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Editorial

Fusarium head blight or head scab of wheat in India

Wheat (*Triticum aestivum* L.), is the second most important staple food crop of the world accounts nearly 30 per cent global cereal production covering an area of 220 million hectares. Wheat production in India has increased many folds from 6.4 mt in 1950 to 109.52 mt during 2020-21. The achievements in wheat production in India have been perhaps the most important and unparallel in the history of developing world. Since the initiation of the 'Green Revolution' in the mid-sixties, India achieved remarkable increase in production and productivity of wheat. The most serious biotic constraints to wheat production are rusts, spot blotch, Karnal bunt and powdery mildew etc. Wheat rusts are very important in many parts of the world including India due to rapid evolution in pathogen population and change in environmental conditions. The concerted efforts of wheat rusts surveillance has contributed significantly in keeping vigil on new rusts pathotypes and devising strategy for developing new resistant varieties ahead the pathogen can cause loss to the crop. In addition to rusts, spot blotch of wheat caused by *Bipolaris sorokiniana* affects approximately 9 mha area of the North-Eastern Plains Zone (NEPZ) of India. Another disease in the north western plains zone (NWPZ) is Karnal bunt (KB) which is important from trade point of view.

Fusarium head blight or head scabis one of most destructive diseases of bread wheat (*Triticum aestivum* L.) and durum wheat (*Triticum durum* Desf.) world wide. The disease was reported first time in England in 1884. *Fusarium* spp. caused reduction in yield and quality of wheat in countries where warm and humid climate prevails. Recently outbreaks of *Fusarium* head blight (FHB) or head scab of wheat caused by *Fusarium spp*., has been reported from Canada, Europe, Asia, Australia and South America. In India, the disease can cause significant yield loss if rain occurs during mid anthesis in the foot hills of Punjab, Himachal Pradesh, Uttarakhand and hilly areas in Tamil Nadu. The *Fusarium* diseases are likely to increase under the impact of global warming and the fast adoption of reduced tillage practices in the main wheat belt, the north west plains of India. *Fusarium graminearum* is known to produce mycotoxins which affect human and animal health. Pathogenicity on wheat spikes is found to be in correlation with mycotoxin producing ability ofpathogen especially deoxynivalenol (DON), acetyl deoxynivalenol (ADON) and Zearalenone production. Conservation tillage and minimum tillage adoption resulted in increase in FHB incidence in USA. Presently, FHB is considered of minor importance in India but due to adoption of zero tillage on large scale by farmers in north western plains and north eastern plains zones along with the increase in precipitation during mid anthesis can result in severe occurrence of disease in near future. From India, disease was first reported in wheat varieties like, Kalyan Sona, Sonalika from Arunachal Pradesh in 1973 and from Wellington, Tamil Nadu during 1985. During 1989–90 crop season,disease was observed in some farmers fields in severe formon variety HD 2329 in Amritsar and Gurdaspur districts of Punjab. During 2005, severe FHB incidence was observed in the ruling wheat variety PBW 343 and durum wheat variety PDW 274 in Gurdaspur area of Punjab, where > 90 % of ear heads were infected.

In India, six *Fusarium* species *viz*., *F. graminearum*, *F. verticillioides*, *F. oxysporum*, *F. equiseti*, *F. solani* and *F. semitectum* were isolated from head scab infected samples. *F. graminearum* was found in most of the samples collected from Lahaul valley, Punjab as well as from Wellington. FHB is highly influenced by environmental conditions particularly during and after anthesis. *Fusarium graminearum* produces ascospores and macroconidia which are formed in perithecia and sporodochia, respectively. Ascospores released and transported by wind and infect flower parts are considered the main source of inoculum for epidemics. Warm temperatures and high humidity are favorable conditions for blighting of ear heads in 2 to 4 days after infection. Ascospores have an optimum of 25-28°C for formation and 20°C to 30°C for infection. Perithecia and sporodochia are fruiting structures of the fungus which over winter in crop

debris. The relationship between crop debris and FHB epidemics has been well documented. Minimum soil temperatures for perithecia production are 6°C to 10°C with an optimum in the range 15°C to 20°C. High relative humidity and soil moisture content arefavorable for perithecia formation; therefore, humid weather during August and September favor FHB epidemics in the following growing season. In the spring, ascospores and macroconidia are released from the fruiting bodies. The optimum temperatures for production of ascospores are 29°C for *F. graminearum*.

Most wheat cultivars currently grown in India are susceptible to FHB. Control of the disease has been difficult, because of the complex nature of the host/pathogen/environment interaction. FHB resistance is known to be governed by many genes in wheat genotypes which is further confounded by the presence of a large environmental variance component. Resistance to the FHB pathogen had been observed both in soft (SWW) and hard (HWW) winter wheat germplasm native to the U.S. Cultivar Truman (SWW), a full-sib of the cultivar Bess, has also shown resistance to FHB pathogen. Cultivars, Freedom (SWW), Roane (SWW), T154 (HWW), Bess (SWW), Century (HWW), Heyne (HWW), Lyman (HWW), Everest (HWW), Harry (HWW), Atlas66 (SWW), and Husker (HWW) have been reported for high disease resistance. In India, since 2000, advance wheat genotypes including popular cultivars were evaluated for FHB resistance under artificially inoculated conditions. Two head scab resistant stocks, HSRBW-2 (bread wheat) and HSRDW-2 (durum wheat) have been developed and registered with NBPGR, New Delhi during 2017.

Due to change in rainfall pattern and farmers preference of minimum tillage, FHB of wheat can inflict severe yield losses in north western wheat growing areas of the country. In northern states, during last 35 years, many stripe rust resistant varieties have been developed but very less effort has been made for developing wheat varieties for FHB resistance along with rusts resistance. FHB resistance sources are available in germplasm not adapted to Indian condition. FHB resistance needs to be incorporated in popular cultivars grown in different wheat growing zones of India. There is need to explore the resistance level for FHB in wheat and its wild relatives.As FHB resistance is quantitatively inherited therefore several resistant genes from different genetic background should be pyramided for effective management of the disease. During 2020–21, India wheat production has crossed 109 mt, so development of FHB resistant cultivars will lead to reduction in the mycotoxin in harvested wheat and thus will help in facilitating export of wheat grains.

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