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SUCCESSFUL MANAGEMENT OF LOOSE SMUT OF WHEAT

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Ustilago segetum (Pers.) Roussel var. *tritici* Schaf. incited loose smut of wheat can be managed by growing resistant cvs. like Kalyansona or PBW 343. Seed treatment with tebuconazole @ 1.5g kg^{-1} seed reduced cent per cent disease incidence. Application of N_{160} P_{80} @ 1 kg ha^{-1} land and delay in sowing were found effective in management of the disease.

Keywords : Loose smut; Seed dresser; Wheat.

Introduction

Wheat, one of the most important cereal crops, providing about 20 per cent world's food calories, is attacked by a large number of diseases. Every year about 20 per cent of wheat that otherwise would be available for food and feed world-wise is lost to disease, either in the field or in storage. Loose smut of wheat casued by *Ustilago segetum* (Pers.) Roussel var *tritici* Schaf. is responsible for heavy losses when susceptible high yielding varieties with infected seeds are grown year after year. None of the present day commercial varieties possesses the requisite resistance to loose smut pathogen and due to its internally seed-borne nature its management is not easy.

Material and Methods

Artificially inoculated seeds with loose smut were obtained from Department of Plant Pathology, CCS Haryana Agricultural University, Hisar. Seeds of highly susceptible cvs. Sonalika and WH 147 at 40 per cent embryo infection were sown in four randomized blocks of 2x2 m plots, in three rows at 50 cm apart for 2 successive years. All recommended cultural practices were followed.

Per cent disease incidence was observed on plant basis counting the number of smutted plants in the total population of the plot.

For evaluation of varietal resistance eleven commercially grown wheat cultivars were tested under artifiicial epiphytotic condition and incidence of the disease in each variety was recorded in 90-day-old plants. Variety with no infection was considered as immune, while upto 5 per cent were considered resistant and others with >5 per cent infection were categorized as susceptible[1].

Infected seeds of cv Sonalika were dry dressed with carboxin (Viitavax 75 WP), carbendazim (Bavistin 50 WP) @ 1.5, 2.0 and 2.5 g kg^{-1} seed and tebuconazole (Rexil- 2DS) @ 1.0, 1.5 and 2.0 g kg^{-1} seed to test their efficacy. For control inoculated seed without any fungicide were sown.

Two strains *Azotobactor chroococcum* and *Pseudomonas striata* were used as biocontrol agents using cv WH 147, as single and mixed dose @ 200 g/10kg seed.

The effect of sowing time on disease incidence was assessed by sowing seeds of cv. Sonalika at three different dates for two consecutive years.

Farm yard manure (FYM) and biogas slurry (BGS) @ 5, 10 and 15 t ha^{-1} land and poultry manure (PM) @ 2, 4 and 6 t ha^{-1} land were ameliorated to the soil, a week before sowing of cv WH 147 in the third week of November. Plots without treatment served as control.

Four different levels of Nitrogen and Phosphorus i.e. N_0 P_0, P_{80} N_{120} P_{60} and N_{160} P_{80} @ 1 kg ha^{-1} land were applied in the form of urea (46% N) and diammonium phosphate (46% P_2O_5 and 18% N) respectively. Half dose of N and full dose of P_2O_5 were drilled at the time of sowing and remaining half dose of N by broadcasting with first irrigation i.e. three weeks after sowing.

Observation and Discussion

Work for developing genetic diversity and identification of loose smut disease resistance in bread wheat has revealed that most of the bread varieties grown in India are susceptible to this disease[2, 3]. During the present investigation screening of popularly cultivated varieties was intended to select cultivar for direct introduction in field to resist disease pressure. Cultivars PBW 343 and Kalyansona appeared resistnat while all other cultivars viz. C 306, WH 147, WH 157, WH 283, WH 291, HD 2009, HD 2329, HD 2285 and Sonalika expressed susceptible reaction to the loose smut disease to varying degree (Table 1). Extensive cultivation of Kalyansona in North-Western region of the country has brought down loose smut incidence[4].

Seed dressing is considered as one of the important components of integrated disease management system. Effect of carboxin (Vitavax 75 WP), carbendazim (Bavistin 50 WP) and tebuconazole (Rexil - 2DS) on disease incidence is recorded in Table 2. All the three fungicides were effective in controlling the disease. However, tebuconazole @ 1.5g kg^{-1} seed appeared to be the best and per cent disease incidence was 1.24, 0.28 and 0.13 per cent respectively with 1.0, 1.5 and 2.0 g tebuconazole kg^{-1} seed and gave 96.96, 99.31 and 99.68 per cent disease control in 2000-01 while during 2001-

Table 1. Performance of popular wheat varieties for their resistance against loose smut during two crop seasons under artificial epiphytotic conditon.

Variety	Per cent disease indicence 2000-01	Per cent disease incidence 2001-02	Average disease incidence per cent	Reaction
C 306	34.67	32.00	33.33	S
WH 147	33.27	30.00	31.63	S
WH 157	40.29	39.33	39.81	S
WH 283	37.50	35.58	36.54	S
WH 291	19.87	18.27	19.07	S
WH 343	05.10	04.50	4.80	R
HD-2009	06.20	06.75	06.47	S
HD- 2329	40.35	38.20	39.27	S
HD 2285	26.67	25.32	25.99	S
Sonalika	46.40	41.28	43.84	S
Kalyanasona	2.23	0.0	1.11	R

R = Resistant, S= Susceptible.

Table 2. Efficacy of seed-dressing fungicides in controlling loose smut of wheat during two crop seasons.

Fungicides	Dose g kg^{-1} seed	2000-2001		2001-2002	
		Per cent disease indicence	Per cent disease control	Percent disease incidence	Percent disease control
Carboxin (Vitavax 75 WP)	1.5	6.86 (15.29)	83.19	6.11 (14.42)	84.19
	2.0	4.07 (11.78)	90.02	3.18 (10.43)	91.77
	2.5	2.26 (8.84)	94.46	1.82 (7.95)	95.29
Carbendazim (Bavistin 50 WP)	1.5	12.60 (20.88)	69.13	11.02 (19.47)	71.49
	2.0	10.23 (18.74)	74.93	10.23 (18.74)	73.56
	2.5	7.90 (16.43)	80.64	7.72 (16.23)	80.03
Tebuconazole (Rexil-2DS)	1.0	1.24 (6.65)	96.96	1.02 (6.03)	97.36
	1.5	0.28 (3.54)	99.31	0 (1.81)	100.00
	2.0	0.13	99.68	0	100.00
Control (untreated)		40.82 (39.77)		38.66 (38.50)	
C.D. (P=0.05)		1.13		0.74	

Figures in parenthesis are angular transformed values.

Table 3. Effect of bioagent on loose smut of wheat during two crop seasons under artificial epiphytotic conditon.

Bioagent dose packet/10 kg seed	Per cent disease indicence 2000-01	Per cent disease incidence 2001-02	Per cent Average disease incidence	Per cent disease reduction over control
Azotobacter chroococcum	25.47 (30.31)	25.60 (30.40)	25.53	---
Pseudomonas striata	27.56 (31.67)	26.33 (30.87)	26.94	---
A. chroococcum and *P. striata*	25.94 (30.61)	24.14 (29.42)	25.04	0.05
Control	24.39 (29.59)	25.96 (30.63)	25.17	---
C.D. (P=0.05)	NS	NS		

Figures in parenthesis are angular transformed values.

Table 4. Effect of organic amendments on the incidence of loose smut of wheat in cv. WH 147 during two crop seasons.

Treatment (ton/ha)	2000-2001		2001-2002	
	Per cent disease incidence	Per cent disease control	Per cent disease incidence	Per cent disease control
FYM 5	42.26 (40.55)	---	42.08 (40.44)	---
FYM 10	40.95 (39.79)	1.77	41.62 (40.17)	---
FYM 15	42.68 (40.79)	---	42.01 (40.40)	---
BGS 5	41.88 (4032)	---	40.55 (39.55)	---
BGS 10	42.40 (40.63)	---	39.83 (39.13)	1.23
BGS 15	42.29 (40.57)	---	41.17 (39.91)	---
PM 2	40.83 (39.72)	1.46	39.30 (38.82)	2.55
PM 4	41.35 (40.02)	0.81	42.25 (40.53)	---
PM 6	41.17 (39.91)	1.24	40.03 (39.25)	0.07
Control (inoculated seeds)	41.69 (40.22)	---	40.33 (39.42)	---
C.D. (P=0.05)	0.30		0.32	

FYM = Farm Yard Manure, BGS = Biogas Slurry, PM = Poultry Manure
Figures in parenthesis are angular transformed values.

Table 5. Effect of irrigation levels on loose smut incidence in wheat cv. WH 147 during two crop seasons.

Irrigation (Nos.)	Irrigation appliciation (days after sowing)	Per cent disease incidence (2000-01)	Per cent disease incidence (2001-02)	Per cent disease increase		Yield (q/ha)	
				2000-01	2001-02	2000-01	2000-02
2*	1-22 2-85	38.27 (38.21)	38.88 (37.39)		---	18.72	19.05
4	1-22 2-45 3-85 4-105	41.20 (39.93)	38.37 (38.27)	7.65	3.88	30.34	31.36
6**	1-22 2-45 3-65 4-85 5-105 6-120	39.20 (38.76)	39.16 (38.73)	2.43	6.18	33.65	33.82
	CD (P=0.05)	0.44	1.03				

* Control

** Recommended irrigation

Figures in parenthesis are angular transformed values.

Table 6. Effect of fertilizer (N-P) dose on loose smut incidence in wheat cv. WH 147 during two crop seasons.

Fertilizer dose (kg/ha)	Per cent disease incidence 2000-01	Per cent disease incidence 2001-02	Per cent Average disease incidence	Per cent disease reduction over control	Yield (q/ha)	
					2000-1	2001-02
N_0P_0	42.01 (40.40)	42.49 (40.68)	42.25	---	19.85	20.04
$N_{80}P_{40}$	39.41 (38.89)	39.75 (39.09)	39.58	6.31	23.56	24.00
$N_{120}P_{60}$	36.92 (37.42)	37.52 (37.77)	37.22	11.90	34.85	34.70
$N_{160}P_{80}$	34.88 (36.20)	32.14 (34.53)	33.51	20.68	36.00	36.21
CD (P=0.05)	0.76	0.65				

Figures in parenthesis are angular transformed values.

Table 7. Effect of sowing dates on the incidence of loose smut during two crop seasons under artificial epiphytotic conditions in cv. Sonalika.

Sowing period	2000-2001		2001-2002		Yiled (q/ha)	
	Sowing date	Per cent disease incidence	Sowing date	Per cent disease incidence	2000-01	2001-02
Early	22 Nov., 2000	49.20 (44.54)	20 Nov., 2001	47.66 (43.65)	26.72	25.66
Normal	18 Dec., 2000	42.33 (40.59)	15 Dec., 2001	40.00 (39.23)	28.80	28.74
Late	5 Jan., 2001	34.86 (36.18)	5 Jan., 2002	31.57 (34.19)	31.04	30.52
C.D. (P=0.05)		0.88		1.91		

Figures in parenthesis are angular transformed values.

02, 97.36 per cent control at 1.0 g kg^{-1} seed and 100 per cent control at higher dose. The present finding is in consonance with others[5,6].

Effect of bioagents on loose smut disease incidence is summarized in Table 3. None of the three biocontrol agents could bring down disease incidence in single or mixed dose in both the crop seasons.

Addition of farm yard manure, biogas slurry and poultry manure in the field prior to sowing wheat cultivar had no beneficial effect on the disease incidence (Table 4). Results were comparable with that of control where no organic manure was added.

The data on the application of different levels of irrigation on application on expression of loose smut are summarized in Table 5. Observations indicated that application of 2 irrigations (control) resulted in the lowest disease incidence of 38.27 and 38.88 per cent during both the crop seasons. A close look on per cent disease incidence indicates that irrigation had a very little effect on suppression or expression of the disease.

Different doses of Nitrogen and Phosphorus in combination were applied and the results are given in Table 6. The data indicate that maximum disease expression, 42.01 and 42.49 per cent, during both the years was in control (No Po) plots which gradually decreased with the increase in N-P level. The disease incidence was minimum, 34.88 and 32.14 per cent, during both the crop seasons at the highest dose of $N_{160}P_{80}$ kg ha^{-1} land. Balanced nutrition provided by higher doses of nitrogen and phosphorus may equipped the plants better to withstand disease pressure.

A persual of data recorded in Table-7 indicates that time of sowing considerably exerts influence on the strength of disease attack. Incidence of the disease decreased as the sowing date was delayed. During 2000-01 the per cent disease incidence was 49.20, 42.33 and 34.86 in plots where wheat was sown on 22 Nov., 18 Dec., 2000 and 5 Jan.2001 respectively with consequently increase in yield from 26.72 q ha^{-1} to 31.04q ha^{-1}. During 2001-02 crop season, more or less similar trend in the disease expression was observed. With delay in sowing disease incidence decreased from 47.66 to 31.57 per cent with corresponding increase in yield from 25.66 q ha^{-1} to 30.52 q ha^{-1}. Dean[7] reported maximum smut development at 23°C and reduced at 15°C. Lower disease incidence observed in late sown crop was probably due to lower temperature.

Host plant resistance is the most preferred approach to crop protection as it is not only economical but also an environmental friendly method. The disease can be managed under complete control by growing resistant varieties like Kalyansona and PBW 343. Further seed-dressing with Tebuconazole (Rexil 2DS), late sowing, balanced fertilizers and correct level of irrigation can control the disease under epiphytotic condition.

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