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COMPARING THE EFFECT OF DIFFERENT PLANT EXTRACTS WITH A CHEMICAL INSECTICIDE FOR MANAGEMENT OF THE APHID, *Aphis gossypii* IN SUNFLOWER

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ABSTRACT

A field experiment was carried out at New Developmental Farm (NDF), The University of Agriculture Peshawar, (34.01° N, 71.53° E) Khyber Pakhtunkhwa-Pakistan during 2012-13 to compare the effect of different plant extracts with a chemical insecticide for management of the aphids in sunflower. The sunflower hybrid Hysun-33 was sown as test crop under natural field conditions. Six different plant extracts viz, Azadirachta indica *oil,* A. indica *seed,* Parthenium hysterophorus*,* Allium sativum*,* Datura alba, Curcuma longa *along with chemical insecticide, Emamectin benzoate 1.9EC and un-treated check plot were tested against aphids infestation on sunflower. Data on mean population density of aphids were recorded on per leaf basis 24h before and then 24h, 48h, 72h and 168h after application of first and second spray. The results on the present study revealed that extract derived from the leaves of* D. alba *was the most successful treatment in term of population reduction of aphids after chemical insecticide Emamectin benzoate. In the remaining treatments, 2% oil of* A. indica *and 2.5% extract of* A. indica *seed also exhibited better results in comparison with other botanicals and un-treated control plot. It was found that 2.5% extract of* C. longa, Parthenium and Al. sativum *treatments did not produce encouraging results in suppressing aphid infestation, however, proved their supremacy over control plot.*

Key words: Aphid, *Aphis gossypii,* Plants extract, Chemical insecticide, control measures, sunflower.

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INTRODUCTION

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Sunflower (*Helianthus annuus* L.) locally known as Suraj-e-mukhi, belongs to the family Compositae. It is one of the most important oilseed crops worldwide and is sown on more than 23 million hectares area, with a net production of about 30 million tones Shirshikar (2005); Skoric *et al.,* (2007). In Pakistan, sunflower cultivation was introduced in 1960's in order to overpass the gap between consumption and production of edible oils in the country (Burney *et al.,* 1990). Currently sunflower (*H. annuus* L.) has witnessed enormous development in terms of area and production in Pakistan. However, this expansion is still insufficient for the growing population of the country. Edible oil produce locally meets only 20% the country demand, whereas the remaining 80% is met through import and a huge foreign exchange is being utilized each year for the export of edible oils. (PODB Annual Report, 2013-14). As per report, the import bill is approximately 2.84 million tons edible oil worth US $2.611 billion (Pak. Rs. 224 billion). This enormous increase in population will definitely require more and more edible oil, which has to be replaced from indigenous sources. Pakistan already pays a huge imports bill to meet up the constraint of oil utilization, which will become harder with the passage of time as the population grows (PODB Annual Report-2013).

The insect pest spectrum of sunflower is quite complex that has been one of the major threats to successful sunflower production. Many of these insect pests ultimately results in a huge yield-reducing issues in sunflower production throughout the world (Carl, 1990). Different species of aphids like *Aphis gossypii* and *Myzus persicae* etc are serious pests to several crops (Kataria *et al.,* 2012). Being polyphagous in nature, aphids attack a wide range of crops (Minks and Harrewijn, 1987) which infest fresh as well as mature leaves, stems and roots (Blackman and Eastop, 2000). Even numerous alternatives are accessible for the successful management of insect pests, however still our growers more often depend on common synthetic chemicals due to their immediate knock down consequence with or without knowing the hazards of these chemicals. In the past many research workers have also evaluated a number of synthetic insecticides against infestation of different pests, particularly against sucking pests on sunflower. The injudicious and frequent use of all these conventional insecticides led to ineffective control of the insect pests, which eventually resulted in severe yield losses. Majority of synthetic insecticides result in serious issues to health and environment safety, due to their extreme toxicity and long lasting perseverance (Kulkarni and Joshi, 1998). Under these circumstances, it became essential to discover certain eco-friendly substitutes for management of different insect pests. Zhang *et al.,* (2004) stated that botanical insecticides like

Datura, essential oils *(A. indica)* and other plant extracts have a numerous compensations i.e. minimum residual, least mammalian and non-target species toxicity etc. Botanicals insecticides and essential oils have a very complex chemical composition as compare to chemical insecticides, so there are minimum possibilities of resistance development in different insect species. Findings on efficacy of different plants extract in the current study are in

Keeping all these constraints in view, the present research project therefore endeavors to evaluate different plant extracts in combination with a synthetic insecticide for the management of the aphid, a polyphagous sucking pest associated with sunflower, under field conditions of Peshawar, Khyber Pakhtunkhwa, Pakistan.

MATERIALS AND METHODS

The present field experiment on comparing the effect of different plant extracts with a synthetic insecticide for management of the aphids in sunflower was conducted at research unit of New Developmental Farm (NDF), The University of Agriculture Peshawar Khyber Pakhtunkhwa-Pakistan for two consecutive years i.e. 2012-13. The research trial was carried out in Randomized Complete Block (RCB) design with eight treatment replicated four times. . Seeds of hybrid sunflower Hysun-33 were collected from local market and consequently sown as test crop. The experimental plot size was kept 3 x 3 m^2 with a space of 60 and 30 cm between rows and plants respectively. Total number of plants in each row was ten and thus, each plot had a population of 50 plants. Sowing of sunflower seeds at the rate of 2.5 kg per hectare was done manually on ridges by placing 3 seeds per hole to a depth of 3 cm from the soil surface in order to maintain optimum population in each test-plot. All the recommended agronomic practices were applied equally for vigorous growth of plants during the course of study. Soon after emergence, excess seedlings of sunflower were carefully thinned out for getting optimum plant population. In order to drain out excess water, appropriate drainage system was also developed in the field. Extract of different locally available plants were prepared and sprayed on each test-plot along with synthetic chemical insecticide. For imposition of different spray materials, knapsack sprayer of high volume was used. Two sprays were applied on need basis. Treatments were applied uniformly to all test-plots according to the recommended dose after the occurrence of aphids reached the economic threshold level.

The treatments used were as follows, T1 = Emamectin benzoate 1.9EC @ 0.07% Concentration, T2 = *Azadirachta indica* oil (Neem) @ 2% Concentration, T3 = *Azadirachta indica* seed Extract (Neem) @ 2.5% Concentration, T4 = *Parthenium hysterophorus*

Extract (Congress grass) @ 2.5% Concentration, T5 = *Allium sativum* (Garlic) Extract @ 2.5% Concentration, T6 = *Datura alba* Extract (Datura) @ 2.5% Concentration, T7 = *Curcuma longa* (Turmeric) Extract @ 2.5% Concentration, T8 = Un-treated check plot.

Data collection

The population density of aphids was recorded by observing the three leaves (one each from top, middle and bottom portion) from randomly selected five plants in each plot and transformed on per leaf basis. Data on incidence of aphids were recorded 24 hours before and then 24, 48, 72 and 168 hours after the application of spray materials. The average population density of aphids on sunflower from the sprayed test-plots were assumed as indirect reflection of efficiency of the plant extracts and chemical pesticide. Thus, a lowest mean incidence of aphids after imposition of spray materials reflected excellent efficacy of the treatments and vice versa.

Preparation of plant extracts

Emamectin benzoate and *A. indica* oil were purchased from the local market, whereas the plant based materials were first brought to the laboratory and shade dried. After which they were ground by using electric blender and later on were sieved through kitchen strainer. Selected plant materials were extracted with distilled water and the residue from the botanical extracts were dried for further evaporation of the solvent and the residue was collected in separate containers for onward application against aphids on sunflower.

Preparation of concentrations

Crushed neem seed of 100 g with 5 g detergent were put in muslin cloth and placed in 1 liter boiled water. The seed remained in the water for 24 h which gave 10% solution of neem seed extract. Concentration was made using formula: $V_1C_1 = V_2C_2$, where, V_1 = volume of water which is required, V_2 = volume of known quantity, C_1= given concentration, C_2= required concentration

The required concentration of extracts was made by using the following formula:

$$C1V1 = C2V2$$

Where C1 = given concentration, V1 = volume of water which is required, C2 = required concentration, V2= volume of known quantity of water

Statistical analysis

The collected data was analyzed by using statistical software, Gen-Stat edition 3rd. Least significance test was also performed in order to separate means when the F- test was significant.

RESULTS AND DISCUSSION

Population density of aphids associated with sunflower Hysun-33 after first spray

The relative population dynamics of aphids from un-treated check plot is furnished in table 1. The data regarding incidence of aphids expressed that 24h before imposition of treatments, the frequency of aphids were more or less same in each block with no considerable variation among their incidence. However, after 24h of application of first spray materials it was found that their population density was significantly affected by various treatments. The average population of aphids was significantly the lowest (1.75 per plant) in plots treated with emamectin benzoate, followed by extract of *D. alba* with minimum incidence of 2.62 aphid per leaf Similarly, *A. indica* oil 2% and *A. indica* seed extract 2.5% were also found effective in suppressing aphid infestation (3.02 and 3.63 aphid per leaf respectively.

Extract of *C. longa* showed a population of 4.32 aphids per plant, whereas *Parthenium* and *Al. sativum* were found the least effective treatments by recording higher incidence of 5.82 and 4.97 aphids per plant respectively. Un-treated check plot was observed with highest (11.61) mean population of aphids per leaf, which was significantly different from all treatments. The same trend was true for data recorded after 48h of first spray where the lowest numbers of aphid (1.38) per leaf was observed in emamectin benzoate treatment, followed by *D. alba* with average population density of 2.00 aphids per leaf. However, both treatments were significantly varied from each other. Test-plots treated by *A. indica* oil and *A. indica* seed extract showed 2.80 and 3.27 numbers of aphids per leaf respectively followed by *C. longa* (3.87). *Parthenium* and *Al. sativum* did not show encouraging results in reducing population of aphids and recorded high frequency of 5.30 and 4.78 aphids respectively. Highest incidence of 12.00 aphids per leaf was observed in control plots.

Similarly, data recorded after 72h, showed that chemical pesticide, emamectin benzoate was the most effective treatment by counting significantly lowest (1.02) occurrence of aphid per leaf , which was followed by *D. alba* (1.55) treated plot. The oil of *A. indica* and extracts of *A. indica* seed also proved their efficacy in suppressing aphid's counts up to 2.56 and 3.05 per leaf respectively, followed by an average population of 3.35 aphids per leaf in *C. longa* treated plots. Un-treated control plot showed maximum population of aphid (12.28 per leaf) which was significantly higher than all other treatments and was followed by *Parthenium* and *Al. sativum* treatments by showing mean incidence of 5.01 and 4.40 aphids per leaf respectively. After 168h of application of first spray, the data on incidence of aphids

expressed that significantly least (0.75) numbers of aphid was observed on emamectin benzoate treatment followed by an average incidence of 1.27 aphids per leaf in *D. alba* treated plots. Similarly, population of aphids was recorded as 2.31 and 2.63 per plant in *A. indica* oil and *A. indica* seed extract treated test-plots, which was significantly different from each other and other treatments as well. Maximum population (5.22 and 4.55 aphid/leaf) was shown by *Parthenium* and *Al. sativum* plots followed by *C. longa* treated plots with an average incidence of 3.53 aphids per leaf. Control plot showed highest (12.71) numbers of aphid, which was significantly different from all treatments.

Table-1. Evaluation of different plants extracts and a chemical pesticide against aphids on sunflower Hysun-33 after first spray during 2012-13

Treatments	24 HBS	24 HAS	48 HAS	72 HAS	168 HAS
Emamectin benzoate	11.48 b	1.75 h	1.38 h	1.02 g	0.75 h
A. indica oil	11.62 a	3.02 f	2.80 f	2.56 e	2.31 f
A. indica seed extract	11.45 b	3.63 e	3.27 e	3.05 d	2.63 e
A. sativum extract	11.58 a	4.97 c	4.78 c	4.40 c	4.55 c
Parthenium extract	11.73 a	5.82 b	5.30 b	5.01 b	5.22 b
D. alba seed extract	11.88 a	2.62 g	2.00 g	1.55 f	1.27 g
C. longa extract	11.15 b	4.32 d	3.87 d	3.35 d	3.53 d
Control	11.46 b	11.61 a	12.00 a	12.28 a	12.71 a

In columns, means followed by same letter(s) do not differ significantly at P = 0.05% level of significance

HBS = Hours before spray, HAS = Hours after spray

Population density of aphids associated with sunflower hysun-33 after second spray

Data on efficacy of different plant extracts and a chemical pesticide on reduction of aphid's counts is given in table 2. After 24h of second spray, emamectin benzoate treated plot produced significant results in term of lowest population of aphid (1.71) followed by *D. Alba*, with average occurrence of 2.37 aphid per leaf. The next best treatments were concentration of *A. indica* oil and extract of *A. indica* seed with mean population density of 3.15 and 3.67 aphid per leaf respectively. However, these treatments differed significantly from

each other and remaining treatments. Intermediate (4.15) number of aphids was recorded in *C. longa* treated plots, whereas maximum (6.00 and 5.38) incidence of aphids per plant was observed in *Parthenium* and *A. sativum* treated plots. The highest (10.76) population of aphid per leaf was recorded in un-treated check plot, which was statistically the highest compared to all other treatments. After 48h of second spray, the data revealed that emamectin benzoate showed lowest counts of aphid (1.38) which was significantly different from all treatments followed by *D. alba* with average numbers of 2.02 aphids per leaf. Similarly, concentration of *A. indica* oil and extract of *A. indica* seed treated plots were ranked third by showing average density of 3.15 and 3.67 aphids per leaf respectively. *Parthenium*, *A. sativum* and *C. longa* treatments were found least effective in reducing mean number of aphids by recording 5.71, 5.10 and 3.86 aphids per leaf respectively. However, extracts of these botanical treatments showed good results in comparison with control plots, where highest (10.76) population of aphid per leaf was observed. Likewise after 72h, results on population density of aphid revealed that emamectin benzoate and *D. alba* were most successful treatments, which considerably suppressed incidence of aphid to a minimum level of 1.10 and 1.88 per plant respectively. However, both treatments significantly varied from each other. Moreover, average number of aphid was recorded as 2.55 and 3.13 per plant on *A. indica* oil and *A. indica* seed extract treatments followed by *C. longa* (3.61).

Significantly, higher but below ETL incidence of aphid (5.55 and 4.77 per leaf respectively) was observed in extracts of *Parthenium* and *Al. sativum* treated plots. The un-treated check plot manifested maximum mean counts of aphids (11.42) per leaf that was significantly different from all other treatments. Data recorded after application of second spray revealed that considerably lowest (0.78) numbers of aphid was counted in emamectin benzoate treatment followed by *D. alba* by observing average number of 1.45 aphids per leaf. Similarly, average incidence of aphids was recorded 2.86 and 2.28 per leaf in test-plots treated by *A. indica* oil and *A. indica* seed extracts, whereas intermediate mean number (3.75) of aphid per plant was recorded in *C. longa* treated plots. Un-treated check plot found with highest (11.75) mean counts of aphids, which was further followed by another high (5.73 and 4.85) incidence of aphids per plant in *Parthenium* and *Al. sativum* treated-test plots.

Table-2. Evaluation of different plants extracts and a chemical pesticide against aphids on sunflower Hysun-33 after second spray during 2012-13

Treatments	24 HBS	24 HAS	48 HAS	72 HAS	168 HAS
Emamectin benzoate	10.58 b	1.71 h	1.38 h	1.10 h	0.78 h
A. indica oil	10.56 b	3.15 f	2.86 f	2.55 f	2.28 f
A. indica seed extract	10.75 a	3.67 e	3.35 e	3.13 e	2.86 e
Al. sativum extract	11.00 a	5.38 c	5.10 c	4.77 c	4.85 c
Parthenium extract	10.67 b	6.00 b	5.71 b	5.55 b	5.73 b
D. alba extract	10.87 a	2.37 g	2.08 g	1.88 g	1.45 g
C. longa extract	10.71 a	4.15 d	3.86 d	3.61 d	3.75 d
Control	10.50 b	10.76 a	11.22 a	11.42 a	11.75 a

In columns, means followed by same letter(s) do not differ significantly at P = 0.05% level of significance

HBS = Hours before spray, HAS = Hours after spray

It became evident that the effect of all treatments was significant in reduction of aphids' density after 24h, 48h, 72h and 168h after application of first and second spray. The results on present study revealed that the average incidence of aphid was significantly controlled during the above-mentioned time intervals as against un-treated check plot, where no spray material was imposed. Following, synthetic insecticide emamectin benzoate, extract of *D. alba* proved to be the most excellent plant-based indigenous insecticide, followed by oil of *A. indica* and extract of *A. indica* seeds.

It has been observed that many research workers have previously developed techniques of making homemade extracts from locally available weeds and plants like *Datura, Parthenium*, garlic and many others for the successful management of insect pests. These botanical insecticides are eco-friendly, safe to non-target species, easily available and above all are very low in cost. The current results regarding successful suppression of aphid by emamectin benzoate are in line with the previous works reported by Udikeri *et al.,* (2004). Isman (2006) further reported that plant extracts are naturally slow acting substances and are mostly safer to non-target organisms and to environment as compare to chemical pesticides. Our results are also in conformity with that of close conformity with the previous observation of Khan *et al.,* (2011) who studied and evaluated the efficacy extracts from crude leaves *D. alba* for the control of American cockroach, *Periplanta americana* and Khan *et al.,* (2013) resulted that 2%

concentration from extracts of neem and datura showed effective results against the population of jassids, *A. devastans* (Dist.), thrips, *T. tabaci* and whiteflies, *B. tabaci*.

CONCLUSION

On the base of present research findings, it can be concluded that various plant extracts, *D. alba, A. indica* oil and *A. indica* seed extract @ 2 and 2.5% concentrations respectively were found efficient in controlling the population density of aphids associated with sunflower. Therefore, these plant-based insecticides are recommended to be used for the effective management of aphids in sunflower, due to minimum environmental and health hazards unlike conventional chemical pesticides.

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