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EVALUATION OF RECOMMENDED WHEAT VARIETIES FOR RESISTANCE AGAINST *SCHIZAPHIS GRAMINUM* (RONDANI) (APHIDIDAE: HOMOPTERA) UNDER LABORATORY CONDITIONS

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ABSTRACT:- Fifty recommended wheat varieties were evaluated for seedling bulk test and three components of resistance i.e., antixenosis, antibiosis and tolerance against greenbug, *Schizaphis graminum* (Rondani). NARC-09, Momal-2002, TD-1 and Zarlasta-99 were found resistant in seedling bulk test. Momal-2002 was the least preferred in antixenosis mechanism of resistance NARC-2009, Momal-2002 and Sulaman-96 were the least fecund in antibiosis mechanism of resistance and TD-1, NARC-2009 and Sussui were highly tolerant in tolerance mechanism of resistance. Out of 50 varieties under trial three varieties namely NARC-09, Momal-2002 and TD-1 were recommended as resistant varieties against *S. graminum* for higher yield and least pest pressure.

Key Words: Wheat Germplasm; Schizaphis graminum; Mechanism of resistance; Antixenosis; Antibiosis; Tolerance Tests; Pakistan.

INTRODUCTION

Aphids affect all higher-latitude agricultural regions, including the UK, the EU, North America, and North East Asia. In a field of plants that have some inducible resistance to aphids, a plant could be used that's susceptible to aphid attack to 'switch on' the defence mechanism through the natural underground connection. (www.fwi.co.uk, 2013).

Screening and identification of resistant germplasm is fundamental and continuous process for sustainable production (Akhtar et al., 2006). Important cereal aphids are *Schizaphis graminum* (Rondani), *Rhopalosiphum padi* L., *R. maidis* F., *Sitobion avenae* F. *S. miscanthi*, *Diurapis noxia* M., and *Metopolophium dirhodum* W. (Schotzik and Perez, 2000). *S. graminum*, *R. padi*, *R. maidis* and *D. noxia* attack wheat throughout the world including Pakistan causing severe damage to wheat crop (Inayatullah et al., 1993). Some species are directly involved in transmission of plant viruses such as Maize Mosaic Strip Virus (MMSV) and Barley Yellow Dwarf Virus (BYDV) and indirectly include the sooty mould production by depositing honeydew (Akhtar and Khaliq, 2003). *S. graminum* adults cause direct damage to wheat through sucking phloem sap of leaves, blocking photosynthesis resulting in leaf distortion, gall production, discoloration, stunting, leaf curling, wilting, twisting and pre

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mature leaf fall (Karimullah and Ahmed, 1988).

MATERIALS AND METHOD

Estimation of Greenbug Density, *Schizaphis graminum* (Rondani)

For estimating the population density of greenbug, three wheat fields were selected at random. From each field, three random samples (each of 25 plants in a row) were taken. All the greenbugs on each plant were counted.

Establishment of Culture

Greenbug was collected from NARC wheat fields and culture was established in rearing room. About 20 seeds of wheat cultivar were sown in plastic pots. The pots were kept in a rearing cage, measuring 112cm x 50cm x 62 cm. The cages were lit with five fluorescent tubes (20 W) provided at the top of the cage. Greenbugs were released on the seedlings when they were about 15 cm tall. After every 3 days, pots having healthy plants were placed near the pots with dying plants so that greenbugs automatically shift to the healthy plants. Afterwards pots with dead plants were replaced with new one.

In these studies, four tests namely seedling bulk, antixenosis, antibiosis and tolerance tests were applied for determining resistance in different wheat varieties.

Seedling Bulk

Fifty recommended wheat varieties (Table 1) were tested in metal trays measuring 51 cm x 35 cm x 9 cm having standard mix soil. There were eight rows in a tray, each having 20 seedlings of an entry. When the seedlings were about 5 cm high, 10 green bugs were released per seedling. The plants were observed daily. After 10 days of infestation, the damage was visually recorded on a 0-9 damage rating scale (0 = healthy and 9 = worst/dead) (Webster and Inayatullah, 1984). The entries were classified as highly resistant with damage rating (DR) 0-3, moderately resistant with DR 4-6 and susceptible with DR> 6. On the basis of damage rating scale. Out of 50 recommended wheat varieties four resistant, three moderately resistant and three susceptible varieties (total ten varieties) were selected for further studies of mechanism of resistance.

Antixenosis

Ten varieties selected through seedling bulk test were randomized and planted in a circular pattern, about 3 cm from the edge of a plastic pot of 30 cm diameter. The experiment was replicated five times in 5 separate pots. When the seedlings were 5-8 cm tall, 50 apterous green bugs were released on the soil in the centre of the pot. The plants and greenbugs were covered with a plastic cage of 29 cm dia. The tops of the cages were covered with muslin cloth. There were also two muslin cloth covered ventilation holes (5 cm dia) on the sides of the cages (Inayatullah, et al., 1993). After 24, 48 and 72 h, the numbers of greenbugs present on each plant were recorded. Data were analyzed on computer software minitab-16. The means were separated for significance by using LSD test and were categorized as least preferred, moderately preferred and highly preferred.

Antibiosis

The same ten varieties were

planted in a pot of 7 cm diameter separately having standard soil mixture. After germination, seedlings were thinned to one in all pots and were arranged in CRD design with five replications, in total 50 pots were used. The plants in all pots were infested with one laboratory-reared apterous greenbug at first-leaf stage (Akhtar et al., 2012). Each plant was then covered with a plastic cage of 30 cm height and 6cm diameter, having muslin cloth at the top and ventilation holes in the sides. The cages confined the greenbugs and also prevented contamination from occasional stray aphids. The plants and green bugs were observed daily. When reproduction began, adults were removed, leaving five nymphs on each plant. Nymphs were allowed to grow on the plant until they matured and began to reproduce. At this time, all aphids, but one, were removed from the plant. Nymphs were removed from the plant daily, and their numbers were recorded until the adults stopped reproducing about 20 days later. The plants were clipped periodically to facilitate handling. Results were categorized as least fecund, moderately fecund and highly fecund as done by Akhtar et al. (2010).

Tolerance

The same ten varieties were planted in a pot of 7 cm as above design diameter having standard soil mixture. After germination, seedlings were thinned to one in all pots. When the seedlings attained a height of 5 - 6 cm, they were infested with laboratory-reared apterous greenbug females at the rate of 10 per seedling following the methodology used by Akhtar et al. (2010). The seedlings were covered with plastic cages as described in the antibiosis section. The plants were observed daily and the green bugs were added or removed daily and a level of 10 per plant was maintained. Twelve days later, the infested plants were visually rated for damage by using a damage scale ranging from 0 (no damage) to 9 (worst or dying plant). Results were categorized as tolerant, moderately tolerant and highly tolerant. The data were analyzed statistically by using Minitab-16 with completely randomized design and means were compared by LSD test.

RESULTS AND DISCUSSION

Seedling Bulk

Four varieties namely NARC-09, Momal-2002, TD-1 and Zarlasta-99 were resistant with DR of 2-3 and 14 varieties including Ufaq, Lasani-2008, Dera, Wafaq-01, Farid-2006, Bakkhr-2002, Deman, Chenab-2000, MH-97, Chakwal-97, AARI-2011, Pirsabak-05, Suleman-96 and Iqbal-2000 were susceptible with DR of 7-9. The remaining 32 varieties were moderately resistant with DR of 4-6. Akhtar and Parveen (2002) also used this technique for the identification of resistant wheat varieties. They added that aphid density was at peak at the end of February. After that this pest started moving from the leaves to the ears. Akhtar et al. (2010) also used this technique for the identification of resistant wheat varieties against *R. padi* under the controlled conditions in laboratory and found five varieties resistant to this pest. Akhtar (2001) indicated that two rainfed wheat lines V-4 and RF-95022 were resistant against *R. maidis*.

Table 1. Damage caused by aphids in seedling bulk test

Varieties	Damage Rating	Remarks	Varieties	Damage Rating	Remarks
Maruat-J01	5	MR	Manthar	5	MR
Marui-2000	6	MR	Auqab-2000	4	MR
Imdad-2005	6	MR	NARC-2011	4	MR
Pirsabak-05	7	S	Seher-2006	5	MR
Suleman-96	8	S	Raskoh	6	MR
Iqbal-2000	7	S1	Pirsabak-04	4	MR
Kiran	6	MR	D-97	6	MR
AARI-2011	7	S	Tatara	6	MR
SKD-1	6	MR	Saleem-2000	4	MR
Mairaj-2008	5	MR	AS-2002	4	MR
Bakkhr-2002	7	S	SH-2003	6	MR
Deman	8	S	Margala-99	5	MR
Chenab-2000	9	S	Kirman	5	MR
MH-97	8	S	Dera	8	S
Chakwal-97	9	S	Haider-2000	5	MR
Farid-2006	9	S	Lasani-2008	7	S
Wafaq-01	7	S	Shafaq-2006	4	MR
Bahawalpur-2 000	5	MR	Fakhre Sarhad	4	MR
Kohistan-97	5	MR	Nowsehra-96	5	MR
Chakwal-50	5	MR	GA-2002	6	MR
Sussi	4	MR	Punjab-2011	5	MR
Faisalabad-2008	5	MR	NARC-09	3	R
TD-1	3	R	Punjab-96	6	MR
Zarlasta-99	3	R	Momal-2002	3	R
Pirsabak-2008	5	MR	Ufaq	7	S

R = Resistant varieties MR = Moderately resistant varieties S = Susceptible varieties

Antixenosis

Momal-2002 performed well among all 10 varieties with least mean aphid population (0.4 aphids/ seedling). This variety was least preferred by *S. granimum* (Table 2) and Zarlasta-99 and Bahawalpur-2000 had aphid population of (1.0 and 1.3 aphids / seedling, respectively. These three varieties are most suitable for general cultivation and higher production. The varieties highly preferred by *S. granimum* were Chenab-2000 and Punjab-96 with mean aphid population of 2.7 and 2.4, respectively. The resistant varieties had comparatively more Trichomes followed by Zarlasta-99 and Bahawalpur-2000 as compared to others and this character might create

Table 2. Antixinosis test of recommended wheat varieties against *S. granarium*

S.No	Variety	Hours			Mean
		24	48	72	
1	TD-1	1.5	2.2	2.1	1.9 [ab]
2	Zarlasta-99	1.0	1.0	1.0	1.0 [ab]
3	NARC-2009	2.1	2.4	2.0	2.1 [ab]
4	Momal-2002	0.2	0.3	0.8	0.4 [b]
5	Sussui	2.3	2.3	2.0	2.2 [ab]
6	Bahawalpur-2000	1.0	1.3	1.8	1.3 [ab]
7	Punjab-96	1.0	3.2	3.0	2.4 [a]
8	Pirsabak-2005	1.7	1.7	2.7	2.0 [ab]
9	Sulaman-96	1.7	2.3	2.1	2.0 [ab]
10	Chenab-2000	2.4	2.5	3.4	2.7 [a]

Means followed by same letter do not differ significantly

hindrance for aphids. Akhtar and Yaqoob (2006) found three varieties having more trichomes out of 16 as least preferred by *R. padi* in antixenosis test for rainfed wheat cultivars. Akhtar et al. (2008) *R. padi* with mean aphids preference for V-01180 (7.0), DN-47 (7.6) and PR-84 (9.0).

Antibiosis

Results showed that four varieties Bahawalpur-2000, TD-1, NARC-2009 and Momal-2002 were

Table 3. Antibiosis test of recommended wheat varieties against *S. granarium*

Variety	Day											Mean
	1	2	3	4	5	6	7	8	9	10	11	
TD-1	0.4	0.6	0.8	1.0	0.4	0.6	0.8	0.8	0.6	0.6	1.0	0.7 [b]
Zarlasta-99	0.4	1.4	1.0	1.2	0.4	0.4	0.4	0.8	1.8	2.2	1.4	1.0 [ab]
NARC-2009	0.6	0.8	1.6	0.4	0.6	0.8	0.4	0.8	0.8	0.8	0.6	0.7 [b]
Momal-2002	0.6	0.6	1.6	0.8	0.2	0.8	0.8	0.8	0.6	1.0	1.0	0.8 [b]
Sussui	0.4	0.4	0.4	0.6	0.4	0.8	1.0	0.6	1.0	2.4	2.2	0.9 [ab]
Bahawalpur-2000	0.4	1.0	0.4	0.4	0.8	0.8	0.8	0.4	0.8	0.4	0.6	0.6 [b]
Punjab-96	0.8	1.0	1.6	0.4	0.6	0.6	0.6	0.6	0.6	0.8	2.8	0.9 [ab]
Pirsabak-2005	1.2	1.4	0.8	0.8	1.2	3.0	2.6	1.6	3.4	1.0	2.0	1.7 [a]
Sulaman-96	0.2	0.4	1.2	0.2	0.6	0.8	0.4	0.6	2.2	2.0	1.4	0.9 [ab]
Chenab-2000	1.6	1.0	1.0	1.0	0.4	0.8	0.6	0.8	2.4	0.6	0.8	1.0 [ab]

Means followed by same letter do not differ significantly

resistant with least fecundity (0.6, 0.7, 0.7 and 0.8 nymphs/seedling), (Table 3). On the other hand, Pirsabak-2005 was highly fecund with mean number of nymphs laid (1.7) Akhtar and Yaqoob (2006) found three out of 16 varieties least preferred by *R. padi* in an antibiosis test for rainfed wheat cultivars. Akhtar et al. (2010) reported that the least fecundity of *R. padi* was observed in varieties Diamond and Wafaq. Seven varieties/lines SD-66, 99B2278, RWM-9313, SARC-5, Inqlab-91, Margalla-99 and V00183 were moderately fecund and line V00125 emerged as the highly fecund.

Tolerance

This test includes all plant responses with the ability to withstand infestation and to support insect populations that would severely damage susceptible plants. The results (Table 4) indicated non significant differences (> 0.05). No variety was highly tolerant. Among all varieties used, TD-1 and NARC-2009 were comparatively tolerant with mean DR of 4.1 and 4.2, respectively. Sussui, Momal-2002 and Bahawalpur-2000 were moderately tolerant with mean DR of 4.5, 4.7 and 4.8, respectively. On the other hand least tolerant varieties were Pirsabak-2005, Sulaman-96 and Chenab-2000 with mean DR of 5.3, 5.6 and 5.6, respectively against *S. granimum*. The results of current studies are in line with Akhtar and Yaqoob (2006) and Akhtar et al. (2009) who screened the wheat varieties in the same way and selected the tolerant varieties.

These tests are good indicators for selection of varieties/ lines for resistance in any crop against any insect. It is concluded that among all varieties across these tests, TD-1, Momal 2002, Bahawalpur-2000, Zarlasta-99 and NARC-2009 performed better in all respects against greenbug, (*S. graminum* R.).

Table 4. Tolerance test data of recommended wheat varieties

Variety	Day 1	Day 2	Mean
TD-1	3.8	4.4	4.1 [a]
Zarlasta-99	3.8	6.6	5.2 [a]
NARC-2009	3.8	4.6	4.2 [a]
Momal-2002	3.8	5.6	4.7 [a]
Sussui	3.8	5.2	4.5 [a]
Bahawalpur-2000	3.8	5.8	4.8 [a]
Punjab-96	3.8	6.2	5.0 [a]
Pirsabak-2005	3.8	6.8	5.3 [a]
Sulaman-96	3.8	7.4	5.6 [a]
Chenab-2000	3.8	7.4	5.6 [a]
Mean	3.8	6.0	-

Means followed by same letter do not differ significantly

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