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Impact of Environmental Factors and Physico-morphic Characters of Sunflower (*Helianthus annus*) Genotypes on Insect Pest Complex

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Abstract: The present research was conducted on ten different genotypes of sunflower against white fly, semilooper, plant hopper and flea beetle in research field of NARC, Islamabad during 2002.Genotypes resistance was only observed for plant hoppers. All genotypes of sunflower supported same level of resistance to white fly, semilooper and flea beetle. Insect's pest complex shows variable response to physico-morphic characters of sunflower genotypes. White fly was positively correlated with dry weight, plant hair density, leaf area, plant height and negatively correlated with fresh weight of genotypes. Plant hopper population was positively correlated with dry weight, plant hair density and negatively correlated with fresh weight, leaf area and plant height of genotypes.Semilooper population was positively correlated with fresh weight, leaf area and negatively correlated with dry weight, plant hair density and plant height of genotypes. Flea beetle was positively correlated with fresh weight, plant height and negatively correlated with dry weight, plant hair density and leaf area of sunflower genotypes. Impact of environmental factors including temperature, humidity and rainfall were variable on insect's pest complex of sunflower. Impact of rain fall was maximum with range of 0-48% followed by temperature 0-28% and humidity 0-20% on insect's pest complex of sunflower.

Key words: *Helianthus annus*, host plant resistance, *Bemisia tabaci, Emposca* spp., *Thysanoplusia orichalcea*

INTRODUCTION

Sunflower (*Helianthus annus* L., Composite) is an important source of edible oil in the world. Sunflower was originated from Mexico and southwestern America from where it had been spread world wide (Gibbon and Pain, 1985). The insuperable challenges facing by Pakistan is attaining the self-sufficiency in edible oil, which constitute the largest food import commodity (Dogar, 1997). Sunflower (*Helianthus annus* L., Composite) can meet this deficiency of oil and protein due to its wide range of adaptability and highest oil seed contents ranging from 40-50% (Baksh *et al*., 1999). Sunflower was the second most source edible oil in the world (Sackston, 1981). It was introduced in Pakistan during the 1960. Efforts are under way to increase the area under sunflower as well as its yield to bridge the edible oil gap in Pakistan which is increasing@ 11.0%per annum (Beg, 1983). The edible oil production is not sufficient to meet the national oil demand. The gap is being bridged by importing edible oil, costing a substantial use of resources from national exchanges (Khan *et al*., 2000). It is grown both in irrigated as well as arid areas in Pakistan during the spring and autumn to furnish raw material to the oil and ghee manufacturing industries (Aslam *et al.,* 2000). The oil is palatable, contains soluble vitamins A, D, E and K seed meal of sunflower is a rich source of food for fattening animals and poultry birds (Cobia and Zimer, 1975).There is a need of the day that its area, production and protection should be enhanced (Aslam *et al*., 2000). There are several natural factors involved in lowering the sunflower yield like hail storm, wind storm and insect pests attack (Khan *et al*., 2000). Sunflower is attacked by number of insect pests which cause a heavy loss to crop. Major insect's pests are *Bemisia tabaci* Gennad (White fly), *Amrasca* spp. (Leaf hopper), *Helicoverpa armigera* (American boll worm), (Sattar *et al*., 1984). Makhdoomi (1984) reported 43 insect species-attacking sunflowers. The major insect pests attacking sunflower include aphid (*Aphis gossypii* Glov.) white fly (*Bemisia tabaci* Genn.) and green sting bug (*Nezara viridula* Z.) (Aslam *et al*., 2000). White fly was serious pest of autumn and green sting bug was minor pest. The most important species attacking on the fourteen sunflower genotypes was white fly (*Bemisia tabaci* Gannad) (Ashfaq and Aslam, 2001). Misbah-ul-haq *et al.* (2003) studied the impact of different sunflower genotypes on the number of *Nezara viridula* L., *Aphis gossypii* Glover and *Bemisia tabaci* Gennad. The objective of the study was to find out the host plant resistance in the sunflower's genotypes and the impact of environmental factors on the population of white fly (*Bemisia tabaci* Gannad), Leaf hopper (*Amrasca* sp.), semilooper (*Plusia orichalcea*) and flea beetle (*Dosonycha* sp.).

MATERIALS AND METHODS

The ten varieties of sunflower (*Helianthus annus*, L.) were planted in a complete randomized block design

Table 1: Mean population of insects pest complex on different sunflower varieties

Genotyes	Mean plant hopper	Mean white fly	Mean semilooper	Mean flea beetle
DK 3915	0.4033a	0.6133a	1.667E-02a	3.667E-02a
SF 187	0.4233a	0.6200a	2.333E-02a	3.667E-02a
S 278	0.4233a	0.6367a	2.667E-02a	4.033E-02a
65 A 24	0.5133ab	0.6433a	3.000E-02a	4.033E-02a
PARSUN-1	0.5933ab	0.6633a	3.000E-02a	4.400E-02a
9706	0.5933ab	0.7633a	3.000E-02a	5.133E-02a
HYSUN-33	0.6600ab	0.7667a	3.333E-02a	5.133E-02a
6451	0.6867b	0.9100a	3.333E-02a	5.500E-02a
64 A 93	0.7033b	0.9533a	4.000E-02a	5.867E-02a
FH81	0.7133b	0.9867a	4.000E-02a	6.600E-02a

(RCBD) during the Autumn 2002 in the experimental area of National Oilseed Programme at National Agricultural Research Center, Islamabad. The experimental plot was 5x4 m^2.The row to row distance was 0.75 m and numbers of rows of each genotype were four. The genotypes planted were Hysun-33, 6451,SF 187,PARSUN-1,65 A 24,DK 3915,64 A 93,9706,FH 81,S-278.All the agronomic practices were kept uniform for all the genotypes. Ten plants were randomly selected from each plot and the data for various insects pests were recorded on the whole plant basis at different stages of plant weekly. Fresh weight, dry weight, leaf area, plant height and the leaf hair density were recorded. Thirty leaves of sunflower were weighed on balance for fresh weight. The leaves were dried in the oven for dry weight. The leaf area was measured with the help of leaf area meter and leaf hair density was estimated under the microscope in a 1cm^2.Plant height was taken at different stages of plant growth with the help of meter rod. The meteorological data were collected from the meteorological station National Agricultural Research Center, Islamabad i.e. temperature, humidity and rainfall. Data regarding the response of different insect's pest for sunflower genotypes under field condition were analyzed statistically by using the SPSS (1999) package.

RESULTS AND DISCUSSION

Different varieties of sunflower (*Helianthus annus*) were compared on the basis of insect's pest complex. The insect pest complex included the White fly (*Bemisia tabaci*), plant hopper (*Emposca* spp.), Semilooper (*Thysanoplusia orichalcea*) and Flea beetle (*Dosonycha* sp.). Analysis of variance was applied for the significant result among the varieties to categorize the insect pest complex infestation. Mean population of white fly was non-significant for the different varieties of sunflower with F value of 2.30($P<0.064$). Results were that the infestations of all the varieties of the sunflower remain same for whitefly. According to Misbah-ul-Haq *et al.* (2003) the result was against the previous field studies on genotype resistance to sunflower insect pest, where they had found the difference in genotype resistance. The reasons were that they had standard genotype for comparison and also prevailing weather condition during research work. The mean population of plant hopper resulted the significance difference among all the varieties of the sunflower and with in the replication with F Value of 4.12 and 7.34 ($P<0.005$, $P<0.005$), respectively (Table 1).

According to the significant difference test, Genotypes DK 3915, SF 187 and S 278 were partially resistant, Genotypes 65 A 24,PARSUN-1, 9706 and HYSUN 33 were intermediate in resistance and Genotypes 6451,64 A 93 and FH 81 of sunflower were partially susceptible. Mean population of Semilooper was non-significant among the different varieties of sunflower with F value of 1.11 ($P<0.401$), that the infestation of all the varieties of sunflowers remains same for Semilooper. The mean population of flea beetle was non-significant for different varieties of sunflower with F value of 0.14 ($P<0.911$). It means that the infestation of all the varieties of sunflower remains the same for flea beetle.

Morphological characteristics of sunflower varieties were compared with insect's pest complex population in correlation matrix on the basis of factorial analysis (Table 2).The population of white fly had shown different level of relationship with varieties of sunflower. The mean population of white fly was negatively correlated (- 0.749) and (-0.421) with fresh weight and dry weights of varieties of sunflower respectively. It means that population of white fly decreases with more fresh weight and dry weight of sunflower plant varieties. Population of white fly positively correlated with plant hair density, leaf area and plant height of the sunflower with values of correlation 0.616, 0.429 and 0.080, respectively. The population of plant hopper had shown different levels of relationship with genotypes of sunflower. The mean population of plant hopper was negatively correlated (-0.698) with fresh weight of sunflower. Population was positively correlated with the dry weight and plant hairs and negatively correlated with the leaf area and plant height with correlation values 0.736, 0.048, -0.012 and –0.172, respectively. The mean population of the Semilooper was positively correlated (0.639) with fresh weight of the

Table 2: Correlation of sunflower morphological characters with insect's pest complex

	Fresh weight r=correlation coefficient		Dry weight r=correlation coefficient		Plant hair density r=correlation coefficient		Leaf area r=correlation coefficient		Plant height r=correlation coefficient	
Insects pest	Variety mean (g)	Corr. value	Variety mean (g)	Corr. value	Variety mean (cm^2)	Corr. Value	Variety mean (cm^2)	Corr. Value	Varity mean (cm)	Corr. Value
White fly	6.451	-0.749	1.815	-0.421	234.73	0.616	151.24	0.429	125.34	0.080
Plant hopper	6.451	-0.698	1.815	0.736	234.73	0.048	151.24	-0.012	125.34	-0.172
Semilooper	6.451	0.639	1.815	-0.749	234.73	-0.372	151.24	0.299	125.34	-0.153
Flea beetle	6.451	0.809	1.815	-0.492	234.73	-0.282	151.24	-0.372	125.34	0.403

Table 3: Effect of temperature on the population of white fly, plant hopper, semilooper, flea beetle

Regression values	White fly	Plant hopper	Semilooper	Flea beetle
R Square(r^2)	0.144±0.141	0.135±0.121	0.283±0.006	0.007±0.010
a±S.E	0.600±0.139	0.444±0.119	0.0401±0.006	0.0502±0.01
t-test value	4.304	3.732	6.350	4.838
p-value	0.0026	0.005	0.0002	0.001
b±S.E	0.006±0.005	0.0051±0.005	-0.0004±0.0002	-9.94E-05±0.0004
t-test value	1.164	1.116	-1.777	-0.248
p-value	0.277	0.296	0.113	0.8100

Table 4: Effect of humidity on the population of white fly, plant hopper, semilooper, flea beetle

Regression values	White fly	Plant hopper	Semilooper	Flea beetle
R Square(r^2)	0.2007±0.136	0.167±0.118	0.191±0.007	0.0018±0.010
a ± S.E	0.573±0.134	0.4306±0.116	0.0382±0.0067	0.049±0.010
t-test value	4.257	3.687	5.698	4.710
p-value	0.0027	0.0061	0.00045	0.0015
b ± S.E	0.0026±0.002	0.002±0.002	-0.00012±9.28E-05	-1.75E-05±0.00014
t-test value	1.417	1.269	-1.3729	-0.121
p-value	0.194	0.240	0.207	0.906

Table 5: Effect of rainfall on the population of white fly, plant hopper, semilooper, flea beetle

Regression values	White fly	Plant hopper	Semilooper	Flea beetle
R Square(r^2)	0.489±0.109	0.006±0.129	0.0007±0.007	0.029±0.010
a ± S.E	0.6703±0.046	0.579±0.054	0.0293±0.003	0.046±0.0043
t-test value	14.598	10.643	9.226	10.598
p-value	4.75E-07	5.32E-06	1.54E-05	5049E-06
b ± S.E	0.0163±0.005	-0.0016±0.006	3.09E-05±0.0004	0.00027±0.00056
t-test value	2.769	-0.2318	0.0757	0.4954
p-value	0.024	0.8224	0.9415	0.6335

genotypes of sunflower. It means that the population of Semilooper increases with the increase in fresh weight of sunflower. The mean population of the Semilooper was negatively correlated with the dry weight, plant hairs and plant height and positively correlated with the leaf area with correlation values of –0.749, -0.372, -0.153 and 0.299, respectively. The mean population of flea beetle was positively correlated with fresh weight and plant height and negatively correlated with the dry weight, plant hairs and leaf area with correlation values of 0.809,0.403 and -0.492, -0.282, -0.372, respectively.

The effect of abiotic factors like the temperature, humidity and rain fall were studied among the insect's pest's complex of sunflower on simple regression basis. Simple regression equation was as follow.

$$Y = a + bX$$

The effect of temperature on the population of white fly was regressed with values of r^2=0.144±0.141. The variation in the population of whitefly was about 15% due to the variation in the temperature. This minimum value of white fly population was 0.600±0.139 with t-test value of 4.30 (P<0.0026). The proportional change in the population of white fly due to temperature was 0.006±0.0053.The effect of temperature on the population of plant hopper was regressed with value of r^2=0.1347±0.1208. The variation in the population of the plant hopper was about the 13% due to the variation in the temperature. The minimum value of plant hopper population was 0.444±0.1192 with t-test value of 3.732 (P<0.005).The proportional change in the population of plant hopper due to temperature was 0.0051±0.0045 (Table 3). According to Men *et al.* (1996) studied the effect of weather factors on the population of sunflower jassids and found the positive correlation between pest abundance and maximum temperature and a negative correlation with minimum temperature. The regression equation of pest abundance and maximum temperature was Y=-277.96+10.627x for the temperature ranges 27.4-37.1°C. The population of Semilooper was regressed with value of r^2=0.283±0.006.The variation in the population of Semilooper was about the 28% due to the variation in the temperature.The minimum value of Semilooper population

was 0.0401±0.0063with t-test value of 6.350 (P<0.0002). The proportional change in the population of Semilooper due to the temperature was -0.00043. The population of the flea beetle was regressed with the population of r^2=0.0076±0.0105.The variation in the population of flea beetle was about the 0% (Table 3).

Humidity effect on the population of white fly was regressed with value of r^2=0.2007±0.1367.The variation in the population of white fly was the 20% due to the variation in the humidity. The minimum value of the white fly population was 0.5733±0.1346 with t-test value of 4.257 (P<0.0027). The proportional change in the population of the white fly due to humidity was 0.00264. Humidity effect on the population of plant hopper was regressed with values of r^2=0.1676±0.1185. The variation in the population of plant hopper was 16% due to the variation in the humidity. The minimum value of plant hopper was 0.4306±0.1167 with t-test value of 3.687 (P<0.0061). The proportional change due to the variation in the humidity was 0.0020. The population of Semilooper was regressed with values of r^2=0.1906±0.0068 to the humidity. The variation in the population of Semilooper was 19% due to the variation in the humidity. The minimum value of Semilooper was 0.0382±0.006 with t-test value of 5.698 (P<0.0004). The proportional change due to the variation in the humidity was -0.000127. The population of flea beetle was regressed with values of r^2=0.0018±0.1056 for the humidity. This resulted that the variation in the population of flea beetle was about 0% (Table 4).

In Table 5 the population of white fly was regressed with values of r^2=0.489±0.109 for the rainfall. The variation in the population of white fly was about 48% due to the variation in the rainfall. The minimum value of whitefly was 0.670±0.0459 with t-test value of 14.598 (P<4.75E-07). The proportional change due to the variation in the rainfall was 0.0163.The population of plant hopper was regressed with values of r^2=0.0066±0.1295 for the rain fall which shows that the variation in the population of plant hopper was about 0%. The population of Semilooper was regressed with values of r2=0.00071±0.0075 against rainfall. This resulted that the variation in the population of semilooper was about the 0%. Also the population of flea beetle was regressed with values of r^2=0.0297±0.0104 for the rainfall. The variation in the population of flea beetle was about the 20.97% due to the variation in the rainfall. The minimum value of flea beetle was 0.0463±0.004 with t-test value of 10.598 (P<5.49E-06). The proportional change due to the variation in the rainfall was 0.00027.According to the Men and Thakare (1997) the peak population of semilooper was favoured by minimum temperature of 22.6-23.6°C, maximum temperature of 29.2-32.1°C, morning relative humidity of 57-79%, evening relative of 83-93% and rainfall of 1.0-178.6 mm.

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