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Effect of Date of Sowing and Nitrogen Levels on Spot Blotch Disease of Wheat Caused by *Bipolaris sorokiniana*

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In India, wheat is grown in the *Rabi* season mostly under irrigated condition. The main constraints responsible for less yield of wheat in comparison to other country seem to non-availability of seeds of improved high yielding varieties to farmers, poor fertility, unirrigated land and other inputs. Experimental findings clearly indicates that yield loss due to spot blotch varied between 7 to 30 per cent and loss in 1000-grain weight between 3 to 23 per cent, depending upon the levels of disease. Delayed sowing favored incidence of spot blotch irrespective of nitrogen level and more disease developed at higher nitrogen level in all the three date of sowing. Higher levels of nitrogen at all the three date of sowing increased yield and 1000-grain weight and with delay in sowing, yield and 1000-grain weight decreased significantly at all the three nitrogen level.

Keywords: Date of sowing; fertilizers; Bipolaris sorokiniana.

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) belongs to family Graminae and wheat crop is one of the oldest cereal crops. Since antiquity, wheat was cultivated in Mohanjo-Daro and Harappa nearly 5000 years back [1]. In India, three species of wheat are cultivated, *Triticum aestivum*, *T.*

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duram, and *T. dicoccum* [2]. Bread wheat accounts for approximately 95 per cent of the wheat grown, while 4 per cent is duram wheat and 1 per cent is dicoccum wheat [2]. Wheat is believed to have originated in South-west part of Asia. Some of the earliest remains of the crop have been found in Syria, Jordan and Turkey [3].

The wheat plant has wide range of uses. In India, wheat grain is mainly consumed in form of Chapaties, Puri, Paratha, Dalia, Halwa, Upama, etc. Wheat is also being used for processed food product like baked breads, flakes cakes, pastries, biscuits, noodles, etc.

The wheat cultivation in the warmer and humid region of North-eastern plain zone has extended significantly after green revolution; however, many new diseases and pest problems have been encountered by this crop that created significant yield loss. Wheat crop is affected by many fungal diseases and likely to be exposed to various types of foliar diseases other than rust, powdery mildew, Karnal bunt and loose smut. Among these all diseases, the spot blotch emerged as number one problem in hot and humid wheat cultivating regions (Van Ginkel and Rajaram, 1998).

Information from different countries on managing foliar blight through manipulation of agronomic practices suggests that different mineral nutrients may reduce foliar blight [4,5]. The severity of the spot blotch disease is directly influenced by tillage operation, irrigation scheduling, soil fertility level, sowing density, crop growth stage, occurrence of late rains during crop cycle, heat stress during grain filling, late planting, high temperature and high relative humidity causing more than 12 hours duration of leaf wetness [6]. According to Duveiller and Sharma [7] the use of conservation tillage practices may be favourable for spot blotch incidence in the South-east Asia.

Maity et al. [8] reported that severity of *Helminthosporium* leaf blight under field condition was maximum in the plots treated with 120 kg nitrogen/ha combined with P_o and K_{40}kg/ha. They also reported that increasing level of N and decreasing level of K caused maximum disease severity and poor grain yield. The NPK ratio of 60:80:80 was best for low disease severity and highest grain yield in West Bengal condition. Based on two year data (2000-2002 wheat season), Narayan [9] reported that high level of nitrogen dose (150 and 180 kg N/ha) does not adversely affect leaf blight score, yield and 1000-grain weight at Pusa (Bihar).

Field study carried at Rampur (Nepal) during the year 2001 and 2002 using two wheat varieties (Bhrikuti and Sonalika) showed that the balanced application of nitrogen, phosphorous and potassium reduced spot blotch disease severity by 15 and 22 per cent, respectively, in both varieties [10]. Based on the results of three years (2000-01, 2001-02, 2002-03) of experiments, Chaurasia and Duveiller [11] concluded that higher doses of nitrogen fertilizer resulted in less flag leaf infection under *Tarai* condition of Nepal.

Krupinsky et al. [12] evaluated leaf spot diseases on wheat for 11 years to determine the influence of tillage, N fertilization, and cultivar on disease severity in a long-term cropping system project, which included two cropping systems {spring wheat (SWF)-fallow and annual cropping [spring wheat (SWA)-winter wheat (WWA)-sunflower (*Helianthus annuus* L.)]}. In low precipitation years, the impacts of management practices on leaf spot disease severity were minimal. No-till (NT) did not consistently increase the severity of leaf spot diseases. During the drier years, NT had the advantage of conserving soil water while not increasing the risk to leaf spot diseases. When N treatments influenced leaf spot disease severity, higher levels of disease severity were associated with the low N fertilizer treatment compared with higher levels of N fertilization. When a tillage and N treatment interaction was significant, disease severity was higher with NT at the low N treatment, but at the high N treatment the differences among tillage treatments were greatly reduced or eliminated.

Kandel and Mahato [13] reported that in Sunsari (Nepal) during *Rabi* 2004-05 and 2005-06 nitrogen levels higher than 50 kg/ha significantly reduced disease severity and increased grain yield in all genotypes. Grain yield difference among the genotypes was significant only in 2005-06. Area under disease progress curve (AUDPC) was not significant between two nitrogen doses (100 and 150 kg/ha). The wheat genotypes showed different reactions to disease. Genotype BL 2047 had the lowest incidence of disease followed by BL 1887, whereas BL 2217 had the highest incidence of the disease.

Narayan [9] found that earliest sown crop (10^{th} November) showed minimum leaf blight score and as the sowing was delayed, disease gradually increased. Minimum leaf blight score

(35-36) and maximum yield (34-35 Q/ha) were recorded on 10th November sown crop, while maximum leaf blight score (89) and minimum yield (23-25 Q/ha) were recorded in 20th December sown crop.

Duveiller et al. [14] observed that delayed sowing increased spot blotch severity even in resistant genotypes and caused higher yield losses. They showed that timely sowing avoids the physiological stress that often coincides with the flowering stage which in turn reduces spot blotch.

Chaurasia and Duveiller [11] studies three seasons (*Rabi* 2000-01, 2001-02 and 2002-03) and reported that the third week of November sowing of wheat had lower value of AUDPC as compared to December sowing.

Malik et al. [15] found that the late sown crop had low severity of spot blotch caused by *Bipolaris sorokiniana* as compared to early and normal sown crop in North-western plain zones.

Biswas and Srivastava [16] also reported less spot blotch severity in early sown crop than late sown crop. Reduction in 1000-grain weight under late sowing of wheat was also reported by them.

2. MATERIALS AND METHODS

A field trial was conducted during *Rabi* 2018-19 and 2019-20 at University Farm to see the effect of date of sowing and nitrogen level on spot blotch of wheat under natural conditions. Three date of sowing and three dose of nitrogen were tested. Phosphorus and potassium were applied as per recommended dose for wheat. All fertilizers were applied on per plot basis of wheat. The experiment was laid out as per details given below:

Design	:	Split plot
Treatments	:	
Main plot	:	Date of sowing
D_1	:	28th November 2018 and 25th November 2019
D_2	:	14th December 2018 and 11th December 2019
D_3	:	29thDecember 2018 and 26th December 2019
Sub-plot	:	Nitrogen doses
N_1	:	120 kg/ha
N_2	:	150 kg/ha
N_3	:	180 kg/ha
Replication	:	4
Variety	:	HD-2733
Plot size	:	5 m × 2 m
Seed rate	:	120 kg/ha
Row to row distance	:	20 cm
Fertilizer	:	60 kg P_2O_5 : 40 kg K_2O per hectare

Observations on disease severity were recorded at dough stage following Saari-Prescot in 0-9 scale. The yield and 1000-grain weight were recorded after harvest of the crop. Data was analyzed statistically.

3. RESULTS

To find out the effect of date of sowing and nitrogen levels on spot blotch of wheat under natural, experiments were conducted in split plot design with four replications during *Rabi* 2018-19 and 2019-20. Three date of sowing and three dose of nitrogen were tested.

Five observations on Per cent Disease Index (PDI) and leaf blotch score were taken at fifteen and seven day's intervals during *Rabi* 2018-19 and 2019-20, respectively. Data obtained on the effect of three date of sowing (28th November, 14thDecember and 29th December 2018 during *Rabi* 2018-19 and 25th November, 11th December and26th December 2019 during *Rabi* 2019-20) and three nitrogen levels (120, 150 and 180 kg N/ha) on disease progress of spot blotch of wheat.

Table 1. Effect of date of sowing and nitrogen level on disease progress of spot blotch of wheat during *Rabi* 2018-19

Date of Sowing	Percent Disease Index(PDI)*								Leaf blotch score(0-9dd)*							
	Initial				Final				Initial				Final			
	Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)			
	120	150	180	Mean	120	150	180	Mean	120	150	180	Mean	120	150	180	Mean
28/11/18	8.08	9.08	10.13	9.10	64.73	67.89	72.71	68.44	12	12	12	12	55	56	57	55
14/12/18	8.54	9.65	10.45	9.54	76.82	84.32	87.42	82.86	11	12	13	12	56	66	67	66
29/12/18	5.52	7.52	10.77	7.92	83.42	86.28	90.71	86.80	11	12	13	12	66	67	77	67
Mean	7.39	8.76	9.19		74.99	79.49	83.62		11	12	13		55	66	67	

	CD 5%	SE(m)	CD5%	SE(m)
Date of sowing	1.29	0.36	1.94	0.55
Nitrogen level	0.86	0.28	1.17	0.39
Date of sowing× Nitrogen level	1.61	0.63	NS	0.95

**Average of 4 replications*

Data presented in Table 1 indicates that in *Rabi* 2018-19 at initial, there was significant interaction between date of sowing and nitrogen level. In general level of initial PDI was significantly higher in first and second date of sowing (28thNovember and 14thDecember),at all the nitrogen levels except 180kgN/ha in which initial PDI at all the three date of sowing were statistically at par. At all the three date of sowing, significantly higher PDI (10.13 to 10.77) was observed at180 kg N/ha as compared to lower PDI (5.52 to8.54) at 120 kg N/ha.

At final observation, there was non-significant interaction between date of sowing and nitrogen level. Data clearly indicates that as the dose of nitrogen increased from 120 to 180 kg/ha there was gradual increase in PDI observed at all the three dates of sowing. In case of 28thNovember highest PDI (72.71) was observed where 180 kg N/ha was applied and was statistically superior to those observed in plots given 150 kg N/ha(67.89) and 120 kg N/ha (64.73).Similar results were also obtained in case of 14th December and 29th December sowing. It is apparent that plots sown late recorded more PDI, irrespective of nitrogen levels and in all the three dates of sowing there was gradual increase in PDI and these increases were statistically significant. In nut shell, late sowing and higher doses of nitrogen results in more disease.

In *Rabi* 2018-19 at initial stage there was no marked differences in leaf blotch scores (dd) either at three dates of sowing or at three levels of nitrogen, as leaf blotch score ranged from 11to13 (dd). However, at final stage higher leaf blotch score in all the three dates of sowing were recorded at higher level of nitrogen(180 kgN/ha).At the same level of nitrogen higher leaf blotch score (dd) was observed in late sowing (29th December) as compared to timely sowing (28thNovember).Highest leaf blotch score of 77 was observed in late sown (29thDecember)crop which was given 180 kg N/ha and minimum leaf blotch score of 55 was observed in timely sown (28th November)crop which was given 120 kg N/ha.

Data presented in Table 2 indicates that in *Rabi* 2019-20 also at initial observation of PDI there was non-significant interaction between date of sowing and nitrogen level; however, as the dose of nitrogen increased from 120 to 180 kg N/ha, there was gradual increase in PDI observe data ll the three date of sowing. In case of 25thNovember sowing highest PDI(10.20)was observed when 180 kg N/ha was applied and was statistically superior to those observed in plots given 120kg N/ha and at par with those observed in plots given 150 kg N/ha. Similar results were also obtained in case of 11th and 26thDecember sowing.

Data presented in Table 2 indicates that in *Rabi* 2019-20 at final stage there was significant interaction between date of sowing and nitrogen level significantly higher in third date of sowing (26th December), at all the nitrogen levels except 120 kg N/ha in which PDI at third and second date of sowing was statistically at par. At all the three dates of sowing significantly higher PDI (65.58 to 75.16) was observed at 180 kg N/ha as compared to lower PDI (60.02 to 63.02) at120 kg N/ha.

In *Rabi* 2019-20 at initial stage there was no marked difference in leaf blotch scores (dd) either at the three dates of sowing or at the three levels of nitrogen as leaf blotch score ranged from11 to 13 (dd) only. However, at final stage higher leaf blotch scores in all three dates of sowing were recorded at higher level of nitrogen (180 kg N/ha). At same level of nitrogen, higher leaf blotch score (dd) was observed in late sowing (26thDecember) as compared to timely sowing (25thNovember). Highest leaf blotch score of 68 was observed in late sown (26thDecember) crop which was given 180 kg N/ha and minimum leaf blotch score of 46 was observed in timely sown (25thNovember) crop which was given 120 kg N/ha.

Data presented in Tables 1 and 2 for *Rabi* 2018-19 and 2019-20, respectively, clearly indicates that late sowing resulted in more disease irrespective of nitrogen level. In both the years in all the three date of sowing more disease develop at higher nitrogen level (180kg N/ha).

Data on the effect of date of sowing and nitrogen level on yield and 1000-grain weight of wheat along with PDI.

Data presented in Table 3 reveals that in *Rabi* 2018-19, at initial observation of PDI there was significant interaction between date of sowing and nitrogen level and finally non-significant interaction was observed. Higher value of PDI was recorded at higher dose of nitrogen at all the three dates of sowing and higher value of PDI was also recorded in late sown crop at all the three nitrogen levels.

Data presented in Table 3 indicates that in 2018-19, there was slight increase in yield and 1000-grain weight with the increasing levels of nitrogen at all the three date of sowing but this increase was statistically non-significant. In 28thNovember sown crop grain yield of 31.67q/ha,33.95q/ha and34.84q/ha and 1000-grain weight of 40.74, 41.60 and 41.72g were recorded, respectively at 120, 150 and 180 kg N/ha nitrogen level. In 14th December sown crop grain yield of 24.92 q/ha, 25.99 q/ha and 26.78 q/ha along with 33.77, 34.59 and 34.70 g 1000-grain weight were recorded in plots given 120, 150 and 180 kg N/ha, respectively. In late sown crop (29thDecember) only23.54,23.93and23.94q/ha yield along with 31.00,32.85 and 32.87g1000-grain weight were recorded at 120,150 and 180 kgN/ha, respectively. Data presented in Table 4 clearly revealed that with delay in the sowing there was gradual decrease in yield and 1000-grain weight at all the three nitrogen levels. By enlarge difference in yield and 1000-grain weight at different date of sowing at different nitrogen level were significant, except yield obtained in plots sown on 14th and 29th December and given 120 kg N/ha.

Data presented in Table 4 reveals that in *Rabi* 2019-20, at initial observation of PDI there was non-significant interaction between date of sowing and nitrogen level and finally significant interaction was observed. Higher values of PDI were recorded at higher dose of nitrogen at all three dates of sowing and higher value of PDI was also recorded in late sown crop in all three nitrogen levels.

Data presented in Table 4 indicates that in *Rabi* 2019-20, increase in yield and 1000-grain weight with the increasing levels of nitrogen were recorded at all the three dates of sowing but this increase was statistically non-significant. In 25thNovember sown crop grain yield of 39.52 q/ha, 40.00 q/ha and 41.27 q/ha and 1000-grain weight of 42.98, 43.40 and 44.97 g were recorded, respectively at 120,150 and 180 kg N/ha. In11thDecember sown crop grain yield of 33.77q/ha,34.00q/ha and 34.52q/ha along with 37.58, 38.38 and 38.37g 1000-grain weight were recorded in plots given 120,150 and 180 kg N/ha, respectively. In late sown crop (26thDecember) only 25.52, 26.27 and 27.27 q/ha yield along with 30.75, 31.98 and 32.65 g 1000-grain weight were recorded at 120, 150 and 180 kg N/ha, respectively. Data clearly revealed that with delay in the sowing there was significant decrease in yield and 1000-grain weight at all the three nitrogen levels. In 120 kg N/ha plots highest yield (39.52 q/ha) and 1000-grain weight (42.98g) were recorded in25thNovember sown crop which were statistically superior to11thDecember (33.77q/haand37.58g) and 26thDecember (25.52q/ha and 30.75g) sown crop. A similar trend was also observed in 150 and180 kgN/ha plots.

Data presented in Tables 3 and 4, respectively for *Rabi* 2018-19 and 2019-20, clearly indicates that late sown crop resulted in more disease irrespective of nitrogen level and more disease develop at higher nitrogen level in all the three dates of sowing. Increase in grain yield and 1000-grain weight were recorded at higher levels of nitrogen at all the three dates of sowing but this increase was statistically non- significant and with delay in sowing there was significant decrease in yield and 1000-grain weight at all the three nitrogen levels.

Table 2.Effect of date of sowing and nitrogen level on disease progress of spot blotch of wheat during *Rabi*2019-20

Date of Sowing	Percent Disease Index(PDI)*								Leaf blotch score (0-9dd)*							
	Initial				Final				Initial				Final			
	Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)			
	120	**150**	**180**	**Mean**	**120**	**150**	**180**	**Mean**	**120**	**150**	**180**	**Mean**	**120**	**150**	**180**	**Mean**
25/11/19	8.30	9.64	10.20	9.38	60.02	61.91	65.58	62.83	11	12	12	12	46	55	57	56
11/12/19	9.97	10.78	11.66	10.80	62.80	63.24	70.97	65.67	11	12	13	12	55	57	66	56
26/12/19	11.33	11.59	12.29	11.74	63.02	69.30	75.16	69.10	12	12	13	12	66	67	68	67
Mean	9.88	10.65	11.39		61.94	64.81	70.57		11	12	13		56	56	67	
		CD 5%	**SE(m)**		**CD5%**	**SE(m)**										
Date of sowing		1.10	0.31		1.41	0.40										
Nitrogen level		0.88	0.29		0.69	0.23										
Date of sowing× Nitrogen level		NS	0.54		1.33	0.69										

Average of 4 replications

Table 3. Effect of date of sowing and nitrogen level on yield, test weight and Percent Disease Index (PDI) of spot blotch of wheat during *Rabi* 2018-19

Date of Sowing	Percent Disease Index(PDI)*								Yield(q/ha)*				1000 grain weight (g)*			
	Initial				Final											
	Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)			
	120	**150**	**180**	**Mean**	**120**	**150**	**180**	**Mean**	**120**	**150**	**180**	**Mean**	**120**	**150**	**180**	**Mean**
28/11/18	8.08	9.08	10.13	9.10	64.73	67.89	72.71	68.44	31.67	33.95	34.84	33.48	40.74	41.60	41.72	41.45
14/12/18	8.54	9.65	10.45	9.54	76.82	84.32	87.42	82.86	24.92	25.99	26.78	25.89	33.77	34.59	34.70	34.35
29/12/18	5.52	7.52	10.77	7.92	83.42	86.28	90.71	86.80	23.54	23.93	23.94	23.80	31.00	32.85	32.87	32.24
Mean	7.39	8.76	9.19		74.99	79.49	83.62		26.71	27.96	28.52		35.17	36.34	36.43	
	CD 5%		**SE(m)**		**CD5%**	**SE(m)**		**CD5%**		**SE(m)**		**CD5%**		**SE(m)**		
Date of sowing	1.29		0.36		1.94	0.55		1.69		0.48		1.43		0.41		
Nitrogen level	0.86		0.28		1.17	0.39		NS		0.51		NS		0.65		
Date of sowing× Nitrogen level	1.61		0.63		NS	0.95		NS		0.83		NS		0.70		

Average of 4 replications

Table 4. Effect of date of sowing and nitrogen level on yield, test weight and Percent Disease Index(PDI) of spot blotch of wheat during *Rabi* 2019-20

Date of Sowing	Percent Disease Index(PDI)*								Yield(q/ha)*				1000 grain weight (g)*			
	Initial				Final											
	Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)				Nitrogen level(kg/ha)			
	120	150	180	Mean	120	150	180	Mean	120	150	180	Mean	120	150	180	Mean
25/11/19	8.30	9.64	10.20	9.38	60.02	61.91	65.58	62.83	39.52	40.00	41.27	40.35	42.98	43.40	44.97	43.78
11/12/19	9.97	10.78	11.66	10.80	62.80	63.24	70.97	65.67	33.77	34.00	34.52	34.10	37.58	38.38	38.37	38.10
26/12/19	11.33	11.59	12.29	11.74	63.02	69.30	75.16	69.10	25.52	26.27	27.27	26.32	30.75	31.98	32.65	31.79
Mean	9.88	10.65	11.39		61.94	64.81	70.57		32.93	33.42	34.35		37.10	37.92	38.66	

	CD 5%	**SE(m)**	**CD5%**	**SE(m)**	**CD5%**	**SE(m)**	**CD5%**	**SE(m)**
Date of sowing	1.10	0.31	1.41	0.40	1.75	0.45	1.44	0.41
Nitrogen level	0.88	0.29	0.69	0.23	NS	0.44	NS	0.44
Date of sowing×NS Nitrogen level	0.54	1.33	0.69	NS	0.86	NS	0.71	

**Average of 4 replications*

4. DISCUSSION

Present finding clearly indicates that late sown crop resulted in more disease irrespective of nitrogen level and more disease develops at higher nitrogen level in all the three dates of sowing. Increase in grain yield and 1000-grain weight were recorded at higher levels of nitrogen at all the three dates of sowing but this increase was statistically non- significant and with delay in sowing there was significant decrease in yield and 1000-grain weight at all the three nitrogen levels. Duveiller et al. [14], Chaurasia and Duveiller [11] and Biswas and Srivastava [16] have also studied the effect of sowing on spot blotch of wheat and their findings support our findings. According to Hobbs et al. [17] an understanding of manipulation of date of sowing is critical for sustainable management of leaf blight under rice-wheat rotation system. Narayan [9] found that at Pusa (Bihar) earliest sown crop (10^{th} November) showed minimum leaf blight score and as the sowing was delayed, disease gradually increased. Minimum leaf blight score (35-36) and maximum yield (34-35 Q/ha) were recorded on 10th November sown crop, while maximum leaf blight score (89) and minimum yield (23-25 Q/ha) were recorded in 20th December sown crop. Duveiller et al. [14] observed that delayed sowing increased spot blotch severity even in resistant genotypes and caused higher yield losses. They showed that timely sowing avoids the physiological stress that often coincides with the flowering stage which in turn reduces spot blotch. Biswas and Srivastava [16] also reported less spot blotch severity in early sown crop than late sown crop. Reduction in 1000-grain weight under late sowing of wheat was also reported by them. Similar results were also obtained by Singh et al. [5].

Ojha and Mehta [18] reported that susceptibility increases with increasing dose of nitrogen but decreases with increasing doses of phosphorus and potash. Singh et al. [19] reported that high fertilizer and irrigation levels favour the incidence and severity of foliar blight of wheat. Singh et al. [5] reported that foliar blight intensity was low (65 per cent) with half fertilizer dose (60N: 30P: 30K) as compared to full dose of fertilizers (120N: 60P: 60K) in which it was 80 per cent. Rahman et al. [20] reported that disease severity was significantly higher with both higher (150 kg N/ha) and lower (0 kg N/ha) doses of N than the recommended dose, i.e. 100 kg N/ha. The disease severity reduced significantly under the recommended doses (N-100 kg/ha, P-26 kg/ha, K-50 kg/ha, S-20 kg/ha, B-1 kg/ha) of chemical fertilizers. The lowest plant height, spikes/m^2, grains/spike and grain yield were reduced with the treatment where N was not applied at all.

5. CONCLUSION

In Uttar Pradesh yield loss due to spot blotch varies between 7 to 30 per cent and loss in 1000-grain weight between 3 to 23 per cent, depending upon the levels of disease.

Delayed sowing favors incidence of spot blotch irrespective of nitrogen level and more disease develops at higher nitrogen level in all the three date of sowing. Higher levels of nitrogen at all the three date of sowing increased yield and 1000-grain weight and with delay in sowing, yield and 1000-grain weight decreases significantly at all the three nitrogen level.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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