Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(3): 1219-1225

Received: 19-03-2017
Accepted: 20-04-2017

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Screening of sunflower (*Helianthus annuus* L.) varieties against sucking insect pests, predators populations and their yield comparison under semi-arid climatic conditions

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Abstract
The present study was conducted for screening of some popular varieties of sunflower *viz.,* Armoni, Hysan-33, NK-Singi, S-278 and US-666 against sucking pests namely jassid, aphid, whitefly, thrips, dusky cotton bugs and predators namely ladybird beetle and green lacewing at the research farm area of The Islamia University of Bahawalpur, Pakistan during spring, 2014. According to analysis of variance, there was significant difference in population of jassids on different varieties. Significantly more population was observed in US-666 (20.36) and lowest in S-278 as 16.43 (P<0.05). Significant difference was not found in population of other pests and predators in different genotypes. However significant difference in the populations of these pests and predators was found on different dates of observations. On harvesting yield, maximum yield was 963 Kg/hec on variety S-278 followed by NK-Singi (900 Kg/hec), Hysun-33 (808 Kg/hec), US-666 (767 Kg/hec) and Armoni (699 Kg/hec) in descending order.

Keywords: Sunflower insect pests, oil seed crops, sucking insect pests, yield

1. Introduction
Sunflower (*Helianthus annuus* L.) belongs to the family compositae and is amongst the major oil seed crops grown for edible oil in the world. Sunflower oil is being ranked fourth after palm, soya and rapeseed oil with a worldwide production of about 34.6 million tons of seed in 2010 [12]. This crop is becoming popular among the farmers because of short duration, drought tolerance and high-income return [19].

Production of edible oil in Pakistan is chronically deficient and with rapid increase in population growth rate, the situation is worsening day by day [7]. During the year 2012-13, 1.738 million tons of edible oil valued at US$ 1.595 billion has been imported. The local production during 2012-13 was 0.612 million tones. Total availability of edible oil from all sources was estimated to be 2.35 million tons during 2012-13. Sunflower was cultivated on an area of 700 thousand acres with seed production of 378 thousand tones and oil production of144 thousand tones during 2012-13. Sunflower ranked third important oil seed crop after cotton and rapeseed [13].

The major hazards to sunflower seed production are insects. Insect pest attacking sunflower crop include aphid, whitefly, leaf miner, green leaf hopper, painted bug and seed weevil. It has been discussed that major insect pests found on sunflower genotypes were *Amrasca devastans, thrips tabaci, bemisia tabaci,* tinged bug and *Eutetranychus spp*. [10]

A diverse collection of both beneficial and harmful insect species is associated with sunflower. This crop is a reservoir of large number of predators, parasitoids and pollinators also.

Sunflower is an introduced crop in Pakistan and pest complex is different from temperate region. This crop is attacked by a large number of insect pests depending on the season and adjacent crops. It has been found *Bemisia tabaci*, *Amrasca devastans*, *Aphis gossypii* and semilooper attacking sunflower crop [21].

Aphids often called plant lice and green flies have a wide host range. Aphids significantly affect various field crops, fruits and vegetables as sucking pests [3].

The abundance of aphid adversely affects the nitrogen and protein contents, weight of 1000 grains, number of grains per ear [11] and results in decrease in carbon assimilation rate, transpiration and total chlorophyll [24] and reduction in plant biomass [16].

Jassid (*Amrasca biguttula biguttula* Ishida) has a broad host range including cotton, okra, brinjal, eggplant, jute and aubergine and sunflower [20]. Both nymphs and adults stages can destroy the plants by not only sucking the leave tissues but also by transmitting different viral diseases and yield loss. The extent of jassid damage to number and weight of okra fruits could approach 54% [22].

Whitefly (*Bemisia tabaci* Gen.) was described over 100 years ago as a pest of tobacco in Greece. Since then, it has become one of the most important sucking pests of world's industrial and food crops like cotton, sunflower, melon, tomato, brinjal etc. Over 500 plant species from Asia, Africa, America, Europe, Russia, Australia and the Pacific Islands confirms its polyphagous nature [14].

Thrips are cosmopolitan and are found in all kinds of habitats or ecological zones like forests, grasslands, gardens and crops in the world [5]. *Thrips tabaci* has successfully exploited diverse niches due to their extraordinary adaptive ability. They have not only established themselves as phytophagous, mycophagous, carnivorous predators, gall makers, pollinators, and vector transmitter but also have survived on plant litter and in the bark of living and dead trees [8].

Thrips attack leaves, buds, flowers and even fruits of plants. Nymphs do more damage than adults [17] because they are more numerous and less mobile. Thrips not only cause feeding injuries but also cause oviposition damage to the plants [9].

Dusky cotton bug, *Oxycarenus* spp has become broad spread pest of economic importance. Both nymphs and adults feed on immature seeds of many crops causing many types of injuries to the crop including decreased in cotton yield, seed weight and oil contents. It causes severe damage to the embryo and reduces seed viability [25].

Keeping in view the importance of the subject, the present research work was conducted with following objectives:

1. Estimation of population of sucking insect pests, *e.g.,* aphid, jassid, whitefly, thrips and dusky cotton bug and also the population of beneficial insects *e.g.,* ladybird beetle and green lacewing on five sunflower varieties.
2. Comparison of yield of five varieties.

2. Materials and Methods

A field experiment was conducted to determine the screening of five sunflower varieties against sucking insect pests namely aphid, jassid, whitefly, thrips, and dusky cotton bug and the predators namely ladybird beetle and green lacewing. The experiment was carried out in March of year 2014 at the research farm, The Islamia University of Bahawalpur, Pakistan. Five varieties of sunflower namely Hysun-33, US-666, NK-Singi, Armoni and S-278 were sown in second week of March 2014 by dibbling method using the seed rate of 7.5 kg ha^{-1}. The plot size was (3 m × 2.5 m) = 7.5 m^2 for each variety and row-to-row distance was maintained at 60 cm while plant to plant distance was 25 cm. Treatments were replicated thrice in a Randomized Complete Block Design (RCBD). The crop was provided with 152 kg N, 100 kg P and 62 kg K ha^{-1}in the form of urea, DAP and sulphate of potash (SOP). No pesticides were used during experimental time (1). Data was recorded from the 11th of April, 2014 (35 days after sowing) on three-day interval till harvesting (110 days after sowing). For this purpose the samples of 12 leaves were randomly selected twice a week from upper, middle and lower parts of sunflower plants per plot. The average number of pests per plant for each variety was calculated.

2.1 Yield (kg ha^{-1})

One square meter containing six plants/heads per variety was harvested from each plot and per replication. Average yield was converted into kg per hectare and measured by the following formula (18).

$$\text{Seed yield (kg per ha)} = \frac{\text{Seed yield (kg)} \times 10000 \text{ (m.sq)}}{\text{Harvested area (m.sq)}}$$

2.2 Statistical Analysis

The data were subjected to analysis of variance and means were compared by Least Significance Difference test (LSD) at *P*=0.05. Correlation of population of pest insects and two beneficial insects was also done with weather factors (Temperature: Min & Max; Rainfall) to see the relationship of weather factors with population change during the season using the software Statistix 8.1 (26).

3. Results

According to analysis of variance, there was significant difference in jassid population on different sunflower varieties (Table 1; $P<0.05$). However there was also significant difference in the population of jassid on different dates of observations (Table 2; $P<0.05$).

According to LSD test for jassid population observed on different dates on five varieties, mean population was highest on 1st May (10th week of sowing) 55.66, while on 16th June (17th week of sowing) jassid mean population was lowest (1.00) with significant difference (Table 2; P=0.00).

The comparison for screening of five varieties for jassid population showed that the maximum population was recorded on US-666 (20.36) and minimum population was recorded on S-278 (16.43), with a significant difference in mean population of jassid on these varieties (Table 1; P=0.00).

According to analysis of variance, there was no significant difference in aphid population on different sunflower varieties (Table 1; $P>0.05$). However there was significant difference in the population of aphid on different dates of observations (Table 2; $P<0.05$).

According to LSD test for aphid population observed on different dates on five varieties, mean population was highest on 11th April (6th week of sowing) 3.40 while on 22nd May (13th week of sowing) aphid mean population was lowest (0.06) with significant difference (Table 2; P=0.00).

The comparison for screening of five varieties for aphids showed that the maximum population of aphid was observed on US-666 (0.51) and minimum population was recorded on NK-Singi (0.28), with no significant difference in mean population of aphid on these varieties (Table 1; P=0.43).

According to analysis of variance, there was no significant difference in whitefly population on different sunflower varieties (Table 1; $P>0.05$). However there was significant difference in the population of whitefly on different dates of observations (Table 2; $P<0.05$).

According to LSD test for whitefly population observed on different dates on five varieties, mean population was highest on 11th April (6th week of sowing) 16.13 while on 16th June (17th week of sowing) whitefly mean population was lowest (1.20) with significant difference (Table 2; P=0.00).

The comparison for screening of five varieties for whitefly showed that the maximum population of whitefly was observed on US-666 (8.50) and minimum population was recorded on Armoni (7.56), with no significant difference in

mean population of whitefly on these varieties (Table 1; P=0.22).

According to analysis of variance, there was no significant difference in thrips population on different sunflower varieties (Table 1; *P*>0.05) however there was significant difference in the population of thrips on different dates of observations (Table 2; *P*<0.05).

According to LSD test for thrips population observed on different dates on five varieties, mean population was highest on 11th April (6th week of sowing) 9.06 and on 29th May (14th week of sowing) thrips mean population was lowest (0.06) (Table 2; P=0.00).

The comparison for screening of five varieties for thrips showed that the maximum population of thrips was observed on US-666 (1.30) and minimum population was recorded on NK-Singi (1.00), with no significant difference in mean population of thrips on these varieties (Table 1; P=0.32).

According to analysis of variance, there was no significant difference in dusky cotton bug population on different sunflower varieties (Table 1; *P*>0.05), however there was significant differences in the population of dusky cotton bug in different dates of observations (Table 2; *P*<0.05).

According to LSD test for dusky cotton bug population observed on different dates on five varieties, mean population was highest on 1st May (10th week of sowing) 13.66 while on 12th June (16th week of sowing) dusky cotton bug mean population was lowest (0.13) (Table 2; P=0.00).

The comparison for screening of five varieties for dusky cotton bug showed that the maximum population of dusky cotton bug was observed on S-278 (3.08) and minimum population was recorded on NK-Singi (2.41), with no significant difference in mean population of whitefly on these varieties (Table 1; P=0.33).

According to analysis of variance, there was no significant difference in green lacewing population on different sunflower varieties (Table 1; *P*>0.05). However there was significant difference in the population of green lacewing on different dates of observations (Table 2; *P*<0.05).

According to LSD test for green lacewing population observed on different dates on five varieties, mean population was highest on 14th April (7th week of sowing) 2.66 while on 22nd May (13th week of sowing) June green lacewing mean population was lowest (0.06) (Table 2; P=0.00).

The comparison for screening of five varieties for predator green lacewing showed that the maximum population of the predator green lacewing was observed on Hysun-33 (0.33) and minimum population was recorded on Armoni (0.11), with no significant difference in mean population of green lacewing on these varieties (Table 1; P=0.22).

According to analysis of variance, there was no significant difference in ladybird beetle population on different sunflower varieties (Table 1; *P*>0.05). However there was a significant difference in the population of ladybird beetle on different dates of observations (Table 2; *P*<0.05).

According to LSD test for ladybird beetle population observed on different dates on five varieties, mean population was highest on 28th April (9th week of sowing) 18.00 and on 19th May (13th week of sowing) ladybird beetle mean population was lowest (0.06) (Table 2; P=0.00).

The comparison for screening of five varieties for predator ladybird beetle population showed that the maximum population of ladybird beetle was observed on US-666 (5.08) and minimum population was recorded on Hysun-33 (4.06), with no significant difference in mean population of lady bird beetles on these varieties (Table 1; P=0.19).

Correlation of weather factors (temperature and rainfall) (Table 4) with population of pests insects and predators showed that temperature (Min & Max) as well as rainfall had most of the time an inverse relationship (negative *r* value) with populations of these studied pests and predators (Table 3).

The average yield for the variety S-278 was highest (963 Kg hec^{-1}) and the variety Armoni had the lowest yield (699 Kg hec^{-1}) (Fig 1).

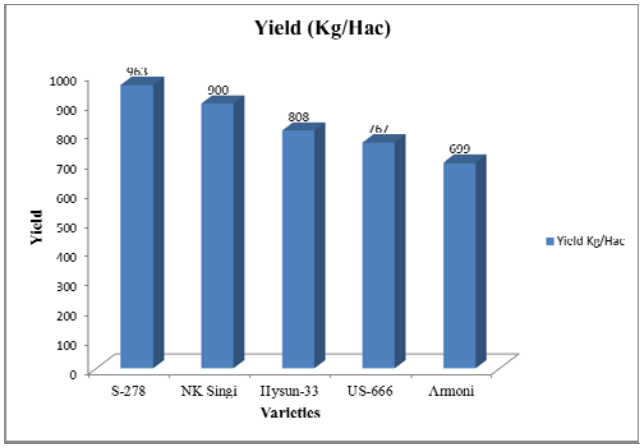

Fig 1: Yield (Kg/Hac) of sunflower in different sunflower varieties

4. Discussion

Current results regarding insect pest populations can be compared with other authors [6, 15, 4] for screening some sunflower varieties against different sucking insect pests in Pakistan. To compare current results with previous studies it shows difference in pest infestation level for different insects. Firstly because in previous studies different authors screened different set of varieties. Secondly pest infestation level was different. For example in a two years study in 2008 and 2009 [4] screening of sunflower varieties was done against different insect pests. In their results maximum population for aphid was 1.92 on variety FH-259 and minimum was 1.105 on FH-37. Maximum mean population for jassid was 1.09 on the variety FH-106 and minimum was 0.75 on FH-237. Maximum mean population for whitefly was 0.39 on variety FH-259 and minimum number of whitefly was 0.04 on variety FH-37. In current studies we had a different set of varieties. Present results showed per leaf pest population of jassid and whiteflies were much more than noted in previous studies by [4]. Current results showed highest mean number of jassid was recorded on US-666 as 20.36 and minimum mean number of jassid was 16.43 on the variety S-278 which was significantly less than on all other varieties. Population of aphids was found maximum on US-666 and minimum was on NK-Sinji ranging from 0.51 to 0.28. Population of aphids remained low (less than 1.0) on all varieties and with no significant difference in population was observed between varieties. Population of whiteflies was recorded maximum on US-666 and minimum population was on Armoni ranging from 8.50 to 7.56. Whitefly population per leaf remained less than jassid population and much more than aphids population but with no significant difference between varieties. Thrips population was found maximum on US-666 and minimum was observed on NK-Sinji ranging from 1.30 to 1.00 mean insects per leaf. This population was less than jassids and whiteflies but little more than aphids and with no significant difference between varieties. Dusky cotton bugs population was highest on S-278 and minimum was on NK-Sinji ranging from 3.08 to 2.41

mean insects per leaf and with no significant difference between varieties. Dusky cotton bugs population was less than jassid and whiteflies populations but more than aphids and thrips populations. Predator (green lace wing) population was highest on Hysun-33 and minimum found on Armoni variety ranging from 0.33 to 0.11 per leaf mean population and with no significant difference between varieties. Lady bird beetles population was highest in US-666 and minimum was on Hysun-33 ranging from 5.08 to 4.06 per leaf population with no significant difference between varieties.

In a similar type of study while screening 16 varieties of sunflower against sucking insect pests pest population difference to be noted for whiteflies with maximum 11.23 on the variety SF-177 and least on the variety 64-A-93 (0.43), highest aphid population 6.43 on variety SF-177 and least on the 64-A-93 (0.36) with significant difference (15). In contrast with this we had a different set of genotypes and highest population of whiteflies on US-666 as 8.50 and lowest on Armoni (7.56) in descending order with no significant difference.

Predators like *C. carnea* population ranged from 0.33 to 0.11 and lady bird beetle population was on US-666 (5.08) and minimum (4.06) on Hysun-33. More population of lady bird beetles on US-666 represent the predatory nature of this predator on varieties with more prey population for this predator on variety US-666 which had relatively more populations of pests like aphids, jassids, whiteflies and thrips. Predators have been shown to decrease pest population [2]. *C. carnea* population though was relatively more on Hysun-33 (0.33) but its population was negligible and difference was non-significant between varieties with minimum population of 0.11 on variety Armoni.

The crop was sown in spring season. Seasonal population dynamics of pests showed that population of jassids, aphids, whiteflies, thrips, dusky cotton bugs remained comparatively more in the month of April followed by their populations in moth of May and populations declined in June. This could be due to more temperature in later months coupled with senescence which crop faced at maturity. Sucking insects mostly rely on sap of plants which gradually decreased as crop approaches maturity.

Pest populations for different insects feeding on sunflower varied significantly with respect to different dates of observation. Insects are cold blooded animals and their body temperatures mainly depend upon temperature of their surroundings. These arthropods have limited temperature ranges of survival and reproduction. Therefore their population abundance might dependent on temperature ranges to which they can tolerate up to certain limits (Table 4).

Our results further showed insect populations varied as Jassids > Whiteflies > Coccinellids > Dusky cotton bugs > Thrips > Aphids > Green lacewing in descending order on sunflower. These results show relative importance of Jassids, whiteflies and dusky cotton bugs as pests while lady bird beetles as important predators. Pests like thirps and aphids and the predator green lacewings with relatively low population can be regarded as less important on sunflower in this area. Although the sucking insect pests in this research are polyphagous in nature but as different geographic locations have different set of environmental factors that can affect different arthropod populations in a different way. Therefore it would be important to evaluate different genotypes of sunflower under different geographic locations in a country simultaneously so as to see the effect of particular geographic location and its weather effect on these insect pests and predator populations.

Our results can be compared with those of [6]. They conducted a study on sunflower varietal screening for 14 varieties against different sucking insect pests at Pind Gondal. Hysun-777 gave the maximum yield (888.8 kg hec^{-1}) and Hysun-33 gave yield (500.00 kg hec^{-1}). In our studies, the average yield for the variety S-278 was highest (963 Kg hec^{-1}) and the variety Armoni has the lowest yield (699 Kg hec^{-1}).

Our results can also be compared with those of (23). They conducted a study on sunflower varietal screening for 5 varieties. Eggro-9704 gave the maximum yield (1002 kg hec^{-1}) and FH-75 gave yield (571 kg hec^{-1}). In our studies, we have a different set of the varieties. The average yield for the variety S-278 was highest (963 Kg hec^{-1}) and the variety Armoni has the lowest yield (699 Kg hec^{-1}).

Table 1: Comparison of sucking insect pests and predators populations on different sunflower varieties

Variety	Jassid	Variety	aphid	Variety	whitefly	Variety	thrips	Variety	Dusky Cotton Bug	Variety	*C. carnea*	Variety	Coccinellids
US-666	20.36a	US-666	0.51ns	US-666	8.50ns	US-666	1.30ns	S-278	3.08ns	Hysun-33	0.33ns	US-666	5.08ns
Hysun-33	20.08a	Armoni	0.48	Hysun-33	8.40	Hysun-33	1.30	Armoni	2.98	S-278	0.30	NK-Singi	5.01
Armoni	19.16a	S-278	0.45	NK-Singi	7.93	Armoni	1.18	US-666	2.78	NK-Singi	0.23	Armoni	4.68
NK-Singi	19.03a	Hysun-33	0.41	S-278	7.85	S-278	1.01	Hysun-33	2.51	US-666	0.21	S-278	4.63
S-278	16.43b	NK-Singi	0.28	Armoni	7.56	NK-Singi	1.00	NK-Singi	2.41	Armoni	0.11	Hysun-33	4.06
F	3.53	F	0.94	F	1.42	F	1.18	F	1.15	F	1.43	F	1.51
Df	4	Df	4	Df	4	Df	4	Df	4	Df	4	Df	4
P	0.00	P	0.43	P	0.22	P	0.32	P	0.33	P	0.22	P	0.19

Table 2: Comparison of sucking insect pests and predators populations on sunflowers varieties on different dates of observation

Dates	Means Jassids	Dates	Means aphids	Dates	Means white flies	Dates	Means Thrips	Dates	Means Dusky cotton bugs	Dates	Means *C. carnea*	Dates	Means Coccinellids
01-05-2014	55.66a	11-04-2014	3.40a	11-04-2014	16.13a	11-04-2014	9.06a	01-05-2014	13.66a	14-04-2014	2.66a	28-04-2014	18.00a
28-04-2014	50.00b	12-05-2014	3.20a	08-05-2014	14.46ab	01-05-2014	3.26b	11-04-2014	7.60b	21-04-2014	0.66b	17-04-2014	13.60b
24-04-2014	40.73c	19-05-2014	1.06b	14-04-2014	14.20b	12-05-2014	2.86bc	05-05-2014	7.13b	24-04-2014	0.46bc	21-04-2014	12.93b
21-04-2014	37.73c	14-04-2014	0.40c	01-05-2014	12.80bc	14-04-2014	2.26c	28-04-2014	5.20c	15-05-2014	0.26cd	11-04-2014	12.73b
12-05-2014	31.00d	15-05-2014	0.40c	21-04-2014	11.33cd	28-04-2014	2.13c	12-05-2014	3.86cd	11-04-2014	0.20cd	24-04-2014	10.46c
17-04-2014	29.86d	08-05-2014	0.06c	05-05-2014	11.20cd	24-04-2014	0.93d	08-05-2014	3.40d	28-04-2014	0.20cd	01-05-2014	10.33c
05-05-2014	28.80d	22-05-2014	0.06c	28-04-2014	11.20cd	21-04-2014	0.66de	14-04-2014	2.93de	17-04-2014	0.13cd	14-04-2014	9.33c
14-04-2014	22.53e	17-04-2014	0.00c	17-04-2014	10.60d	15-05-2014	0.66de	24-04-2014	2.40def	02-06-2014	0.13cd	05-05-2014	4.66d
08-05-2014	22.46e	21-04-2014	0.00c	29-05-2014	9.86d	26-05-2014	0.53de	21-04-2014	1.86ef	22-05-2014	0.06d	08-05-2014	0.86e
11-04-2014	13.93f	24-04-2014	0.00c	24-04-2014	9.73d	05-05-2014	0.40de	19-05-2014	1.60efg	01-05-2014	0.00d	12-05-2014	0.33e
15-05-2014	7.66g	28-04-2014	0.00c	26-05-2014	7.26e	08-05-2014	0.33de	17-04-2014	1.13fgh	05-05-2014	0.00d	02-06-2014	0.26e
02-06-2014	7.40g	01-05-2014	0.00c	22-05-2014	6.40ef	29-05-2014	0.06e	26-05-2014	1.13fgh	08-05-2014	0.00d	26-05-2014	0.20e
22-05-2014	6.06gh	05-05-2014	0.00c	02-06-2014	5.33f	17-04-2014	0.00e	22-05-2014	1.06fgh	12-05-2014	0.00d	22-05-2014	0.13e
26-05-2014	5.73ghi	26-05-2014	0.00c	12-05-2014	5.20f	19-05-2014	0.00e	02-06-2014	1.06fgh	19-05-2014	0.00d	19-05-2014	0.06e
19-05-2014	5.13ghi	29-05-2014	0.00c	09-06-2014	3.33g	22-05-2014	0.00e	15-05-2014	0.93fgh	26-05-2014	0.00d	15-05-2014	0.00e
05-06-2014	4.00ghi	02-06-2014	0.00c	19-05-2014	2.80gh	02-06-2014	0.00e	12-06-2014	0.13gh	29-05-2014	0.00d	29-05-2014	0.00e
09-06-2014	3.66ghi	05-06-2014	0.00c	12-06-2014	2.73gh	05-06-2014	0.00e	29-05-2014	0.00h	05-06-2014	0.00d	05-06-2014	0.00e
29-05-2014	2.60ghi	09-06-2014	0.00c	05-06-2014	2.60gh	09-06-2014	0.00e	05-06-2014	0.00h	09-06-2014	0.00d	09-06-2014	0.00e
12-06-2014	1.33hi	12-06-2014	0.00c	15-05-2014	2.60gh	12-06-2014	0.00e	09-06-2014	0.00h	12-06-2014	0.00d	12-06-2014	0.00e
16-06-2014	1.00i	16-06-2014	0.00c	16-06-2014	1.20h	16-06-2014	0.00e	16-06-2014	0.00h	16-06-2014	0.00d	16-06-2014	0.00e

Table 3: Correlation of population of insect pests and predators on sunflower with weather factors (Tem: Min & Max; Rainfall) under Bahawalpur Agro-ecological Conditions

	Jassids		Aphids		Whiteflies		Thrips		Dusky cotton bugs		Green lace wings		Lady bird beetles	
	r	P	r	P	r	p	r	p	r	p	r	p	r	p
Temperature Minimum	-0.5234	0.0179*	-0.3937	0.0859	-0.4065	0.0753	-0.5352	0.0150*	-0.3861	0.0927	-0.4959	0.0262*	-0.6967	0.0006*
Temperature Maximum	-0.3203	0.1686	-0.3984	0.0819	-0.1620	0.4949	-0.2827	0.2271	-0.1602	0.4998	-0.4120	0.0711	-0.3514	0.1287
Rainfall	-0.0649	0.7918	0.1504	0.5389	-0.2199	0.3658	-0.0342	0.8895	-0.1395	0.5690	-0.0255	0.9173	-0.1583	0.5173

* denote correlation is significant at p=0.05.

Table 4: Weather data (Temperature: Min & Max; Rainfall) of Bahawalpur on respective data recording dates of research trial during 2014

Date	Temperature Minimum (°C)	Temperature Maximum (°C)	Rainfall (mm)
11.4.2014	20.61	39.4	0
14.4.2014	21.74	37.71	0
17.4.2014	22.83	38.4	2.63
21.4.2014	21.58	36.81	0.28
24.4.2014	24.21	41.08	,04
28.4.2014	26.67	44.43	0
1.5.2014	26.73	44.57	0
5.5.2014	26.96	40.95	0
8.5.2014	27.81	42.03	0
12.5.2014	26.32	38.33	4.35
15.5.2014	27.88	35.3	14.09
19.5.2014	25.37	39.3	0
22.5.2014	26.44	45.22	0
26.5.2014	27.74	43.97	0
29.5.2014	30.59	48.21	1.15
2.6.2014	28.76	44.67	0
5.6.2014	31.88	48.07	0
9.6.2014	30.9	48.15	0
12.6.2014	31.77	43.75	0.14
16.6.2014	33.6	45.92	0

Source: Pakistan Meteorological Department

5. Conclusion

From these results it can be concluded that pest insects like jassids and whiteflies dominated other insects' populations. Lady bird beetles were recorded most often with more population than does green lacewings. Population of ladybird beetles was more on varieties with more pest populations representing their prey feeding trend on certain varieties over the other ones. As jassids population varied significantly on different varieties and it dominated pest populations it might have exerted more effects on yield of varieties like US-666 or Armoni and least effects on variety like S-278 which had least population of jassids and comparatively more yield than other varieties. Weather factors like temperature had inverse relationship with insect populations. In June when temperature is high the sunflower crop was also mature and had little sap to sustain sucking insect population which declined therefore in month of June. For yield effect, it is further recommended to include control treatments *e.g.,* wire house planting of genotypes under study to exclude pests and predators while screening against pest insects or predators to include any genetic factors that contribute towards yield when planted without insect pests and predators populations.

6. Acknowledgement

The authors acknowledged the provision of weather data, 2014 (Temperature: Min & Max; Rainfall) of Bahawalpur region from Pakistan Meteorological Department.

7. References

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