Effect of Inorganic Nutrients on Leaf Blight Severity in Wheat Caused by *Helminthosporium sativum*

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ABSTRACT

Inorganic nutrients, nitrogen, phosphorus and potassium in different doses and their combinations were evaluated for the severity of leaf blight of wheat under field conditions. Severity was maximum in the plots treated with 120 kg N ha^{-1} with combination P_0 and K_{40} kg ha^{-1}. With increasing level of nitrogen and decreasing level of potassium caused maximum disease severity and poor gain yield. Nitrogen, phosphorus and potassium at the ratio of 60 : 80 : 80 was suitable for low disease severity and highest gain yield in West Bengal conditions.

Key words : Leaf blight, inorganic nutrients, *Helminthosporium sativum,* Wheat.

West Bengal is not traditionally a wheat growing tract but at present wheat is gradually occupying an important position as a cereal crop next to rice. During 1996 - 1997, the area under wheat cultivation in West Bengal was 351.09 thousand hectares with a total production of 839.04 thousand tonnes and the productivity was 2390 Kg ha^{-1}. In India, among the pthogens caused severe in wheat, is rust caused by *Puccinia sp* and next leaf blight or leaf spot caused by *Helminthosporium sativum* caused heavy loss in yield (Nema & Joshi, 1971). In West Bengal, the disease was first reported by Chattopadhyay and Chakroborty (1968), which was found to be most destructive in causing foot rot, leaf blight and grain infection. Some information are now available on use of different fertilizer levels that can reduce disease incidence significantly in many crops and restrict damage to tolerable limits (Ojha & Mehta 1970; Dwivedi & Sukla, 1981; Conner *et al.,* 1992). In this contest, a study was conducted to reduce the leaf blight of wheat by using balanced inorganic fertilizers and their effect on yield of wheat crop.

Materials and Methods

The field trials were conducted during 1992 - 93 and 1993 - 94 at the University Experimental Farm, Kalyani, Wheat cv. H. P. - 1209 was sown on 3 x 5m plots with a spacing 23 x 7cm in a row to row and plant to plant, respectively. The pathogen, *H. sativum* was isolated in pure form from infected wheat leaves and maintained on freshly prepared PDA. Conidial suspension of *H. sativum* were used as inoculum. R.B.D. was followed using three replications. Seeds were sown on 15th November and harvested on 8th March in each year. In case of single fertilizer treatments, there were five levels of nitrogen (N), phosphorus (P) and potassium (K) *viz.,* N_0, N_1 (40 kg ha^{-1}), N_2 (80 kg ha^{-1}), N_3 (120 kg ha^{-1}) and N_4 (160 kg ga^{-1}, P_0 P_1 (30 kg ha^{-1}), P_2 (60 kg ha^{-1}), P_3 (90 kg ha^{-1}), P_4 (120 kg ha^{-1}) and K - K_0, K_1 (30 kg ha^{-1}), K_2 (60 kg ha^{-1}), K_3 (90 kg ha^{-1}) and K_4 (120 kg ga^{-1}) were applied separately. Standard doses of NPK (100 : 60 : 40) were applied in the treated plots. In all cases, total P and K were applied as basal. The application of N was made in two equal split doses. The first dose was given as basal and the 2nd dose was applied at 21 days after sowing (DAS) followed by irrigation. The N, P and K were used in the form of urea, single super phosphate and muriate of potash, respectively. All the plots were inoculated at 30, 45 and 60 DAS with an aquous spore suspension of *H. sativum* of 1.5 - 2 x 10^3 spores/ml using hand sprayer at evening hrs. followed by irrigation. The disease severity were recorded at 55 and 85 days after sowing (DAS).

According to the rate of disease severity of individual a separate experiment was conducted to evaluate the disease severity and crop yield in different combination of three nutrients in two consecutive years. Three dose of each nutrients N-O 60, 120 kg ha^{-1}, P-O, 40 and 80 kg ha^{-1} and K - 0, 40 and 80 Kg ha^{-1} their interactions of different combinations in the form of urea, single superphosphate and muriate of potash respectively were used. Split plot design was followed using three replications with 3 x 5 m plot size. Variety HP - 1209 was sown in 15 November and harvested in 8 March in each year. Inoculation was done in plots by the process mentioned earlier. The disease severity data were recorded at 55 and 85 DAS as per standard disease rating scale and yield were recorded after harvest.

Results and Discussion

The disease incited by *H. sativum* caused heavy yield loss. Different level of N had shown a positive response towards disease severity from 85 DAS, which increased in the age of the crop upto 160 kg ha^{-1}. But the difference in disease severity was statistically at par in both the years. The significant difference in disease severity was observed when the plots treated with lowest (N_0) and highest N_{160}) fertilizer application (Table 1).

In case of phosphorus no significant variation in disease severity was observed among different levels when it was applied singly. Potash also showed similar results like that of nitrogen, only exception was that with increase in potash, there was a decrease in disease severity (Table 2). Different NPK levels and their combinations had shown a positive response towards disease severity from 55 DAS onwards which increased with the age of the crop as well as with increase of NPK level upto 75 DAS. Different N and P levels and their interaction showed that at the age of 55 DAS, $N_{120}P_0$ showed maximum disease severity (26.49%) followed by $N_{120}P_{40}$ (23.59%). The lowest disease severity was observed in the plots treated with N_0P_0 (20.12%). Different combinations of N and K were also showed different disease reactions in the 55 DAS. The highest disease severity was observed in the plots treated with $N_{120}K_0$ (29.26%) followed by N_0K_0 (23.53%) and lowest was observed in N_0K_{80} treated plots irrespective of P applications. More prominent and significant variations in disease severity in different NPK levels were observed when the crop attaining 75 days old. It was observed that with increase in N, and P simultaneously decrease in K recorded highest disease severity of *H. sativum*. The highest disease severity was observed in $N_{120}P_0$ treated plots and lowest in N_0P_{40} and their difference are statistically significant (Table 2). Different levels of N and K and their interactions in disease severity was also showed similar results like that of N and P, only exception in lowest disease severity recorded in N_0K_{80} treated plots.

In combined application of NPK and their interactions were also showed that with increasing crop age, there was an increase in disease severity. The highest disease severity was observed in the plots treated with $N_{120}P_0K_0$ (71.54%) followed by $N_{120}P_{40}K_0$ (61.19%), $N_{120}P_{80}K_0$ (60.82%). The treatments like $N_{120}P_{40}K_0$ and $N_{120}P_{80}K_0$ were not statistically significant with regards to disease severity. The lowest disease severity was observed in $N_0P_{40}K_{80}$ (32.73) followed by $N_0P_0K_{80}$ (32.92%) which statistically at par in disease severity (Table 2). The results contradicted with the observation made by Teplyakov (1977) that phosphorus (120 kg ha^{-1}) application was more effective in reducing the development of disease on spring wheat in Russia. Phosphorus fertilization reduced predisposition of all the leaf spot diseases of wheat in all the zones of Siberia (Chulkina *et al.*, 1981). Increase of N fertilization increased disease severity because of decrease in the total phenol level in wheat leaf which influenced phenol oxidation and thereby disease susceptibility in case of rust of wheat (Kiraly & Farkas, 1962). Rashid *et al.* (1988) reported that increased doses of N and P fertilizer significantly increased the severity of leaf blight of wheat. Whereas Tinline *et al.* (1993) reported that disease severity of *H. sativum* was not affected by phosphate or nitrogen + phosphate fertilizer, but significantly reduced by potassium in 5 of the 8 years trial.

Table 1. Effect of nitrogen, phosphorus and potassium on development of leaf blight disease of Wheat

Dosage	55 DAS 1992-93	55 DAS 1993-94	55 DAS Mean	85 DAS 1992-93	85 DAS 1993-94	85 DAS Mean
	% Disease index					
N_0	19.62	15.86	17.74	71.11	72.63	71.87
	(26.30)	(23.46)		(57.49)	(58.48)	
N_1	20.73	16.87	18.80	71.61	71.93	71.77
	(27.08)	(24.23)		(57.81)	(58.04)	
N_2	20.98	16.85	18.92	70.45	71.44	71.45
	(27.48)	(24.24)		(57.16)	(58.35)	
N_3	20.87	17.33	19.10	81.33	84.29	82.88
	(27.17)	(24.70)		(64.53)	(66.72)	
N_4	21.91	17.33	19.62	81.33	85.26	83.30
	(27.89)	(24.70)		(64.43)	(67.44)	
SEm±	0.80	0.81		1.37	1.48	
CD (P=0.05)	NS	NS		3.16	3.41	
P_0	19.83	16.14	17.99	69.89	70.47	70.18
	(26.44)	(23.67)		(56.62)	(57.08)	
P_1	20.73	16.34	18.54	70.87	71.54	71.21
	(27.08)	(23.86).		(57.34)	(57.78)	
P_2	19.91	16.53	18.41	71.20	71.45	71.33
	(26.51)	(23.97)		(57.55)	(57.72)	
P_3	20.34	16.47	18.41	71.29	71.45	71.33
	(26.80)	(23.93)		(57.55)	(57.72)	
P_4	20.62	17.03	18.83	71.12	72.27	71.70
	(26.99)	(24.33)		(57.50)	(58.23)	
SEm±	0.49	0.55		0.80	0.50	
CD (P=0.05)	NS	NS		NS	NS	
K_0	19.73	17.39	18.56	71.17	71.16	71.17
	(26.11)	(24.64)		(57.53)	(57.33)	
K_1	19.79	17.22	18.51	69.38	71.05	70.22
	(26.42)	(24.50)		(56.42)	(57.44)	
K_2	19.38	17.73	18.56	64.35	68.20	66.28
	(26.13)	(24.90)		(53.35)	(55.68)	
K_3	20.13	17.49	18.81	57.51	61.33	59.42
	(26.66)	(24.70)		(52.67)	(51.57)	
K_4	20.33	17.65	18.99	58.71	59.48	59.10
	(26.80)	(24.88)		(50.01)	(50.46)	
SEm±	0.54	0.59		0.60	0.61	
CD (P=0.05)	NS	NS		1.37	1.40	

Figures in the parenthesis are angular transformed values

Table 2. Role of fertilizers on leaf blight disease severity and grain yield

Nitrogen	Phosphorus	Disease severity (%) 55 DAS Potassium K-1	K-2	K-3	85 DAS Potassium K-1	K-2	K-3	Yield (q/ha) Potassium K-1	K-2	K-3
	P-1	20.25	20.47	19.65	52.97	40.41	32.92	14.5	15.0	15.6
		(26.74)	(26.92)	(26.32)	(46.72)	(39.48)	(35.00)			
N-1	P-2	25.68	20.35	20.77	49.13	40.13	32.73	14.9	15.2	15.9
		(30.45)	(26.81)	(44.50)	(39.33)	(34.89)				
	P-3	24.65	23.40	19.53	43.57	40.74	42.19	15.1	14.9	15.8
		(29.78)	(28.91)	(25.91)	(41.30)	(39.70)	(40.48)			
Mean		23.53	21.41	19.98	48.56	40.43	35.95	14.83	15.03	15.77
		(28.99)	(27.25)	(26.44)	(44.17)	(29.51)	(26.79)			
	P-1	21.18	21.07	19.98	50.62	41.38	42.22	36.70	41.0	42.90
		(27.41)	(27.27)	(26.50)	(45.34)	(39.90)	(40.51)	(36.70	41.0	42.90
N-2	P-2	21.69	21.51	21.07	43.58	41.38	38.36	45.0	47.0	47.5
		(27.76)	(27.62)	(27.28)	(41.45)	(40.05)	(38.27)			
	P-3	21.03	20.53	19.61	47.46	38.84	37.78	37.0	47.80	50.90
		(27.32)	(26.94)	(26.30)	(43.57)	(38.54)	(37.94)			
Mean		21.30	21.04	20.22	47.22	40.53	39.45	39.57	45.27	47.10
		(27.49)	(27.28)	(26.63)	(43.45)	(39.49)	(38.91)			
	P-1	31.32	27.67	20.48	71.54	59.87	37.48	34.30	37.20	39.10
		(34.01)	(31.73)	(26.92)	(57.78)	(50.74)	(37.76)			
N-3	P-2	30.03	20.23	20.51	61.19	41.51	42.75	33.9	43.9	43.7
		(33.23)	(26.70)	(26.99)	(51.48)	(40.12)	(40.82)			
	P-3	26.42	21.64	20.40	60.82	45.59	41.98	33.2	42.5	43.3
		(30.94)	(27.71)	(26.82)	(51.28)	(43.06)	(40.39)			
Mean		29.26	23.18	20.46	64.52	48.99	40.74	33.80	41.20	42.03
		(32.73)	(28.71)	(26.91)	(53.51)	(44.64)	(39.66)			

Fertilizer	SEm±	CD (P=05)	SEm±	CD (P=0.05)	SEm±	CD (P=0.05)
Nitrogen	0.31	0.88	0.41	1.16	0.42	1.19
Phosphorus	0.45	NS	0.41	1.16	0.42	1.19
N x P	0.53	1.51	0.71	2.01		
Potassium	0.31	0.88	0.41	1.16	0.42	1.19
N x K	0.53	1.51	0.71	2.01	0.73	2.07
P x K			0.71	2.01		
N x P x K			1.23	3.49	1.20	3.39

Data are the average of three replications (pooled of two years)
Figures in the parentheses are the angular transformed values (Pooled date of two years)
Superscripts indicates groups according to the Duncan's multiple range test (DMRT).

In effect of fertilizer doses and the occurrence of disease severity had ultimately reflected in the grain yield of the crop. Highest grain yield was observed when the plots treated with medium dose of nitrogen (N_{60} kg ha^{-1}) and significantly reduced to N_{120} kg ha^{-1}and N_0. Similar results were also observed in case of phosphorus and potassium, only difference was that $P_{40}P_{80}$ and K_{40}, K_{80} were statistically at par. Highest grain yield was observed when the plots treated with $N_{60}K_{40}$ and lowest was observed in N_0K_0. With increasing N and K there was a decrease in grain yield also. The interaction effect of NPK has significantly reflected in grain yield of hweat. Highest yield was observed in the plots treated with $N_{60}P_{80}K_{80}$ (50.90 t ha^{-1}) which was statistically at par with $N_{60}P_{80}K_{40}$ (47.8 t ha^{-1}) and $N_{60}P_{40}K_{80}$ (47.5 t ha^{-1}). (Table 4). Among the other treatments, increased use of N increased disease severity and reduced the grain yield of wheat. Ronginskaya *et al.* (1979) observed; losses of grain yield of wheat increased with increasing doses of NPK.

So, it was concluded from the above experiment that NPK was suitable @ 60 : 80 : 80 kg ha^{-1} or 60 : 80 : 40 kg ha^{-1} for increasing grain yield as well as reducing leaf blight disease severity of wheat caused by *H. sativum* in West Bengal conditions.

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