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Population Dynamics of Insect Pests of Indian Squash (*Citrullus Vulgaris*)

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Abstract:

The population fluctuation of insect pests of Indian squash was monitored from 1st July to 30th September 2015 at Government Seed Farm at Usta Muhammad, Balochistan using RCB design in three replicates. Whitefly (Bemisia tabaci), Squash bug (Anasa tristis),

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Squash beetle, Epilachna borealis, Squash vine borer, Melittia cucurbitae and Fruit fly Bactrocera cucurbitae were found infesting Indian squash foliage and fruits. The nymphs/larvae and adult populations were separately recorded. The data indicated that the weekly population of Bemisia tabaci, Anasa tristis, Epilachna borealis, Melittia cucurbitae and Bactrocera cucurbitae was significantly fluctuated (P<0.05). The adult white fly population was in the range of 1.15-4.65/leaf averaging 2.57/leaf; while the nymphal population was in the range of 2.39-9.67/leaf averaging 5.35/leaf. The total nymph and adult white fly population was in the range of 3.54-14.32 averaging 7.92/leaf and peak population (14.32/leaf). Squash bug adult population was in the range of 0.22-2.42/leaf averaging 1.42/leaf; while nymphs were in the range of 1.13-3.92/leaf averaging 2.52/leaf. The total squash bug population (nymph and adult) was in the range of 1.35-6.28/leaf, averaging 3.93/leaf. The insect population was 1.35/leaf, sharply reached at maximum (6.28/leaf) and then decreased.

Key words: Population, dynamics, whitefly, fruit fly, borer, Indian squash

1. INTRODUCTION:

Indian squash (*Citrullus vulgaris*) is a member of *Cucurbitaceae* family, In the Indo-Pak region a number of names are given to this vegetable like tinda, dil pasand etc. and generally Indian squash is cultivated as summer crop [3]. The Indian squash vines and fruits are devastated by a number of insect pests which includes *Bemisia tabaci, Thrips palmi, Haplothrips gowdeyi, Anasa tristis*, *Melittia cucurbitae* and these insect pests can devastate foliage; while fruits are damaged by *Epilachna borealis* and *Bactrocera cucurbitae* [12]. The leaves and fruits of Indian squash have been found under severe attack of sucking insect pests such as aphids, jassid and whitefly [18]. Among the other sucking pests, *Coptosoma*

cribraria (Fabricius.) and *Riptortus pedestris* (Fabricius) also found to be occurred in large numbers throughout the cropping period. The foliage of squashes is mainly infested by *Anasa tristis*, *Melittia cucurbitae* and *Bemisia tabaci;* while fruits are damaged by *Epilachna borealis and Bactrocera cucurbitae.* The fruit borers were also found to be the major pests of this vegetable that not only infest the fruits but also devastate the vines [6]. The *Aphis craccivora,* a serious pest sucks the sap from tender shoots, inflorescence resulting in drying up of vines and premature fall of flower buds. *Bemisia tabaci*, *Epilachna borealis and Bactrocera cucurbitae* as the major insect pests of *Citrullus vulgaris* L.; while, aphid population on squash and at the peak of aphid population hay cover attracted 13% (26 May) and 18% (2 June) more aphids compared to bare soil [7, 19]. High population of *B. tabaci* and other sucking as well as fruit borers on squash, silverleaf whitefly was found abundant on squash plantation. The population of Ladybird Beetle, *Epilachna chrysomelina* (Coleoptera: Coccinellidae) Fabricius, on vegetables including squash and melons. 35-75% of infestation at seedling stage of squash [1. 9, 11, 17]. Sucking complex including aphids, thrips, whitefly and jassid were commonly present in the fields; while in squashes, the infestation of fruit borers and worms were also recorded. Similarly, whitefly population is commonly present in the cucurbit fields; while in squashes, the infestation of fruit borers and worms were also recorded [20]. *Melittia cucurbitae* is a very important pest of squash and pumpkins. The extent of losses varied between 30 to 100%, depending on the cucurbit species and the season [8]. The present study was carried out on the population fluctuation of insect pests of Indian squash at Government Seed Farm, Usta Muhammad, Balochistan. Therefore the study was conducted to record the infestation of different insect pests of Indian squash and to determine seasonal population fluctuation of insect pests of Indian squash.

2. MATERIALS AND METHODS

The study was carried out during the year 2015 to examine the population dynamics of insect pests of Indian squash (*Citrullus vulgaris*). The experiment was conducted at the Government Agriculture Farm, Usta Muhammad, Balochistan using RCB design in three replicates.

2.1 Preparation of Land

Following the recommendations regarding the land preparation, the experimental land was ploughed up by cross-wise disc plough. After soaking dose, when the land came in condition, the seedbed was prepared by using cross-wise cultivator followed by rotavator. The clods were crushed completely by clod crusher followed by planking. Sowing of experimental crop was done on 25th June, 2015 by means of single coulter hand drill in rows. The channels and bunds were prepared to facilitate the irrigation process and further monitoring of the crop against any pest problem.

2.2 Collection of Insect Pests

The experimental Indian squash crop was surveyed daily for the appearance of the insect-pests. Afterwards, it was visited after an interval of week's time when presence of insect pests could no longer do it an economic injury. Whitefly *(Bemisia tabaci),* Squash bug (*Anasa tristis*), Squash beetle, *Epilachna borealis,* Squash vine borer, *Melittia cucurbitae* and Fruit fly *Bactrocera cucurbitae* were found infesting Indian squash foliage and fruits. The nymphs/larvae and adults were separately counted and then total population was assessed. The data on these insect pests were collected from 1st July 2015 to 30th September, 2015 in separate sheets

2.3 Fertilizer Application

Fertilizers were applied at the recommended dose of 120-80-50 kg N-P-K per hectare; and all P and K (in the form of single superphosphate and sulphate of potash) along with 1/3rd of N (in the form of urea) were applied as basal dose at the time of sowing by mixing in the soil, while remaining N was divided into two equal splits and were applied at the second and third irrigations. All the necessary cultural operations were adopted throughout the growing period uniformly according to the crop requirements in all the plots.

2.4 Observations

Ten vines from each replication were selected at random for recording pest population. The observation on the infestation of various insect pests was made on per leaf basis. From each of ten labeled vines, five leaves were selected from each vine such as two leaves from bottom side of the vine, two leaves from the middle of the vine and two leaves from growing side of the vine. Per leaf infestation was monitored for Whitefly *(Bemisia tabaci),* Squash bug (*Anasa tristis*) and Squash beetle, *Epilachna borealis;* while for recording infestation of Squash vine borer, *Melittia cucurbitae* and Fruit fly *Bactrocera cucurbitae*, all fruits from each labeled vine were collected and population of these insect pests was recorded.

2.5 Statistical Analysis

The data recorded on above characters were subjected to statistical analysis of variance following Gomez and Gomez (1984) and L.S.D. test were applied to discriminate the superiority of treatments means.

3. RESULT

The population dynamics of insect pests of Indian squash, the study was carried out during the year 2015. RCB design was used in three replicates in laying out the experiment. Whitefly *(Bemisia tabaci),* Squash bug (*Anasa tristis*), Squash beetle, *Epilachna borealis,* Squash vine borer, *Melittia cucurbitae* and Fruit fly *Bactrocera cucurbitae* were found infesting Indian squash foliage and fruits. The nymphs/larvae and adults were separately counted and then total population was assessed. The data on these insect pests were collected from 1st July 2015 to 30th September, 2015.

3.1 Seasonal fluctuation in adult and nymphal population/leaf of whitefly (*Bemisia tabaci*) on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Whitefly (*Bemisia tabaci*) is a major insect pest of Indian squash and major losses in relation to crop foliage and fruits are associated with white fly infestation. The data Table-1 and ANOVA showed that statistically the weekly population of white fly varied significantly during the entire cropping period (F=11.69, P=0.0000, DF=41, CV=21.44%). The white fly nymphal population was higher than the adult white flies. The adult white fly population was in the range of 1.15-4.65/leaf averaging 2.57/leaf; while the nymphal population was in the range of 2.39-9.67/leaf averaging 5.35/leaf. The total nymph and adult white fly population was in the range of 3.54-14.32 averaging 7.92/leaf. The total whitefly population at first observation on 1st July 2015 was 3.54/leaf, which gradually increased reaching at its peak population (14.32/leaf) on 12th August 2015 and then started decreasing. The whitefly population from 22nd July onwards and till 12th August was higher but showing statistically non-significant variation

(P>0.05) between weeks. However, whiteflies remained in the Indian squash field/plantation throughout the observational period and at the last observation on 30th September, 5.08/leaf whitefly population was recorded. It was further observed that last week of July and first two weeks of August was the period of high white fly infestation and later the whitefly was present in the field relatively in lower population.

3.2 Seasonal fluctuation in adult and nymphal population/leaf of Squash bug (*Anasa tristis*) on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Squash bug (*Anasa tristis*) is also a major insect pest of Indian squash and considerable yield losses are associated with squash bug infestation. The data Table-2 and ANOVA suggested that statistically the weekly population of squash bug varied significantly during the period of study (F=13.68, P=0.0000, DF=41, CV=18.82%). The nymphs of squash bug were in larger number than their adults at all dates of population monitoring. The population of squash bug adults was in the range of 0.22-2.42/leaf averaging 1.42/leaf; while the population of squash bug nymphs was in the range of 1.13-3.92/leaf averaging 2.52/leaf. The total squash bug population (nymph and adult) was in the range of 1.35-6.28/leaf, averaging 3.93/leaf. The total squash bug population at first observation on 1st July 2015 was 1.35/leaf, which sharply increased at its maximum level (6.28/leaf) on 7th July 2015 and then decreased. Monitoring on 5th August showed again higher population (5.64/leaf) and then dropped to 1.76/leaf in the following week and again reached at higher levels of 5.64, 5.64 and 5.00/leaf when monitored on 16, 23 and 30 September, 2015 respectively. The data clearly indicated that squash bugs remained active throughout the fruiting season of Indian squash and with the exception of month of August, the Squash bug population was higher in July

and September months. There was non-linear trend of squash bug population and it fluctuated unevenly during the observational period.

3.3 Seasonal fluctuation in adult and nymphal population/leaf of Squash beetle (*Epilachna borealis)* on Indian squash at Government Seed Farm at Usta Muhammad during 2015

The Squash beetle (*Epilachna borealis)* is another insect found infesting Indian squash and give losses to the crop by damaging crop foliage. The results Table-3 and ANOVA indicated that statistically weekly population of squash beetle fluctuated remarkably during the period of study (F=13.78, P=0.0000, DF=41, CV=21.64%). The data exhibited that nymphs of squash beetle, *Epilachna borealis* were in higher population than the adult *Epilachna borealis* at all dates of observation during this study. The population of squash beetle adults was in the range of 0-2.12/leaf averaging 1.34/leaf; while the population of squash beetle nymphs was in the range of 0-2.65/leaf averaging 1.82/leaf. The total squash beetle population (nymph and adult) was in the range of 0-4.77/leaf, averaging 3.16/leaf. The data showed that *Epilachna borealis* appeared in the third week of July 2015 and reached at its peak infestation level (4.77/leaf) in the fourth week of July. The population of *Epilachna borealis* remained established throughout the season with minor variation. Apparently, the *Epilachna borealis* remained persistent during the period of high temperature, while there was some decrease in the *Epilachna borealis* population under mild temperature in late September. A considerable beetle population was recorded (2.72/leaf) at the last observation on 30th September 2016. However, mid-July to mid-September was the major period of *Epilachna borealis* infestation in Indian squash.

3.4 Seasonal fluctuation in adult and larval population/fruit of fruit fly *Bactrocera cucurbitae* on Indian squash at Government Seed Farm at Usta Muhammad during 2015

The Fruit fly (*Bactrocera cucurbitae)* is a devastating insect that can spoil the Indian squash fruits leaving unmarketable. The data Table-4 and ANOVA demonstrated that the weekly *Bactrocera cucurbitae* population fluctuated significantly ($P<0.05$) between the observation dates ($F=14.05$, $P=0.0000$, $DF=41$, $CV=26.90\%$). The ANOVA shows a high variation in fruit fly population between replicated plots of Indian squash vines. The data showed that the population of *Bactrocera cucurbitae* larvae on Indian squash fruits was higher as compared to the adult *Bactrocera cucurbitae* at all the observation dates. The population of fruit fly adults was in the range of 0.25-3.88/fruit averaging 1.97/fruit; while the fruit fly larval population was in the range of 0.39-6.01/fruit averaging 3.05/fruit. The total fruit fly population (larvae and adult) was in the range of 0.64-9.89/fruit, averaging 5.01/fruit. The results indicated that *Bactrocera cucurbitae* was present in the squash fields in first week of July 2015 with population of 3.19/fruit and after showing a declining fluctuation, started reestablishing gradually in July and reached to its highest level of 9.89/fruit in the first fortnight of September. The higher *Bactrocera cucurbitae* population was recorded during whole month of August till the first fortnight of September and then a decrease in the population was recorded. At the last observation on 30th September, the *Bactrocera cucurbitae* population was minor (1.66/fruit). The results showed persistence in fruit fly population, particularly from the last week of July till the 2nd week of September, 2016

3.5 Seasonal fluctuation in adult and larval population/fruit of Squash vine borer (*Melittia cucurbitae)* on Indian squash at Government Seed Farm at Usta Muhammad during 2015

The squash vine borer (*Melittia cucurbitae)* is a destructive insect that not only devastates squash vines, but also spoils fruits by boring inside. The data Table-5 and ANOVA showed that the weekly population of squash vine borer (*Melittia cucurbitae)* population fluctuated significantly ($P<0.05$) between the observation dates ($F=13.89$, $P=0.0000$, $DF=41$, $CV=26.11\%$). The coefficient of variation suggested a higher fluctuation in population of squash vine borer between replicated plots of Indian squash vines. The data indicated that the larval population of *Melittia cucurbitae* on Indian squash fruits was higher as compared to the adult *Melittia cucurbitae* at all the observation dates from 1st July to 30th September 2015. The population of *Melittia cucurbitae* adults was in the range of 0-3.15/fruit averaging 1.77/fruit; while the *Melittia cucurbitae* larval population was in the range of 0-4.98/fruit averaging 2.79/fruit. The total *Melittia cucurbitae* population (larvae and adult) was in the range of 0-8.13/fruit, averaging 4.56/fruit. The data indicated that *Melittia cucurbitae* was appeared in squash fields in the second week of July 2015 with population of 1.70/fruit and declined in the following week. There was a gradual increase in the *Melittia cucurbitae* population from third week of July and the peak population of this insect pest was recorded in fourth week of August (8.13/fruit) and first week of September 2016 (8.10/fruit). The higher *Melittia cucurbitae* population was recorded during whole month of August and till the first week of September and then a gradual decrease in the population was monitored. At the last observation on 30th September, the *Melittia cucurbitae* population was yet considerable (5.26/fruit).

4. DISCUSSION

The present study was carried out on the population fluctuation of insect pests of Indian squash from 1st July to 30th September 2015 at Government Seed Farm at Usta Muhammad, Balochistan using RCB design in three replicates. Whitefly *(Bemisia tabaci),* Squash bug (*Anasa tristis*), Squash beetle, *Epilachna borealis,* Squash vine borer, *Melittia cucurbitae* and Fruit fly *Bactrocera cucurbitae* were found infesting Indian squash foliage and fruits. The findings of the study are discussed as the data indicated that the weekly population of *Bemisia tabaci*, *Anasa tristis*, *Epilachna borealis, Melittia cucurbitae* and *Bactrocera cucurbitae* was significantly fluctuated ($P<0.05$). The whitefly population on Indian squash was higher from 22nd July onwards till 12th August showing non-significant variation ($P>0.05$) during this period. Whiteflies remained in the Indian squash field/plantation throughout the observational period and last week of July and first two weeks of August was the period of high white fly infestation. The squash bugs remained active throughout the fruiting season of Indian squash and with the exception of month of August, the insect population was higher in July and September months. The squash beetles remained in the fields throughout the season with minor variation and mid-July to mid-September was the major period of infestation in Indian squash. The higher fruit fly was recorded during August till the mid of September and the insect showed persistence particularly from the last week of July till the 2nd week of September. The high squash vine borer population was recorded during whole month of August and till the first week of September. [12] Who reported *Anasa tristis*, *Melittia cucurbitae* and *Bemisia tabaci; Epilachna borealis and Bactrocera cucurbitae, Thrips palmi, Haplothrips gowdeyi* insect pest species infesting foliage and fruits of squashes. In India, leaves and fruits of Indian squash

have been found under severe attack of whitefly [18]. *Bemisia tabaci*, *Epilachna borealis* and *Bactrocera cucurbitae* is the major insect pests of *Citrullus vulgaris* L.; while [7] recorded abundant whitefly population on squash and at the peak of insect population hay cover attracted 13% (26 May) and 18% (2 June) more white flies compared to bare soil. High population of *B. tabaci* and other sucking as well as fruit borers on squash whitefly was found abundant on squash plantation [7, 9, 11, 19]. However [10] indicated that there were three population peaks on squash and musk melon, i.e., 91.4±3.56, 77.4±2.48, 56.2±2.67 male per trap during first and third week of April and first week of May and two population peaks on Indian squash i.e., 81.8±3.44, 66.4±3.50 males per trap during first and third week of April, respectively. 35-75% of infestation at seedling stage of squash [17]. Sucking complex including aphids, thrips, whitefly and jassid were commonly present in the fields; while in squashes, the infestation of fruit borers and worms were also recorded [20]. The population of *Epilachna chrysomelina, Anasa tristis*, *Melittia cucurbitae* and *Bemisia tabaci;* while fruits are damaged by *Epilachna borealis and Bactrocera cucurbitae*, on vegetables including squash melons and found that this is a phytophagous insect that feed on cucurbit plants [1]. [8] Reported *Melittia cucurbitae* is a very important pest of squash and pumpkins. To date, this lepidopteran had its distribution reported for eastern United States, southeastern Canada, and Mexico. They reported for the first time the occurrence of squash vine borer, *M. cucurbitae* for South America, being the first record to Brazil. [4] mentioned that the melon fruit fly, *Bactrocera cucurbitae* damages 81 host plants and is a major pest of cucurbitaceous vegetables, particularly the bitter gourd (*Momordica charantia*), muskmelon (*Cucumis melo*), snap melon (*C. melo* var. *momordica*), and snake gourd (*Trichosanthes anguina*). The extent of losses varied between 30 to 100%, depending on the cucurbit species and the season.

5. CONCLUSION

The whitefly population on Indian squash was higher from 22nd July onwards till 12th August showing non-significant variation (P>0.05) during this period. Whiteflies remained in the Indian squash field/plantation throughout the observational period and last week of July and first two weeks of August was the period of high white fly infestation. The squash bugs remained active throughout the fruiting season of Indian squash and with the exception of month of August, the insect population was higher in July and September months. The squash beetles remained in the fields throughout the season with minor variation and mid-July to mid-September was the major period of infestation in Indian squash. The higher fruit fly was recorded during August till the mid of September and the insect showed persistence particularly from the last week of July till the 2nd week of September. The high squash vine borer population was recorded during whole month of August and till the first week of September.

Table 1: Seasonal fluctuation in adult and nymphal population/leaf of whitefly (*Bemisia tabaci*) on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Date of observation	Adults	Nymphs	Adults+Nymphs
	Mean±SE	Mean±SE	Mean±SE
1st week	1.15±0.138	2.39±0.287	3.54±0.425 D
2nd week	1.55±0.186	3.22±0.386	4.77±0.572 D
3rd week	2.55±0.306	5.30±0.636	7.85±0.942 C
4th week	2.65±0.318	5.51±0.661	8.16±0.979 B
5th week	3.88±0.466	8.07±0.968	11.95±1.434 A
6th week	4.25±0.510	8.84±1.061	13.09±1.571 A
7th week	4.65±0.558	9.67±1.160	14.32±1.718 A
8th week	3.12±0.374	6.49±0.779	9.61±1.153 B
9th week	2.54±0.305	5.28±0.634	7.82±0.938 B
10th week	2.65±0.318	5.51±0.661	8.16±0.979 B
11th week	2.25±0.270	4.68±0.562	6.93±0.832 C
12th week	1.88±0.226	3.91±0.469	5.79±0.695 C
13th week	1.25±0.150	2.60±0.312	3.85±0.462 D
14th week	1.65±0.198	3.43±0.412	5.08±0.610 D
Average	2.57±0.308	5.35±0.642	7.92±0.950

Table 2: Seasonal fluctuation in adult and nymphal population/leaf of Squash bug (*Anasa tristis*) on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Date of observation	Adults	Nymphs	Adults+Nymphs
	Mean±SE	Mean±SE	Mean±SE
1st week	0.22±0.026	1.13±0.136	1.35±0.162 E
2nd week	2.36±0.283	3.92±0.470	6.28±0.754 A
3rd week	1.25±0.150	2.08±0.250	3.33±0.400 C
4th week	1.65±0.198	2.74±0.329	4.39±0.527 B
5th week	1.25±0.150	2.08±0.250	3.33±0.400 C
6th week	2.12±0.254	3.52±0.422	5.64±0.677 A
7th week	0.66±0.079	1.10±0.132	1.76±0.211 E
8th week	0.35±0.042	2.10±0.252	2.45±0.294 D
9th week	0.95±0.114	1.58±0.190	2.53±0.304 D
10th week	1.25±0.150	2.08±0.250	3.33±0.400 C
11th week	1.65±0.198	2.74±0.329	4.39±0.527 B
12th week	2.42±0.290	3.12±0.374	5.64±0.677 A
13th week	2.02±0.242	3.62±0.434	5.64±0.677 A
14th week	1.88±0.226	3.12±0.374	5.00±0.600 B
Average	1.42±0.170	2.52±0.302	3.93±0.472

Table 3: Seasonal fluctuation in adult and nymphal population/leaf of Squash beetle (*Epilachna borealis)* on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Date of observation	Adults	Nymphs	Adult+Nymphs
	Mean±SE	Mean±SE	Mean±SE
1st week	0±0	0.00±0	0.00±0 D
2nd week	0±0	0.00±0	0.00±0 D
3rd week	1.5±0.180	2.18±0.262	3.68±0.442 B
4th week	2.12±0.254	2.65±0.318	4.77±0.572 A
5th week	1.32±0.158	2.65±0.318	3.97±0.476 B
6th week	1.25±0.150	2.15±0.258	3.40±0.408 B
7th week	1.66±0.199	2.08±0.250	3.74±0.449 B
8th week	1.88±0.226	2.35±0.282	4.23±0.508 A
9th week	1.9±0.228	2.38±0.286	4.28±0.514 A
10th week	1.45±0.174	1.81±0.217	3.26±0.391 B
11th week	1.66±0.199	2.08±0.250	3.74±0.449 B
12th week	1.75±0.210	2.19±0.263	3.94±0.473 B
13th week	1.1±0.132	1.38±0.166	2.48±0.298 C
14th week	1.21±0.145	1.51±0.181	2.72±0.326 C
Average	1.34±0.161	1.82±0.218	3.16±0.379

Table 4: Seasonal fluctuation in adult and larval population/fruit of fruit fly *Bactrocera cucurbitae* on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Date of observation	Adults	Larvae	Adult+Larvae
	Mean±SE	Mean±SE	Mean±SE
1st week	1.25±0.150	1.94±0.233	3.19±0.383 E
2nd week	0.25±0.030	0.39±0.047	0.64±0.077 F
3rd week	0.5±0.060	0.78±0.094	1.28±0.154 F
4th week	1.25±0.150	1.94±0.233	3.19±0.383 E
5th week	1.75±0.210	2.71±0.325	4.46±0.535 D
6th week	2.66±0.319	4.12±0.494	6.78±0.814 C
7th week	2.88±0.346	4.46±0.535	7.34±0.881 B
8th week	2.85±0.342	4.42±0.530	7.27±0.872 B
9th week	3.02±0.362	4.68±0.562	7.70±0.924 C
10th week	3.25±0.390	5.04±0.605	8.29±0.995 B
11th week	3.88±0.466	6.01±0.721	9.89±1.187 A
12th week	2.12±0.254	3.29±0.395	5.41±0.649 D
13th week	1.2±0.144	1.86±0.223	3.06±0.367 E
14th week	0.65±0.078	1.01±0.121	1.66±0.199 F
Average	1.97±0.236	3.05±0.366	5.01±0.601

Table 5: Seasonal fluctuation in adult and larval population/fruit of Squash vine borer (*Melittia cucurbitae)* on Indian squash at Government Seed Farm at Usta Muhammad during 2015

Date of observation	Adults	Larvae	Adult+Larvae
	Mean±SE	Mean±SE	Mean±SE
1st week	0±0	0.00±0	0.00±0 E
2nd week	0.66±0.079	1.04±0.125	1.70±0.204 D
3rd week	0.25±0.030	0.40±0.048	0.65±0.078 E
4th week	1.15±0.138	1.82±0.218	2.97±0.356 D
5th week	1.25±0.150	1.98±0.238	3.23±0.388 D
6th week	2.65±0.318	4.19±0.503	6.84±0.821 B
7th week	2.25±0.270	3.56±0.427	5.81±0.697 C
8th week	2.45±0.294	3.87±0.464	6.32±0.758 B
9th week	3.15±0.378	4.98±0.598	8.13±0.976 A
10th week	3.14±0.377	4.96±0.595	8.10±0.972 A
11th week	2.08±0.250	3.29±0.395	5.37±0.644 C
12th week	2.01±0.241	3.18±0.382	5.19±0.623 C
13th week	1.65±0.198	2.61±0.313	4.26±0.511 C
14th week	2.04±0.245	3.22±0.386	5.26±0.631 C
Average	1.77±0.212	2.79±0.335	4.56±0.547

REFERENCES

1. Al-Digai, S.A., A.I. Assagaf and J.A. Mahyoub. Effect of temperature and humidity on the population abundance of spotted oriental cucumber beetle *Epilachna chrysomelina* (F.) (Coccinellidae : Coleoptera) In Al – qunfudah western Saudi Arabia. Current world environment, An International Research Journal of Environmental Science. 2012; 4 (2/3):65-69.
2. Bethke, J.A., R. A. Redak and U. K. Schuch. Melon aphid performance on chrysanthemum as mediated by cultivar, and differential levels of fertilization and irrigation. Entomologia Experimentalis et Applicata. 1998; 88 (1): 41-47.
3. Chayote, S.W. 2009. Squash: *Cucurbita* spp. In: Wikipedia, browsed on 1st May 2009.
4. Dhillon, M.K., R. Singh, J.S. Naresh and H.C. Sharma. The melon fruit fly, *Bactrocera cucurbitae*: A review of its biology and management. J Insect Sci. 2005; 5: 40.
5. Gomez, K. A., and A. A. Gomez. Statistical procedures for Agri. Res. (2nd Ed.) John Willy and Sons New York. 1984; 69-75.
6. Govindan, R., Insects of the field bean and gourds with special reference to the biology and ecology of the pod borer, Adisura atkinsoni Moore. (Lepidoptera: Noctuidae). M. Sc. (Agri.) thesis, University of Agricultural Sciences, Bangalore. 1974; 1-34.
7. Katja, Z., B. Dean, S. Marisa, D. Gvozden, G. Smiljana, Z. Dragan. Aphid population in squash, *Citrullus lanatus* Thunb. Production. Delo Je Prispelo. 2009; 2 (2): 22-27.
8. Krinski, D. First report of Squash Vine Borer, *Melittia cucurbitae* (Harris, 1828) (Lepidoptera, Sessidae) in Brazil and South America: distribution extension and

geographic distribution map. The Journal of Biodiversity Data. 2015; 11 (3):39-44.

9. Lanjar, A.G. Population ecology of the whitefly, *Bemisia Tabaci* Gennadius (homoptera Aleyrodidae). PhD thesis, Sindh Agriculture University, Tando Jam, 2010.
10. Lanjar, A.G., H.A. Sahito, M.A. Talpur and M.S. Channa. Biology and population of melon fruit fly on musk melon and Indian squash. International Journal of Farming and Allied Sciences. 2013; 2 (2):42-47.
11. Lourencao, A.L., A.C. Alves, A.M.T. Melo and G.E. Valle. Development of leaf silvering in squash cultivars infested by silverleaf whitefly. Hortic. Bras. 2011; 29 (1):87-92.
12. Napier, T. Insect pests of cucurbit vegetables. Prime fact 833, Insect pests of cucurbit vegetables; district horticulturist, intensive industries development, Yanco. 2009; 719.
13. Nashat, A. and H. Ali. Effect of Certain Cucumber Varieties on the Biology of *Aphis gossypii* (Homoptera: Aphididae). The Florida Entomologist. 2009; 91 (3): 250-166.
14. Oloyede, F.M., G.O. Agbaje and I.O. Obisesan. Effect of NPK fertilizer on fruit development of pumpkin (*Cucurbita pepo* Linn.). American Journal of Experimental Agriculture. 2013; 3(2): 403-411.
15. PCCARD. Squash production guide. PCCARD. Los Banos, Laguna, Philippines. 2000; 1-4.
16. Qureshi, S.A., D.J. Midmore, S.S. Syeda and D.J. Reid. A comparison of alternative plant mixes for conservation bio-control by native beneficial arthropods in vegetable cropping systems in Queensland Australia. Bulletin of Entomological Research. 2009; 100:67-73.

17. Rashid, M.A., M.A. Khan, M.J. Arif and N. Javed. A review of host susceptibility and management practices. Academic Journal of Entomology. 2014; 7 (1):38-54.
18. Rekha, S. and C.P. Mallapur. Abundance and seasonability of sucking pests of vegetables. Karnataka J. Agric. Sci. 2007; 20 (2):397-398.
19. Servín, V.R., J.L.G. Hernández, B.M. Amador, A. Tejas and J.L.M. Carrillo. Stability of insecticide resistance of silverleaf whitefly (Homoptera: Aleyrodidae) in the absence of selection pressure. Folia Entomol. Mex. 2006; 45 (1):01-10.
20. Singh, S., J.C. Gupta and H.N. Sharma. Influence of trap design in controlling insect pests in the field of cucurbitaceae. Ind. J. Biol. Stud. Res. 2014; 3 (1):37-43.