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Response of Different Insect Pests to Some Sunflower (*Helianthus annuus* Linnaeus, Compositae) Genotypes and their Correlation with Yield Component under Field Conditions

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Abstract: Field studies were carried for response of different insect pests to some sunflower genotypes and their correlation with yield component. The most important species attacking on the fourteen sunflower genotypes were Whitefly (*Bemisia tabaci* Gennad.), Surface grasshopper (*Chrotogonous* spp.) and Green leafhopper (*Empoasca* spp.). As for as the infestation of *Bemisia tabaci* is concerned, the sunflower genotypes 9705 was found partially resistant whereas $JH_2$99S and $JH_1$99S were partially susceptible. The sunflower genotypes Parsun-1, PSF-025, Hysun-777, Award and 9707 were found intermediately susceptible. The sunflower germplasms XF-263, T-562 and PNSF-1 were susceptible. The genotypes 1435 and 9706 were considered as highly susceptible. The results described for *Empoasca spp.* concluded that the genotypes of sunflower 9705 and $JH_2$99S were found partially resistant whereas $JH_1$99S and Hysun-777 were considered as partially susceptible. The sunflower germplasms T-562, XF-263, PNSF1, 1435 and PSF-025 were taken as partially susceptible. The genotypes Parsun-1 and 9706 were found susceptible whereas 9707 and Award were highly susceptible. The genotypes 9705, 9707 and $JH_2$99S were found partially susceptible against *Chrotogonous spp.* whereas $JH_1$99S, PSF-025 and 1435 were declared as intermediately susceptible as compared to Hysun-33. PNSF1, Hysun-777 and 9706 were susceptible and the Parsun-1, T-562, XF-263 and Award were taken as highly susceptible. The genotypes 9705, $JH_2$99S, 9707 were partially susceptible against *Chrotogonous* damage as compared to Hysun-33 whereas PSF-025 was taken as intermediately susceptible. The sunflower genotypes 1435, PNSF1 and Hysun-777 were found susceptible and when Hysun-33 was compared with the sunflower genotypes 9706, Parsun-1, T-562, XF-263 and Award, these were highly susceptible. A negative correlation was observed between the population of pests and yield of sunflower genotypes. The correlation between percent plot damage and *Chrotogonous* population was found positive which understand that with increase in pest population, the damage was also increased.

Key words: *Helianthus annuus*, L. genotypes, yield component, *Bemisia tabaci, Empoasca* spp., *Chrotogonous* spp

Introduction

Sunflower (*Helianthus annuus* Linnaeus) is native to America. It was originated from Mexico and South Western USA from where it had been spread worldwide (Gibbon and Pain, 1985). It is an important oil seed crop and also grown as an ornamental plant since ancient times. In Russia, Canada, Hungary, Yugoslavia, Romania and Chile, it is grown as ornamental as well as oil seed crop (Ram, 1980). The world production of sunflower for oil is about 3.5 million MT, down from 1974 (Metcalfe and Elkins, 1980).

Sunflower cultivation is also on rise in Pakistan (Quresh, 1997). It was cultivated on an area of 144191 hectares with production of 199454 tonnes in 1998 (Govt. of Pakistan, 1998-99). Sunflower is photo and thermo insensitive crop; therefore it can be planted twice a year i.e in spring and autumn. In India, it can be grown in any season viz. kharif, rabi and summer (Ram, 1980). It has great importance for its uses i.e it can be fed as sillage and fodder, used as litter, fuel and soil improver. It has great importance for medicinal actions. The seeds of sunflower contain 40-50 % oil and have diuretic properties. The oil is quite palatable, contains soluble vitamins A, D, E, K and is used in salads, cooking and margarines and as a lubricant.

The major hazards to sunflower seed production are insects. These insect pests serve as vector for virus and other diseases. Leaf curling, chlorosis and premature senescence of plants can be due to severe infestation on sunflower by *Empoasca abrupta* (Rogers, 1981). Of 50 species of insects, recorded on sunflower in Texas, about 15 are considered potentially major pests. Lourencao and Ungaro (1983) had previously reported the feeding preference of caterpillar of *Chlosyne lacinia saundersii* on sunflower varieties. The sunflower moth is the major pest of sunflower. Stem weevils, seed weevils, the girdler complex and thistle caterpillar are of secondary importance (Patrick, 1914). The most important species attacking sunflower are *Bemisia tabaci, Empoasca spp., Thysanoplusia orichalcea, Diacretia obliqua, Nezara viridula, Helicoverpa armigera* and *Nysius inconspicuus* (Kakakhel *et al.*, 2000). The excessive use of chemicals for these insect pests is hazardous to our environment. Development of resistant cultivars is one of the most useful methods in which pesticides use in an agro-ecosystem can greatly be reduced. Many plant breeders have reported their work on various crops and their insect pests (Howe and Pesho, 1960; Painter, 1958; Barnes and Ratcliffe, 1967; Mornhinweg *et al.*, 1990). Aslam and Rehman (2000) screened six different genotypes of sunflower against Aphid (*Aphis gossypii*), White fly (*Bemicia tabaci*), Leaf miner (*Phytomyza atricornis*), Green leaf hopper (*Empoasca* spp.) Painted bug (*Bagrada* spp.) and Seed weevil (*Smicronyx* spp.) at early, growing and anthesis stages. SMH-9707 was found partially resistant against aphids, whereas SF-187 was found less susceptible. Sethi *et al.* (1978) observed the incidence of insect pests on five sunflower varieties during winter and found *Bemisia tabaci* and *Amrasca bigutella* as the major pests. They further reported that variety E.C. 89049 remained relatively pest free throughout the season.

This research was aimed to observe the response of insect pests to different sunflower genotypes, to determine the resistance level (if any) of sunflower genotypes against different insect pests under field conditions by keeping into view their response to sunflower genotypes and to evaluate the impact of these insect pests on the yield of different sunflower genotypes. Another aim was (to some extent) enhance the cultivation of sunflower in the area by demonstrating such research trials to the growers of the area

by discussing with them the problems pertaining to insect pests and their proper solutions.

Materials and Methods

The experiment was carried out to know the response of different insect pests to different sunflower genotypes and to determine the resistance of sunflower genotypes against these insect pests under field conditions by keeping into view their response at Pind Gondal during Autumn 2000 under UGC, UAAR sunflower project. The insect pests observed on sunflower (*Helianthus annuus* L.) genotypes were White fly (*Bemisia tabaci*), Green Leaf hopper (*Empoasca* spp.) and Surface Grass hopper (*Chrotogonous* spp.).

The seed of fourteen genotypes of sunflower (Hysun-777, XF-263, Award, T-562, 9706, 9707, 9705, PSF-025, Parsun-1, 1435, $JH_1$99S, $JH_2$99S, PNSF1, Hysun-33) were collected from UGC/UAAR Sunflower Project and NARC, Islamabad.

The available germplasms of sunflower (*Helianthus annuus* L.) were planted in Randomized Complete Block Design during autumn, 2000 at Pind Gondal. The experimental plot was 150 x 300 cm^2 with 25 cm plant to plant and 75 cm row to row distance. Planting was done by dibbling with three seeds per hill. After germination of all genotypes one plant per hill was maintained by manual thinning. All the intercultural practices required for sunflower crop including thinning, hoeing, weeding out and earthing up etc. were also carried out at appropriate timings.

Ten plants of sunflower were selected randomly from each plot and the data for various insects were recorded on weekly basis. Insect count was made per plant and the percent damage per plot (in some cases) was also taken. A total number of 5460 observations for whitefly and green leafhopper were taken separately in thirteen weeks. The observations taken for each *Chrotogonous* spp. and *Chrotogonous* damage were 12012 in eleven weeks. The plant of sunflower genotypes were observed though naked eye for counting the number of insects. The leaves were turned upward through forceps carefully for whitefly and green leafhopper so that insect may not be disturbed. The data were recorded date wise in the form of table. After the maturity of sunflower genotypes, the yield of each genotype was also recorded.

All the collected information regarding the response of different insect pests to some sunflower genotypes under field conditions were analyzed statistically by using statistical package, SPSS 10.01 for Windows (1999) on computer. The sunflower genotype, Hysun-33 was kept as standard susceptible check because it was the commercial variety in Punjab. Following Aslam (1999), the lines, which showed higher response by different insect pests when compared with Hysun-33, were classified as highly susceptible. The genotypes which did not differ from Hysun-33 to show the response by the insect pests were classified as susceptible, while the lines which showed significantly less response by the insect pests than the susceptible cultivar were classified as intermediately susceptible, partially resistant, resistant or highly resistant depending upon nature of groupings of the means. The yield of different sunflower genotypes was also correlated with the population of insect pests found on different genotypes of sunflower so as to see the impact of infestation on the yield component.

Results and Discussion

Data were recorded on the number of *Bemisia tabaci* (whitefly), *Empoasca* spp. (green leaf hopper) and *Chrotogonous* spp. (surface grasshopper) and their population were also correlated with yield components. The results on various sunflower genotypes are explained and discussed below for each insect pest separately.

Whitefly (*Bemisia tabaci*): The infestation of *Bemisia tabaci* L. to sunflower crop has been previously reported in Pakistan (Aslam and Rehman , 2000, Khan *et al.*, 1978, Kakakhel *et al.*, 2000, Piracha, 1989 and Sattar *et al.*, 1984) , India (Sethi *et al.*, 1978 and Singh *et al.*, 1994) and in Egypt (Khalifa and El-Khidir, 1964). Data were recorded for the evaluation of response and non-preference against whitefly and was found that its infestation started from 37th week of the year and remained throughout the crop season. The highest population was recorded during the 41st week of the year having mean population per plant 5.705 ± 0.288 and the significant difference in population was observed as the weeks passed (Fig. 1). Rafiullah had also observed in his experiment that there was significant difference in population of whitefly as the days passed. The results were also coinciding with Kakakhel (2000) that the population of whitefly remained high up to October.

The sunflower genotype 9705 had the lowest number of pest population (1.205 ± 0.127) and was significantly different from Hysun-33 (a standard susceptible check) whereas $JH_2$99S and $JH_1$99S are almost similar to 9705 (Table 1). By comparing Hysun-33 with Parsun-1, PSF-025, Hysun-777, Award and 9707, we found that these genotypes had less significant difference as compare to JH199S. The sunflower germplasms XF-263, T-562 and PNSF-1 did not differ from standard variety. The genotype 9706 had the highest number population per plant i.e. 3.918 ± 0.368 and is significantly different from Hysun-3 whereas 1435 had population less than 9706.

After crop maturity, yield of different genotypes was also recorded. The average yield of sunflower germplasms ranges from 266.66 to 1711.11 Kg ha^{-1} (Table 2).

The population of whitefly was also correlated with yield of sunflower genotypes and was found that population of whitefly was negatively correlated (-0.801) with yield of sunflower varieties and the correlation was highly significant (Table 3). It means that when population of whitefly increased on different sunflower genotypes, the yield was decreased.

Green leaf hopper (*Empoasca* spp.): The infestation on sunflower had been previously reported by Khan *et al.*, (1978). At Pind Gondal (research site) the attack of leafhopper started from 37th week of the year with steady increase in population to 43rd week of the year (Fig. 2). The average population 4.798 ± 0.356 / plant was recorded during 43rd week of the year from it gradually decreased till the end of the crop season. Kakakhel *et al.* (2000) also observed that population of leafhopper remained high up to first week of October.

The genotypes Award and 9707 had the highest population mean as compared to Hysun-33 whereas Parsun-1 and 9706 did not differ from standard variety (Table 4). The germplasms T-562, XF-263, PNSF-1, 1435 and PSF- 025 had the numbers slightly greater than Hysun-33. The sunflower genotypes, 9705 and $JH_2$99S contained the lowest mean population/plant. The yield recorded for sunflower genotypes was also correlated with response of leafhopper (Table 5) and found that yield was negatively correlated (-0.092).

Surface grasshopper (*Chrotogonous* spp.): The surface grasshopper caused damage to sunflower by feeding on leaves of the plant. Aslam *et al.* (2000) had previously reported its

Table 1: Mean population of *Bemisia tabaci* per plant on 14 genotypes of Sunflower (*Helianthus annuus* L.) at Pind Gondal.

Genotypes	Mean population
9705	1.205 ± 0.127a
$JH_2$99S	1.421 ± 0.135ab
$JH_1$99S	1.646 ± 0.0214ab
Parsun-1	2.123 ± 0.214bc
PSF-025	2.123 ± 0.293bc
Hysun-777	2.126 ± 0.264bc
Award	2.149 ± 0.205bc
9707	2.290 ± 0.244bc
XF-263	2.536 ± 0.345cd
T-562	2.582 ± 0.316cd
Hysun-33	2.633 ± 0.311cd
PNSF1	2.851 ± 0.399cd
1435	3.269 ± 0.395de
9706	3.918 ± 0.368e

Mean followed by the same letters do not have significant difference at Alpha = 0.05

Table 2: Yield of different sunflower genotypes cultivated at Pind Gondal

Genotypes	Yield (kg ha^{-1})
Hysun-777	888.8
XF-263	266.66
Award	1131.11
T-562	786.66
9706	473.33
9707	1026.66
9705	1711.11
PSF-025	733.33
Parsun-1	951.11
1435	568.88
$JH_1$99S	977.77
$JH_2$99S	1466.66
PNSF1	488.88
Hysun-33	500.00

Table 3: Correlation between population of Whitefly and yield of Sunflower genotypes at Pind Gondal

		Yield	Whitefly
Yield	Person correlation	1.000	-0.801**
	Sig. (2-tailed)		0.001
	N	14	14
Whitefly	Person correlation	-0.801**	1.000
	Sig. (2-tailed)	0.001	
	N	14	14

** Correlation is significant at 0.01 level

Table 4: Mean population of Empoasca spp. plant on 14 varieties of Sunflower (*Helianthus annuus* L.) at Pind Gondal

Genotypes	Mean Population
9705	0.613 ± 0.103a
$JH_2$99S	0.795 ± 0.124a
$JH_1$99S	0.882 ± 0.144ab
Hysun-777	1.015 ± 0.169abc
T-562	1.136 ± 0.190abcd
XF-263	1.144 ± 0.154abcd
PNSF1	1.167 ± 0.209abcd
1435	1.305 ± 0.232abcd
PSF-025	1.344 ± 0.208abcd
Parsun-1	1.692 ± 0.373bcd
9706	1.721 ± 0.279bcd
Hysun-33	1.869 ± 0.347cd
9707	1.962 ± 0.322e
Award	3.687 ± 0.500e

Mean followed by the same letters do not have significant difference at Alpha = 0.05

Table 5: Correlation between population of green leaf hopper and yield of sunflower genotypes at Pind Gondal

		Yield	Leaf hopper
Yield	Person correlation	1.000	-0.092
	Sig. (2-tailed)		0.754
	N	14	14
Leaf hopper	Person correlation	-0.092	1.000
	Sig. (2-tailed)	0.754	
	N	14	14

Table 6: Mean population of *Chrotogonous* spp. per plot on 14 genotypes of sunflower at Pind Gondal.

Genotypes	Mean Population
9705	0.364 ± 0.114a
9707	0.606 ± 0.150a
$JH_2$99S	0.679 ± 0.166a
$JH_1$99S	0.848 ± 0.195ab
PSF-025	0.970 ± 0.092ab
1435	1.152 ± 0.209ab
Hysun-33	1.576 ± 0.289abd
PNSF1	2.06 ± 0.374bcd
Hysun-777	2.606 ± 0.444cde
9706	2.909 ± 0.414def
Parsun-1	3.061 ± 0.496def
T-562	3.758 ± 0.625ef
XF-263	3.970 ± 0.532f
Award	5.788 ± 0.795g

Mean followed by the same letters do not have significant difference at Alpha = 0.05

Table 7: Correlation between population of surface Grasshopper and yield of sunflower genotypes at Pind Gondal

		Yield	Grasshopper
Yield	Person correlation	1.000	*0.306
	Sig. (2-tailed)		0.287
	N	14	14
Grasshopper	Person correlation	-0.306	1.000
	Sig. (2-tailed)	0.287	
	N	14	14

Table 8: Mean *Chrotogonous damage* (%) per plot on 14 genotypes of Sunflower at Pind Gondal

Genotypes	Mean Population
9705	9.879 ± 1.817a
$JH_2$99S	11.988 ± 1.560a
9707	12.514 ± 1.964a
$JH_1$99S	12.525 ± 1.580a
PSF-025	16.203 ± 1.959ab
1435	20.800 ± 2.136bc
Hysun-33	20.812 ± 1.802bc
PNSF1	24.239 ± 1.993c
Hysun-777	26.743 ± 2.047c
9706	33.464 ± 2.577d
Parsun-1	36.100 ± 2.528de
T-562	42.138 ± 2.656ef
XF-263	45.057 ± 3.142f
Award	48.222 ± 2.951f

infestation on sunflower (*Helianthus annuus* L.). At Pind Gondal, its attack to sunflower started from 39th week of the year till the end of the crop season during autumn 2000. The peak population (6.810 ± 640/plot) was observed during 43rd week of the year from where it gradually declined (Fig. 3). Aslam *et al.* (2000) had also observed population of *Chrotogonous* spp. on sunflower.

The genotypes Parsun-1, T-562, XF-263 and Award had the highest *Chrotogonous* number per plot as compare to Hysun-

Table 9: Correlation between percent plot Damage done by *Chrotogonous* spp. and yield of sunflower genotypes at Pind Gondal

		Yield	Damage
Yield	Person correlation	1.000	-0.296
	Sig. (2-tailed)		0.304
	N	14	14
Damage	Person correlation	-0.296	1.000
	Sig. (2-tailed)	0.304	
	N	14	14

Table 10: Correlation between population of *Chrotogonous* spp. and its percent plot damage of Sunflower genotypes at Pind Gondal

		Chrotogonous spp.	Damage
Chrotogonous spp.	Person correlation	1.000	0.972**
	Sig. (2-tailed)		0.000
	N	14	14
Damage	Person correlation	0.972**	1.000
	Sig. (2-tailed)	0.000	
	N	14	14

** Correlation is significant at 0.01 level

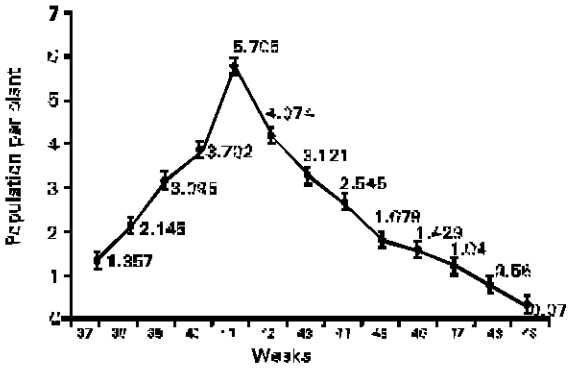

Fig. 1: Weekly population trend of *Bemisia tabaci* per plant of sunflower at Pind Gondal

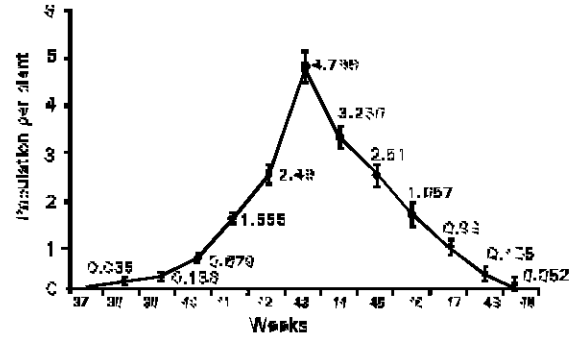

Fig.2: Weekly population trend of *Empoasca* spp. per plant of sunflower at Pind Gondal

33 whereas PNSF-1, Hysun-777 and 9706 had pest population similar to standard variety (Table 6). The genotypes JH$_1$99S, PSF-025 and 1435 were less attracted towards *Chrotogonous* as compare Hysun-33. The sunflower germplasms 9705, 9707 and JH$_2$99S had the least numbers of pest per plot than other genotypes.

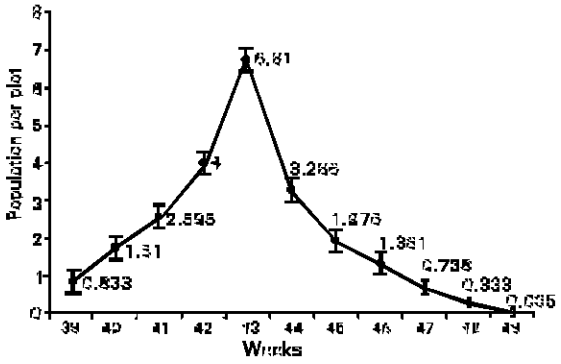

Fig. 3: Weekly population trend of *Chrotogonous* spp. per plot of sunflower at Pind Gondal

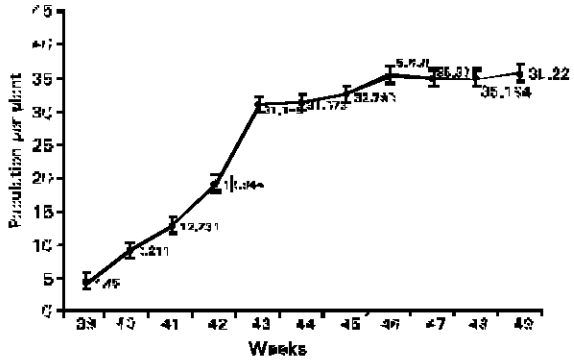

Fig. 4: Weekly % Damage done by *Chrotogonous* spp. per plot of sunflower at Pind Gondal

The correlation was also carried out between yield of different germplasms and population of *Chrotogonous* spp. (Table 7) to observe the effect of pest population on yield of sunflower genotypes. Negative correlation (-0.306) was present which meant when the pest population increased, the yield was decreased.

The percent damage per plot by grasshopper: The damage by *Chrotogonous* spp. was recorded by visual observation. The damage was started at seedling stage. The maximum damage per plot observed during 49th week when the population of *Chrotogonous* spp. was at its peak (Fig. 4). The significant difference in percent plot damage was found among sunflower genotypes (Table 8). The genotypes 9705, JH$_2$99S, 97907 and JH$_1$99S were less damaged by *Chrotogonusspp.* as compare to Hysun-33 whereas PSF-025 had damage slightly greater than JH199S. The *Chrotogonous* damage on 1435, PNSF1 and Hysun-777 were similar to damage found on standard variety. The highest damage was recorded on genotypes 9706, Parsun-1, T-562, XF-263 and Award. The genotypes 9705, JH$_2$99S, 97907 were partially susceptible as compare to Hysun-33 whereas PSF-025 were taken as intermediately susceptible. The sunflower genotypes 1435, PNSF1 and Hysun-777 were found susceptible and when Hysun-33 was compared with the sunflower genotypes 9706, Parsun-1, T-562, XF-263 and Award, it was found that these were highly susceptible. The correlation between *Chrotogonous* damage and yield of different sunflower germplasms was also taken (Table 9) and found that the sunflower genotypes, which were more damaged than others

produced low yield. So, there is negative correlation (-0.296) among the damage of different sunflower genotypes.

The correlation between population of *Chrotogonous* spp. and its damage was also observed. It was found that there was positive correlation (0.972) between pest population and its damage (Table 10). The correlation was highly significant thus it was concluded that pest population caused increase in damage of sunflower genotypes.

Keeping in view the results of different insect pests against different sunflower genotype it is concluded that in case of *Bemisia tabaci,* the sunflower genotypes 9705 was found partially susceptible whereas JH_299S and JH_199S were partially resistant because of much smaller difference from 9705. The sunflower genotypes Parsun-1, PSF-025, Hysun-777, Award and 9707 were found intermediately susceptible. The sunflower germplasm XF-263, T-562 and PNSF-1 were susceptible. The genotypes 1435 and 9706 were considered as highly susceptible. The population of whitefly was negatively correlated with yield of different sunflower genotypes and the correlation was highly significant. Aslam and Rehman (2000) had also found significant varietal difference among sunflower genotype against whitefly. Bracken (1991) found that by the increase of pest population, yield was decreased.

The results described for *Empoasca* spp. concluded that two genotypes of sunflower 9705 and JH_299S were found partially resistant whereas JH_199S and Hysun-777 were considered as partially susceptible. The sunflower germplasms T-562, XF-263, PNSF1, 1435 and PSF-025 were taken as partially susceptible. The genotypes Parsun-1 and 9706 were found susceptible whereas 9707 and Award were highly susceptible. A negative correlation was found between pest population and yield of different sunflower germplasm. Rogers (1981) evaluated twenty-nine species of sunflower in laboratories for resistance to *Empoasca* spp. Development was significantly at 5% level prolonged and survival was significantly decreased on the most species of *Helianthus* than on hybrid 896. Roger (1981) conducted research on various species of sunflower and found that *Helianthus* had resistance against leafhopper. Results of sunflower genotypes against *Chrotogonous* spp., concluded that 9705, 9707 and JH_299S were partially susceptible against this pest whereas JH_199S, PSF-025 and 1435 were declared as intermediately susceptible as compare to Hysun-33. PNSF1, Hysun-777 and 9706 were susceptible and the Parsun-1, T-562, XF-263 and Award were taken as highly susceptible. The negative correlation was observed between pest population and yield of different sunflower germplasms.

As for as *Chrotogonous* damage is concerned, the genotypes 9705, JH_299S, 9707 were partially susceptible as compare to Hysun-33 whereas PSF-025 were taken as intermediately susceptible. The sunflower genotypes 1435, PNSF1 and Hysun-777 were found susceptible and when Hysun-33 was compared with the sunflower genotypes 9706, Parsun-1, T-562, XF-263 and Award, we found that these were highly susceptible. There was negative correlation between pest population and yield of sunflower genotypes. The correlation between percent plot damage and *Chrotogonous* was found positive which understand that with increase in pest population, the damage was also increased.

There were great variations in the sunflower genotypes as regards numbers of insect pests attracted to them. All pests observed in research trial have negative correlation with yield of sunflower genotypes. The variation in the results proved very helpful in selecting sunflower plant resistant to insect. By planting the resistant genotypes, the dependence on the use of pesticide will be reduced and planting the resistant genotypes will minimize pollution problems due to heavy use of insecticides.

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