi Arabia. Optimum temperature of 25°C and half moistened soil during planting are most important for the development of covered smut. It infects all groups of sorghum, including Johnson grass. The pathogen is seedborne and infection is systemic, which begins at the seedling stage and progresses to the inflorescence.



Disease symptoms

- Normally, in an infected panicle individual ovules are replaced by conical to oval smut sori that are covered by persistent peridia that are larger than normal grain.
- Initially each sorus is covered with a light pink/silver-white membrane, which later ruptures to reveal brownish-black spores.
- Smut sori are generally smooth, oval, conical or cylindrical, and vary in size.

Management

- The disease is generally kept under control by seed treatment with chemical fungicide. Seed treatment with carboxin @ 2 g/kg is recommended.
- Remove and burn head smut galls before the spores are scattered.



Downy mildew, caused by *Peronosclerospora sorghi*

Pathogen/disease description

Sorghum downy mildew is economically important and widespread in many tropical and subtropical regions of the world where sorghum and maize are grown. The disease has also been observed in the Jazan region of Saudi Arabia. The disease is highly destructive due to its systemic nature of infection resulting in death of plants or lack of panicle initiation.

Disease symptoms

- Systemic infection occurs when the young meristematic tissues of the growing seedlings are infected and the symptoms appear as chlorotic foliage and stunted, often resulting in death of seedlings. The first infected leaf shows chlorosis on the lower part of the lamina, which further grows to cover larger part of the leaf. The other leaves on a plant that gets infected subsequently show more chlorosis.
- Under cool and humid weather conditions, the abaxial surface of chlorotic leaves produce abundant spores (conidia) that appear as white, downy growth. As the plant grows, new emerging leaves exhibit parallel stripes of green and white tissue; the white interveinal tissue dies, and leaf shredding occurs.
- The local lesions on foliage are the result of infection by conidia. These appear as stippled, necrotic lesions on leaf blades.



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Management

- Some of the highly resistant lines/varieties are: QL 3, IS 3443, IS 8283, IS 1331, IS 2474, IS 3547, IS 5743, IS 7179, IS 8185, IS 8276, IS 8607, IS 8864, IS 8906, IS 8954, IS 18757, IS 22228, IS 22229, and IS 22230.
- Crop rotation for at least two years is helpful.
- Seed treatment with metalaxyl 35 SD @ 1 g ai/kg seed followed by one spray of metalaxyl 35 WS @ 1.5 mL/L water at 40 days after emergence (DAE) is effective.



Crazy top, caused by *Sclerophthora macrospora*

Pathogen/disease description

The disease develops in young plants growing in wet soil and is generally more prevalent in the wetter parts of a field. Oospores present in soil are the main inoculum source of *S. macrospora*; wild and cultivated grasses may also serve as reservoirs of infection.



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Disease symptoms

- In young plants, the disease produces mottled yellow plant tissue like that of mosaic symptoms caused by some viruses.
- As the disease progresses, leaves become thick and twisted.
- In the infected plants, the heads often do not emerge or are malformed.

Management

- Fields frequently subjected to flooding should be avoided. Improving drainage in fields, deep tillage and crop rotations for more than three years are helpful in disease management.
- Seed treatment with metalaxyl at 2 g a.i./kg seed is recommended.



Grain mold, caused by several fungal species

Pathogen/disease description

Grain mold is a major constraint for optimum sorghum grain yield and quality. Early maturing, high yielding hybrids and improved varieties that are grown during the rainy season are more vulnerable to grain mold. The major pathogenic fungi associated with grain mold complex are species of *Fusarium* (*F. thapsinum*, *F. proliferatum*, *F. andiyazi*, *F. nygamai* and *F. verticillioides*), *Curvularia lunata*, *Alternaria alternata*, and *Phoma sorghina*. Some of the strains of *Fusarium* species are known to produce mycotoxins, such as fumonisins, moniliformin and trichothecenes.

Disease symptoms

- Initial symptoms of grain mold are discolouration of grains due to infection and colonization by mold fungi. Grain discolouration varies from light whitish, pinkish, greyish, to shiny black depending on infection and colonization by individual fungal species. Often grains are colonized by multiple fungi. In severe cases, grains turn completely black.
- In case of severe infection at anthesis, grain development is affected resulting in chaffy florets or small grains.
- Grain mold infection leads to reduced kernel development, discolouration of grain, colonization and degradation of endosperm and germ, decreased grain density, decreased germination and seedling vigour.



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Management

- Host plant resistance: Several resistant accessions (IS 2815, IS 21599, IS 10288, IS 3436, IS 10646, IS 10475 and IS 23585) have been incorporated in breeding programmes to develop restorer lines, varieties and hybrid parents.
- Harvest crops at physiological maturity and ensure thorough drying. For optimal storage, maintain grain moisture content at or below 10 percent.



- Spray propiconazole 25 EC @ 0.1 percent at flowering.

Head blights, caused by *Fusarium* and *Colletotrichum* spp.

Pathogen/disease description

Head blight is a panicle disease of sorghum. It is caused by many of the same fungi responsible for grain mold primarily *Fusarium* and *Colletotrichum* spp. The disease is described differently due to different symptoms. It is considered a minor disease with sporadic incidence in major sorghum growing areas of the world.

Disease symptoms

- Symptoms of the disease include reddening of the pith tissues of the peduncle and the rachis or rachis branches.
- The initial infection takes place at the lower part of the panicle that spreads upward.
- Elevated humidity levels during the flowering stage favours infection and colonization.
- In some cases, the presence of small black reproductive structures (acervuli) bearing spines (setae) on the panicle indicates infection by *Colletotrichum* spp., the causal agent of anthracnose.



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Management

- Host plant resistance is the best management option. Elite sorghum breeding lines need to be screened in Saudi Arabia for resistance against head blight.
- Harvesting at physiological maturity.



Sooty stripe, caused by *Ramulispora sorghi*

Pathogen/disease description

Sooty stripe is an important leaf disease in many sorghum-producing regions. It can cause serious yield losses in Africa, India, and United States of America. The pathogen also infects Columbus grass, Johnson grass, and Sudan grass.

Disease symptoms

- The initial symptoms appear as small non-diagnostic lesions on the lower leaves. These lesions elongate and form the typical diagnostic oval-elongate sooty stripe lesions surrounded by a prominent reddish-brown lesion margins with yellow (chlorotic) halos.
- The production of numerous black microsclerotia in the centre of mature lesions gives the lesions a sooty appearance.
- Lesions may expand and result in leaf blight.
- The disease progresses under favourable weather conditions and lesions may occur on all leaves of the plant.



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Management

- Crop rotation and removal of crop residues.
- Fungicides registered in Saudi Arabia for sorghum can be tested for their efficacy against sooty stripe.

Banded leaf and sheath blight, caused by *Rhizoctonia solani*

Pathogen/disease description

Rhizoctonia sheath blight is one of the destructive diseases affecting sorghum, and other tropical cereals such as maize and rice growing in high rain fall conditions. The casual fungus is soil borne and survives between cropping seasons on crops like corn, rice, mung bean, other plants and weeds as mycelium and in the soil as sclerotia.

Disease symptoms

- Normally, the disease starts from the basal leaf sheaths and spreads upward reaching as high as the panicle.
- The infected hosts develop water soaked grey-green leaf and sheath lesions which becomes necrotic and give the infected tissues a banded appearance.
- Mycelial strands and fluffy white to light brown mycelial mats (sclerotia) of the casual fungus can be clearly seen on the surface of the lesions.



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Management

- Various species of *Trichoderma*, *Gliocladium*, and *Laetisaria*, along with bacteria such as *Pseudomonas* sp., *Bacillus subtilis* and nematodes like (*Aphelenchus avenae*) have demonstrated antagonistic activity against *Rhizoctonia* spp. and can be tested in Saudi Arabia.
- In maize, removal of the second and third leaf sheaths from ground level at 35–40 days after sowing has proven effective in reducing disease incidence.
- Selection of a well-drained field and planting on raised beds, optimum plant population, application of farmyard manure prior to planting are important cultural aspects to manage the disease.

Grey leaf spot, caused by *Cercospora sorghi*

Pathogen/disease description

Grey leaf spot, or rectangular leaf spot or Cercosporiosis is a disease of medium importance as it appears late in the crop. It occurs in most of the sorghum-growing regions and has also been observed in the Jazan region of Saudi Arabia. The pathogen is disseminated via infected seed and airborne spores. Warm temperatures, frequent rainfall, and high humidity levels favour the development of the disease.

Disease symptoms

- Initial symptoms include small red spots on leaves which then enlarge to form narrow rectangular lesions delimited by veins.
- As the disease progresses, the spots elongate and heavy sporulation occurs, indicated by velvety grey spore masses on both the surfaces of leaf.

Management

- Crop rotation, use of healthy seeds or resistant cultivars, avoiding overcrowding, proper field sanitation, removal of infected plant debris, and other recommended management practices. are helpful in disease management.
- Propiconazole 25 percent EC @ 1 mL/L water can be used.



Goss's wilt, caused by *Clavibacter nebraskensis*

Pathogen/disease description

The disease is caused by a bacterium which primarily infects leaves that have been wounded. The disease was observed in the Jazan region of Saudi Arabia with about 10 percent disease severity (FAO Saudi Arabia Pest and Disease Survey Report). The pathogen infects several hosts including maize, grain sorghum, green foxtail, barnyard grass, shattercane, large crabgrass, and others. The disease can spread from plant to plant and disease development is favoured by warm climatic conditions.

Disease symptoms

- The primary symptoms appear on leaves as elongated tan lesions with irregular margins extending parallel to the veins.
- Dark, water-soaked spots ('freckles') develop within the margin of the expanding lesions. When these "freckles" are observed against the light, transparent spots can be seen.
- Shiny patches of dried bacterial ooze can be observed on the lesions.
- The seedling blight phase of this disease may cause wilting and death of seedlings.

Management

- Rotate with broadleaf crops and small grains excluding sorghum and maize, which serve as primary hosts.
- Employ deep tillage to bury infected crop residues, accelerating decomposition and thereby reducing the pathogen load in the soil.



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Mosaic virus

Pathogen/disease description

Maize mosaic virus (MMV) is an economically important sorghum virus prevailing in semi-arid tropics of the world. The MMV-S, is serologically related to MMV and classified within the plant Rhabdovirus subgroup, characterized by four major proteins. MMV-S is transmitted by a delphacid planthopper *Peregrinus maidis* which is one of the major pests on sorghum.



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Disease symptoms

- The symptoms include the appearance of fine continuous chlorotic or broken streaks between the veins on leaves that may become necrotic as the disease progresses.
- Severe stunting of plants with shortened internodes and fewer seed setting on panicles.
- Some of the symptoms of nutrient deficiency in sorghum and diseases such as downy mildew also resemble the symptoms of viral diseases. Therefore, symptoms diagnosis should be confirmed by other techniques.

Management

- Eradication of weed hosts, removal of ratoons, roguing of symptomatic plants, adjustment of sowing time, when possible, avoidance of the vector and chemical control of vector with acetamiprid 20 percent SP 0.5 g/L water is useful in the management of MMV in sorghum.

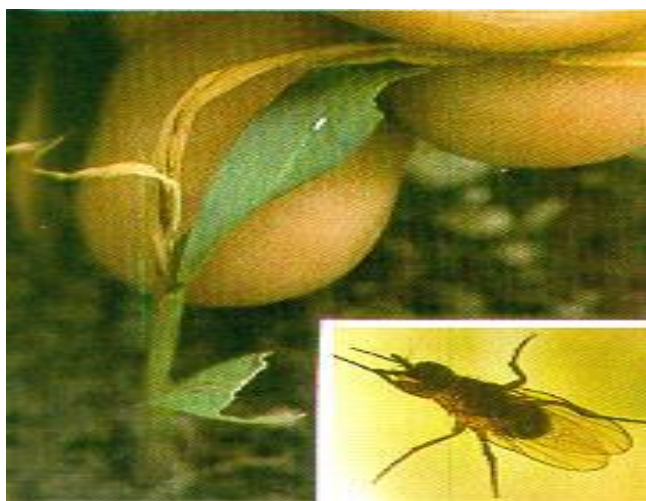


Insect pests of sorghum

Shoot fly, *Atherigona soccata* (Muscidae: Diptera)

Pest description

- Shoot fly females lay cigar shaped eggs on the lower leaf surface at the 1 to 7 leaf stage.
- Eggs - White, cylindrical, distal slightly flattened; Adult - Whitish grey fly.



Damage symptoms

- The maggot bores inside the stem and cuts the growing point.
- Central shoots dry up and produce “dead heart” symptom.
- The infested plant produces side tillers.

Management

- *Trichogramma chilonis* and *T. simmondsi* serve as egg parasitoids, while various species of spiders act as natural predators of shoot fly eggs. They can be mass-reared and deployed as biological control agents.
- In case of early sowing, maintain a high seed rate.
- Pulling out alternate weed host such as barnyard grass.
- Seed treatment with acetamiprid 70 WDG @ 5 g/kg of seeds.
- Under late plantings, shoot fly can be controlled with the application of imidacloprid 2 GR @ 450 g/ha at the time of planting in the seed furrows. Alternatively, shoot fly damage can be minimized by spraying chlorantraniliprole 20 percent SC @ 0.3 mL/L water at 7 and 14 days after the emergence of seedlings.
- For monitoring, set up the low-cost fish meal trap @ 12/ha during the 30 days of crop growth.

Stem borer, *Chilo partellus* (Crambidae: Lepidoptera)

Pest description

Eggs - Scale-like flat oval eggs in batches on the surface of leaves near the midribs.

Larva - Yellowish brown with a brown head and prothoracic shield.

Adult - Moth is medium sized and straw coloured.



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Damage symptoms

- Withering and drying of central shoot - “dead heart”.
- Red mining in the midrib.
- Bored holes visible on the stem near the nodes.
- Tender folded leaves have parallel “shot holes”.
- Affected parts of stem may show internal tunnelling of caterpillar holes.
- Tunnelling of ear heads results either in its breakage, or complete/ partial chaffy earheads affecting the grain development.

Management

- Set up light traps till mid night to monitor, attract and kill adults of stem borer, grain midge and earhead caterpillars.
- *Trichogramma chilonis* and *Cotesia chilonis* are egg and larval parasitoid, respectively, and *Chrysoperla zastrowi* is a predator of stem borer that can be used to manage stem borer.
- Emamectin benzoate 5 SG @ 0.4 g/L water or imidacloprid 2 GR @ 450 g/ha can be used.
- Sorghum genotypes ICSV 700, ICSV 705, IS 18551 and ICSV 93046 have tolerance to stem borer.

Fall armyworm, *Spodoptera frugiperda* (Noctuidae: Lepidoptera)

Pest description

Larvae with four black spots arranged (in square shape) on eighth and ninth abdominal segment and inverted “Y” shaped mark on head. Male adult moth’s forewings are brown with triangular white spots whereas, females’ forewings are greyish brown.



Damage symptoms

- Scrapping of leaf surface by young larvae.
- The damage by late instars (4th instar) results in extensive defoliation of leaves and the presence of large amounts of fecal pellets in whorls.



Scraping of leaf



Extensive foliage damage



Whorl damage with excreta

Source: ICRISAT team own elaboration

Management

- Critical period to protect the crop is up to 50–60 days after seedling emergence.
- Seed treatment with cyantraniliprole-10 percent OD @ 4 mL/kg seed is reported to offer protection for 2–3 weeks after germination.
- Scouting and assessment of the damage and existence of natural enemies.
- Mass trapping: Pheromone traps @ 25 traps/ha.
- *Telenomus remus* and *Trichogramma* spp. are egg parasitoids and ladybird beetles and ground beetle feed on young caterpillars which can be used as natural enemies.
- Azadirachtin (5mL/L): Ovipositional deterrent.
- Other effective pesticides are emamectin benzoate 5 SG @ 0.4 g/L of water or chlorantraniliprole 20 percent SC @ 0.3 mL/L water.

Aphids, *Rhopalosiphum maidis*/*Melanaphis sacchari* (Aphididae: Hemiptera)

Pest description

- ***Rhopalosiphum maidis***: The aphid is dark bluish-green and slightly ovate with black legs.
- ***Melanaphis sacchari***: The sugarcane aphid is yellow to buff coloured.

Damage symptoms

- Yellowing of leaves.
- Colonies of aphids found in central leaf whorl.
- The aphids secrete honeydew, which falls on leaves and on the ground on which sooty molds grow.

Management

- Yellow sticky traps @ 15–20 traps/ha can be used for the effective control of aphids in sorghum plants.
- *Aphelinus nigritus* is an effective parasitoid and most of the ladybird beetle species are general predators.
- Avoid applying excessive doses of nitrogenous fertilizers.

- Spraying acetamiprid 20 percent SP 0.5 g/L water controls the aphids.
- Sorghum cultivars IS 40618, ICSV 12001, ICSV 12002, ICSV 745, ICSV 700, ICSV 708 have tolerance to aphids.



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Earhead bug, *Calocoris angustatus* (Miridae: Hemiptera)

Pest description

- **Eggs** - Blue cigar shaped, laid under the glumes or into the middle of the florets.
- **Nymphs** - Slender, green in colour.
- **Adults** - Male is green in colour and female is green with a brown margin.



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Damage symptoms

- Nymphs and adults suck the juice from within the grains when they are in the milky stage.
- Grains become shrunken and turn black in colour and exhibit poor filling resulting in chaffy kernels.
- The presence of large number of nymphs and adults is seen on the earhead.

Management

- Apply acetamiprid 20 percent SP @ 0.5g/L water at the 3rd and 18th day after panicle emergence or spray twice with 5 percent neem seed kernel extract at 10 percent heading and after 9 days.

Chinch bug, *Blissus leucopterus* (Blissidae: Hemiptera)

Pest description

- Adults are small, black bugs about 1/8-inch-long with white wings folded over the back.
- Two small, dark, triangular markings appear near the mid-portion of the wings.

Damage symptoms

- Bugs attack any part of the vegetative phase of sorghum.
- Heavy infestation sometimes results in the death of young plants.
- Even if plants are not killed, the growth may be stunted, and grain and fodder yield is reduced.

Management

- Seed treatment with acetamiprid 70 WDG @ 5 g/kg seeds followed by spraying acetamiprid 20 percent SP @ 0.5 g/L water controls the bugs.



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Earworm, *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Pest description

The eggs are pale green when first deposited; larva's head colour is usually orange or light brown, patterned like a white net. The forewings of the moths are yellowish brown, and hind wings are creamy white basally and blackish.

Damage symptoms

- Larvae chew circular holes in the seed and feed on the starchy content.
- Earheads are partially eaten with a chalky appearance.

Management

- Installation of sex pheromone traps @ 12 traps/ha at 1 ft height above earhead formation for the monitoring of adult male moths.
- Larvae generally appear at earhead stage, hand collection and destruction of this pest is suggested.
- Spinosad 45 SC @ 0.25 ml/L, azadirachtin (5 mL/L), emamectin benzoate 5 SG @ 0.4 g/L water or chlorantraniliprole 20 percent SC @ 0.3 mL/L water can be recommended for the management of earworm.
- *Habrobracon hebetor* and *Chelonus blackburni* are parasitoid and wolf spiders are predators of this pest which can be used as natural enemies.



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https://agritech.tnau.ac.in/crop_protection/crop_prot_crop_insectpest%20_cereals_sorghum.html





Pests and diseases guide of pearl millet

Pearl millet [*Cenchrus americanus* (L.) Morrone, synonym: *Pennisetum glaucum* (L.) R. Br.], is a staple food for millions of people living in the semi-arid tropical regions of Africa and Asia. The crop is grown both for grain and fodder.

Besides food for human consumption, grains are also used for poultry feed and some industrial uses. Pearl millet is attacked by many diseases caused by oomycetes, fungal, bacterial, and viral pathogens. However, only a few diseases such as downy mildew, blast, rust, ergot, and smut are economically important. Downy mildew is the most destructive and widespread disease of pearl millet. These diseases can be best managed by growing disease resistant varieties and hybrids. Multiple disease resistant improved lines developed at ICRISAT can be evaluated under various agroclimatic conditions in Saudi Arabia.

Worldwide, at least 150 insect species have been recorded as feeding on millets; most of these pests are common to all species of millets. Insect damage in millets has been recorded across all plant growth stages and can occur on foliage, flowers as well as on seeds. Pests and diseases infesting/infecting different plant parts at various plant growth stages result in economic losses due to decreased crop productivity, grain quality, and fodder yield. Pearl millet is grown in the South-West of Saudi Arabia mainly in Al Baha, Aseer, Makkah and Jazan. Caterpillar leaf damage, millet stem borer (*Acigona ignefusalis*), head miner (*Heiliocheilus albipunctella*) and leaf spot diseases have been observed on pearl millet in the Jazan region of Saudi Arabia. This digital guide provides detailed pest/disease description, pictorial representation of damage symptoms of insect pests and diagnostic signs and symptoms of diseases, and pest/disease management options in pearl millet.



Diseases of pearl millet

Downy Mildew, caused by *Sclerospora graminicola*

Pathogen/disease description

Downy mildew is a highly destructive and widespread disease of pearl millet in Asia and Africa. It causes about 20–40 percent grain yield losses annually worldwide and the losses could be much higher when a susceptible cultivar is repeatedly grown in the same field. Genetically uniform single-cross F₁ hybrids are more susceptible than heterogeneous open-pollinated varieties.

The pathogen is highly variable and propagates both sexually (oospores) and asexually (sporangia-zoospores).



Disease symptoms

- Primary infection occurs at the seedling stage from the infection caused by soil-borne oospores. Systemic symptoms generally appear as chlorosis on the second leaf, and on all the subsequent leaves. Half-leaf symptoms are also observed.
- Whitish growth of the pathogen in the form of sporangiophores and sporangia appear more on the abaxial leaf surface. These spores get blown off by wind and rain splash and cause secondary infection in the field.
- Green ear symptoms are the appearance of green panicles due to transformation of floral parts into leafy structures.

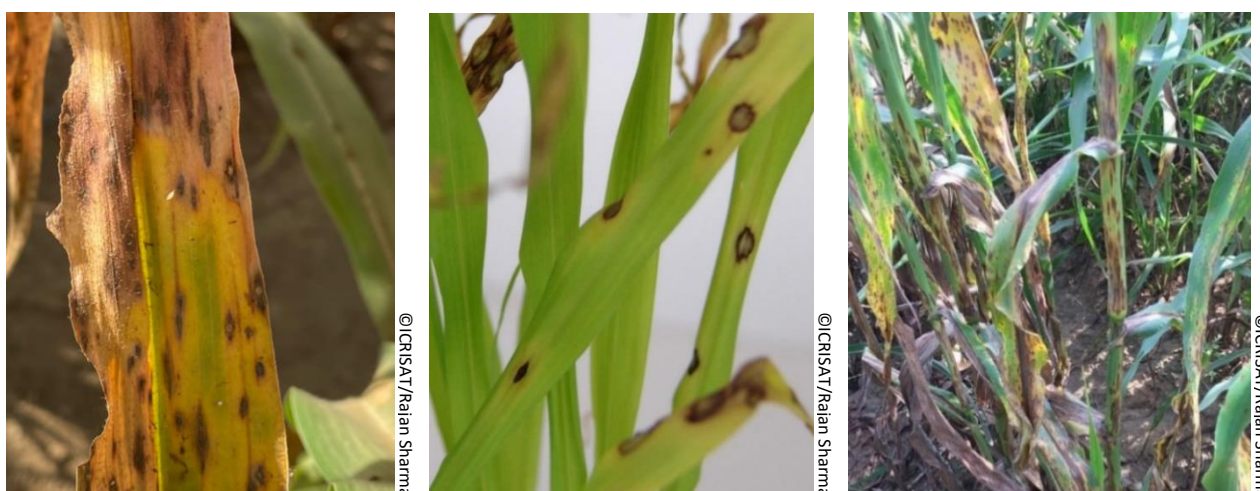
Management

- The disease can be successfully managed through host plant resistance; several resistance sources were identified at ICRISAT and systematically used in the breeding programmes.
- Removal and complete destruction of infected plants from the field; downy mildew-infected plant debris should be burnt, or the field should be ploughed deeply to bury the debris.
- Seed treatment with metalaxyl at 2 g a.i./kg seed controls the disease for about the first 35 days after sowing.
- Metalaxyl seed treatment, deep ploughing and rouging of diseased plants, and the use of resistant cultivars can be combined to develop an effective disease management strategy for pearl millet downy mildew.

Blast, caused by *Pyricularia grisea* [teleomorph - *Magnaporthe grisea*]

Pathogen/disease description

Pyricularia leaf spot, also known as blast disease, is an important disease in the southern United States of America and more recently it has emerged as a serious disease of dual purpose (grain and fodder) pearl millet hybrids in India. The disease appears in several countries in WCA such as Senegal, Mali, Burkina Faso, Niger, Nigeria and Chad. It was also observed in the Jazan region of Saudi Arabia. Leaf blast has been found to be negatively correlated with green-plot yield, dry matter yield and digestive dry matter thus affecting the productivity and quality of the crop. The pathogen infects more than 50 gramineous hosts including rice, wheat, pearl millet, finger millet, foxtail millet, forage, turf grass and several weed hosts. The pathogen is highly variable but specialized in its host range.



Disease symptoms

- Greyish, water-soaked lesions on foliage that enlarge and become necrotic.
- The lesion morphology is variable, ranging from small, round, elliptical, diamond-shaped to elongated forms.
- Lesions expand and coalesce to cover large surface areas and cause necrosis of tissues. Lesions are often surrounded by a chlorotic halo, which turns necrotic, giving the appearance of concentric rings.
- In susceptible cultivars, the entire foliage may exhibit a burnt appearance.
- Severely infected plants produce no grain or few shriveled grains in blasted florets.

Management

- Pathotype-specific resistance sources have been identified at ICRISAT and are being used in breeding programmes in India.
- Three sprays of tebuconazole 50 percent + trifloxystrobin 25 percent WG @ 0.4 g/L or propiconazole 25 percent EC @ 1 mL/L water have been found effective in controlling blast.
- Some species of *Pseudomonas*, *Streptomyces* and *Bacillus* have been reported for their antagonistic action against *M. grisea*.
- Integrated approaches to manage pearl millet blast include removal of infected crop residues and weed hosts, use of resistant cultivars and foliar sprays of tebuconazole 50 percent + trifloxystrobin 25 percent WG @ 0.4 g/L or propiconazole 25 percent EC @ 1 mL/L water.

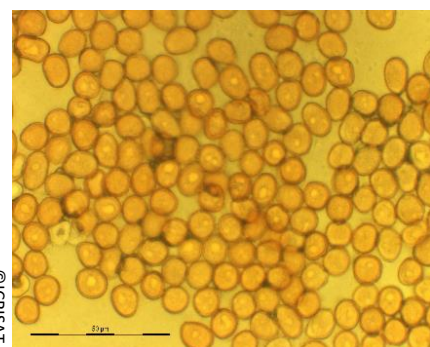
Rust, caused by *Puccinia substriata*

Pathogen/disease description

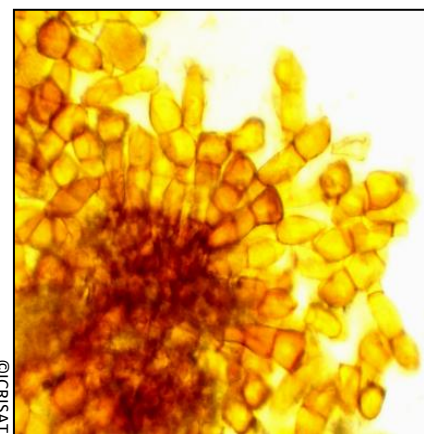
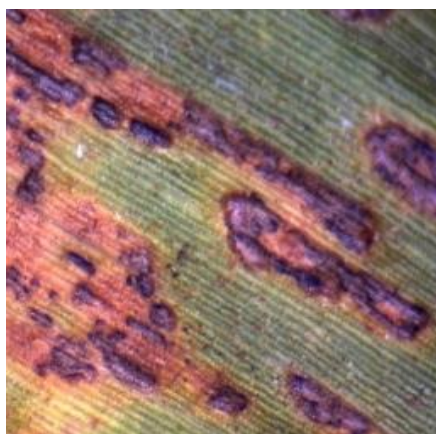
Rust on pearl millet has been reported from many countries of Asia and Africa, and from the US and Brazil. Substantial losses in grain yield and fodder quality may occur when infection occurs before flowering. Rust is of greater importance on multicut forage hybrids where even low severity can result in substantial losses of digestible dry matter yield. The disease initiates from the infection by urediniospores available from the off season or volunteer pearl millet plants or by the aeciospores from *Solanum* species. Clear, cool nights (<20°C) and dew formation favour infection and rust development.

Disease symptoms

- The rust pathogen is heteroecious and requires two unrelated hosts to complete its life cycle. Pearl millet, on which uredial and telial stages are produced, is called the 'primary host' and brinjal (eggplant – *Solanum melongena* L.) on which spermatia and aeciospores are produced, are the 'alternate host'.
- Infected leaves initially show pinhead chlorotic flecks, which later turn into reddish-orange, round to elliptical pustules on both surfaces. Individual pustules (uredinia) are small and erumpent, and as the disease progresses, they coalesce to occupy larger leaf surface. These pustules contain numerous urediniospores that become airborne as pustules burst.
- As the pustules age, teliospores also appear, although with low frequency.



Uredinial pustules and urediniospores



Telial pustules and teliospores

Source: ICRISAT team own elaboration

Management

- A large number of germplasm accessions were evaluated, and many resistant lines have been identified at ICRISAT, some of them integrated into breeding programmes.
- Spraying the crop with propiconazole 25 percent EC @ 0.1 percent have been found effective in controlling rust.
- Avoid overhead irrigation; refrain from planting pearl millet near eggplant.

Smut, caused by *Moesziomyces bullatus*

Pathogen/disease description

Smut is an important disease of pearl millet in India, western Africa and United States of America. Although, present in almost all countries where pearl millet is grown, no epidemics have been reported so far, and the extent of losses caused by the disease is quite variable. It is a panicle disease that is more severe in CMS-based single-cross hybrids than in open-pollinated varieties.

Disease symptoms

- Smut symptoms appear on the panicle as green, shining smut sori in place of grains two weeks after infection; the sori mature within the next two weeks. Matured sori turn brown and rupture to release dark brown to black sporeballs of numerous teleutospores.
- Smut infection begins with soil- and seed-contaminated (not internally seed borne) inocula. Teleutospores from the previously infected florets are left in the soil and seeds get contaminated at threshing.
- Because of the long latent period secondary spread within a crop is limited, but the late tillers and late planted crops in the adjacent fields may get infected.



Management

- Roguing out of infected ears, use of clean seed, field sanitation, crop rotation and hot weather deep ploughing are some of the cultural practices that reduce primary inoculum of the fungus.
- Several lines were evaluated at hot spots in India and countries in WCA and several lines with stable resistance to smut were identified. Some of the resistant lines are - SSC FS 252-S-4 (ICML 5), ICI 7517-S-1 (ICML 6), EBS 46-1-2-S-2 (ICML 7), EB 112-1-S-1-1 (ICML 8), NEP 588-5690-S-8-4 (ICML-9) and P 489-S-3 (ICML 10) that can be tested.
- Integrated approach to manage pearl millet smut includes removal of smutted ears, use of clean seeds, deep summer ploughing, crop rotation, and use of smut resistant cultivars.



Insect pests of pearl millet

Millet head miner (MHM), *Heliocheilus albipunctella* (Noctuidae: Lepidoptera)

Pest description

The millet head miner is a monophagous species that feeds only on millet. Female moths lay eggs on the developing millet heads and full-grown caterpillars are pink in colour. The mature caterpillars drop to the ground, where they burrow into the soil to pupate, usually close to the host plant.

Damage symptoms

- Young larvae perforate millet glumes and eat the flowers, whereas mature larvae cut the floral peduncles, thereby preventing grain formation or causing mature grains to spill, with grain yield losses ranging from 15 to 85 percent.
- As the larvae chew between the rachis and flowers, they lift the destroyed flowers or developing grains, leaving a characteristic spiral pattern on the millet head.

Management

- ICMP 177001, ICMP 177002, ICMV 177003, ICMV IS 90311, LCIC 9702, Souna 3, ICMV IS 94206 and PE 08043 have moderate resistance to MHM.
- Biological control with the parasitoid wasp *Habrobracon* (= *Bracon*) *hebetor* Say (Hymenoptera: Braconidae) resulted in parasitism of 80 percent of the MHM larvae and 30 percent increase in grain yield thus can be used as natural enemy.
- Insecticides, chlorantraniliprole 20 percent SC @ 0.3 mL/L water, and insect growth regulators (diflubenzuron @ 1 g/L, lufenuron @ 1.5 mL/L) can significantly reduce the pest incidence with a single application at 75 percent flowering or two applications, the first at the beginning of flowering and the second 5–7 days later.



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Shoot fly, *Atherigona approximata*, Malloch (Muscidae: Diptera)

Pest description

Eggs are laid generally singly parallel to the midrib on the undersurface of the third to fifth leaf; maggots are typically yellow in colour, and the adults are dark brown and resemble housefly.

Damage symptoms

- Damage by larvae at the seedling stage (5 to 30 days after seedling emergence) leads to the typical dead heart symptoms.
- The larvae cut the growing point. As a result, the central leaf dries up forming a dead heart, which can be pulled out easily.
- Late infestations may also damage the panicle in the formative stage, resulting in rotting or drying up and the ear head appears like cat's tail.



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Management

- Use of resistant/tolerant varieties/hybrids.
- Use a higher seed rate and remove the shoot fly-damaged seedlings at the time of thinning.
- Set up hanging type plastic fishmeal trap @ 12/ha till the crop is 30 days old.
- Seed treatment with thiamethoxam 25 WG @ 5 g/kg of seeds.
- Under late plantings, shoot fly can be controlled with the application of imidacloprid 2 GR @ 450 g/ha at the time of planting in the seed furrows. Alternatively, shoot fly damage can be minimized by spraying chlorantraniliprole 20 percent SC @ 0.3 mL/L water at 7 and 14 days after the emergence of seedlings.



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Stem borers, *Coniesta ignefusalis* and *Sesamia* spp. (Crambidae: Lepidoptera)

Pest description

- ***C. ignefusalis***: A full-grown larva measures 15–18 mm, has a whitish grey body with black oval spots on each segment.
- ***Sesamia* spp.**: Pinkish brown with dark head.

Damage symptoms

- The pink larvae of *Sesamia* are gregarious in nature, congregate inside the leaf whorls and feed on the central leaves causing typical 'pin hole' symptoms.
- The central shoot turns brownish and dries out that leads to the typical dead heart symptoms, although the lower leaves remain green and healthy. Bored holes are plugged in with excreta.
- Early season attack by *C. ignefusalis* results in the destruction of the growing points of millet plants, resulting in premature plant death called 'dead heart'. Attack on older plants by tunnelling larvae causes disruption of nutrient flow, stem lodging and poor or no grain formation.



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Management

- Spray chlorantraniliprole 20 percent SC @ 0.4 mL/L; or thiamethoxam 25 percent WG @ 0.5 g/L at third and eighteenth day after panicle emergence.
- *Tetrastichus atriclavus* is a larval parasitoid of stem borer that can be used as natural enemy.
- Set up light traps till mid night to monitor, attract and kill adults of stem borer, grain midge and earhead caterpillars.



Fall armyworm, *Spodoptera frugiperda* (Noctuidae: Lepidoptera)

Pest description

Larvae with four black spots arranged (in square shape) on eighth and ninth abdominal segment and inverted “Y” shaped mark on head. Male adult moth’s forewings are brown with triangular white spots whereas, females’ forewings are greyish brown.

Damage symptoms

- Scrapping of leaf surface by young larvae.
- The damage by late instars (4th instar) results in extensive defoliation of leaves and the presence of large amounts of fecal pellets in whorls.

Management

- Critical period to protect the crop is up to 50–60 days after seedling emergence.
- Seed treatment with cyantraniliprole 10 percent OD @ 4 mL/kg seed is reported to offer protection for 2–3 weeks after germination.
- Scouting and assessing the damage and existence of natural enemies.
- For mass trapping, use pheromone traps, 25 traps/ha.
- *Telenomus remus* and *Trichogramma* spp. are egg parasitoids, and ladybird beetles and ground beetle feed on young caterpillars. These can be used as natural enemies of the pest.
- Spinosad 45 SC @ 0.25 mL/L or azadirachtin (5 mL/L) can be used.
- Other effective pesticides are: Emamectin benzoate 5 SG @ 0.4 g/L; chlorantraniliprole 20 percent SC @ 0.3 mL/L water.



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Earhead worm, *Helicoverpa armigera* (Noctuidae: Lepidoptera)

Pest description

Most of the larvae are dark greenish brown, but they can also be pink, cream or almost black coloured.

Damage symptoms

- Egg laying by female moth is specifically done on the pearl millet earheads at earhead emergence stage.
- Freshly hatched larvae feed on stigma which ultimately leads to poor grain setting and it is sometimes misguided with sterility.

Management

- Installation of sex pheromone traps @ 12 traps/ha at 1 ft height above earhead formation for monitoring of adult male moths.
- *H. armigera* larvae generally appear at earhead stage, hand collection and destruction of this pest is suggested.
- Spinosad @ 0.25 mL/L is an effective ovicidal; Azadirachtin (5 mL/L) an ovipositional deterrent can also be used.
- *Habrobracon hebetor* and *Chelonus blackburni* are parasitoids and wolf Emamectin benzoate 5 SG @ 0.4 g/L water and chlorantraniliprole 20 percent SC @ 0.3 mL/L are effective pesticides.



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Suggested readings

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Pests and diseases guide of sesame

Sesame (*Sesamum indicum* L.) commonly known as gingelly, til and simsim is widely cultivated for its high-quality edible oil. Despite its cultural significance and economic potential, sesame cultivation faces substantial challenges from insect pests and diseases that severely impact yield and overall productivity across diverse agroclimatic zones. Insect pests cause yield losses ranging from 10–60 percent under different climatic conditions contributing to low productivity of sesame (Kumar *et al.*, 2022). Considerable yield losses due to diseases have also been reported in different sesame growing areas.

Sesame is grown in the South-West of the Kingdom of Saudi Arabia mainly in Al Baha, Aseer, Makkah and Jazan. Fusarium wilt is one of the main diseases of sesame observed in the fields in Jazan region of the Kingdom of Saudi Arabia.

The major insect pests and diseases of sesame observed in the region are - Leaf roller and capsule borer, White fly, Hawk moth, Leaf hopper, Beet armyworm, Fusarium wilt, Charcoal rot, Powdery mildew, Phyllody or Crazy top, and Leaf blight.

This digital c provides detailed pest/disease description, pictorial representation of damage symptoms of insect pests and diagnostic signs and symptoms of diseases, and integrated pest/disease management options in sesame.

Diseases of sesame

Charcoal rot, caused by *Macrophomina phaseolina* - (Sclerotial stage - *Rhizoctonia bataticola*)

Pathogen/disease description

Charcoal rot of sesame has been reported from all over the growing areas in the world. Poor plant stand per unit area caused by seedling death due to seed-borne infection exacerbates the disease problem and results in low yield. A highly variable pathogen, *Macrophomina phaseolina*, causes the disease; isolates of the fungus vary in microsclerotial size and in the presence or absence of pycnidia. The fungus primarily spreads through contaminated seeds that harbor pycnidia and sclerotia. The fungus also disperses via sclerotia that are carried by the soil, and the secondary spread is through the conidia disseminated by rain and wind.



Disease symptoms

- Yellowing of lower leaves is the first symptom of the disease, which is then followed by drooping and defoliation. Dark brown lesions can be observed on stem portions near the ground level and bark at the collar region shows shredding. Dead plants can also be observed in patches. The section of the stem near soil line in adult plants shows a high concentration of black pycnidia.
- The stem portion can be easily pulled out leaving the rotten root portion in the soil.
- When the infection spreads to pods, they open prematurely, and immature seeds get shriveled and become black in colour. Minute pycnidia are also seen on the infected capsules and seeds.
- Day temperatures of 30°C or higher along with extended droughts promote disease development.

Management

- Disease can be managed by growing resistant cultivars.
- Dipping sesame seeds in hot water at 60°C for 5 minutes.
- Soil solarization by covering soil with transparent polyethylene sheet for six weeks in summer after ploughing and irrigation.
- Pre sowing seed soaking in indole butyric acid at 100 ppm or salicylic acid at 4 mM produces healthy plants.



Phyllody, caused by *Candidatus Phytoplasma aurantifolia* or *Candidatus Phytoplasma asteris*

Pathogen/disease description

Sesame phyllody, caused by phloem-limiting phytoplasmas, is primarily distributed in the tropics. With a broad host range the pathogen can survive on a variety of alternative hosts including *Arachis hypogaea*, *Brassica campestris* var. *toria*, *B. rapa*, *Cicer arietinum*, *Crotalaria* sp., and *Trifolium* sp., which serve as source of inoculum. The disease is transmitted by the leafhopper vector, jassid, *Orosius albicinctus*. The optimum acquisition period of vector is 3–4 days, while a half-hour window is ideal for inoculation feeding. The incubation period of the pathogen in the vector may be 15–63 days, whereas in sesame, it may be 13–61 days. Nymphs stages of the vector are non-transmissible in disease spread. The vector population increases in the summer and decreases in the winter.



Disease symptoms

- The initial symptoms are vein clearing of leaves.
- The disease manifests itself mostly during flowering stage, when the floral parts are transformed into green leafy structures, which grow profusely.
- The flowers are rendered sterile.
- The veins of phylloid structure are thick and prominent.
- The diseased plants are stunted with reduced internodes and abnormal branching.

Management

- Remove all the reservoir and weed hosts, and infected plants.
- To control vector, spray neem oil @ 2 percent.
- Avoid growing sesame near cotton, groundnut and grain legumes.
- Seed treatment with imidacloprid 70 WS @ 5g/kg of seed at the time of sowing.
- Spray acetamiprid 20 SP @ 0.2 g/L of water.
- Spray neem oil (1 percent) at flowering.



Fusarium wilt, caused *Fusarium oxysporum* f. sp. *sesami*

Pathogen/disease description

Fusarium wilt is a globally recognized disease that has been reported in sesame cultivated regions with documented outbreaks in multiple production regions. On susceptible cultivars, the disease can be devastating, and reports of epiphytotic cases of the disease date back to 1959 in Venezuela and 1961 and 1964 in United States of America. The fungus is restricted in its host range to sesame. It is reported that the pathogen is transmitted by seeds and soil, and it can live in the soil for a long time. Warm, moist soil and high temperatures favour the growth of disease; 30°C or above is the ideal soil temperature for root infection.

Disease symptoms

- Plants get infected at any stage of the crop development including the damping-off phase in the seedling stage. The first obvious sign of wilt in the field is the drooping and yellowing of the leaves in later stages of the plant growth. These leaves can occasionally exhibit inward rolling of the edges before drying out.
- The plant gradually withers and shows wilting symptoms.
- Vascular necrosis appears as long, dark black streaks on infected sections of the root and stem.
- In a severe infection, the entire plant is defoliated and dries.

Management

- Sesame seeds soaked in ascorbic acid and salicylic acid (5 mM) for 24 h and sown and then treated with ascorbic acid and salicylic acid 15 days after sowing give good control of the disease through induced host resistance.



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Powdery mildew, caused by *Golovinomyces cichoracearum*

Pathogen/disease description

Powdery mildew is one of the important diseases of sesame. The disease causes up to 40 percent yield loss; for every 1 percent increase in disease severity, yield loss of 5.63 kg/ha has been reported. The disease is caused by an obligate parasite that perennates through cleistothecia in the infected plant debris in soil. Primary infection is caused by the ascospores produced in cleistothecia. The secondary spread is through conidia that are carried by the wind. Warm and humid weather favours disease development.

Disease symptoms

- Greyish-white powdery growth initially develops on the upper surface of leaves. A powdery coating may cover the entire leaf surface when multiple spots combine.
- The several affected leaves may be twisted and malformed.
- In severe infestations, flowers and young capsules may also exhibit symptoms' leading to premature shedding and reduced yield potential.
- The development of cleistothecia causes the mycelial growth to turn dark or black in the latter stages of disease.



Management

- Use of host plant resistance appears to be the most promising method for the control of powdery mildews of sesame.
- Remove and destroy the infected plant debris.
- Fungicides registered in Saudi Arabia need to be tested for their efficacy against powdery mildew.

Leaf blight, caused by *Alternaria sesami*

Pathogen/disease description

Leaf blight caused by *Alternaria sesame* is widespread and continues to be a major constraint in the production and productivity of sesame all over the world. The pathogen survives through seed, plant debris, soil and weed hosts. The disease cycle begins when dormant mycelium in infested crop debris produces spores (conidia), which are disseminated by wind and splashing water to infect sesame crops. Low temperature (20-25°C), high relative humidity and cloudy weather favour the disease development.

Disease symptoms

- Initially small, circular, reddish-brown spots (1–8 mm) appear on leaves which enlarge later and cover large area with concentric rings.
- The lower surface of the spots turns greyish brown in colour.
- In severe blighting, defoliation occurs.
- Dark brown lesions also appear on petioles, stems and capsules.
- Infection of capsules results in premature splitting and shriveled seeds.

Management

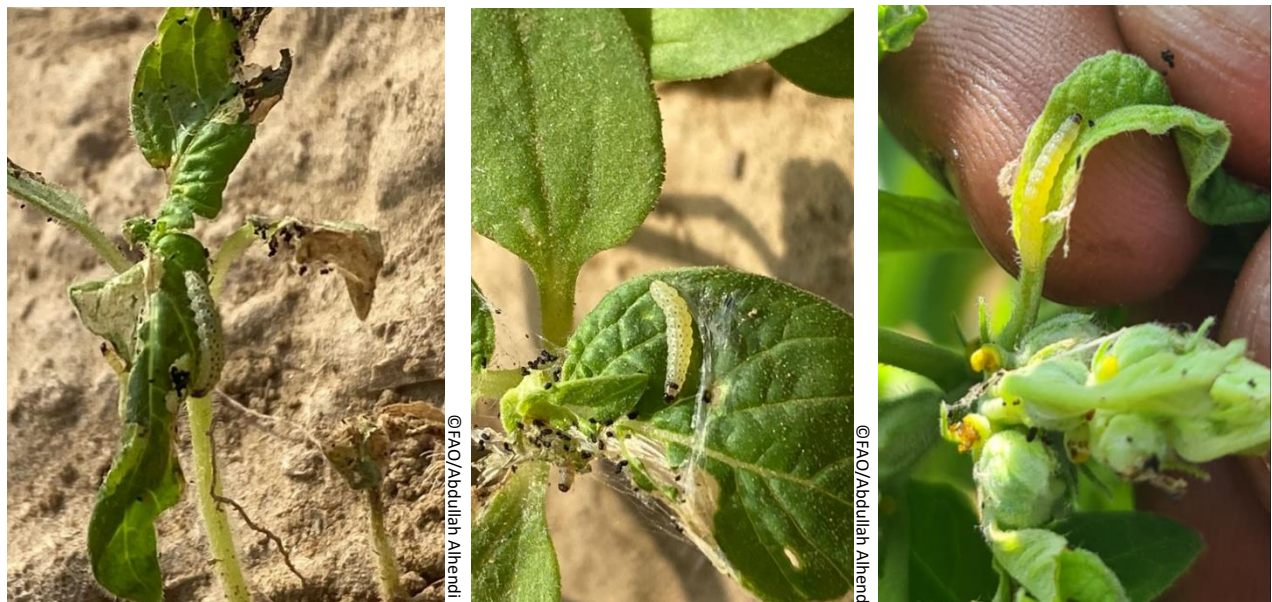
- Remove the reservoir host periodically.
- Host plant resistance is the best management option.
- Avoid closer spacing.
- Fungicides registered in Saudi Arabia need to be tested for their efficacy against leaf blight.



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Insect pests of sesame

Leaf webber, roller and capsule borer: *Antigastra catalaunalis* (Crambidae: Lepidoptera)



Pest description

- **Larvae:** Greenish in colour with black head having short white hairs.
- **Adult:** Medium sized moth with reddish yellow forewings.

Damage symptoms

- A few top leaves are rolled together by the young larvae, who then feed on them.
- The plant dies in the early stages of infestation without producing any branches or shoots.
- Infested shoots stop growing in the later stages of the attack.
- At flowering, larvae feed inside flowers, and when capsules form, larvae bore into them to feed on the developing seeds.

Management

- Collect and destroy the larvae from the leaf webs during the initial stages of plant growth.
- Erect bird perches @ 40-50/ha to facilitate predation of larvae.
- Two round sprays of neem oil 2 percent @ 5 mL/L of water.
- Spray spinosad 48 SC @ 0.25 mL/L or chlorantraniliprole 20 SC @ 0.3 mL/L.

Hawk moth: *Acherontia styx* (Sphingidae: Lepidoptera)

Pest description

Larva: Stout, sturdy, greenish with oblique stripes and a prominent dorsal curved anal horn.

Adult

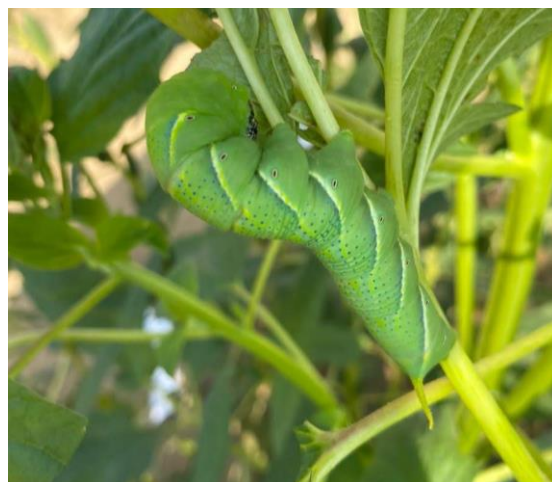
- Brownish giant hawk moth.
- Thorax with a characteristic skull marking.
- Abdomen has violet and yellow bands.
- Forewings are dark brown and hind wings are yellowish with two black lines.

Damage symptoms

- This pest is polyphagous; in addition to sesame, it has also been found to feed on potato, brinjal, lablab, and ornamental plants.
- Caterpillars defoliate the plants by feeding on the leaves. Throughout the growing season, the pest continues to feed on both young and mature crops.
- The adult moth is also harmful; it sucks honey from the honeycombs in apiaries.

Management

- The pest can be managed through predators - lacewing, ladybird beetle, reduviid bug, spider, red ant, black drongo (King crow), common mynah, big-eyed bug (*Geocoris* sp.), pentatomid bug (*Eocanthecona furcellata*), praying mantis and a major egg parasitoid *Trichogramma chilonis* Ishii.
- Deep ploughing exposes the pupae for predation to insectivorous birds.
- Hand picking and destruction of caterpillars.
- Spray chlorantraniliprole 20 SC @ 0.3 mL/L or emamectin benzoate 5 SG @ 0.5 g/L of water.



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Leaf hopper: *Orosius albicinctus* (Cicadellidae: Hemiptera)

Pest Description

Adult: Light brown coloured hopper.

Damage symptoms

- Both nymphs and adults suck the sap from leaves and transmit phyllody disease.
- The edges of leaves curl and turn red or brown.
- The leaves dry up and shed.
- It is a vector of sesamum phyllody disease.

Management

- Seed treatment with imidacloprid 70 WS (5 g/kg seed).
- Predators: Spider, ladybird beetle, lacewing, and other natural predators.
- Spraying of acetamiprid 20 SP @ 0.2 g/L or spiromesifen 24 SC @ 1 mL/L have been found effective and economical for the management of leaf hopper.



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Beet armyworm, *Spodoptera exigua* (Noctuidae: Lepidoptera)

Pest description

While the colour of beet armyworm caterpillars (larvae) varies, they usually have an olive-green body with a yellowish, lengthwise stripe running down either side. The skin on the body is nearly hairless and silky.

Damage symptoms

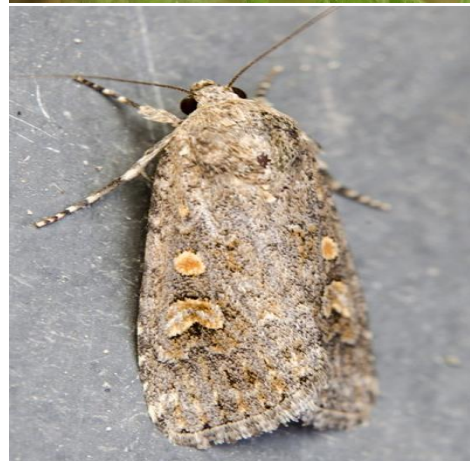
- Young larvae consume the lamina on the underside of leaves while frequently leaving the bigger veins and upper epidermis unharmed.
- Larger larvae leaves irregularly, while fully developed larvae totally consume foliage, leaving just the main veins.

Management

- *Chelonus* spp. and *Cotesia* spp. are the most common *parasitoids*. Among important predators are minute pirate bugs and predatory stink bugs; the predators usually attack the eggs and small larvae.



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- Emamectin benzoate 5 SG @ 0.5 g/L or chlorantraniliprole 20 SC @ 0.3 mL/L of water can be used to control the pest.

White fly, *Bemisia tabaci* (Aleyrodidae: Hemiptera)

Pest description

- ❖ The male is slightly smaller than the female, and adults measure around 1 mm in length.
- ❖ The pest has a white, powdery, waxy coating across its body and both wings.
- ❖ The yellow body is visible because the wings are kept tent-like above and slightly apart.

Damage symptoms

- ❖ Whiteflies attack the bottom leaves and secrete “honey dew” that primarily colonize the lower foliage and promotes fungal growth.
- ❖ The darkening of the leaves reduces photosynthesis, and the sucking of the sap from the leaves weakens the plants.
- ❖ Under severe infestations, plants may wilt.

Management

- ❖ Seed treatment with imidacloprid 70 WS (5 g/kg seed).
- ❖ Use low-cost yellow sticky traps @ 100/ha during the initial phase of the crop to check the early infestation of whitefly.
- ❖ Spray acetamiprid 20 SP @ 0.2 g/l or spiromesifen 24 SC @ 1 mL/L or imidacloprid 20 SL @ 0.5 mL/L of water for an effective management of white fly.



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Suggested readings

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TNAU Agri portal

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