Diseases and insect pest management

Barley is exposed to various diseases and insect pests responsible for heavy reduction in yield and quality. Though barley is attacked by many pathogens but few are economically important in India, which need attention through resistance breeding or chemical control. In India, stripe rust / yellow rust (*Puccinia striiformis f. sp. hordeii)* and leaf rust/ brown rust (*Puccinia hordei)* are major problems in NWPZ, while in NEPZ leaf rust and leaf blights are common. In NH Zone, stripe rust and powdery mildew are serious problems. In recent years, stripe rust has become the most damaging cereal rust in cool climate across international locations (Yadav, 2003). Barley stripe rust has the potential to greatly affect the barley industry in India due to the races with shorter life cycles, capable of producing more urediniospores and adapted to warm temperature. Stripe rust appears early in season that other two rusts. Symptoms includeyellow orange pustulesdevelop on leaves and eventually grow together forming stripes. The orange pustules contain spores that re-infect barley. Losses to stem rust / black rust (*Puccinia graminis tritici*) in barley have been very rare in many areas because the disease occurs in late season. Leaf rust develops rapidly between 15 and 22 ^{o} C in the presence of free moisture.

During earlier days, the Helmithosporium leaf blights were considered as a minor disease as most of barley was under rainfed cultivation in dry areas, but due to change in climate and cropping patterns and adoption of new technologies the disease levels of leaf blight have increased. The spot blotch (*Bipolaris sorokiniana)* is gaining importance in regions where the day temperature increases during March. Initial leaf infections in the field result from airborne conidia produced either on wild grasses or on plant residue in

or above the soil. Extended periods of warm of 20 ^{o} c (> 16hrs), moist weather are conducive to epidemic development. Yield losses of 10-20% may occur when environmental conditions are favourable for 1-2 weeks after plants have headed; losses may be as high as 20-30% when favourable conditions persist for 3-4 weeks (Singh, 2004).

In case of malt barley cultivation, application of more fertilizers under irrigated condition results in more foliage growth favoring build up of pathogens. In late sown barley, the vegetative stage coincides with warm and humid conditions during February and March, which provides good spread of blights. In recent years, leaf blights assumed an important yield limiting factor in barley cultivation causing very heavy losses. The net blotch (*Pyrenophora teres)* is also recorded in NEPZ occasionally. Severe infection kills leaves prematurely and mainly causes reduced seed weight. It may also reduce number of ears and number of grains per ear. Yield reductions of 20 to 30 per cent can occur and grain quality may also be affected. Powdery mildew (*Erysiphe graminis f. sp. Hordei)* development is optimal at temperatures between 15 and 22°C and is markedly retarded above 25°C. Barley is most susceptible during periods of rapid growth. Dense stands of susceptible cultivars, heavy nitrogen fertilization, high humidity and low temperatures favours disease development.

The loose smut (*Ustilago tritici)* infected heads emerge as a mass of dark brown powdery spores replacing the entire head of plants with little development of floral bracts and awns. Smutted heads often emerge earlier than healthy heads. Spores are dislodged and scattered by wind when the delicate membranes surrounding them break. The pathogen survives from

one season to the next only as dormant mycelium within the embryo of infected barley seed and the seed treatment with systemic fungicide Carboxin eradicates the pathogen. The covered smut (*Ustilago hordei)* infected heads remain intact until harvest and the disease is externally seed borne.

Among insect pests, barley foliar aphid (*Rhopalosiphum maydis)* can cause damage early in the season and yield loss through direct feeding damage. Heavy infestations can cause a reduction of the number of grains per ears and thus a noticeable reduction of the yield. Usually found on the lower leaves, but if numbers increase they may spread all over the plant. If conditions are suitable, aphid populations can build up rapidly and cause direct injury to plants. Foliar sprays with Confidor @ 20 g a. i./ ha at the appearance of foliar aphids and later at 15 days intervals till physiological maturity is very effective. The cereal cyst nematode (CCN) causes small swellings along the roots, from which many small roots will develop and CCN affected plants become stunted occurring in patches. Root systems are shortened and development retarded..

Under AICW&BIP, barley entries are screened under various nurseries viz., Initial Barley Disease Screening Nursery (IBDSN), National Barley Disease Screening Nursery (NBDSN) and Elite Barley Disease Screening Nursery (EBDSN) respectively) for resistance against various diseases, aphid and CCN in different cooperating centers (Selvakumar et al., 2013). Presently, there are 14 centres involved in disease/ pest evaluation under AICW&BIP representing all barley growing zones. Each centre has specific responsibility for screening the different nurseries under barley network. Experiments on

chemical control of leaf and stripe rusts and blight have also been conducted at various locations to evaluate various fungicides for management of diseases.

Pathotypes analysis and seedling resistance test

DWR regional station at Flowerdale is responsible for maintenance and regular supply of pathotypes of three rusts of barley in addition to identification/ pathotyping of races from samples collected during the crop seasons across the country. In stripe rust, there are five pathotypes available viz., M (1S0), G (4S0), 24 (0S0-1), Q (5S0) and 57 (0S0) and all NBDSN & EBDSN entries are being screened for SRT with these pathotypes individually.

In case of leaf rust, pathotypes H1, H2, H3, H4 and H5 are being maintained and new entries are being tested against the mixture for SRT analysis. For stem rust, five pathotypes viz., 11 (79G31), 40A (62G29), 117-6 (37G19), 122 (7G11) and 21A-2 (75G5) are available but the entries are going to be screened with mixtures of pathotypes. These SRT screening arrangements have being made in order of relative importance of the three rusts in barley.

In general, use of resistant varieties which are now available with minimum number of sprays of chemicals is suggested for management of barley disease as it would be more economical. Singh *et al.* (2007) identified an IPM module for management of barley diseases and insect pests. Under AICW&BIP, seed treatment with Vitavax Power @ 3g/kg of seed followed by seed treatment with Gaucho @ 0. 06 g a. i./kg of seed at sowing followed by foliar sprays of Tilt (25 EC) @ 0. 1% at the appearance of rusts and foliar

blight and later at 15 days intervals in case if need arise till physiological maturity and Foliar sprays of Confidor @ 20 g a. i./ ha is recommended at the appearance of foliar aphids and later at 15 days intervals till physiological maturity.

Sources Used

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