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Advanced Wheat Genotypes Response to *Helicoverpa armigera* Hubner Infestation

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Abstract. In the evaluation of the response of 20 wheat genotypes in terms of spike and grain damage caused by *Helicoverpa armigera* Hubner, a significant genotypic variability was found to exist among the wheat genotypes for all the traits studied. Grain yield ranged from 2931 (DN-10) to 4333 (AUP-9701) kg/ha, whereas, spike and grain damage ranged from 19.95 to 80.47 and 3.90 to 22.16% in various wheat genotypes, respectively.

Keywords: *Triticum aestivum*, *Helicoverpa armigera*, variety, grain yield, losses

Introduction

Pakistan is the 6th most populous country in the world with a population of 160.9 million in mid 2008, which is estimated to double in the year 2045, at the present rate of growth of 1.8 percent (Economic Survey of Pakistan, 2008). Wheat is the most widely grown crop in the world. In Pakistan, wheat, being the staple diet, is the most important crop and is cultivated on the largest acreage of 8.459 million hectares with a production of 22.5 million tons during 2006-07. It contributes 13.7 percent to the value added in agriculture and 3.0 percent to GDP (Economic Survey of Pakistan, 2008). About 9.3 to 42% of attainable wheat production is lost as a result of attack of pests, pathogens and weeds in spite of control measures (Dhaliwal and Arora, 2001).

Wheat suffers from various biotic and abiotic stresses like rusts and smut diseases, aphids, *Helicoverpa armigera*, termites, salinity, drought, etc. *H. armigera* is a destructive pest of wheat and causes economic damage (Patankar *et al*., 2001; Dhaliwal and Arora, 1993). Saleem and Rashid (2000) reported a loss of 13.98% in grain yield in wheat caused by a single caterpillar of *H. armigera* per tiller. The 1st generation cotton bollworm larvae mainly injure winter wheat in the late stage growth with 90% of the eggs of the 1st generation oviposited on wheat ears (Xia *et al*., 1997; He *et al*., 1996). The larvae mainly feed on wheat ears. One larva could destroy approximately 47.7 grains of wheat. *H. armigera* infest cotton and other crops after the wheat is harvested (Wang *et al*., 1997; He *et al*., 1996).

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Seed quality is an important parameter that determines the acceptability of a commodity among the consumers (Bhatty, 1988). The grain quality of wheat is deteriorated due to the *H. armigera* infestation resulting in reduced market value, thus, causing a significant economic loss to the wheat growers. It is, therefore, imperative to resolve this serious issue. There are many possible solutions to the problem but the more economical ones include chemical control of the pest to ensure good quality and quantity of wheat and cultivation of resistant/tolerant wheat cultivars.

Wheat being the staple food and consumed directly after harvesting, chemical control of the pest is not feasible as the residual effects of chemicals may be hazardous to human health. Thus the most economically viable solution to the problem is the screening and development of genotypes with in-built resistance/tolerance to *H. armigera*. Keeping in view the significance of the pest, various genotypes of wheat were screened for their resistance/tolerance to *H. armigera* in this study.

Materials and Methods

A field experiment was conducted to evaluate the response of wheat genotypes in terms of spike and grain damage caused by *Helicoverpa armigera* during the Rabi season 1998-99 at Regional Agricultural Research Institute, Bahawalpur Pakistan (29° 23' 60N; 71° 40' 60E; 112 m asl). Experiment consisted of 20 advanced strains of wheat including two checks (V-95219, 94B-3047, WS-94194, V-94105, PR-68, D-94654, SD-4, 92T001, V-95153, AUP-9701, V-94091, 93B2707, PR-67, V-95069, DN-10, V-8120, 91BT010-1, V-94045, Inqlab-91

and Bahawalpur-97). The experiment was laid out in complete randomized block design with three replications on plot size of 12 m^2. Wheat strains were sown on 30 November. N and P_2O_5 fertilizers were applied at the rate of 160 and 110 kg/ha, respectively. Four irrigations were applied to the crop. Weeds were controlled chemically with Bromoxynil @ 1250 ml/ha. Observations of spike damage were recorded at the time of harvest by counting the total number of spikes and the number of spikes damaged by the pest from three randomly selected spots of 1 ft^2 from each plot. Grain-damage data were recorded by counting the total number of grains and the number of grains damaged by the pest from five randomly selected spikes from each plot after the harvest. The percentage of damaged spikes/grains was calculated as described by Saleem and Rashid (2000) as under:

$$\text{Spike/grain damage (\%)} = \frac{\text{No. of damaged spikes/grain}}{\text{No. of total spikes/grain}} \times 100$$

Data were subjected to statistical analysis using a computer package MSTATC. Correlations were computed using the correlation subprogram of MSTATC. Means were compared by Duncan's New Multiple Range Test (Steel and Torrie, 1980).

Results and Discussion

Highly significant differences were found among the wheat genotypes with respect to grain yield and spike and grain damage percentage ($P<0.01$) (Table 1). Grain yield ranged from 2931 (DN-10) to 4333 (AUP-9701) kg/ha. The genotype AUP-9701 had significantly higher yield than all the other genotypes except the genotypes V-95219, 92T001 and V-95153. Spike and grain damage ranged from 19.95 to 80.47 and 3.90 to 22.16% in various wheat genotypes, respectively (Table 2). The most susceptible genotype in terms of spike damage were D-94654 (80.47%) followed by PR-68 (76.00%), WS-94194 (59.53%), and V-94091 (58.28%), while the most tolerant/ resistant one was 92T001 having spike damage of 19.95%. The wheat genotype SD-4 had the maximum grain damage (22.16%) and V-8120 had the lowest (3.90%) (Table 2). A significant positive correlation ($r^2=0.422$) was found between spike and grain damage values. The data shows large differences between damaged spike percentage and damaged grains percentage. This means that the pest damaged the spikes to some extent but not necessarily the grains inside that spike.

The present results support the findings of Saleem and Rashid (2000) who found 13.98% loss in grain yield of wheat by a single caterpillar of *H. armigera* per tiller. The present findings also get support from the results of Xia *et al*. (1997) and He *et al*. (1996) who reported that *H. armigera* injure winter wheat in later growth stages by laying 90% of the eggs on wheat ears and the larvae mainly feed on wheat ears, thus damaging the spike and the grains. Wang *et al*. (1997) found that one larva could destroy approximately 47.7 grains. The infestation of *H. armigera* on wheat deteriorates the quality of grains resulting in reduced market value. Thus, causing a significant economic loss to the wheat growers and the other stakeholders.

Table 1. Analysis of variance of data with regard to yield, spike and grain damage of various wheat genotypes by *Helicoverpa armigera*

Parameters	Damaged spikes (%)	Damaged grains (%)	Yield (kg/ha)
Means squares	65392	96.35	953680
Probability	0.000	0.000	0.000
CV (%)	3.54 %	7.32 %	9.65 %
LSD (5 %)	2.728	1.558	358
LSD (1 %)	3.654	2.086	425

Table 2. Yield and damage to wheat genotypes due to infestation of *Helicoverpa armigera*

Genotypes	Damaged spikes (%)	Damaged grains (%)	Yield (kg/ha)
AUP-9701	34.58	06.12	4,333
V-95219	41.01	11.48	4,062
92T001	19.95	04.09	4,035
V-95153	45.75	20.52	4,021
91BT010-1	45.33	04.00	3,986
V-94105	52.37	09.58	3,861
94B-3047	39.34	14.19	3,861
Bahawalpur-97	41.31	19.12	3,771
WS-94194	59.53	15.18	3,674
Inqlab-91	52.37	19.78	3,674
93B2707	37.85	14.32	3,674
V-95069	36.22	12.29	3,604
V-94091	58.28	11.44	3,597
PR-67	46.72	09.01	3,507
V-8120	24.23	03.90	3,382
V-94045	52.42	18.24	3,326
D-94654	80.47	18.09	3,292
PR-68	76.00	14.94	3,243
SD-4	39.04	22.16	3,049
DN-10	50.48	09.96	2,931
LSD (5%)	2.73	1.56	358

Conclusion

Wheat genotypes responded differently to infestation of *H. armigera*. The infestation by *H. armigera* caused significant damage to spikes and grains. It is, therefore, suggested

that the studies on the occurrence of *H. armigera* Hubner in the area and identification of resistant/tolerant cultivars should be encouraged. The genotypes identified to be resistant/tolerant to *H. armigera* should be released for general cultivation. Efforts are on the way to develop wheat genotypes resistant/tolerant to *H. armigera* at the Regional Agricultural Research Institute, Bahawalpur, Pakistan.

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