Chemical Science Review and Letters ISSN 2278-6783

Review Article

Overview on New Trends in Management of Spot Blotch of Wheat

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Abstract

After green revolution, new varieties of wheat were introduced and some minor disease become occupied the place of major diseases. *Bipolaris sorokinina* (sacc.)shoem, the causal agent of Spot blotch of wheat, become more prevalent in warmer region of the world and shows symptoms on leaves, spikes, grains and seeds. *Bipolaris sorokiniana* showed wide host range which lead to the spread of this disease into different host too. About 30-86 percentage of yield loss was reported due to this pathogen. So the management strategies of spot blotch found a special attention at present. Conventional practices like cultural, biological as well as chemical methods are showing positive response to the control of this disease. In this review, we have mainly focused on new trends in disease Management such as use of botanicals, developments of resistant varieties and molecular level of managements. Diagnostic PCR assay are helpful to analyse the disease in field soil and wheat leaves also. Although number of practices made to detect and control these diseases, base level detection at fields are yet to be find out.

Keywords: Wheat, Spot blotch disease, *Bipolaris sorokiniana*, Management practices

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Introduction

Wheat is the food crop, which is widely grown and consumed all over the world. In India wheat contributes nearly one third of the total food grain production and about one tenth of the global production - The anticipated global demand of wheat. A staple food of nearly 35 % of the world's inhabitants is projected to 1,050 million tons [22] at the end of second decade of 20th century. To accomplish the projected target, world's wheat production will have to enhance from 1.6 % to 2.6 %, annually [30]. The country needs to produce 100 million tons of wheat by 2030 to feed the ever-growing population, which is a major challenge under changing climatic scenario. Both biotic and abiotic stress plays a major role in the yield loss of wheat. Foliar pathogens are one of the major threats. Spot blotch is the diseases which are caused by the pathogen *Bipolaris sorokiniana* become major disease after green revolution due to the susceptibility of the high yielding varieties against this pathogen.

Global scenario of spot blotch

Mega environment which is characterized by high temperature and humidity spot blotch become most important disease [40]. Increasing of the disease becoming a cause of concern particularly in the warm and humid environments of Indian sub-continent [14] where the mean temperature of the coolest month is higher than 17.5˚C [12]. In recent reports, spot blotch Started to expand into the cooler, non-traditional irrigated rice-wheat growing areas [14]. Spot blotch severity aggregates due to higher temperature [13] [14] [38] wheat yield losses in the region considered to be due to increase in temperature which resulted in spot blotch epidemic over the recent years [37].

Yield loss

Spot blotch has a potential to destroy the yield considerably in wheat. [10] Reported 38 percent yield loss in growth chamber studies under gone in Netherlands. During favourable years, 30 to 86 per cent losses from spot blotch alone were reported from Brazil and in some fields shows 100 per cent loss [16] [25]. In Bangladesh, the disease caused 4-21 per cent loss in grain yield in commercial varieties like Sonalika, Akbar, Kanchan and Ashrani [31].

Symptoms

Spot blotch symptoms typically appear on the leaf, sheath, node and glumes as small light brown lesions, mostly oval to oblong to somewhat elliptical in shape, measuring 5–10 mm long and 3–5 mm wide. These lesions encircled with brown margins and are often scattered throughout the leaves and gradually increase in size and coalesce and to form larger necrotic patches (reaching several centimetres). The affected leaves soon become chlorophyll deficient and eventually die. In case of most severe conditions, the spikes will also affect and shows black point symptoms on the germinating seeds.

Host Range

[24] noted that various grasses and broad leaved weeds(dicots) such as Commelina diffusa, Chloris 12 barbata, Dactylac tenium aegypticum, Eleusine indica, Cynodon dactylon, Paspalum conjugatum, Leptochloa chinensis, Brachiaria distachya, Cyperus difformis, C. fimbricatus, B. mutica, Imperata cylindrical, Rottboellia exalata, and Echinochfora colona grown all over the year in Philippines and they may harbour the pathogen causing spot blotch.

[39] reported that, obligate weed of wheat, *phalaris minor,* which act as an alternate host of spot blotch pathogen. [6] noted that, small grain cereals like *Triticum aestivum*, *Hordeum vulgare*, *Avena sativa*, *Sorghum bicolour* and a large number of other grasses are the different hosts of *B. sorokiniana* among monocotyledonous plants.

Pathogen

Spot blotch refers to the disease caused by *B. sorokiniana* (Sacc.) Shoemaker (syn. *Helminthosporium sativum*) (teleomorph: *Cochliobolus sativus*). In nature, the teleomorph of the fungus is only reported to occur in Zambia, where two different mating types must appear together [28]. Conidiophores are short, mostly single and bear one to six conidia. Conidia typically have five to nine cells, are ellipsoid, dark olive-brown, mostly straight to slightly curved with a thick wall and measure 60 to 120 x 12 to 20 µm [42].

Disease Cycle

B. sorokiniana primarily survives as thick walled conidia. Disease cycle does not give importance for the sexual stage of the pathogen. The pathogen penetrates both externally by conidium and internally by mycelium in seeds. As well as in infected crop residues, volunteer plants, secondary hosts and free dormant conidia in the soil are act as the primary source [33]. Secondary infection is due to air borne inoculum. Infection can occur when free moisture prevails over a wide range of temperature. Under favourable condition, the conidiophore starts to germinate. The infection hypha divides rapidly and ramifies along the intercellular spaces of the mesophyll tissue, immediately after the entrance of conidia in the host cell [1]. Infected seed and crop residues are main sources of infection reported [34].

Cultural practices

Sanitation and cleanliness is an important part of management and control of the disease spread. Roughing out the infected plants and debris from the field and their proper disposal is essential. Good crop management and optimum agronomy may also reduce spot blotch disease severity up to certain level [36]. Proper application of fertilizers also plays certain role to disease control. Previous studies were available to shows the role of potash in reducing spot blotch severity [13] [23] [32]. Potassium helps to prevent disease development by hindering multiplication, development and survival of pathogen and controlling the internal metabolism of the plant and thus affecting food supply for the pathogen, as well as preventing the establishment of the pathogen and its spread within the plant.

Biological Control

Powder formulation of *P. fluorescence,* applied in the form of seed treatment and foliar spray, developed by [15] [41], find out that under field conditions guard (*T. harzianum*) reduce spot blotch of wheat disease up to 64.29%. *Idriella bolleyi*, *Chaetomium sp*., and *Gliocladium roseum* are act as the successful antagonist against seed borne *B. sorokiniana* [21].

Chemical Control

Management by using different chemicals are always an easy way to control diseases. Use of fungicides has proven useful and economical for the control of spot blotch [21]. The Triazole group (e.g.-Tebuconazole and Propinazole) especially have proven to be very effective against spot blotch disease.

Experiments conducted by [36], demonstrated that the fungicide Opus effectively control spot blotch disease under soil nutrient stressed farmers' field conditions. However, environmental sustainability after the use of these chemicals related questions raised [2]. Fungicides like Difenoconazole, Mancozeb,control seed borne pathogen *Bipolaris sorokiniana* and in addition to that improves seed germination and seedling vigour, ensuring the maximum yield [35].

Management by using Botanicals

Apart from chemicals, for the sustainable management botanicals are playing major role. *J. mimosifolia* leaf extract with very low dose of chemical fungicide applied as a foliar spray (*J. mimosifolia* 0.6%+mefenoxam 0.1%) is a new promising approach for the management of leaf blight and spot blotch in wheat [27].

Essential oil of flowering buds and potential extracts of *Eucalyptus camaldulensis Dehn* were evaluated on the most aggressive isolate of *Bipolaris sorokiniana* from wheat crop shows 97 percentage in-vitro inhibition of the pathogen.

Neem extract on mycelia growth of *Bipolaris*, and found that 25.67% more effective was Neem seed alcoholic extract in retarding the *Bipolaris sorokiniana* growth than the leaf alcoholic extract 15.79% and water extract 3.5%[4].

Resistant varieties

Till date, the best sources of resistance were discovered in the Brazilian and Zambian wheat lines [11] [29]. SW895422, Chirya1, Chirya3, Chirya7, NL781, and NL785 are the few Chinese genotypes also showed significant resistance levels to spot blotch [21] Somaclonal variation is regarded as a supplementary tool to the well-established breeding approaches [9] [17] [19]. In wheat, somaclonal variants have been reported for various plant traits [5] generated Somaclones from immature embryos of two spring wheat varieties HUW-206 and HUW-234 shows improved resistance to spot blotch disease and increased yield over parents developed in regeneration.

Nano technology

Biosynthesized nanoparticles development and application o opened a new avenues in agricultural research oriented to developing eco-friendly and effective means of controlling plant diseases [26] reported the application of bsAgNPs significantly reduced *B. sorokiniana* infection in wheat plants.

Molecular Characterisation and Management

This sequence characterized amplified region (SCAR) marker designated as SCRABS (600) it could be clearly differentiate *B. sorokiniana* from other fungal plant pathogens, including *Bipolaris spp.* The utilization of this diagnostic PCR assay it become a new trend effective management of the disease. It help in the analysis of field soil and wheat leaves [2].

Genetic divergence and differentiation of thirty six *B. sorokiniana* isolates through URP (Universal rice primer), ISSR (Inter-simple sequence repeats) and RAPD (Random amplified polymorphism) markers. [18].

Different molecular markers are used for the identification of pathogen variability as well as aggressiveness. The study made by [8] observed the *Bipolaris sorokiniana* of cluster A were the highly aggressive and of clusters B, C, D, F and G were moderately aggressive. Those of clusters E, H and I were the least aggressive. Thus SSR molecular marker can differentiate the *Bipolaris sorokiniana* fungal isolates in general and for their relative aggressiveness

Conclusion

Due to increasing variability among the pathogens, management of diseases are become a complex process. Conventional methods like cultural, biological and chemical methods are always a base of our management strategies, even though more accurate and fast detecting and eradicating methods of disease managements are seeking more attention at present scenario. Breeding of resistant varieties, use of nanotechnology and diagnostic PCR assays are some of the new trends in management of spot blotch disease.

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Publication History	
Received	07.01.2020
Revised	04.03.2020
Accepted	11.03.2020
Online	30.03.2020