Varietal Evaluation and Testing of Synthetic Insecticides Against Peach Aphids (*Myzus Persicae* Sulzer) Under Field Conditions at Ari, Mingora Swat

Arsalan Arif[1], Muhammad Salim[1], Hayat Ali Shah[1], Ahmad Ur Rahman Saljoqi[1], Shahid Sattar[1] and Amjad Usman[2]

[1]Department of Plant Protection, Faculty of Crop Protection Sciences, The University of Agriculture, Peshawar, Pakistan.

[2]Department of Entomology, Faculty of Crop Protection Sciences, The University of Agriculture, Peshawar, Pakistan.

Correspondence:ansiarsalan@gmail.com, muhammadsalim@aup.edu.pk

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The current study was carried out at Agricultural Research Institute Swat in order to evaluate the resistance of different peach cultivars to green peach aphid's infestation and the efficacy of different synthetic insecticides against peach aphids (*Myzus persicae* Sulzer) during peach season, 2022-23. The study comprised different experiments such as the evaluation of peach cultivars (Coronate, Florida gold, No 4 Flame, China No 5 and A-69 against peach aphid infestation, percent parasitism data collection, and testing of different synthetic insecticides (Bifenthrin, Chlorpyrifos Imidacloprid, and Matrine) against Myzus persicae. The treatments of all the experiments were arranged in a randomized complete block (RCB) design. The green peach aphids populations were significantly different among the tested cultivars. Among the tested cultivars, A-69 was found resistant having a lower infestation of green peach aphids, while peach cultivar Coronate was observed as highly susceptible having the maximum number of aphids per leaf. Data regarding the mean percent parasitism of peach aphids showed that a significantly higher percentage of parasitism per leaf (9.00) was observed in peach cultivar Florida gold, followed by Coronate (8.00). While peach cultivar on cultivars China No. 5 (5.00) and No. 4 flame (7.00) exhibited lower mean percent parasitism of aphids per leaf. Similarly, the maximum yield in kg/tree was recorded in A-69 (76.00) followed by China No.5 (75.00) and No. 4 Flame (73.00). The Florida gold showed a minimum value in terms of yield in kg/tree (45.50) followed by Coronate (46.00 kg/tree). Similarly, the application of different insecticides significantly controlled green peach aphid's infestation. During the entire season, the application of imidacloprid and bifenthrin effectively minimized the infestation of green peach aphids per leaf. However, a higher mean number of aphid's were found in untreated controlled plots. Based on the experimental results, peach cultivar A-69 and insecticides (imidacloprid and Bifenthrin) are recommended to the farmers for effective control of Myzus persicae in peach orchards under the agro-ecological conditions of Swat Valley.

Keywords: Peach, Aphids, Swat, Imidacloprid, Varieties.

Introduction:

Peach (*Prunus persica* Batsch.), botanically belongs to the family Rosaceae. After Plum, peach is the 2nd valuable fruit in Pakistan. Peach is native to China, grown in temperate regions across the world it can be yellow, red, pink, and pale and is regarded as the queen of fruits in these growing regions of the world [1][2]. Peaches were the first time grown in China for about 4000 years ago. The name *Persica* refers to the large-scale cultivation of peach in Persia (Iran), from where it was transplanted to the continent of Europe[3]. Due to chilling requirements mostly, it is cultivated in temperate areas of the world [4]. Peaches have a sweet flavor and 100 g of peaches provide 39 calories of energy, essential vitamins i.e. Vitamins C, A, and E and minerals such as potassium, magnesium, phosphorus, manganese, zinc, and iron. China produced 58% of peaches and nectarines in the world. The top five countries in the world with the highest production of peaches are China which produced 14.4 million tons, followed by Spain with production of 1.5 million tons, Italy produced 1.4 million tons and the United States of America produced 0.9 million tons [5]In Pakistan, Peaches are grown in cold and temperate areas of Khyber Pakhtunkhwa which include district Swat, Malakand, Hazara division, Mardan, Peshawar, tribbles districts (Waziristan, Kurram Agency) and upland valleys of Quetta (Baluchistan). Pakistan annually produces 66792 tons of peaches. The total area in Khyber Pakhtunkhwa under peach is 7649 hectares with 48499 tons of production which contributes about 73% production to that of the country's production (MINFALL, 2020-21). Peaches are a rich source of vitamins A and C, iron, and calcium which help cure various disorders and diseases of the skin, vision, and nervous system. Its minerals contribute to the strength of the immune system whereas its fiber plays a role in digestion [6]. 100 g of peach slice contain 89% water, 10% CHO, 0.6% protein, 0.6% fiber, 0.1% fat and provide 39 calories of energy [7]. Fruit flies, peach curl aphids, San Jose scale, and green peach aphids are the major insect pest of peaches. The peach tree is the primary host of green peach aphids (*Myzus persicae* Sulzer) and is thought to be one of the important pests of peach which transmit viral disease in disease free area [8][9]In the time being, it is also the vector of plum pox virus [10]. *Myzus persicae* sucks sap from the peach leaves and leads toward distortion of shoot and blossom's fall. These aphids secrete dew on plant parts which promote fungus growth such as sooty mold, black fungi which interrupt the photosynthetic activity of plant [8]. Further, it also spoils and reduces the market values of fruit [11]. Green peach aphids are widely studied and investigated pest but still there is a gap to be filled [10]. This pest has the ability to develop resistance to various insecticides [12][13]. *Myzus persicae* infestation symptoms vary in degree from leaf curling to destruction of fruits while additionally, it affects the vegetative growth of the host plant [14]. Due to severe infestation of *M. persicae,* the infested parts lead to deformed stems and leaves, which alternatively shoots and buds of the host plant. Ultimately, it causes an extreme reduction in production [15]. There are other species of aphids like black and brown peach aphids, which are considered important pests of peach in many countries of the world like Europe, Africa, the Eastern Mediterranean, Southeast Asia and the Middle East [16].Among different management techniques, Host Plant Resistance (HPR) is environment-friendly management practice for eradicating of the pest. But still, there is a problem of resistant breaking in aphid species toward hosts [17]. Due to the insufficient efficiency of biological and chemical control; various HPR have been screened for peach aphid within *Prunus* genus [18]. HPR has been recorded as one of the best management practices for green peach aphids. But still there is a gap which should be filled for the screening of *Myzus persicae* [19][20].Among the several management methods for pest control, natural plant host resistance was thought to be more effective techniques and importantly it is accepted globally. It adapts natural resistance mechanism for green peach aphids control [21]. Wide categories of chemicals have been used for the management of *M. persicae.* Synthetic insecticides are the easiest and cheapest method of aphid control in peach orchards. The adaptation of these methods helped in pest eradication and attaining maximum peach fruit production. Usually,

aphids are controlled by means of insecticides, but it mostly depends upon the mode of action of insecticides. These are used as repellants, baits, attractants, and cover sprays. Some examples of insecticides are Chlorpyriphos, Talstar (Bifenthrin), Mospilon (Acetamiprid), Calypso (Thiacloprid), Polo (Diafenthiruon), Lorsban, Confidor (Imidacloprid) and plenum [22]. Therefore, this study aimed to evaluate the resistance of different peach cultivars to *Myzus persicae* (green peach aphid) infestation and to assess the efficacy of various chemical insecticides in managing aphid populations under the agro-ecological conditions of the Swat Valley.

Novelty:

This research is the first to document the population dynamics of aphids and their associated natural enemies across different peach cultivars in Swat. It identifies Peach cultivar A-69 as resistant to green peach aphid infestation, exhibiting lower aphid populations and higher yields compared to other cultivars. This finding highlights A-69 as a suitable variety for commercial cultivation in the Swat Valley's agro-climatic conditions. Furthermore, the study demonstrates that Imidacloprid and Bifenthrin are highly effective insecticides for managing aphid infestations, providing practical recommendations for integrated pest management in peach orchards.

Materials and Methods:

A field study entitled "Varietal evaluation and testing of synthetic insecticides against peach aphids (Myzus persicae Sulzer) under field conditions was carried out at the Agricultural Research Institute Mingora, Swat during the summer of 2022. The average daily temperatures in Swat, Pakistan, ranged from approximately 3°C in January to 26°C in June and July, showing significant seasonal variation. The relative humidity varied throughout the year but typically hovered around 37% in drier months like December and was higher during the monsoon season, which spans July and August, due to increased rainfall and cloud covering. The methodology of the various experiments is illustrated in the schematic diagrams as below.

Methodology:

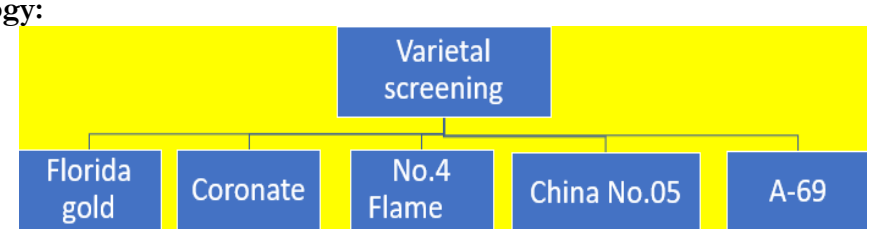

Figure 1. Schematic Diagram for the Data Collection Aphids & Percent Parasitism

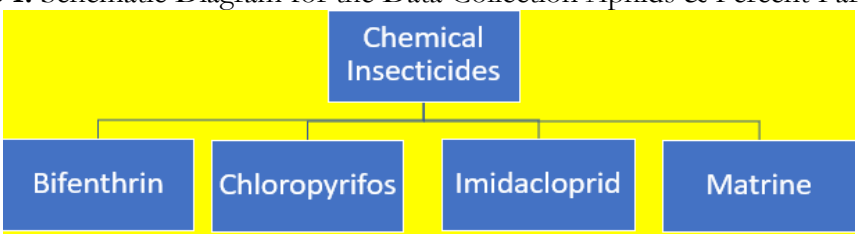

Figure 2. Schematic Diagram for Data Collection Aphids following insecticides applications

Experiment No 1:

Resistance Of Peach Cultivars Against Green Peach Aphid:

A peach orchard having all five peach cultivars namely Florida Gold, Coronate, No.4 Flames, China No.5, and A-69 covering an area of 2 acres were selected for the study. Three Peach trees (6-8 years old) of each variety were randomly selected and monitored on a weekly basis for *M. persicae* aphid infestation. The peach orchard was established with a spacing of 12–15 feet between plants and 18–20 feet between rows to ensure optimal sunlight exposure, air circulation, and ease of orchard management. Effective agronomic practices including regular irrigation, balanced fertilization (250:125:125 grams of NPK per tree), and annual pruning are

done to maintain an open canopy structure and improve fruit quality. The layout of the experiment is presented in Table 1.

Table 1. Field lay out of the experiment.

R I	R II	R III
Florida Gold	Coronate	No.4 Flame
Coronate	No.4 Flame	China No.5
No.4 Flame	China No.5	A-69
China No.5	A-69	Florida Gold
A-69	Florida Gold	Coronate

Data collection:

Data on peach aphids' population was collected on three different trees of each variety. One peach tree (6-8 years old) was randomly selected per replication. Three leaves, i.e. bottom, middle, and top of the selected plant were randomly tagged on four sides i.e. North, South, East, and West. Just after sprouting, the experimental field was frequently visited on a weekly basis to observe green peach aphid (*Myzus Persicae*) pest infestation. On noticing the infestation, the data on *M. persicae* were recorded over the tagged portion of the leaves with the interval of one week till fruit harvesting. Three trees (replications) per treatment were selected using a Randomized Complete Block Design. This experimental design was chosen to manage variability caused by factors like differences in microclimatic conditions (temperature, humidity), soil properties, and management practices across the experimental field. Based on the aphid population, the peach cultivars were grouped as resistant, tolerant, and susceptible.

Experiment No. 2:

Percent Parasitism of Green Peach Aphids, Myzus persicae in Different Peach Varieties:

To find the percent parasitism of *M. persicae*, 20 curled leaves (aphid infested) per tree per replication were randomly plucked fortnightly from all of its four sides i.e. north, south, east, and west. Mummies from these leaves were removed and kept in a petri dish for the emergence of parasitoids. The leaves along with leftover live aphids were counted and kept in Jars containing two filter papers 8 × 12 cm for moisture absorption. The Jars were covered with muslin cloth and the conversion of aphids into mummies watched for 7 days. The newly formed mummies were regularly shifted into petri dishes for parasitoid emergence. The percentage parasitism was calculated using the formula described by [23][24].

Experiment No.3:

Field Efficacy of Different Chemical Insecticides:

Peach trees of Florida Gold, Coronate, No.4 Flame, China No.5 and A-69 varieties were randomly sprayed with four different insecticides (Table 1) i.e. Legend (Matrine), Talstar (Bifenthrin), Lorsban (Chloropyrifos) and Confidor (Imidacloprid) on noticing of green peach aphids infestation, using an appropriate method of Randomized Complete Block Design, while these treatments were replicated three times. An untreated control was also kept in this experiment. Data on the mean number of *M. persicae* was recorded before and after 24 hours, 48 hours, 72 hours, one week, two weeks, and three weeks of insecticide application.

Table 2: Trade name, constituent, and recommended dosage of each insecticide used in the experiment.

Name of Insecticide	Constituent	Dosage
Legend	Metrine	150 mL/100 Liter
Confidor	Imidacloprid	60 mL/100 Liter
Lorsban	Chlorpyrifos	150mL/100 Liter
Talstar	Bifenthrin	125 mL/100 Liter

Statistical data analysis:

The data regarding the various parameters were analyzed using analysis of Variance

through the statistical software "Statistics 8.1". The means were compared using the least significance differences (LSD) test at P≤0.05 level of significance.

Results:

The results of varietal resistance of peach cultivars and chemical insecticides against green peach aphids are described below.

Host preferences of green peach aphids:

Data regarding the host preferences of green peach aphids against different peach cultivars is shown in Table 3. The data regarding the host preferences of peach aphids showed that significantly different aphid populations were observed on different peach cultivars ($P \leq 0.05$). A comparison of mean data exhibited that a higher mean number of aphids (12.00) per leaf was recorded for peach cultivar "Florida gold" in the last week of February which was statistically similar to the mean number of aphids population (10.60) per leaf No. 4 flame. These cultivars were followed by Coronate and China no.5 with (10.30) and (8.6). However, the lowest mean number of aphid population (8.30) per leaf was recorded for peach cultivar A-69. Comparison of the mean data analysis further shows that a significantly higher number of aphid's population (21.60) per leaf was recorded for peach cultivar Florida gold during the 1st week of March, followed by Coronate (31.70), while intermediate aphid's population per leaf was recorded for peach cultivars China No. 5 (17.00) and No. 4 Flame (19.00). The results further show a lower number of aphid's population (8.60) per leaf for peach cultivar A-69. The data further reveal that aphid population maximum (63.60) per leaf recorded on the peach cultivar Florida gold during the last week of March, followed by cultivar Coronate (62.00), while a moderate aphid's population was observed for cultivars China No. 5 (56.30) and No. 4 flame (58.30). While minimum aphid population (47.60) $leaf^{-1}$ was recorded for cultivar A-69. Data analysis of the last week of April revealed significant differences in aphid's population per leaf among the tested peach cultivars. Mean data comparison depicted that the maximum aphid's population was observed for peach cultivar Florida gold (36.30), followed by Coronate (31.30). While peach cultivar on cultivars China No. 5 (56.30) and No. 4 flame (43.30) exhibited an intermediate aphid's population per leaf. In addition, peach cultivar A-69 (17.00) displayed the lowest aphid's infestation among the tested cultivars.

Analysis of variance pertaining to seasonal aphid's infestation per leaf exhibited highly significant differences among the tested peach cultivars. The mean data comparison reveals that the highest aphid's population per leaf was observed for the peach cultivar Florida gold (40.20), which was found statistically at par with the peach cultivar Coronate (37.20), these were followed by China No. 5 (31.00) and No. 4 flame (34.40). However, a lower aphid's population per leaf was noted for peach cultivar A-69 (24.50).

Treatments means within columns followed by different letters are significantly different at $P \leq 0.05$.

Table 4 pertaining to the data regarding the yield of different varieties shows that the maximum yield in kg/tree was recorded in A-69 (76.00) followed by China No.5 (75.00) and No. 4 Flame (73.00). The Florida gold showed a minimum value in terms of yield in kg/tree (45.50) followed by Coronate (46.00 kg/tree).

Table 3: Population of Myzus persicae per leaf on different peach cultivars at ARI, Mingora, Swat during summer 2022.

Peach Cultivars	February 2022	March 2022				April 2022	May 2022	Seasonal Population Means
	Week IV	Week I	Week II	Week III	Week IV	Week I Week II Week III Week IV	Week I Week II	
Florida gold	12.00 a	21.60 a	47.60 a	44.60 a	63.60 a	71.30a 64.00 a 49.00 a 36.30a	19.60a 13.30a	40.20
Coronate	10.30abc	20.00 ab	45.00 b	44.00 a	62.00a	68.60ab 53.00b 47.30 a 31.30b	16.60ab 11.30a	37.20
No. 4 Flame	10.60 ab	19.00b	36.00 c	43.00 a	58.30b	69.00 ab 55.00 b 45.00a 27.30c	11.60bc 3.60b	34.40
China No. 5	8.60 bc	17.00c	33.00 d	42.60 a	56.30 b	66.00b 46.30 c 37.00b 22.60d	9.00c 3.00b	31.00
A-69	8.30 c	8.60 d	21.00 e	34.30b	47.60 c	54.30c 43.60 c 32.30c 17.00e	2.00d 1.00b	24.50
LSD (P<0.05)	2.17	1.78	2.50	6.54	3.61	4.28 4.65 4.5 1.89	5.87 3.69	3.77

Table 4: Yield of different peach verities in kg/tree at agriculture research station Mingora swat during, 2022.

Varieties	Yield in kg/tree
Florida gold	45.333 b
Coronate	46.500 b
No. 4 Flame	73.000 a
China No. 5	74.667 a
A-69	74.667 a

This means that columns followed by different letters are significantly different at P ≤0.05.

Percent parasitism of green peach aphids, *Myzus persicae* in different peach varieties during 2022:

Data regarding the mean percent parasitism of peach aphids at different peach cultivars is shown in Table 5. The statistical analysis of the data revealed that the percent parasitism of green peach aphids was significantly ($P \leq 0.05$) different among the tested peach cultivars. A comparison of mean percent parasitism data exhibited that higher mean percent parasitism (14.00) per leaf was recorded for peach cultivar "Coronate" in the last week of February followed by significantly lower percent parasitism data of 13.00 in Florida gold and No. 4 Flame. However, significantly lowest mean percent parasitism data (11.00) per leaf was recorded for peach cultivar A-69. Comparison of the mean data analysis further shows that higher aphids parasitism (17) per leaf was recorded for peach cultivar Coronate followed by China No. 5 (16), Florida gold, and A-69 peach cultivar with 15.00 percent parasitism during 1st week of March 2022. The statistical analysis of the data further revealed that the percent parasitism was maximum (24.00) per leaf was recorded on peach cultivar China No. 5 during the last week of March, followed by cultivar Florida gold and A-69 (15.00) each, while significantly lower mean percent parasitism was observed in peach cultivar Coronate (11.00). Data analysis of the last week of April revealed that significantly higher mean percent parasitism of peach aphids per leaf (9.00) was observed in peach cultivar Florida gold, followed by Coronate (8.00). While peach cultivar on cultivars China No.5 (5.00) and No. 4 flame (7.00) exhibited lower mean percent parasitism of aphid per leaf. Analysis of variance about the seasonal mean percent parasitism per leaf exhibited highly significant differences among the tested peach cultivars. The mean data comparison revealed that the highest mean percent parasitism per leaf was observed for the peach cultivar Florida gold (16.3), followed by peach cultivar Coronate (15.00), these were followed by China No 5 (12.00) and No. 4 flame (13.3). However, lower mean percent parasitism per leaf was noted for peach cultivar A-69 (1.62)

Table 5: Weekly mean percent parasitism of peach aphids, *Myzus persicae* at ARI, Mingora, Swat during summer 2018.

Peach Cultivars	February 2022	March 2022				April 2022	May 2022	Seasonal Population Means
	Week IV	Week I	Week II	Week III	Week IV	Week I Week II Week III Week IV	Week I Week II	
Florida gold	13.00b	15.00 bc	14.00ab	16.00a	15.00b	30.00 a 25.00a 12.0a 9.00 a	19.0a 10.6a	16.32
Coronate	14.00a	17.00a	16.00a	12.00b	11.00c	26.00b 23.00a 9.0 a 8.00a	17.0b 10.0a	15.00
No. 4 Flame	13.00b	14.00 c	14.00ab	13.00ab	13.00bc	26.00b 22.00a 6.00 ab 7.0ab	13.0 c 6.0b	13.36
China No. 5	12.00bc	16.00b	13.00ab	14.00ab	24.00a	20.00c 15.00b 5.00 b 5.00b	11.0d 3.0c	12.90
A-69	11.00c	15.00bc	12.00b	13.00ab	15.00b	16.00d 14.00b 5.60 b 3.30c	7.0 e 1.0c	1.62
LSD (P<0.05)	1.68	1.68	1.64	3.36	3.03	3.5. 3.7 3.01 1.28	1.68 2.95	2.50

Treatments means within columns followed by different letters are significantly different at P ≤0.05.

Field Efficacy of Various Chemical Insecticides Against Myzus Persicae:

The mean data about the field efficacy of various chemical insecticides against *Myzus persicae* is tabulated in Table 6. Statistically analyzed data revealed that after 24 hours of insecticide application, the green peach aphids population was significantly different among the treated plots. The aphid's infestation was found lower in treated plots as compared to the control. Means data comparison exhibited that the application of chlorpyriphos effectively minimized aphids population by recording significantly lower mean number of aphids (1.00) compared to the application of other insecticide, followed by imidacloprid and bifenthrin with (1.30 and 1.70) mean number of aphids per leaf respectively. However, the insecticide Matrine was found less effective in controlling aphids infestation after 24 hours of application. Statistical analysis of the data indicated significant differences among the treated plots after 48 hours of insecticide application. Aphid's population was significantly higher in the control plot as compared to the treated plots. Mean data comparison indicated that the application of imidacloprid was found highly effective in controlling aphids population with a lower mean number of aphids (2.00), followed by chlorpyrifos and bifenthrin with (3.7 and 3.00) mean number of aphids per leaf respectively which was found statistically similar with application of imidacloprid. Furthermore, the application of Matrine was observed less effective in the control of green peach aphid's with a maximum mean number of aphids (9.0). The overall means analysis of the variance of aphids population has shown significant differences among the treated plots after insecticide application. Mean data comparison revealed that a higher population of aphids was observed in control (70.00) as compared to treated plots. Among the tested insecticides, the application of imidacloprid was found highly effective in the control of green peach aphid's infestation with a minimum number of aphids population (2.00), followed by bifenthrin and chlorpyriphos with 2.10 and 5.50 mean number of aphids population. Moreover, the application of Matrine insecticides was noted less effective in the control of green peach aphid's infestation.

Table 6: Field efficacy of various chemical insecticides against green peach aphid (Myzus persicae) infestation per leaf of peach cultivar Florida gold at ARI, Mingora, Swat during summer 2022.

Insecticides	Pre-Treatment	Post- treatment infestation per leaf					Means
		Day 1	Day 2	Day 3	Day 7	Day 14	
Matrine	58.70 a	5.30 b	9.00 b	4.00 b	7.00 b	7.30 c	6.50 b
Bifenthrin	59.30 a	1.70 c	3.00 c	2.30 bc	1.30 c	2.30 c	2.10 b
Chloropyriphos	51.00 b	1.00 c	3.70 c	2.00 bc	4.70 bc	16.30 b	5.50 b
Imidacloprid	52.00 b	1.30 c	2.00 c	1.70 c	2.00 c	3.00 c	2.00 b
Control	58.00 a	57.00 a	56.00 a	57.00 a	79.00 a	104.30 a	70.70 a
LSD (P≤0.05)	**4.50**	**3.00**	**3.50**	**2.30**	**4.60**	**7.30**	**4.60**

Treatments means within columns followed by different letters are significantly different at *P* ≤0.05.

Discussion:

The current research work was planned with the aim of assessing the resistance of various peach cultivars and the field efficacy of various chemical insecticides against *Myzus persicae* at peach orchards in Swat Valley during the summer of 2022. Five different cultivars of peach such as Florida gold, Coronate, No.4 flame, China No.5, and A-69, while the effectiveness of four different chemical insecticides i.e. Matrine (Legend), Bifenthrin (Talstar), Chloropyrifos (Lorsban) and Imidacloprid (Confidor) was tested against green peach aphids

infestation. The untreated control was also kept in this research. Results indicated that the resistance of peach cultivars against green peach aphids was significantly different among the tested cultivars.

The first observation during the last week of February revealed significant differences among the peach cultivars. Among the cultivars, A-69 was observed highly resistant while peach cultivar Florida Gold was found susceptible to green peach aphid's infestation. The second observation during the first week of March also showed significant differences among the tested cultivars against green peach aphid's infestation. Among the tested peach cultivars A-69 exhibited maximum resistance while the peach cultivar Coronate was observed as most susceptible to green peach aphid's infestation. Likewise, the means data of 6th observation during the 1st week of April exhibited significant variation among the tested cultivars against green peach aphid's infestation. Mean data comparison indicated that peach cultivar A-69 suppressed aphid's infestation per leaf, while peach cultivar Coronate had higher green peach aphid's infestation. Furthermore, the finding depicted that aphids infestation per leaf among the tested peach cultivars were significantly varied during the whole season. The highest aphid's population was observed during the whole season on the peach cultivar Florida Gold. However, the peach cultivar A-69 had lower aphid's infestation. Similarly, Staudt [25] conducted an experiment to assess the emission of volatile organic compounds (VOCs) induced by green peach aphids attacking different resistant and susceptible peach cultivars. He observed high VOC emissions from resistant peach genotypes were higher as compared to susceptible cultivars and concluded that VOC emissions play an important role in the defense mechanism of plants against green peach aphid's infestation. Our finding agrees with the results of Verdugo *et al.*[26], who also reported similar green peach infestation in different peach cultivars and noted A-69 as a resistant peach cultivar against green peach aphids infestation. Similarly, Bus *et al.* [27] stated that breeders used two derived genes ER1 and ER2 from apple varieties "Northern Spy" and "Robusta 5" to improve resistance in apple rootstocks against woolly apple aphids (*Eriosoma lanigerum* Hausm). In the same way, Pascal et al. [28] reported a red spot on the apex and the basal part petiole of young apical leaves and stated that the reddish spot is associated with the induce response of the green peach aphids departure. Raqib [29] also reported peach variety 'Swanee' is highly resistant to green peach aphid infestation among the tested varieties under the agroecological conditions of Swat Valley. Aphids reach plant phloem by overcoming plants physically and chemically. In response, host plants develop indirect resistance by activating resistant genes that lead to the production of organic compounds that attract natural enemies of aphids. Activation of resistance genes and production of organic compounds play a significant role in the sustainable control of insect pests [30][31], reported that phlegmatic factors, pathway activity disturbance, leaf surface traits, such as trichomes, wound response system, transgenic events, and physiologically active compounds are involved in plant resistant mechanism against *M. persicae*. Pelletier et al. [32] reported high and low resistance against aphid's infestation in eight different Solanum species. They further stated that the phenology of plants can affect the level of resistance demonstrated by the specie, he further stated that the use of molecular and genetic markers is an important tool to identify resistant genes and improve plant resistance against insect pests.

Data regarding the mean percent parasitism of peach aphids showed that significantly higher percent parasitism per leaf (9.00) was observed in peach cultivar Florida gold, followed by Coronate (8.00). While peach cultivar on cultivars China No. 5 (5.00) and No. 4 flame (7.00) exhibited lower mean percent parasitism of aphids per leaf. These results are in line with the work of Ronquim *et al.* [33] who recorded the variation in parasitism of aphids by parasitoids on different oat cultivars. Similarly, Farid *et al.*[34] have analyzed the impact of varieties on

wheat resistant to the aphids *D. noxia* and its parasitoids, *Diaeretiella rape* compared to the sensitive variety, the resistant ones suffered less damage due to the aphids nourishment, presenting small reduction of the leaf surface, a higher percentage of parasitoids occurrence was observed on the mummies collected from the resistant cultivars.

Similarly, the maximum yield in kg/tree was recorded in A-69 (76.00) followed by China No.5 (75.00) and No. 4 Flame (73.00). The Florida gold showed a minimum value in terms of yield in kg/tree (45.50) followed by Coronate (46.00 kg/tree). These results agree with the findings of Capinera [35] who concluded that aphids infestation significantly reduces the growth, development, and yield of the peaches. Khan et al.[36] reported that M. persicae reduces the yield of different potato varieties. Similar results regarding the reduction of yield of tomatoes by *M. persicae* are also reported by [37].

Moreover, the means data analysis pertaining to the application of different synthetic insecticides depicted significant variation in the infestation of green peach aphids as compared to untreated control. 24 hours after the application of different insecticides, chlorpyriphos, and imidacloprid were found highly effective in the suppression of aphid's infestation while marine was observed less effective in reducing aphid's population. Likewise, 48 hours after the application of insecticides, imidacloprid effectively suppressed the infestation of aphid's followed by the application of chlorpyrifos, while the application of machine was noted as least effective in the eradication of green peach aphid's infestation. Similarly, after 72 hours of the application of insecticides, the insecticide Imidacloprid was found highly effective in the suppression of aphid's infestation, followed by the application of Bifenthrin, while machine was noted to less effective in the eradication of green peach aphids. In the same way, one week after the application of insecticides statistically the application of imidacloprid and bifenthrin effectively suppressed the infestation of green peach aphids, while the application of machine was observed less effective. Also, after the second week of insecticide application exhibited that the application of bifenthrin and imidacloprid effectively reduced the number of green peach aphids per leaf, while the application of machine was observed less effective in minimizing the infestation of aphid's. Our results agree with the finding of Zeb and Naeem [38] who reported that the synthetic insecticide imidacloprid effectively suppressed the infestation of green peach aphids as compared to the application of other synthetic insecticides. Cutler [33] stated that sub-lethal application of imidacloprid induces hermetic responses in *M. persicae* and stimulates the reproduction rate but alternatively, a higher dose reduces the infestation of *Myzus persicae*. Similarly, Yu et al. [34] also reported that lower concentrations of imidacloprid induce stimulation of fecundity but higher doses cause inhibition. Srigiriraju et al.[35] monitored tobacco-adapted *M. persicae* resistance to imidacloprid and found that some colonies of *M. persicae* developed moderate levels of resistance to the application of imidacloprid. Our results are strongly supported by the finding of Diaz and Mcleod [34]who observed an effective reduction in M. persicae infestation with the application of imidacloprid after five weeks of application. Likewise, Alyokhin et al. [36] also reported that foliar application of Imidacloprid effectively suppresses the infestation of aphids and transmission of viruses in treated potato plots. In addition, [9] also reported that foliar application of Imidacloprid effectively reduces the occurrence *M. persicae* in potato fields. Patil et al. [37] carried out a laboratory experiment against M. persicae and found thiamethoxam the most effective closely followed by imidacloprid. Similarly, Das [38] also reported the effectiveness of Imidacloprid against chili aphid. Patil et al. [37] stated that imidacloprid effectively reduces the infestation of sucking insect pests. [14] stated that Imidacloprid and acetamiprid effectively control the occurrence of sucking pests. Our findings have also been confirmed by previous work of N.K and Joshi [39], who reported that the sole application of Imidacloprid or in combination with fungicides effectively suppressed the infestation of wheat aphids. Khan *et al.*

[40] also reported similar results while using imidacloprid against Myzus persicae infestation in tobacco crops. Khan et al. [39] also reported imidacloprid is highly effective in suppressing of aphids population as compared to other insecticides. Likewise, Saljoqi et al. [41]found Imidacloprid effective among the tested insecticides. Link et al. [42] stated that commercial formulation of imidacloprid (Confidor) efficient in M. persicae control. N.K and Joshi [39] studied different concentrations of Imidacloprid sprayed with different time intervals and found that application of 400 ml ha-1 effectively controls the infestation of wheat aphids. Similarly, Das [43] observed a high mortality rate of aphids three days after the application of Imidacloprid insecticides applied in different concentration. Yadav and Yadav [42] also reported similar results while using Imidacloprid against mustard aphid compared to other insecticides. The results of this experiment are in agreement with the finding of Singh and Verma [44]who also noted effective reduction in aphid's infestation with the application of imidacloprid.

Conclusion and Recommendations:

Conclusion:

Based on the results of the current study, peach cultivars A-69 were observed resistant to green peach aphid. Moreover, the peach cultivars No. 4 Flame and China No. 5 were found less susceptible as compared to Coronate and Florida gold. Data regarding the mean percent parasitism of peach aphids showed that significantly higher percent parasitism per leaf was observed in peach cultivar Florida gold. Similarly, the maximum yield in kg/tree was recorded in A-69 (76.00) followed by China No.5 (75.00) and No. 4 Flame (73.00). Among the insecticides, Imidacloprid and Bifenthrin were found highly effective in the control of green peach aphid's infestation, while Matrine was observed less effective in the eradication of green peach aphids infestation.

Recommendations to farmers:

Peach cultivar A-69 is found resistant to green peach aphid infestation with fewer aphids infestation and maximum yield; therefore, it is recommended to the farmers for commercial cultivation under the agro-climatic conditions of Swat Valley. Among the tested insecticides, Imidacloprid and Bifenthrin effectively suppressed the infestation of aphid, therefore it is recommended for commercial application in peach orchards. Moreover, further research is needed to assess these insecticides on other peach varieties against green peach aphid infestation in peach-growing areas of Khyber Pakhtunkhwa.

Ethical Responsibility:

This manuscript is original research, and it is not submitted in whole or in parts to another journal for publication.

Informed Consent:

The author(s) have reviewed the entire manuscript and approved the final version before submission.

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