

Blast disease:

A threat to finger millet cultivation

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Finger millet (Eleusine coracana L. Gaertn), commonly known as Ragi or Mandua is a nutritionally important coarse cereal and a traditional crop widely grown under varied agroclimatic regions, especially in semi-arid areas of African and Asian countries and plays a key role in the livelihood of small-holding farmers in these regions. Though finger millet is one of the hardiest crops, it is affected by a good number of diseases, and the blast disease caused by Pyricularia grisea is the most destructive disease in which seedlings may die under epidemic conditions, and broken pedicels and empty fingers may result in mature plants causing leaf, neck and finger blast, respectively. An integrated management approach should be undertaken to tackle the disease and to increase the yield towards potentiality. This article aims to provide the farmers' and researchers' society with concise knowledge about this devastating disease of finger millet for its early detection and mitigation.

Keywords: Finger blast, Finger millet, Leaf blast, Neck blast

FINGER millet (*Eleusine coracana* L. Gaertn), is one of the most significant small millets in the tropics (12% of global millet area) and is grown as grain and fodder crops in over 25 nations across Africa and Asia. Regular use of finger millet has a number of health advantages, including hypo cholesterolemic, hypoglycemic, and anti-ulcerative properties. The nutritional quality of finger millet grain makes it an ideal food for expectant women, lactating mothers, children, the sick, and diabetics. In India, the area under finger millet cultivation is declining, as is the production, although productivity has grown with time due to the introduction of new and improved varieties. Finger millet is more adaptable to a wide range of environmental and climatic conditions than most other tropical cereals, thrives at greater elevations (up to 2,300 m amsl) and withstands salinity better than most cereals. This resilience of the crop to hot and dry climates or CO₂-deficient conditions

may be due to its C₄ nature.

Despite being one of the hardiest crops, finger millet is susceptible to a variety of diseases, including blast, sheath blight, seedling blight, foot rot, smut, leaf spot, green ear, damping off, streak, and mottling viruses. As many as 25 fungal, 4 viral, 5 bacterial and 6 nematode pathogens are found to attack this crop. Among these, the blast caused by *Pyricularia grisea* (Cooke) Sacc. [teleomorph: *Magnaporthe grisea* (Hebert) Barr] is the most destructive disease. According to reports, India's average loss from blasts ranges from 28–36% and in endemic areas, yield losses could be as high as 80–90%. In India, McRae (1922) was the first to document the occurrence of blast in finger millet in the Tanjore area of Tamil Nadu. After that, this disease has been reported in different states of India as well as in different other countries like Uganda, Kenya, Tanzania, Zambia, Somalia, Nepal, Japan, Sri Lanka and others.

Blast disease symptoms

The pathogen *Pyricularia grisea* infects all plant parts of the finger millet plant and causes prominent spots in the invaded plant components, known as blast. The disease in the field damages the leaf, neck, and fingers of the plant. Ragi blast symptoms are extremely comparable to rice blast symptoms. It can attack plants at any stage of development, from seedlings to ear heads. It is both seed and air-borne. If the seeds used for sowing are contaminated, seedling death is widespread in nurseries and failure also occurs in crops that are directly seeded.

Leaf blast: The lesions or spots on leaves initially appear as small bluish-brown flecks, then progress to become elliptical or diamond or spindle-shaped, pointed at both ends, about 0.5–1.0 cm wide and about 1–3 mm in diameter, greenish-green centre, often with grey, yellowish or brownish margins of chlorotic halo, but later the central

portion turns whitish and gradually disintegrate. On younger leaves, they grow up to several centimetres long and 1.0 cm wide while remaining round on older leaves. As the lesion progresses, the core area takes on a water-soaked appearance and turns light green or dull greyish green.

Changes in environmental circumstances as well as varietal response affect the form, size, and colour of the lesions. A susceptible cultivar may develop a number of greyish spots that, in favourable conditions, become larger, broader, and combine, causing the entire leaf to wither. Older leaves develop a greyish or nearly straw-coloured centre. The leaf sheath also develops similar symptoms. The grey fungal growth consisting of the conidiophores and the conidia, especially on the upper surfaces of the leaves, may cover the centre areas of lesions when the environment is humid. The lesions are discrete in the early stages of the infection but frequently merge fast and cover large regions. The farthest parts of the leaves beyond the lesions might dry up, break and fall off. When young, healthy seedlings get infected, their leaves have a burned appearance owing to severe leaf blight and eventually die. Along with decreasing the yield, it also negatively affects the quality of the grain and the biomass of the plant, making the leaves unfit for use as animal feed.

Neck blast: The pathogen damages the culms, particularly at the nodal region, causing that area

to become blackened. Symptoms of blast disease on the neck appear as elongated, initially brown, then black lesions, which are most frequently visible 1–2 inches below the ear and rupture at the infected location where sporulating fungus can be seen. The neck infection stage is the most devastating which can result in significant losses in grain quantity and weight, and cause an increase in spikelet sterility. The infected plants may be clearly identified by the blackish patch on the neck area. The grains are not filled and the panicle stays upright if the infection starts well before the development of the grains. If the infection occurs after some grains have developed, the panicle hangs down. However, the ear often breaks and falls off because of the necrosis of the neck tissues. A higher degree of neck blast also causes a higher level of seed infection and lower seed viability. This is because the blast fungus weakens the vascular, parenchymatous, and sclerenchymatous tissues of the neck area, which prevents nutrition from reaching the grains.

Finger blast: The symptoms start at the tip of the finger and spread to the base before turning brown. In the affected areas, the fungus attacking the head results in inadequately formed grains or extensively blasted florets. The base of the fingers fails to expand further when an infection develops nearby, although the rest of the ear may continue to grow properly.

The grains may turn black and sometimes the entire finger length of the ear is impacted. As

the infection destroys the growing grains, shrivelled, blackened seeds appear. When the infection is at the seed-setting stage, empty fingers are seen. Under-developed seeds are produced when the disease infects later.

Management

Several disease management methods such as cultural, chemical and biological control have been recommended with variable success to reduce losses caused by the disease.

Cultural management

- Use of resistant varieties is always preferred because it reduces the yield losses and management costs which accompany the disease. Several blast-resistant varieties have been released from past years to till-date. Some of such varieties are listed in Table 1 with their salient features.
- The best time to plant medium to late-maturing varieties of finger millet is the second fortnight of July in order to avoid finger millet blast, but early-duration cultivars may be sown as late as the first fortnight of August. It could be because the crop's panicle emerging stage was more vulnerable to pathogenic invasion, which happens to coincide with favourable circumstances and virulent pathogens.
- High plant density should be avoided. Managing seed rates, increasing the spacing and



Leaf blast, neck blast and finger blast symptoms appeared in finger millets

Table 1. Salient features of some significant released blast resistant varieties of finger millet (1993–2021)

Variety	Institute where developed	Year of release	Maturity (days)	Average yield (q/ha)	Area of adoption	Special features
Gautami (PR 1158-9)	MRS, Vizianagaram	1993	115–120	28–30	Andhra Pradesh (AP)	Tolerance to blast, high yield
Suraj (VR 520)	ANGRAU, Vizianagaram (AP)	1994	90–95	22–28	All over India	Early maturity, resistant to blast and tolerant to drought
Saptagiri (PR 2614)	APAU, Perumallapalle	1995	110–115	25–30	Tamil Nadu, Maharashtra, Odisha, Andhra Pradesh	Resistant to blast and tolerant to drought
GPU 28	PC Unit, Bangalore	1996	110–115	35–40	Karnataka	Highly blast resistant
PR 230 (Maruthi)	ANGRAU, Paleru	1998	90–100	25–30	Andhra Pradesh (Telangana region)	Resistant to blast and blight
BM 9 – 1	OUAT, Berhampur	1999	103–105	25–30	Karnataka, Andhra Pradesh, Odisha, Madhya Pradesh and Maharashtra	Moderately resistant to blast and brown spot
GPU 26	PC Unit, UAS, Bangalore	2000	100–105	30–35	Karnataka	Early, blast tolerant, suitable late sowings and summer
GPU 45	PC Unit, UAS, Bangalore	2001	95–100	27–29	Gujarat, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra	Early, blast resistant
VL 315	VPKAS, Almora	2004	105–115	26–28	Uttaranchal	Moderately resistant to finger and neck blast
GPU 48	PC Unit, UAS, Bangalore	2005	95–100	30–35	Karnataka	Early, high yield, blast resistant and suitable for summer also
Bharathi (VR 762)	ANGRAU, Vizianagaram	2006	110–115	26 – 30	Andhra Pradesh	Moderately resistant to blast
Srichaitanya (VR 847)	ANGRAU, Vizianagaram	2009	110–115	26–28	Andhra Pradesh	Moderately resistant to blast
OEB 526	OAUT, Bhubaneswar	2011	110–115	25–26	Odisha, Bihar, Chhattisgarh, Karnataka, Tamil Nadu	Moderately resistant to leaf, neck and finger blast diseases
Indira Ragi 1	IGKV, Jagdalpur	2012	120–125	25–26	Chhattisgarh	Non-shattering, non-lodging, responsive to fertilizers
VL 376	ICAR-VPKAS, Almora	2016	103–109	29–31	All Ragi growing areas of the country	Responsive to fertilizer and moderately resistant to blast
VL Mandua 376 (VL 376)	ICAR-VPKAS, Almora	2017	103–109	29–31	All Ragi growing areas of country	Responsive to fertilizer and moderately resistant to blast
VL Mandua 379 (VL 379)		2018	107–109	31–35	Uttarakhand, Bihar, Jharkhand and Madhya Pradesh	Suitable for rainfed <i>kharif</i> ecology, fertilizer responsive, resistant to neck and finger blast, tolerant to ear head caterpillar incidence
Vegavathi (VR 929)	ARS, ANGRAU, Andhra Pradesh	2019	115–120	36.1 (grain) 72 (fodder)	Andhra Pradesh	Suitable for rainfed <i>kharif</i> season, maturity 115–120 days, highly resistant to brown spot, banded blight, foot rot and <i>Cercospora</i> leaf spot. Resistant to leaf, finger and neck blast, low incidence of grasshopper, <i>Myllocerus</i> weevil and ear head caterpillar, higher Zn content (199.1%) with high Fe, Ca, protein content, dietary fibre and low in tannin content
CFMV 2 (FMV 1118) (GN-9/ Gira)	Hill Millet Research Station, Waghai, Navsari Agricultural University, Gujarat	2020			Andhra Pradesh, Chhattisgarh, Gujarat, Maharashtra, Odisha	Resistant to leaf blast, foot rot, brown spot, grain mould and moderately resistant to neck blast, finger blast and banded blight. It is superior in respect to Ca, Zn, crude fibre and mineral matter
CFMV-3 (Ekvijay)	Hill Millet Research Station, Navsari Agricultural University, Gujarat	2021	120–125	32.17	Andhra Pradesh, Tamil Nadu, Telangana, Maharashtra and Gujarat	Suitable for profuse tillering, highly suitable for rainfed cultivation. Moderately resistant to leaf blast, finger blast, neck blast, foot rot and banded blight (PDI). Found superior in respect to protein (6.98%), showed good and high nutritional value

weeding of the finger millet fields two or three times to eliminate weed hosts are known to reduce finger millet blast disease levels.

- Excessive use of fertilizers is not recommended. A combination of organic and inorganic fertilizers at the recommended rate has been reported to minimize blast infection.
- Intercropping has also been effectively used to manage blast disease. Finger millet planted with pigeon peas, produces good yields.

Biological management: Use of biocontrol agents such as *Pseudomonas fluorescens* (0.6%) and *Trichoderma harzianum* (0.3%) as field spray as well as in seed treatment greatly reduce finger millet blasts.

Chemical management: Seed treatment with Carbendazim (2 g/kg) or Tricyclazole (2 g/kg) results in lower leaf, neck and finger blast incidence and enhances the yield of finger millet. Application of fungicides such as Edifenphos (0.1%), Carbendazim (0.2%) and Mancozeb (0.2%) with first spraying at the initiation of disease and the subsequent spraying at 15 days intervals give efficient management to the disease.

SUMMARY

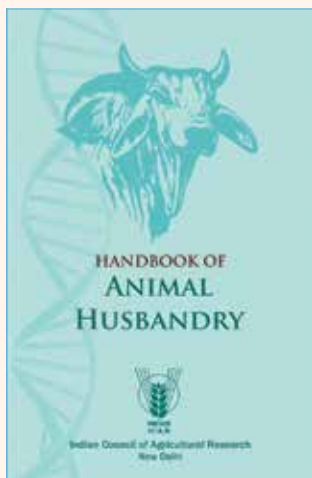
Finger millet is a boon crop that may cope up with the present global warming, changing climatic conditions, etc. Although, blast disease comes up as the main problem for the cultivation of this crop, and most interestingly the disease can

attack in different organs of host at different stages of development and thus attracts attention throughout the crop growing season by causing major crop losses. Most of the cost involved in finger millet cultivation is spent on protection aspect. So, it is highly needed to have an insight of the major diseases beforehand so that early detection and respective management actions might help in preventing the disease to get established in a large scale. Hence, the detailed discussion of various blast diseases hopes to help in the proper detection and efficient management, which will benefit the farmers and the whole human society.

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TECHNICAL SPECIFICATIONS

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