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Towards Healthy Mustard Crops: The Power of Integrated Disease Management

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SUMMARY

Mustard (*Brassica juncea*) is an important oilseed crop of India grown mainly in the northern and eastern regions, but its productivity is severely affected by several fungal diseases such as alternaria blight, powdery mildew, sclerotinia stem rot, and white rust. These diseases cause significant yield and quality losses under favorable environmental conditions. Integrated disease management (IDM) offers a sustainable approach by combining host resistance, cultural practices, biological agents, and chemical treatments. The use of resistant varieties, timely sowing, crop rotation, biological control agents like *Trichoderma spp*., and judicious application of fungicides effectively reduce disease incidence and enhance mustard productivity.

INTRODUCTION

Mustard (*Brassica juncea*), the principal edible oilseed brassica crop in India, is extensively cultivated in the marginal and sub-marginal soils of the eastern, northern, and northwestern regions of the country. The main element influencing mustard's luxuriant growth and productivity in Indian states during the winter is the country's cool, humid environment. Mustard is exclusively cultivated as a mixed crop for condiment-grade seed in the Central and Southern states because of their comparatively warmer winter environments. The productivity of mustard is affected by several biotic and abiotic stresses. Among biotic stresses, fungal diseases cause significant economic yield and quality losses. Among the diseases, alternaria blight (*Alternaria brassicae*), powdery mildew (*Erysiphe cruciferarum*), sclerotinia rot (*Sclerotinia sclerotiorum*) and white rust (*Albugo candida*) are the most important diseases that significantly reduced the yield potential of mustard.

Alternaria leaf blight

Alternaria brassicae is the primary cause of alternaria leaf spot, also referred to as Alternaria blight. This disease significantly reduces crop productivity and can result in a 70% yield loss. The disease first appears on the lower leaves as tiny, slowly growing, round, brown necrotic patches. The stems get wet patches that could eventually get covered with a white cottony growth. Affected stem regions become bleached in appearance as the disease worsens, and eventually the tissues shred. In severe situations, several concentric spots combine to cover vast patches exhibiting defoliation and blightening. The disease is spread naturally through seed (externally and internally seed-borne). Spores (conidia) or mycelium found in diseased plant detritus or weeds allow the pathogen to persist. The development of disease is aided by warm temperatures (12–25°C), intermittent rainfall, and a relative humidity of above 70%.

Powdery mildew

Erysiphe cruciferarum is the cause of a disease that was previously insignificant but has recently emerged as a severe problem in late-sown crops, resulting in significant yield losses. A dirty white, round, floury area on either side of the leaf indicates the presence of symptoms. Entire leaves, stems, flower components, and pods are impacted by favorable environmental circumstances. There could be a powdery substance covering the entire leaf. The cleistothecia present in the crop debris in the field allow the disease to survive from season to season. Conditions that are conducive to the development of disease include high temperatures (15–28 ºC), low humidity, and little to no rainfall.

Sclerotinia stem rot

Sclerotinia sclerotiorum, a soil-borne hemibiotrophic fungus that is widely distributed and causes yearly output losses exceeding several hundred million dollars, is the source of this plant disease. On the stem close to the crown region, elongated, water-soaked lesions first develop and are later covered in cottony mycelial growth. The plant appears yellowish towards its base or internodes while looking from a distance. Other symptoms

include early ripening, drying, and shredding of the stem. Later, sclerotial bodies (brown to black) may also be observed in infected plant sections, brown to black. The pathogen can persist in living or dead plants as mycelium, as well as infected plant components, the soil's surface, and infected seeds that contaminate the soil. Favorable conditions for disease development include high humidity (90-95%) and average temperature (18-25°C) along with moderate wind.

White rust

White rust, also called white blisters, is a fungal disease caused by the fungus *Albugo candida*, which affects cruciferous plants. Except for the roots, it attacks every part of the plant. On the underside of the lower leaves, the disease manifests as noticeable, roundish, elevated, white, and creamy pustules. Many small pustules combine to form large patches of pustules that cover the entire lower surface of the leaf. This disease alters inflorescence by, causing hypertrophy and hyperplasia and results in a 17–34% yield reduction. White and creamy pustules also appear on the affected hypertrophied parts. Infected host tissues and soil harbour the pathogen's oospores, which allow it to live. Zoospores and sporangia spread new infections by secondary infection. Warm weather (12–25 °C) combined with sporadic rains and wet environments (over 70% relative humidity) are conducive to the development of disease.

Integrated disease management (IDM)

IDM is a systems strategy that reduces the financial losses caused by diseases by combining a variety of crop production and protection techniques.

Host/varietal resistance or tolerance

Host plant resistance (HPR) is the most economical and efficient method of plant disease management. In addition to significantly reducing the usage of pesticides and delaying the rate at which pesticide resistance develops, HPR will boost the activity of beneficial organisms and lower the amount of pesticide residues in food and food products. Some of the varieties showing resistance or tolerance can be used. Varieties like NRCHB 5-6, Pusa Mustard 25, NRCDR 601 and DMH-I varieties can be used against alternaria blight infection. Indian Mustard-91, Toria-16, Gobhi Sarson-11, Karan Rai-4, Taramira-5 and Black Mustard-1 resistant varieties can be used against alternaria blight, powdery mildew and white rust.

Cultural methods in integrated disease management

Cultural methods and agronomic practices such as timely sowing of crop as there is a direct correlation between delayed planting and the occurrence of high disease incidence in most mustard-growing areas in the country. The use of early maturing varieties allows the diseases escape. The use of certified seeds of resistant/tolerant varieties has been recommended against all pathogens. Proper field sanitation, following proper crop rotation, destruction of crop debris, particularly stag heads of previous year crop, removal of weeds mainly collateral host plants, avoiding over irrigation or water stagnation, following crop rotation with non-host crops like, rice and maize and application of the recommended dose potash reduces the incidence of alternaria leaf spot, sclerotinia stem rot, powdery mildew and white rust disease.

Biological control/botanicals

Although biological control agents have great potential for managing diseases and pests, their use in mustard is restricted. *Trichoderma harzianum*, *T. viride*, *Bacillus subtilis*, and *Streptomyces* sp. strains are effectively used in the management of soil borne diseases. It is possible to achieve systemic induction of resistance in susceptible mustard plants by first inoculating the plant with an incompatible isolate of *Albugo candida*. Numerous plant-based products and botanicals are said to be helpful in management. Among these, the extracts of garlic (*Allium sativum*) bulbs (1% w/v) and leaves (1.5–2%) show the most promise.

Chemical control

Effective fungicides can be used to treat seeds to prevent pre- and post-emergence seedling blight and damping-off diseases caused by *Rhizoctonia solani*, and *Sclerotium rolfsii*. Typically, a combination of thiram + carbendarim (2:1) or thiram + carboxin (2:1) @ 0.2% is used for seed treatment. For downy mildew infection during the seedling stage, the disease is managed through seed treatment with Apron 35 SD (metalaxyl) @ 6 g/kg seed. For foliar disease, spraying of Metalaxyl M 4% + Mancozeb 64% WP @ 1000 g in 400 liter of water/acre and Metalaxyl 8% + Mancozeb 64% WP @1000 g in 400 liter of water/acre is done.

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