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RESPONSE OF WHEAT CULTIVARS TO DIFFERENT INOCULUM LEVELS OF *ANGUINA TRITICI*

by
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Summary. Inoculation of plants with 1000, 5000, 10,000, 15,000, 20,000 or 30,000 juveniles of *Anguina tritici* suppressed the number, length and weight of ears and weight of grains/plant of six wheat cultivars. The nematode densities (except 1000 juveniles) induced characteristic rolling and crinkling of leaves and formation of seed galls or cockle hernels being greatest with 30,000 juveniles/pot. The three highest inoculum levels caused increasingly significant decline in the yield parameters of the tested cultivars. Reduction in weight of grains/plant at these inoculum levels were 6-18%, 12-28% and 24-43%, respectively. The greatest yield loss (43%) was recorded with cv. Lokone but maximum cockles were recorded on cv. HUW-234. Seed gall formation on the cultivars was significantly different from each other.

The seed-gall nematode, *Anguina tritici,* is an important pest of wheat in Asia. Ear-cockle disease caused by the nematode is quite common in India and frequently appears in northern states such as Madhya Pradesh, Rajasthan, Punjab, Haryana, Bihar and Uttar Pradesh (Paruthi and Bhatti, 1990). The endoparasitic invasive juveniles infect the stem growing points and are carried with the embryonic ear (floral parts) as the stem elongates. Feeding of the juveniles transmutes the ovule and other floral parts into galls, which eventually turn brown or black (cockles). Yield losses may be as high as 69-93% (Anwar and Haq, 1992).

Symptoms of nematode attack can be discerned at seedling stage, but farmers generally fail to recognize the disease before harvesting and threshing the plants. Seed-gall nematode has been virtually eliminated where seed cleaning of commercial stocks is undertaken. Where this is not practised, as in the case of some Asian developing countries, resistant cultivars would be of value. Therefore commonly cultivated cultivars of wheat were tested against *A. tritici* (Steinbuch) Chitw.

Materials and methods

Six cultivars of wheat (*Triticum aestivum* L.), HD-2285, HUW-234, Lokone, RR-21, UP-262 and WH-283, obtained from Quarci Agricultural Farm, Aligarh were screened agaisnt six inoculum levels of *A. tritici* (Tables I-V), in winter (December 1994 - March 1995). Clay pots (25 cm diam.) were filled with autoclaved loam soil and five seeds were planted in each. Two days after sowing the pots were inoculated with the appropriate nematode suspenisons. Nematode suspensions were prepared by gently crushing water soaked seed-galls and collecting the juveniles in 26 µm sieve. Non-inoculated pots served as control.

Ten pots were maintained for each inoculum level of each cultivar. The pots were maintained

TABLE I - *Effect of inoculum levels of* Anguina tritici *on % of seed gall formation on different cultivars of wheat.*

Juveniles/ pot	Cv.						L.S.D. P = 0.05
	RR-21	HD-2285	HUW-234	UP-262	WH-283	Lokone	
0	0	0	0	0	0	0	–
1000	0	0	0	0	0	0	–
5000	2.1	1.6	3.0	2.2	0	1.9	0.2
10000	6.3	4.3	3.7	4.1	3.2	6.1	0.4
15000	9.7	7.6	6.1	6.7	7.5	8.1	0.7
20000	12.5	10.2	8.5	11.0	9.2	10.0	1.0
30000	20.0	23.8	25.2	18.7	14.8	21.3	1.2

TABLE II - *Effect of inoculum levels of* A. tritici *on ear number formation of different cultivars of wheat.*

Juveniles/ pot	Cv.					
	RR-21	HD-2285	HUW-234	UP-262	WH-283	Lokone
0	1.61	1.92	1.20	1.12	2.16	1.28
1000	1.58	1.91	1.17	1.11	2.13	1.28
5000	1.57	1.85	1.16	1.10	2.13	1.26
10000	1.50	1.82	1.16	1.08	2.12	1.23
15000	1.46*	1.70*	1.07*	1.05	2.08	1.15*
20000	1.32*	1.54*	0.95*	0.98*	1.99*	1.07*
30000	1.14*	1.38*	0.85*	0.77*	1.86*	0.85*
L.S.D.	0.13	0.17	0.10	0.08	0.12	0.11

* = Significantly different from the control (0 juvenile) at P = 0.05.

in the open air. A week after sowing, germinated seedlings were thinned to one per pot. Plants were regularly observed for the appearance of symptoms of nematode infection. Plants were harvested three and a half month after sowing and number of ears/plant, lenght of ear and weight of ears and grains/plant and percent seed galls were recorded. The data were subjected to analysis of variance (ANOVA) and least significance difference was calculated.

Results and discussion

All wheat cultivars inoculated with *A. tritici* except with 1000 and 5000 juveniles per pot developed foliar symptoms. Abnormal rolling and crinkling of the leaves was apparent in plants after one and a half months growth, the extent of the symptoms increasing with the increase in inoculum level. Similar symtoms, also recorded on wheat by Paruthi and Gupta (1985) and Swarup and Sosa-Moss (1990), appear due to ecto-parasitic feeding on the leaf tips and growing points (Gokte and Swarup, 1987). Other symptoms such as swelling of basal stem part and early emergence of ears caused by the ectoparasitic feeding did not appear on any of the six cvs. Foliar symptoms were relatively more discernible on the cvs. HD-2285, UP-262 and WH-283 compared to rest of the cultivars.

Seed-gall formation on six cultivars recorded at harvest was significantly different from each other cvs at different inoculum levels; however, it became evident at inoculum levels of 5000

juveniles/pot and of 10,000 for the cv WH-283; being greatest at the highest inoculum level (Table I). The largest numbers of seed galls were formed on cvs HUW-234 (25.2%) and HD-2285 (23.8%) at 30,000 juveniles/pot.

Nematode infection suppressed the ear formation leading to a significant decline in number of ears/plant of all the cvs inoculated with 15,000 juveniles/pot (except UP-262 and WH-283), 20,000 or 30,000 juveniles/pot compared to the control (Table II). Decrease was greatest for Lokone (33.6%), followed by UP-262 (31.3%) at 30,000 inoculum level and for HUW-234 (20.8%) and HD-2285 (19.8%) at 20,000 juveniles/pot. Infection of plants also led to the formation of smaller ears compared to the uninoculated plants (Table III). Response of the ear length to *A. tritici* was more or less similar to that of ear formation. Here, however, percent decrease in the length was relatively less, and maximum decrease of 27.7 and 18,9% was recorded for the cv HD-2285 at 30,000 and 20,000 juveniles, respectively.

Weight of ears or grains/plant was considerably influenced by nematode infection (Table IV and V). Ears of all the cvs inoculated with 15,000 (except UP-262), 20,000 or 30,000 juveniles were significantly lighter than those of uninoculated plants (Table IV). Lightest ears were formed on HD-2285 (26.4%) and HUD-234 (17.2%) inoculated with 30,000 and 20,000 juve-

TABLE III - *Effect of inoculum levels of* A. tritici *on length (cm) of ear of different cultivars of wheat.*

Juveniles/ pot	Cv.					
	RR-21	HD-2285	HUW-234	UP-262	WH-283	Lokone
0	7.0	7.0	7.4	7.1	6.8	7.4
1000	6.9	6.8	7.4	7.0	6.7	7.3
5000	6.9	6.8	7.3	6.9	6.7	7.3
10000	6.8	6.7	7.2	6.9	6.5	7.0
15000	6.5*	6.4*	6.9*	6.7	6.2*	7.0
20000	6.1*	6.7*	6.3*	6.3*	5.5*	6.7*
30000	5.3*	5.1*	6.0*	5.8*	4.9*	5.9*
L.S.D.	0.4	0.4	0.4	0.5	0.4	0.4

* = Significantly different from the control (0 juvenile) at P = 0.05.

TABLE IV - *Effect of inoculum levels of* A. tritici *on weight (g) of ears of different cultivars of wheat.*

Juveniles/ pot	Cv.					
	RR-21	HD-2285	HUW-234	UP-262	WH-283	Lokone
0	0.94	0.72	0.68	0.87	1.12	0.84
1000	0.93	0.70	0.68	0.85	1.12	0.84
5000	0.93	0.69	0.67	0.84	1.10	0.82
10000	0.91	0.68	0.63*	0.84	1.07	0.82
15000	0.89	0.67*	0.60*	0.82	1.04*	0.78*
20000	0.85*	0.60*	0.55*	0.76*	0.99*	0.77*
30000	0.75*	0.53*	0.55*	0.67*	0.93*	0.65*
L.S.D.	0.07	0.05	0.04	0.06	0.05	0.06

* = Significantly different from the control (0 juvenile) at P = 0.05.

TABLE V - *Effect of inoculum levels of* A. tritici *on total weight (g) of grains/plant of different cultivars of wheat.*

Juveniles/ pot	Cv.					
	RR-21	HD-2285	HUW-234	UP-262	WH-283	Lokone
0	1.51	1.38	0.82	0.97	2.41	1.07
1000	1.47	1.34	0.80	0.95	2.39	1.07
5000	1.46	1.33	0.78	0.92	2.34	1.04
10000	1.37*	1.31	0.76*	0.90	2.29	1.01
15000	1.30*	1.14*	0.70*	0.91	2.22*	0.95*
20000	1.12*	0.99*	0.65*	0.81*	2.11*	0.83*
30000	1.02*	0.87*	0.59*	0.63*	1.83*	0.61*
L.S.D.	0.08	0.07	0.05	0.06	0.19	0.08

* = Significantly different from the control (0 juvenile) at P = 0.05.

niles, respectively. Maximum decline in weight of grains/plant was recorded for Lokone at 30,000 (43%) and HD-2285 at 20,000 juveniles (28.4%) inoculum levels (Table V). The cv HUD-234 also exhibited significant suppression of ear weight with 10,000 juveniles/pot. Significant reduction in grain weight at 10,000 inoculum level occurred in RR-21 (9.3%) and HUD-234 (7.3%).

Most of the studies reveal that *A. tritici* causes yield decline due to conversion of normal grains into cockles (Southey, 1972; Agrios, 1988; Swarup and Sosa-Moss, 1990). In the present investigation seed-gall formation alone was not found responsible for the yield losses. For instance, 21 and 10%, cockles were formed on Lokone and HD-2285 at 30,000 and 20,000 inoculum levels, whereas the corresponding decline in weight of grains/-plant was 43 and 28.4%, respectively. This indicates that ectoparasitic feeding by the juveniles rendered the plants weak and/or the endoparasitic feeding impaired the normal development of those grains which did not transform into cockles. On the basis of this observation, symptoms or gall formation alone cannot be used as an efficient parameter to assess yield loss caused by *A. tritici.*

The study revealed that the damage threshold level of *A. tritici* varied with the yield character and the cultivar. It was between 1000-5000 juveniles/pot for seed gall formation; 1000 juveniles for ear formation in cvs HD-2585, UP-262 and Lokone and greater in cvs RR-21, HUV-234 and WH-283 and for length of ears, weight of ears and total weight of grains/plant in all six cultivars.

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