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Management of spot blotch disease of wheat in Eastern Uttar Pradesh

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Abstract

Spot blotch caused by *Bipolaris sorokiniana* (Sacc.) Shoem is one of the most important wheat leaf disease all over world; it appears in almost all wheat growing areas and causes severe yield loss every year. The spot blotch disease caused by *Bipolaris sorokiniana* (Sacc.) Shoem is one of the most important wheat leaf diseases all over world, it appears in almost all wheat growing areas and causes severe yield loss every year. For the management of spot blotch disease of wheat one bio-agent, one bio-enhancer and seven fungicides were used. Plant disease intensity decreased with the application of different treatment over untreated control. Minimum plant disease intensity was recorded (21.11 % first year and 20.68% second year) under T9 (Seed treatment with Raxil @ 2.5 gm/kg seed + 2 foliar sprays of propiconazole @ 0.1 %, first at boot leaf stage second after 20 days), Maximum plant disease intensity was recorded (72.37% first year and 73.68% second year) under T11 (Control), Which has highly significant compared to all the treatments. Maximum grain yield was recorded (38.26 q/ha and 38.47 q/ha first and second year) and maximum thousand seed weight was recorded (41.25g and 41.54g first and second year) under T9 (Seed treatment with Raxil @ 2.5 gm/kg seed + 2 foliar sprays of propiconazole @ 0.1 %, first at boot leaf stage second after 20 days), Minimum grain yield was recorded (31.25q/ha and 31.04q/ha during the both year) and minimum thousand seed weight was recorded(35.58g and 35.47g during 2018-19 and 2019-20) under T11 (Control), Which has highly significant compared to all the treatments.

Keywords: About wheat, Spot blotch, Pathogen, Disease, Symptoms, Yield loss and their management

Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal food crop of the world as well as the second most important cereal food crop in India, which contributes nearly one-third of the total food grains production. It is one of the oldest cereal crop. Since antiquity, wheat has been cultivated in Mohanjo-Daro and Harappa for over 5000 years (Pal, 1966). Wheat crop in eastern Uttar Pradesh suffers from a number of fungal diseases. Spot blotch caused *Bipolaris sorokiniana* is more severe than other diseases. It attacks at all the growth stages of the crop starting from the seedling to spikes, that's why it was thought desirable to work on management of spot blotch disease.

Wheat (*Triticum aestivum* L.) crop belongs to family Poaceae (Graminae). It is the most important cereal crop after rice in India and major staple food of South Asian region countries. Three species, namely *Triticum aestivum* L. (Bread wheat), *Triticum durum* Desf. (Macaroni or durum wheat), and *Triticum dicoccum* Schrank. (Emmer wheat), are commonly cultivated at present. India is the world's second largest wheat producer, behind china and ahead USA.

Wheat provides nearly 55 per cent of the carbohydrate and 20 per cent of food calories which is consumed by two billion people (36 per cent of the world population) as staple food. It is utilized for bread, cakes, cookies, noodles, pestri products, chapatti, macaroni etc. Beside staple food for human being, wheat straw is also a good source of feed for a large population of cattle in our country. It has good nutrition profile with an average of 11.5 per cent protein, 2.10 per cent fat, 1.5 per cent ash, 1.4 per cent reducing sugars, 73.9 per cent starch, 78.10 per cent total carbohydrates and provides 314 kcal/100g of food (Kumar *et al.*, 2011). Wheat is also a good source of minerals and vitamins *viz.*, calcium (37 mg/100g), iron (4.1 mg/100g), thiamine (0.45 mg/100g), riboflavin (0.13 mg/100g) and nicotinic acid (5.4 mg/100mg).

Unlike other cereals, wheat contains a high amount of gluten, the protein that provides the elasticity necessary for excellent bread making. Hard wheat is high in protein (10-17 per cent) and yields a flour rich in gluten, making it particularly suitable for yeast breads. The low protein (6-10 per cent) softer type yields flour lower in gluten and therefore, better suited for tender baked products such as biscuits, pastries and cakes. *T. durum* wheat, although high in gluten, is not suitable for baking but suitable for semolina; the basis for excellent pasta such as spaghetti and macaroni preparation.

Spot blotch caused by *Bipolaris sorokiniana* (Sacc.) Shoem. (syn. *Helminthosporium sativum*, teleomorph *Cochliobolus sativus*) is an important wheat disease in warmer and humid growing regions of the world such as Eastern India, South East Asia (Joshi *et al.*, 2007) [5]. Yield losses were estimated to be 18-22 per cent in India (Saari, 1998) [19]. The control strategy for the diseases caused by *B. sorokiniana* is based on an integrated approach where genetic resistance is a major element, because economic returns have not always resulted in commercial grain production from fungicide inputs (Duveiller and Sharma, 2009) [2]. Hence, search of effective non-fungicidal control of spot blotch disease is of utmost importance. The best, long term, economically and environmentally safe method for sustainable disease control is the use of resistant varieties.

The pathogen

The fungus spot blotch is caused by *Bipolaris sorokiniana* (Sacc.) Shoem. Syn. *Drechslerasorokiniana* (Sacc.) [Syn. *Helminthosporium sativum*, teleomorph *Cochliobolus sativus*] Subram and Jain, *Cochliobolus sativus*, *Drechslera* Dastur [anamorph *Bipolaris sorokiniana* (Sacc.) Shoem.] and several synonyms of the anamorph have been used like *Helminthosporium sorokinianum*, *Drechslera sorokiniana* and *Helminthosporium sativum* (Maraita *et al.*, 1998) [1]. *Bipolaris sorokiniana* is characterized by thick-walled, elliptical conidia (60-120 μm \times 12-20 μm) with 5-9 cells. In axenic culture, the mycelium is composed of hyphae interwoven as a loose cottony mass and appears as white or light to dark grey depending on the isolates (Kumar *et al.*, 2002) [7].

The disease

Spot blotch caused by *Bipolaris sorokiniana* (Sacc. in Sorok.) Shoem. is an important disease of wheat. In India, foliar blight of wheat had been noticed as early as 1924 (Kulkarni, 1924) [8], but it was not of much consequence till recently. It has been observed in several other countries (Dickson, 1956) [3]. Spot blotch caused by *Helminthosporium sativum* (*Bipolaris sorokiniana*) was wide spread in six states of India, namely Madhya Pradesh, Uttar Pradesh, Himanchal Pradesh, West Bengal, Punjab and Haryana (Neema and Joshi 1973) [5].

Symptomatology

Symptoms mainly develop on sub-crown internodes, stem, leaves, awns, glumes and seeds. The main symptom caused by the pathogen is spot blotch, which is nothing but the disease of leaves. The early lesions on leaves are 1-2 mm long, small and dark brown in colour. The dark brown necrotic spots (boat shaped) occur on the coleoptiles, leaves, crowns, stems, and roots with or without yellow halo around these. Darkening of the sub crown internode is a characteristic symptom.

Management of spot blotch disease of wheat using Bio-agent, Bio-enhance and Fungicides

Singh *et al.*, (2017) [21] results showed that the seed treatment with vitavax power @ 3 g kg of seed followed by two spray

of propiconazole @ 0.1% at the time of disease initiation on flag -1 leaf and at soft dough stage were best and per cent disease intensity (39.03%) was minimum. Yadav *et al.*, (2015) [26] reported the effect of recommended dose of fungicides (Propiconazole, Carbendazim and Hexaconazole), bio-agents and botanicals on incidence and severity of spot blotch disease and seed yield of wheat. Two sprays of Carbendazim at 0.1% at tillering and boot leaf stage resulted in the maximum reduction in spot blotch incidence and severity followed by two applications of Propiconazole at tillering and boot leaf stage.

Singh *et al.*, (2017) [21] reported effect of seed treatment and foliar spray with fungicides and *T. viride* on disease intensity of spot blotch and yield contributing characters like ear length, number of grains/ ear, thousand grain weight, yield and avoidable yield losses were studied. Yadav *et al.*, (2015) [26] reported Triazole group Propiconazole especially have proven to be very effective against spot blotch disease. Singh *et al.*, (2014) [25] reported seed treatment with Vitavax Power @0.25% and two sprays of Tilt @0.1%, highest average grain yields (42.78 q/ha) and thousand grain weight were in case of in NEPZ, and 57.30 q/ha at Karnal (NWPZ) with gain of 25.7% and 10.6%, respectively, over untreated. The disease appeared at flag leaf visible stage on lower leaves and moved upward in NEPZ whereas it appeared relatively late at boot swollen stage in NWPZ. The first spray was given at boot leaf stage in majority of cases and second after 15 days of it. The lowest spot blotch score (35) was in case of Vitavax power @ 2.5 g/kg of seed and two sprays of propiconazole (Tilt) @0.1%. This experiment was conducted during rabi 2018-19 and 2019-20 at main experimental station farm of Plant Pathology, Acharya Narendra Deva University of Agriculture and Technology Kumarganj Ayodhya Uttar Pradesh.

The experimental details are given below.

Design	:	RBD
No. of treatments	:	11
No. of replications	:	3
No. of plots	:	33
Plot size	:	2.0 \times 2.0 m ²
Variety	:	Raj- 4015

Observations to be recorded

1. Disease appearance date in each treatment.
2. Score of foliar blight before spraying (Kumar *et al.* double digit scale)
3. Score of foliar blight after one week of spraying.
4. Percent disease intensity.
5. 1000 seed weight (g)
6. Yield/plot (q/ha)

Disease intensity was recorded on first appearance of symptoms after 07 days of 1st and 2nd spray. Observations on flag leaf and flag -1 leaf of 10 randomly selected plants from each treatment of each replication. The per cent disease intensity (PDI) was calculated by using the formula:

Per cent disease intensity

It was calculated according to Mc Kinney (1975) formula
PDI (%)

$$\text{PDI (\%)} = \frac{\text{Sum of all the diseaserating}}{\text{Number of plant observed} \times \text{Maximum diseasegrading}} \times 100$$

First observation on disease intensity was recorded before first spraying using (Kumar *et al.*, 1998) [6]. Subsequent

observations were recorded before each spray and finally disease intensity was recorded 20 days after spray. Yield (q/ha), plant disease control and per cent increase in yield were also calculated.

$$\text{Per cent increase in yield} = \frac{\text{Yield in treated plot} - \text{Yield in check plot}}{\text{Yield in check plot}} \times 100$$

$$\text{Per cent increase in yield} = \frac{\text{PDI in check plot} - \text{PDI in treatments plot}}{\text{PDI in check plot}} \times 100$$

Management of spot blotch disease of wheat using bio-agents and fungicides

For the management of spot blotch disease of wheat one bio-agent, one bio-enhancer and seven fungicides were used. Among these bio-agents such as *Trichoderma viride* @ 4 gm/kg seed (T3) and fungicides Thiram 75 WDP @ 3 gm/kg seed (T1), Raxil (Tebuconazole) @ 2.5g/kg seed (T2) used as seed dressers. Whereas, propiconazole @ 0.1% (T9), copper oxychloride @ 0.1% (T6), hexaconazole @ 2.5% (T7), Folicur @ 0.1% (T10), and Nativo (trifloxystrobin 25% + tebuconazole 50%) @ 0.4 gm/lit and one bio-enhancer Jeevamrit @ 2.5ml / lit., first at boot leaf stage second after at 20 days as foliar spray.

Per cent disease intensity (PDI)

The data on plant disease intensity (PDI) was recorded after second spray on wheat crop have been presented in (Table- 1) clearly recoded that plant disease intensity decreased with the application of different treatment over untreated control. Minimum plant disease intensity was recorded (21.11% and 20.68% during 2018-19 & 2019-20) under T9 (Seed treatment with raxil @ 2.5 gm/kg seed + 2 foliar sprays of

propiconazole@ 0.1 %, first at boot leaf Stage second after 20 days). Which has highly significant with all the treatments. Hence, maximum plant disease intensity (PDI) was recorded (72.37% and 73.86% during 2018-19 & 2019-20) under T11 untreated control.

There was lowest per cent disease intensity, highest numbers of tillers, highest numbers of productive tillers per plant, highest 1000 test weight, highest yield q/ha, percent increase yield, highest avoidable yield loss was recorded under the T9 (seed treatment Tubuconazole 2.5g/kg of seed + two spray of Propiconazole @ 0.1%). Among all the eleven treatments. All the fungicidal treatments including one bio-agent *Trichoderma viride* and one bio-inhencer Jeevamrit. The minimum percent disease intensity was found in T₉ (seed treatment with Tubuconazole @ 2.5g/kg of seed + 2 foliar spray of Propiconazole @ 0.1 per cent) and T₁₀ (seed treatment with *Trichoderma viride* @ 3g/kg of seed + 2 spray of Tubuconazole @ 0.1 per cent) with percent disease intensity (22.46 per cent) as they were at par is controlling the disease intensity. Similar trend was observed during second year (2019-20) of study.

Thousand seed weight (g.)

The results presented in the (Table-2) showed that the more thousand seed weight was found in T₉ (41.25 g) which was non-significantly followed by T₁₀ (40.86 g), T₈ (40.12 g), T₄ (39.26 g), T₇ (38.60 g), T₆ (38.23g) and T₅ (37.80 g) and significantly followed by T₂ (36.27 g), T₁ (36.16 g) and T₃ (35.41 g). Minimum thousand seed weight was recorded under T₁₁ (35.58 g) during the first year (2018-19), during both the years of study respectively.

Table 1: Evaluation of different fungicides and bio-agent against foliar blight disease of wheat 2018-19 and 2019-20

S.N.	Treatment	Date of Disease appearance	PDI 2018-19			Date of Disease appearance	PDI 2019-20		
			Before spray	After I spray	After II spray		Before spray	After I spray	After II spray
T ₁	Thiram	03/02/2019	5.26	28.37	36.89	04/02/2020	5.34	28.32	36.53
T ₂	Raxil	02/02/2019	3.56	26.85	35.56	03/02/2020	3.52	26.87	35.70
T ₃	<i>T. viride</i>	02/02/2019	6.83	29.86	38.42	04/02/2020	6.81	29.81	38.13
T ₄	Nativo	28/01/2019	12.25	18.78	24.55	29/01/2020	11.88	18.65	24.52
T ₅	Jeevamrit	31/01/2019	10.00	24.13	32.67	31/01/2020	9.65	23.14	32.19
T ₆	Copper oxychloride	27/01/2019	13.49	25.58	31.47	28/01/2020	13.41	25.53	30.64
T ₇	Hexaconazole	30/01/2019	12.44	19.89	25.67	31/01/2020	12.36	19.75	25.53
T ₈	T ₁ + T ₄	03/02/2019	5.50	16.87	23.40	04/02/2020	5.42	16.41	23.16
T ₉	T ₂ + Tilt	04/02/2019	3.32	14.46	21.11	05/02/2020	3.14	13.35	20.68
T ₁₀	T ₃ + Folicur	02/02/2019	6.67	15.56	22.46	02/02/2020	6.42	15.21	22.36
T ₁₁	Control	22/01/2019	14.81	51.26	72.37	19/01/2020	15.26	52.47	73.86
CD			1.91	4.55	6.79		1.77	5.08	6.90
Sem±			0.65	1.54	2.30		0.60	1.72	2.34

Table 2: Evaluation of different fungicides and bio-agents on test weight, yield, per cent increase of yield and avoidable yield losses against foliar blight disease of wheat 2018-19 and 2019-20

S.N.	Treatment	2018-19				2019-20			
		Test weight	Yield (q/ha)	% increase yield	Avoidable Losses	Test weight	Yield (q/ha)	% increase yield	Avoidable losses
T ₁	Thiram	36.16	33.61	7.55	7.02	36.25	33.71	8.60	7.92
T ₂	Raxil	36.27	33.87	8.38	7.73	36.57	33.97	9.43	8.62
T ₃	<i>T. viride</i>	35.41	33.24	6.37	5.98	36.42	33.34	7.40	6.89
T ₄	Nativo	39.26	37.13	18.81	15.83	39.47	37.23	19.94	16.62
T ₅	Jeevamrit	37.80	34.00	8.80	8.08	38.06	34.12	9.92	9.02
T ₆	Copper oxychloride	38.23	34.13	9.21	8.43	38.45	34.25	10.34	9.37
T ₇	Hexaconazole	38.60	36.68	17.37	14.80	38.90	36.75	18.39	15.53
T ₈	T ₁ + T ₄	40.12	37.78	20.90	17.28	40.36	37.98	22.35	18.27
T ₉	T ₂ + Tilt	41.25	38.26	22.43	18.32	41.54	38.47	23.93	19.31
T ₁₀	T ₃ + Folicur	40.86	37.92	21.34	17.58	40.93	38.13	22.84	18.59
T ₁₁	Control	35.58	31.25	00.00	00.00	35.47	31.04	00.00	00.00
CD		3.57	3.38	3.03	2.07	2.49	3.66	2.64	3.40
Sem±		1.21	1.13	1.03	0.70	0.85	1.24	0.89	1.51

Table 3: Evaluation of numbers of tillers per plant and number of productive tillers per plant in 2018-19 and 2019-20

S.N.	Treatment	2018-19		2019-20	
		No. of Tillers per plant	No. of productive tillers per plant	No. of Tillers per plant	No. of productive tillers per plant
T ₁	Thiram	8.22	7.57	8.35	7.78
T ₂	Raxil	8.92	8.22	8.96	8.36
T ₃	<i>T. virde</i>	7.97	7.42	8.12	7.50
T ₄	Nativo	7.13	6.83	7.16	6.91
T ₅	Jeevamrit	7.24	6.79	7.35	6.95
T ₆	Copper oxychloride	6.81	6.21	6.90	6.43
T ₇	Hexaconazole	7.02	6.62	7.05	6.75
T ₈	T ₁ + T ₄	9.58	8.89	9.68	8.95
T ₉	T ₂ + Tilt	10.47	9.86	10.56	9.95
T ₁₀	T ₃ + Folicur	10.13	9.48	10.16	9.52
T ₁₁	Control	6.25	5.43	6.13	5.64
CD		1.41	1.34	1.48	1.35
Sem±		0.48	0.46	0.50	0.46

Seed yield (q/ha)

It evident from (Table-2) maximum yield of (38.26 q/ha) was recorded in T₉ which was non-significantly followed by T₁₀ (37.92 q/ha), T₈ (37.78 q/ha), T₄ (37.13 q/ha) and T₇ (36.68 q/ha) and significantly followed by T₆ (34.13 q/ha), T₅ (34.00 q/ha), T₂ (33.87 q/ha), T₁ (33.61 q/ha) and T₃ (33.24 q/ha) Least grain yield q/ha recorded under T₁₁ (31.25 q/ha) control plot during 2018-19 in both the years.

Per cent increase yield

Percent increase in yield due to fungicidal, bio-agent and bio-inhancer percent increase in yield were recorded during both the year of study (2018-19 and 2019-20). Maximum increase in yield was noted in T₉ (22.43 per cent) this treatment was at par with T₁₀ and T₈ during 2018-19 and 2019-20. Highest percent increase in yield of wheat grain was found under the treatment of T₉ (23.93 per cent) was non significantly followed with the T₁₀ (22.84 per cent). Therefore, during 2019-20 to 3 treatment proved most effective in increase the yield. Fungicides bio-agent and bio-inhancer treatment also avoided the yield loss of wheat grains. Treatment number 9 avoided the yield loss of 18.32 and 19.31 per cent respectively during both the years of study.

Total number of tiller

Significant variation was found on the number of tillers per plants as a result of treatments (Table No-3). The maximum number of tillers per plant (10.47) was recorded in case of T₉. Minimum number of tillers was found (6.25) on T₁₁ control plot which was statistically at par with T₅, T₄, T₇ and T₆ during the first year (2018-19). Similar result were found during 2019-20.

Number of productive tiller

Significant variation was found on the number of productive tillers per plants as a result of treatments (Table No-3). The maximum number of productive tillers per plant (9.86) was recorded in case of T₉, Minimum number of productive tillers was found (5.43) on T₁₁ control plot which was statistically at par with T₇ and T₆ during the first year (2018-19). Similar result noted in 2019-20.

Earlier also Propiconazole (Tilt 25 EC) have been reported effective against spot blotch of wheat by many other workers (Rashid *et al.*, 2001; Hossain *et al.*, 2001; Patil *et al.*, 2002; Singh *et al.*, 2005; Sharma *et al.*, 2005; Shahidullah, 2006; Ahmed *et al.*, 2007; Zamal, 2007; Malakar and Milan, 2009; Rahman *et al.*, 2013) [18, 4, 16, 20, 23, 1, 27, 11, 17, 22, 25].

Lapis (1985) [9] reported that three sprays of Propiconazole gave the best control of spot blotch and increased grain yield by 65 per cent. Mondol *et al.* (1994) [11] found that Tilt 250 EC (0.05 per cent) was the effective and profitable one, which controlled the disease significantly producing the high yield with maximum gross margin.

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