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Important Barley diseases and their management strategies: A Review

[1] Sunil Kumar Srivastava* and [2] AK Singh

[1, 2] Post graduate Department of Botany, M.L.K.P.G. College, Balrampur, Uttar Pradesh, India

Abstract

Barley is one of the most important cereal crop cultivated in Rabi season, mainly in the state of Uttar Pradesh, Bihar, Punjab and some other states of India. Its rich in vitamins, minerals and other beneficial plant compounds. Currently, it covers an area about 0.67 million hectares as irrigated crop.70% produce is used for cattle and poultry feed, 25% in industries for manufacturing malt and malt extracts and rest 5% for human consumption. Barley grain demand is increasing continuously because of its various uses as high nutritive value. A number of biotic and abiotic factors pose a challenge to increase production of barley. Barley diseases prominently rusts, smuts, black point, spot blotch, net blotch, stripe disease, powdery mildew, barley yellow dwarf, molya disease are the major biotic constraints in enhancing the barley grain production. This review seeks to provide an overview of different barley diseases and their management.

Keywords: Barley, blotches, disease, pathogens, rusts smuts.

Introduction

Barley is an important cereal cultivated in Rabi season, mainly in the state of Uttar Pradesh, Bihar, Punjab and some other states of India. Barley is considered fourth largest cereal crop in the world after maize, rice and wheat with a share of 7.1% goal cereal production in 2018-19, 1.78 million tons of barley was produced in India from 0.66 million ha/ land. it is also known as poor man's crop because of its low input requirement and better adaptability to drought, salinity, alkalinity and marginal lands (Verma *et al.*, 2012) [1]. Barley in India mainly used as cattle and poultry feed and by its utilization for malting and beverages. Only 5% of the total production is used for human consumption (Sing *et al.*, 2016) [2] in addition, it is also consumed as energy drinks like horlics and biscuits, prepared from malt extract. In rural areas of India barley grains are used as sattu a coling drink specialy in summer season (Verma *et al.*, 2012) [1] due to its high industrial and other demand, a substantial yield grains will be needed but , a number of biotic and a biotic factors poses a challenge to increase the production of barley. Mathre (1997) [3] mentioned about 80 different diseases caused by infectious agents in his Compendium of barley diseases, however, of this number, mainly yellow and brown rusts, covered smut, powdery mildew, net blotch, leaf blotch, barley stripe, barley yellow dwarf and molaya disease are economically important in India (Table 1). Barley disease like yellow rust, molaya and foot/rot were also prevalent and destructive at higher altitude in Ladakh region of India (Vaish *et al*., 2011) [4]. Disease occur when a susceptible host is exposed to a virulent pathogen under favorable environment al conditions and they may affect barley yields from 1 – 100% depending on the susceptibility of varieties, virulence level of pathogens, growth stage of crop at the time of infection and favorable weather conditions.

Table 1: Fungal diseases

Fungal diseases organism/Pathogen	Causal
Anthracnose *cereal*	*Colletotrichum*
Common root rot and seedling blight	*Cochliobus sativus (Bipolaris sorokiniana*)
Covered smut	*Ustilago hordei*
Downy mildew	*Sclerophthora rayssiae*
Dwarf bunt	*Tilletia controversa*
Ergot	*Claviceps purpurea*
False loose smut	*Ustilago avenae (U.nigra)*
Kernal blight (Black point)	*Alternaria sp. Cochilbolus sativus*
Leaf (brown) rust	*Puccinia hordei*
Loose smut	*Ustilago tritici(U.nuda)*
Net type Net Blotch (NTBT)	*Pyrenophora teres f. teres*
Powdery mildew	*Blumeria graminis f.sp. hordi*
Pythium root rot	*Pythium arrhenomanes, Pythium graminicola*
Rhizoctonia root rot	*Rhizoctonia solani, R. oryzae*
Scab (Fusarium Head Blight, FHB)	*Fusarium graminearum*
Spot blotch	*Bipolaris sorokiniana (Drechslera sorokiniana*) *Cochliobolus sativus (Telomorph)*
Spot type Net Blotch (STNB)	*Pyrenophora teres f. maculate*
Stem (black) rust	*P.graminis f.sp. tritici*
Stripe disease	*Drechslera (pyrenophora) graminea*
Yellow (stripe) rust	*P.striformis f. sp. hordei*

Table 2: Bacterial diseases

Bacterial stripe	*Psudomonas syringae pv.striafaciens*
Bacterial leaf blight	*Psudomonas syringae pv. Syringae*
Bacterial glume rot	*Psudomonas syringae pv.atrofaciens*
Black chaff and bacterial streak	*Xanthomonas translucens pv. translucens*

Table 3: Nematode disease

Barley roor rot knot nematode	*Meloidogyne chitwoodi*
Molaya disease	*Hetterodera avenae, Heterodera filipjevi*
Root lesion nematode	*Pratylenchus spp.*

Table 4: Viral dieases

Barley mosaic	*Barley mosaic virus (BMV)*
Barley stripe mosaic	*Barley stripe mosaic virus (BSMV*)
Barley yellow dwarf	*Barley yellow dwarf virus (BYDV)*

Table 5: Phytoplasmal disease

Aster yellow	Aster yellow phytoplasma

All diseases are not important in different agro-ecological zone of India. Stripe rust is scourge to barley in cool and humid areas *i.e*. North Western Plain Zone (NWPZ), whereas leaf rust like warmer climate as in Central Zone (CZ). Powdery mildew and smuts are of importance in cooler and humid climate. spot blotch, leaf blotch and net blotch are important diseases in North Eastern Plain Zone (NEPZ) where warm and humid climates exists (Singh, 2017) [5]. In barley, the yield losses due to stripe disease were in the range of 20-70% during 1992-93 (Kumar *et al*., 1998) [6]. Net blotch is second biotic stress, which can lead to losses between 20-30%.The losses dye to spot blotch and net blotch in barley in Haryana, India were 53% in susceptible cultivars (Singh, 2004) [7]. The purpose of this review is provide to brief summary of some of the major diseases impacting barley in India. This update highlights the various barley diseases their causal organisms and disease management strategies.

Disease management strategies

Disease management is best achieved by knowledge of the pathogen and their important factors. Resistant varieties provide the easiest and most effective option to manage the major diseases. Foe effective disease management it is important to use integrated disease management practices.

Genetic resistance

The principle mechanism of control of the cereal rust has been through the use of resistance cultivars. There are two type of genes that used for breeding disease resistant barley cultivars. The first is R-genes, these are pathogen race specific in their action, and effective at all plant growth stages. The second is called adult plant resistance genes (APR-genes) because resistance is functional only in adult plants. In contrast to most R-genes, the levels of resistance conferred by single APR-genes are only partial and allow considerable disease development (Ellis *et al.*, 2014) [8]. In India, barley crop improvement has been obtained through the utilization of genetic resources available as land races of exotic origin. Exotic germplasm of barley received from ICARDA (International centre for Agricultural Research in the Dry Areas) has been remained an important base material for the development of barley varieties. The varieties namely, LSB2, HBL113, Dolma, VLB118, BHS400 and BHS 380 has been release directly for the cultivation in Northern Hill zone of India. Several barley varieties viz. BHS 169, DL 88, BH 393, NDB 1173 and VLB 56 have been developed by adopting hybridization followed by selection in the segregating generations for targeted traits (Singh *et al*, 2016) [2]. (Singh, 2008) [9] Reported that barley cultivars RD 2508, RD 2035, DWRUB 52,RD 2552 and RD2624 have multiple disease resistance in India.

Innovative approaches

Molecular technologies will facilitate designing better strategies for developing disease resistance in crop plants. Mutation, marker assisted selection (MAS), gene cloning, genomics, recombinant DNA technology, targeted induced local lesion in genome (TILLING) and virus induced gene silencing (VIGS) are now being followed by breeders to develop effective resistance in cultivated crops within a short period of time. TILLING, being a non-transgenic method, is expected to become the most powerful tool for developing disease resistant cultivars (Hussain, 2015) [10].

Rotation and stubble management

Diseases such as spot – type net blotch, spot blotch are stubble –borne. Crop rotation with a non-host crop will minimize initial inoculums levels for next season's crop. Molya disease is reduced by rotation with a non host for 1-2 years.

Green bridge management

Three major diseases, barley rusts, powdery mildew and barley yellow dwarf virus (BYDY), persist on living hosts. Barley rust survives o barley volunteers, powdery mildew on barley volunteers and BYDY on cereal regrowth and perrinial grasses. This is also most effective culture techniques for reducing the initial inoculums of many soil borne pathogens. A green bridge of self-sown barley leading in to the cropping season provides host material for these diseases and the aphid vector of BYDV and increase the risk their early onset. Removing this green bridge will greatly reduce the risk of early crop infection.

Seed health

The net-type net blotch (NTBT), loose smut and covered smut are seed borne diseases. Sowing infected seed can introduce disease in to a healthy crop. Therefore clean seed should be used wherever possible. Fungicide treatment can reduce the risk associated with sowing infected seed, particularly for smuts.

Fungicidal disease management

The pose of Fungicide as seed dressing or applied in-furrow with fertilizer can be useful in disease protection. The selection of fungicide should be determined by the target diseases. The purpose of foliar fungicide applied in the crop is to delay disease development and to maintain green leaf area. It reduces disease impact on yield and grain quality. fungicides belonging to diazole group such as Azoxystrobin 25% EC (Amistar), Bayleton 255 EC (Triadimefon), Difenoconazole 25% EC (Score), Propiconazole 25% EC (Tilt) and Tebuconazole 25% EC (Folicur) have been found effective at the rate of 0.1 percent i.e. 1 ml in 1 litre water (Bhardwaj *et al*., 2017) [11]. Seed borne diseases particularly covered and loose smuts, can be managed effectively by seed treatment with Carboxin (Vitavax) @ 2.5 g/kgseed for

loose smut and Vitavax and Thiram(1:1)/ or Tebuconazole @ 1.5 g/kg seed for covered smut. Bayleton, Tilt and Folicure are broad spectrum fungicides, are also effective against foliar diseases like powdery mildew, spot blotch and net blotch diseases.

Conclusions

Barley is affected by a number of airborne, seed borne and soil borne pathogens which cause various disease and considerable loss to grain yield and quality among these spot blotch, yellow rust, net blotch, barley yellow dwarf, and molaya disease are important. The use of genetic resistant varieties are also an effective method. In general, barley diseases are best managed by adopting integrated disease management strategies. Growing resistant/tolerant varieties with minimum number of chemical spray are the best way to manage these diseases.

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