Genetic response of bread and durum wheat and triticale to sunn pest, *Eurygaster integriceps* Put.

Najafi Mirak T[1], Azemaieshfard P[2], Yazdansepas A[1], Khaloobageri M[2]
[1]Cereal Research Dept., Seed and Plant Improvement Institute, Karaj, Iran
[2]Plant Protection Dept., Tehran University, Karaj, Iran

ABSTRACT

Sunn pest (*E.integripes* put.) is the most important pests of wheat in cereal-producing regions of Iran as well as other countries in Central and West Asia and North Africa (CWANA). The use of resistant cultivars is an effective strategy in Integrated Pest Management (IPM). This research was conducted to identify the genetic response of 20 bread and durum wheat and triticale to Sunn pest, and relationship between resistance to sunn pest and some morpho-physiological traits. Genotypes including eight bread wheat lines/cultivars, four durum lines, three triticale lines and five synthetic wheat lines were evaluated for resistance to sunn pest under artificial infestation in field conditions using RCBD with three replications. Analysis of variance revealed significant differences among the genotypes for spike injury caused by adult insects. Shiraz and Falat with 13% and 1.8% spike damage were identified as resistant and susceptible genotypes, respectively. Genotypes 12, 13, 14, 15, 16, 19 and 20 didn't have significant difference with Falat, so they were selected as resistant to adult insects. Based on grain injury caused by nymphs of sunn pest there was not significant difference among genotypes. In this study, no significant correlation was observed between resistance to sunn pest and the morpho-physiological traits. Nymph's feeding from grain reduced Protein%, Zeleny sedimentation, Bread volume, Water absorption, Gluten index and Gluten elasticity of genotypes.

INTRODUCTION

Near to 1.8 million hectares of cereal producing areas of Iran were sprayed with chemical insecticides against sunn pest during 2003-04 crop season (Najafi Mirak and Mohammadi, 2004). Pre-harvest bug damage to wheat caused by *Eurygaster spp*. and *Aelia spp*. occurs in many countries of the Middle East, Eastern Europe and North Africa (Paulian and Popov 1980) and yields grain with reduced bread making quality (Harri et al. 2000). Nymphs and new adult insects have high mobility and attack developing wheat kernels, and the infested grain contains a protease that breaks down the gluten structure of dough (Najafi Mirak et al 2004, Sivri et al 1999). The result of 2-D analysis and decline in quantity of unextractable proteins in SDS buffer suggest that bug-protease causes dough weakening by degradation of polymeric glutenin, presumably by hydrolysis, and possibly other mechanisms that affect the aggregation of the gluten molecules (Sivri et al. 2004). Dough prepared with flour from bug-damaged grain has an abnormal consistency, due to its soft sticky gluten content, and kneading is very difficult. Baking is unsatisfactory and the produced bread is poor in quality because of its crumbly texture, small volume, and low porosity (Mastoukas and Morrison 1990, Every 1993). Gluten content and quality of bug-damaged wheat were assessed as a gluten index after incubation of wet gluten for different intervals (0, 1, 2, 3, 7 and 24h), the result indicated that the amount of wet gluten remained constant, whereas the gluten index showed a steady decrease with the incubation time suggesting an intense protein hydrolysis, so the gluten index was proposed as a parameter for objectively determining the insect attack (Aja *et al.* 2004). Bread baking and dough rheology experiments, in Europe and New Zealand, suggest that high quality bread wheat resist the damaging effects of bug proteinase than low quality bread wheat but there was no relationship between bug-damage susceptibility and grain characters such as colour, hardness and texture, or head characters such as awns and waxiness (Every *et al*. 1997). Experiment in nylon mesh cage with and without bugs has showed that susceptibility to bug damage was significantly different among wheat cultivars and breeding lines (Najafi Mirak and Mohammadi 2004, Every et al. 1997). The high quality bread wheats were less susceptible to the effects of bug proteinase in baking than the poor baking quality wheats, (Every et al. 1997).

Field studies suggest that hard wheat cultivars are attacked more severely by the wheat bug than soft wheat cultivars (Paulian and Popov 1980). Comparison of a susceptible cultivar, Bezostaya-1, with a resistant cultivar, Ukranika, has indicated that there are more small–sized starch grains in the endosperm of susceptible variety (Bezostaya-1) and this endosperm was more rapidly hydrolyzed by salivary enzymes from *E.integriceps* than that of the Ukranika (Sazanova, 1973).

Use of resistant cultivars is an effective and economically important strategy for protecting the crops against this pest by minimizing the use of pesticides. The present study was conducted to identify resistant wheat genotypes and to compare among bread and durum wheat and triticale for resistance to sunn pest.

MATERIAL AND METHODS

In this study, response of 20 genotypes including eight bread wheat lines/cultivars, three durum wheat lines, six synthetic wheat lines and three triticale lines to sunn pest was evaluated under artificial infestation in field conditions using RCBD with three replications. Each genotype was planted on four rows 2m long. The distance between plants was 20cm. Three nylon mesh cages (30×40×120cm) were placed in every plot on 50 plants at the wheat elongation stage. The first and second cages were for evaluation of adult insect and nymph damage, respectively and the third cage was considered as a control. In the heading stage of wheat, 8 insects (4 male and 4 female) were released in the first cage. After three weeks, percent of damaged spikes were recorded and insects and their eggs removed from cages. Biological yield, grain yield, 1000 kernel weight (TKW), number of seed per spike was recorded as host plant tolerance criteria.

In the second cage 30 larva were released on plants at flowering growth stage. Insect larva feed from spike about 20-25 days. After grain harvesting, grain weight, TKW, and damaged grain percentage were measured and recorded. Also seed protein and gluten percent, protein quality and bread volume were measured based on ICC (International Association for Cereal Science and Technology, 2000) methods.

RESULTS AND DISCUSSION

Spike injury caused by adult insects was measured and obtained the percent of damaged spike. Combined analysis of variance for two years revealed significant differences among wheat genotypes. Mean comparison of genotypes (table 1) showed that Falat have the least spike damage (1.8%) and known as the most resistant cultivar. This cultivar has been reported as a resistant to sunn pest by Rezabeigi (1994, 2000) in Iran. Genotypes 12 (Durum wheat), 13, 14, 15 (triticale), 16, 19 and 20 (synthetic wheat) didn't have significant difference with Falat, so they were selected as resistant to adult insects. Shiraz with 13% spike damage was the most susceptible genotype and genotypes 5, 3, 7 (bread wheat), 11 (durum wheat) and 17 (synthetic wheat) were not different with Shiraz and considered as susceptible genotypes to adult insects of *E. integriceps*. These results indicated that resistant genotypes mostly have a gene or genes from related species of wheat such as rye in triticale, *T.tauschii* in synthetic wheat. Falat (KVZ/BUHO//KAL/BB), the most resistant cultivar to sunn pest has a short arm of chromosome 1R in 1B through KVZ.

Based on percentage of grain injury caused by nymphs of sunn pest, there was not significant difference among genotypes. It is believed that cultivar Falat is the most susceptible to larva (based on grain damage) and the most resistant to adult insect (based on spike damage). In this study no significant correlation was found between resistance to sunn pest and some morpho-physiological traits. Effect of insect feeding on some traits, affecting crop yield, indicated that adult insects caused significant reduction in biological yield but it did not affect TKW and grain number per spike. Larva feeding on developing grain caused an increase in grain weight (table 2). We can infer that adult insect decrease grain yield through reduction in spike number per area. Also it seems that larva feeding on some grain leads to compensate the reduction of weight and damage by some other grains in the same plant doing as a sink for materials transferred from the source.

Table 1. Mean comparison of genotypes for grain and spike damaged from adult insect and larva of *E.integriceps.*

Damaged grain %			Damaged spike%		
genotype	Mean	Class	genotype	Mean	Class
2	29.2	A	4	12.99	A
6	28.3	AB	5	11.52	A
4	27.6	AB	3	10.62	AB
17	27.3	AB	17	9.31	ABC
15	24.0	AB	7	9.08	ABC
19	23.9	AB	11	8.70	ABCD
3	23.0	AB	6	7.89	ABCDE
5	22.2	AB	8	7.87	ABCDE
20	22.2	AB	1	7.79	ABCDE
14	21.9	AB	9	6.88	ABCDE
12	21.6	AB	10	5.72	ABCDE
11	21.3	B	18	5.38	ABCDE
18	19.7	B	20	3.89	BCDE
7	19.6	B	13	3.89	BCDE
8	17.0	B	19	3.44	CDE
10	16.8	B	16	2.88	CDE
9	16.3	B	15	2.53	DE
16	15.5	B	14	2.03	E
13	14.2	B	12	2.01	E
1 [c]		-	2	1.80	E

[c:] Because of high susceptibility to yellow rust, It was impossible to estimate the grain damage.

Table 2. Effect of insect feeding on some traits affected on yield.

****: Significant in 1% level**

	1000 kernel weight		Grain weight per ear		Biological yield	
	Adult insect	Larva	Adult insect	Larva	Adult insect	Larva
infested samples	47.55	44.98	1.51	1.65	226.5	-
Control (unifested)	45.05	45.5	1.38	1.38	237.2	-
t-student test	2.8**	0.07^{ns}	2.12*	5.33**	2.91**	-

ns: no significant

Studying the bread quality of grain from infested and uninfested plants showed that the percentage of seed protein had been reduced from 11.79 on uninfested

plants to 11.17 on infested plants. Nymph's feeding from grain also led to reduction in other bread quality traits such as Zeleny sedimentation volume, Bread volume, Water absorption, Gluten index and Gluten elasticity of genotypes (table 3).

Table 3. Effect of insect feeding on bread quality traits.

	Gluten elasticity	Gluten index	Water absorption	Bread volume	Zeleny sed. volume	percent of protein
infested samples	Normal	13.5	63.21	440.8	28.30	11.17
Control (unifested)	Soft	39.2	64.93	480.8	31.58	11.79
t-student test	-	11.89**	10.52**	4.38**	7.03**	6.54**

**: Significant in 1% level

Significant correlation was not found between these characteristics and grain damage. It is possible that a genotype shows high percentage of grain damage but because of high tolerance to pest feeding, has little reduction in bread quality. So for an accurate evaluation of diminished bread wheat quality caused by sunn pest, it it might be better to use quality indices instead of percentage of grain damage.

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