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Comparison of Insect Pest Population and Use of Neem Seed Extract on Different Tomato Varieties

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Abstract: *A study was carried out on Comparison of Pest Population and Use of Neem Seed Extract on Different Varieties of Tomato. Repellency of Neem Seed Extract was studied against sucking insect pest on tomato plants by free choice method in the green house of the Faculty of Agriculture, LUAWMS. Three genotypes of tomato sown separately at Coconut Farm, Uthal. Tomato sown had sprayed with Neem Seed Extract against whitefly, jassid, aphid, borer and population of these insect pests and predators was compared on three varieties of each crop separately sown in Randomized Complete Block Design (RCBD). The result observed that varietal preference of monitored insect pests differed significantly in tomato varieties. The highest population was 7.09, 6.40 and 4.55 whiteflies / leaf on varieties of Tomato Rio, T-1359 and T-206 respectively recorded on 25th January. The highest population of jassid was 2.93, 2.66 and 2.44 / leaf on Tomato Rio, T-1359 and T-206 respectively. The highest population of aphid was 3.26, 3.24 and 3.15 / leaf on T-1359, T-206 and Tomato Rio respectively. Similarly, per plant population was relatively lower on all the varieties of tomato. The average population was negligible (0.060 fruit borer / plant. The population of predator was higher 1.14 / plant on T-1359 variety in 14th February as compared to other varieties 0.60 and 0.76 Tomato Rio and T-206 respectively. Since pest population was increased beyond ETL on 25th January. Therefore 2 percent neem seed extract was applied on the crops on 25th January, 09th February and 24th February. These applications kept the pest population below ETL till the last observation on 5th March. Population of predators was not affected significantly by application of 2 percent of neem seed extract because of predators are not phytophagous like other pests.*

Keywords: Pest Population; Neem Seed; Tomato Varieties; sucking insects; repellency.

1. INTRODUCTION

Vegetables are a major component of human diet. These are rich sources of vitamins which are essential for human health [4]. Among vegetables, the solanaceious crops including tomato (*Lycopersicon esculentum*) is of considerable economic importance. Tomato is one of the most important vegetable plants that produce red berry style fruits consumed in a variety of ways including raw, as an ingredient in many dishes, salads and drinks. Tomato plants are infested by sucking insects, whitefly, *Bemisia tabaci* and cotton aphid, *Aphis gossypii*. American bollworm, *Helicoverpa armigera* attacks the ripped and pre-ripped fruits, contaminating them with frass and exposing them to fungi and bacteria. Cotton leaf worm (*Spodoptera littoralis)* initially damages the summer crops. It causes defoliation, but also it can bore into and feed on interior of fruits. Leaf miner (*Liriomyza trifolii*) attacks also tomato leaves causing different damages [2]. There are few eco-friendly pest-control systems that can be used to avoid excessive rely on greatly toxic chemicals. These methods and treatments for pest control are greatly effective. They can prevent insect pests to infest the crop. All these eco-friendly pest control systems are the part of Integrated Pest Management (IPM). The judicious use of all possible methods to pest control which do not result in the disturbance of environment and no harmful side effects are produced. Therefore preservation and encouragement of the natural enemies is the central feature of the Integrated Pest Management [6]. It coordinates the use of pest biology, environmental information, and available approach to prevent unacceptable levels of pest damage by the most economical means, while posing the least possible risk to people, property, resources, and the environment. IPM provides an effective strategy for managing pests in all areas from developed residential and public areas to wild lands. IPM serves as an umbrella to provide an effective, all encompassing, low risk approach to protect resources and people from pests [7]. IPM is often mistakenly associated only with entomology and insect pests. However, in contrast to entomology, plant pathology has, since its beginning, approached plant pests through multiple, or integrated strategies [9]. [10] reported that among bio-pesticides botanical extracts of neem (3.5 percent), tobacco extract (3.0 percent), neem oil (5 percent), and garlic extract (5 percent) showed significant efficacy against tomato insect pests. [5] showed that 5 percent neem seed extract showed the lowest infestation of aphids and maximum crop yield. There is no need to apply chemical control, because neem seed extract resulted better than the chemical control. Similarly, [8] observed that bio-pesticides, especially neem seed extract (NSE) and tobacco based products may be used against insect pests of *Lycopersicon esculentum*, because the efficacy of neem based bio-pesticides remained highest throughout the study period against all the target pests. The

application of bio-pesticides on tomato is not only provided effective control of insect pests, but due to residual effects of pesticides in tomato fruits, the human health is at risk, because indiscriminate use of the synthetic pesticides has caused several problems related to human health and other biological life. [1] reported that efficacy of synthetic pesticides alone or in combination with oil of neem against *Bemisia tabaci* did not observe a considerable impact on insect population. Profenofos alone and Profenofos+ neem oil had higher efficacy against whitefly than rest of the treatments. The proposed study will be carried out on the comparison of pest population and integrated pest management on different varieties of tomato under field conditions with the objectives to record population of major insect pests on tomato, compare major insect pests on different varieties of tomato vegetable and study botanical pest control material (Neem Seed Extract) against insect pests of these vegetables under field conditions.

2. MATERIALS AND METHODS

The studies were carried out on comparison of pest population on different varieties of tomato as affected by spray application of neem extract against key pests such as whitefly, jassid, aphid, borers and their predators. The efficacy of neem based bio-pesticide (neem seed extract) against these insect pests using three varieties each of tomato. Three varieties of tomato were cultivated four replicated Randomized Complete Block Design (RCBD) in Coconut Farm, Department of Agriculture at Uthal, District Lasbella, Balochistan. The experimental area consisted of one acre of land which was divided into 4 blocks. Each block was divided into 3 plots. All experimental area was divided into 12 plots. Each plot size was 11 m x 22 m.

The land for sowing the experimental crops was adapted not in season. In the beginning, the experimental area had ploughed with running disc plough & 15 day leave. Later, the tractor had used for crushing of clods and leveling the land. Then the area came in proper condition, finally using strips for isolation of plots & preparing channel of feeding 60 cm for row to row distance & 30 cm for plant to plant distance for all experimental crops.

In this study, neem seed extract was applied for controlling the insect pests and dynamical number of the dominant pest & predators was monitored for the entire growing season of each vegetable crop by using the six plants randomly of each variety from each plot. The treatment details are as under;

2.1 Tomato varieties

V1-T-206,
V2- Tomato Rio
V3- T-1359 F1 hybrid.

The experimental crops were sown at recommended sowing time and all the crop production technologies were adopted from sowing view point, inputs application as well as for crop management. For controlling insect pests, the neem seed extract was prepared & sprayed when insect pest appears.

2.2 Preparation of neem seed extract

2 percent neem seed extract was prepared from 40 gm powder of neem seed which had added of 5 gm of detergent. This was wrapped in a muslin cloth and dipped in 2L of hot water. After 15-20 hours the concentrate was squeezed out and diluted to 2% by adding water. During attack of insect pests on crops, application of 2 percent neem seed extract was applied on the crops at 15 days intervals in the field. Neem seed extract spray was applied as repellent in order to keep the insect pests away from the crops.

The result that were together had observed in statistical analysed by using analysis of variance (ANOVA) know the significance differences in insect pests infestation in different treatments and LSD test was employed to compare treatment means. In view of the statistical analysis, the tables containing summarized experimental results were prepared and detailed descriptions are presented in the following.

2.3 Green house studies

Total 24 nursery plants of tomato were collected from different field of farmers in Uthal. Then these Plants were kept in gamla. Then separately for 24 plants twelve cages were made. In each cage two plants (treated and untreated) were kept for experiment of neem seed extract.

This experiment data was taken after (6, 12, 18 hours) intervals. Three control application of neem seed extract (0.5%, 1.0% and 2.0%) were applied in one plant for each cage of two plants (treated and untreated). In every vegetable 1.0% were applied in three cages. In every cage ten whiteflies were released and then counted number of whiteflies after every 6 hours, 12 hours and 18 hours interval. Similarly three reading were taken in tomato vegetable concentration at different time intervals and noted in the diary.

2.4 Statistical analysis

The collected data were statistically analysed using MSTATc software and entire means were subjected to Least Significant Difference (LSD) as well as Tukey test at $P< 0.05$.

3. RESULTS

Repellent effect of neem seed water extract application to tomato plants were initially studied against whitefly in a free choice method in a green house in the Faculty of Agriculture, LUAWMS. Further studies on population dynamics of whitefly, jassid, aphid, borers and predators were compared on different varieties of Tomato, *Lycopersicon esculentum* (T-206, Tomato Rio, T-1359) separately as affected by spray application of neem seed extract. The experimental crop was grown in an experimental area of Coconut Farm, Department of Agriculture Uthal. Three varieties of Tomato were sown separately in Randomized Complete Block Design (RCBD).

3.1 Repellency of Neem Seed Extract against whitefly on tomato

Tomato was used to evaluate repellent effect of neem seed extract against whitefly in green house studies by free choice method as given below. The extract was applied in 2.0, 1.0 and 0.5 percent concentrations to vegetable plants.

3.1.2 Repellency of whitefly on tomato crop

A comparison of mean percent repellency of whitefly on tomato crop at different concentrations of Neem Seed Extract is presented in Table- 3.1. It revealed that the highest repellency of 39.88 % was recorded at 1.00 % concentrations which was significantly different from 39.11%, 22.44 % and 20.88% at application rates of 2.0 %, control and 0.5 % respectively. Repellency values at 2.0 % and control were non significant from each other but these were significantly higher than 20.88% in 0.5 % concentrations. A comparison of percent repellency of whitefly on tomato crop after 6 hours, 12 hours and 18 hours interval is presented in Table-3.2. It revealed that the highest repellency of 36.58% was recorded after 6 hours which was significantly higher than 31.00% and 24.16% after 12 hours and 18 hours respectively. However, repellency recorded after 12 hours was significantly higher than after 18 hours. A comparison of percent repellency in the interaction between concentrations of Neem Seed Extract and time intervals is presented in Table 3.3. The highest repellency of 56.66% was recorded at 2.00% concentration after 6 hours of application. The lowest repellency was recorded in 0.50% and control after 12 hours. Generally, repellency values were higher at higher concentration of Neem Seed Extract.

Table- 3.1: Percent repellency of whitefly at different concentrations of Neem Seed Water Extract applied to tomato plants.

CONCENTRATION	% REPELLENCY
2.00%	39.11[a]
1.00%	39.88[a]
0.50%	20.88[a]
Control	22.44[a]

Note: Mean values having the same letter is not significantly different by Tukey test (P<0.05).

Table-3.2: Percent repellency of whitefly at different time intervals after application of Neem Seed Water Extract to tomato plants

HOURS	% REPLLENCY
6	36.58[a]
12	31.00[a]
18	24.16[a]

Note: Mean values having the same letter is not significantly different by Tukey test (P<0.05).

Table-3.3: Percent repellency of whitefly at different concentrations and time intervals

	% REPELLENCY AFTER TIME INTERVALS		
Concentration	**6 hours**	**12 hours**	**18 hours**
2.00%	56.66[a]	45.00[a]	15.66[a]
1.00%	45.66[a]	49.00[a]	25.00[a]
0.50%	15.66[a]	15.00[a]	32.00[a]
Control	28.33[a]	15.00[a]	24.00[a]

Note: Mean values having the same letter is not significantly different by Tukey test (P<0.05)

3.2 Insect pests on tomato varieties

3.2.1 Whitefly population on tomato varieties

The results regarding per leaf population of whitefly on three tomato varieties at different dates is presented in Table-3.4. It revealed that per leaf population of whitefly absolutely and significantly increased to 7.09 on Tomato Rio, 6.40 on T-1359 and 4.55 on T-206 varieties on 25th Jan. Therefore, Neem Seed Extract was applied at 2% concentrations on 25th Jan. which was continued at 15 days interval on 9th Feb. and 24th Feb.,. However, the lowest number of 0.35 whitefly/leaf was recorded in T-206 on 24th Feb. which was not significantly different from 0.49 and 0.53/ leaf recorded on 5th Mar. and 14th Feb.,. In case of Tomato Rio lowest number of 0.23 whitefly/ leaf was recorded on 29th Feb. which was not significantly different from 0.29 on 19th Feb.,. In case of T-1359 similar trend was observed the lowest number of 0.21 whitefly / leaf was observed on 19th Feb. which was not significant from 0.43/ leaf recorded on 29th Feb.. A comparison of mean number of whitefly on three varieties of tomato is presented in Fig. 3.1. It revealed that the lowest number of 1.54 whitefly/ leaf was recorded in T-206; whereas significantly higher number of 1.87 whitefly/leaf was observed from Tomato Rio which was not significantly different from 1.83 recorded in T-1359. A comparison of mean number of whitefly on tomato varieties at different dates is presented in Fig.3.2. It revealed that the lowest number of 0.27 whitefly/leaf was observed on 29th Feb. which was not significantly different from 0.29 and 0.59 whitefly was observed on 19th Feb. and 5th Mar. However, the highest number of 6.01 whitefly/leaf was recorded on 25th Jan., which was significant from population recorded on all other dates, because of application of neem seed extract.
Interaction between all the three varieties indicated that highest and significantly different whitefly population was recorded on 25th Jan. which dropped significantly with the application on neem seed extract on 25th Jan. and after 15 days intervals. The population of whitefly remained lower but significantly different on different varieties.

Table-3.4: Mean number of whitefly nymph / leaf on tomato varieties at different observation dates.

Obs. Dates	Tomato varieties		
	V1= T-206	**V2= Tomato Rio**	**V3= T-1359**
20-Jan	2.90[d]	2.73[de]	2.63[de]
25-Jan	4.55[c]	7.09[a]	6.40[b]
30-Jan	1.83[gh]	1.40[jk]	1.60[ij]
4-Feb	2.11[fg]	2.21[ef]	2.36[de]

Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

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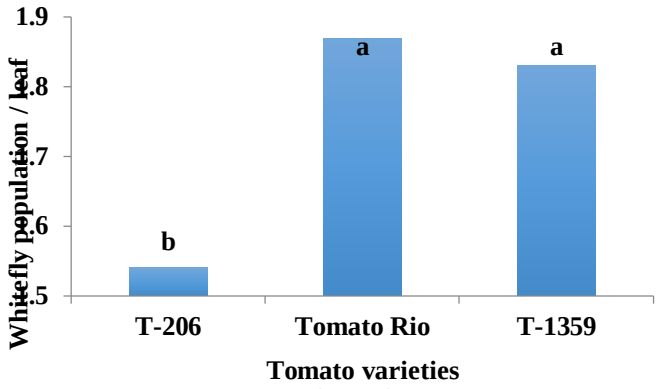

Figure 3.1: Mean number of whitefly on tomato varieties.

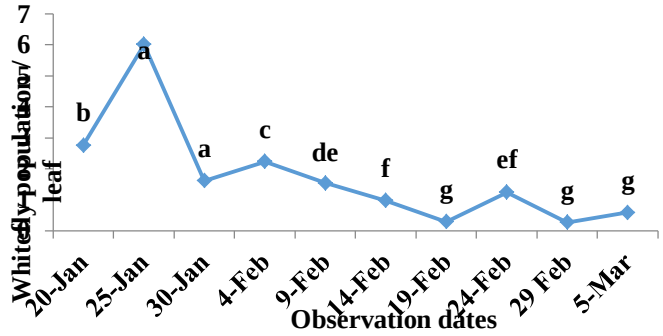

Fig. 3.2: Mean number of whitefly on tomato varieties at different observation dates.

Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05.

3.2.2 Jassid population on tomato varieties

The results of per leaf population of *Amrasca devastan* on three tomato varieties at different dates is presented in Table-3.5. It observed that the highest number of *Amrasca davastan* had noted on 25th Jan. in Tomato Rio variety. It was 2.44, 2.93 and 2.66 on T-206, Tomato Rio and T-1359 respectively. Therefore, Neem Seed Extract was applied at 2% concentrations on 25th Jan, which was continued at 15 days intervals on 9th Feb. and 24th Feb. The lowest population of 0.04 jassid/ leaf was recorded on 19th Feb. in variety T-206 which was not significantly different from 0.18, 0.23, 0.05 and 0.18 was recorded from 14th Feb. to 5th March respectively. In case of Tomato Rio the lowest population of 0.03 jassid/ leaf was observed on 29th Feb. which was not significantly different from 0.04, 0.24 and 0.14 recorded on 19th Feb. to 5th Mar. respectively. In case of T-1359 similar trend was observed, the lowest population of 0.05 jassid/ leaf was observed on 19th Feb. which was not statistically different from 0.08 and 0.29 recorded on 29th Feb. and 14th Feb. respectively. A comparison of mean number of Jassid on three varieties of tomato is presented in Fig. 3.3. It revealed that the lowest population of 0.76 jassid/ leaf was observed in T-206, whereas significantly higher number of 1.02 jassid/ leaf was recorded in T-1359 which was significantly different from 0.91 jassid recorded in Tomato Rio. However, the value of Tomato Rio was not significantly different from the value of T-206. A comparison of mean number of jassid on tomato varieties at different dates is presented in Fig. 3.4. It revealed that the lowest number of 0.04 jassid/ leaf was observed on 19th Feb. which was not significantly different from 0.05, 0.22, 0.28 and 0.37 respectively recorded on 29th Feb., 5th Mar., 14th Feb. and 25th Febr. However, the highest number of 2.69 jassid/ leaf was recorded on 25th Jan. It was not significantly different from 2.24 jassid recorded on 20th Jan., but significantly higher than the numbers recorded on all other dates. Jassid population fluctuated during 30th Jan. to 5th Mar., because of the application of neem seed extract. Interaction between all the three varieties indicated that highest and significantly different jassid population was recorded on 25th Jan. which dropped significantly with the application of neem seed extract on 25th Jan. after 25 days intervals. The population of jassid remained lower but significantly different on different varieties.

Table-3.5: Mean number of jassid nymph / leaf on tomato varieties at different observation dates.

Obs. Dates	Tomato varieties		
	V1= T-206	V2= Tomato Rio	V3=T-1359
20-Jan	1.91^{cde}	2.33^{bcd}	286^{a}
25-Jan	2.44^{ab}	2.93^{a}	2.66^{ab}
30-Jan	1.21^{cde}	1.39^{def}	1.01^{ef}
4-Feb	0.33^{ijk}	0.41^{jhi}	0.89^{jhi}
9-Feb	1.06^{ef}	1.21^{cde}	1.34^{def}
14-Feb	0.18^{mno}	0.36^{fj}	0.29^{jkl}
19-Feb	0.04^{lmn}	0.04^{lmn}	0.05^{lmn}
24-Feb	0.23^{jkl}	0.24^{jkl}	0.63^{jh}
29 Feb	0.05^{lmn}	0.03^{lmn}	0.08^{lmn}
5-Mar	0.18^{mno}	0.14^{mn}	0.35^{ijk}

Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

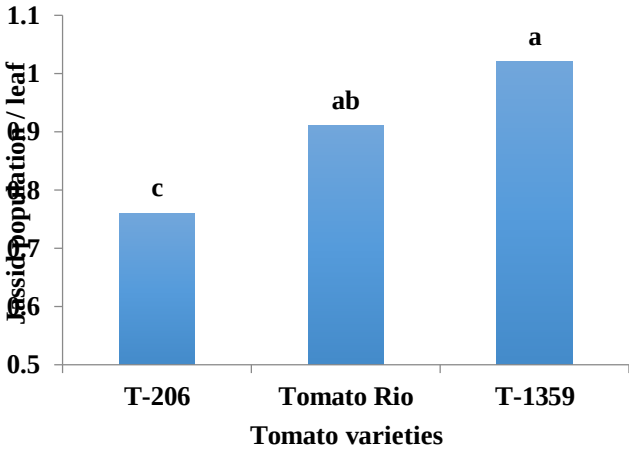

Fig. 3.3: Mean number of jassid on tomato varieties.

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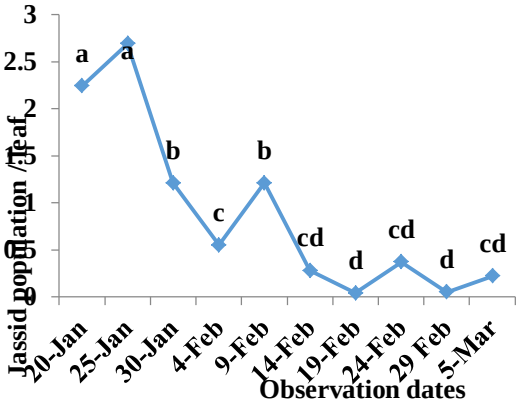

Fig. 3.4: Mean number of jassid on tomato varieties at different observation dates.
Note: Means sharing same letters are not significantly different by Fisher's LSD test at P = 0.05.

3.2.3 Aphid population on Tomato varieties

The results of per leaf population of *Aphis gossypii* on three tomato varieties at different dates is presented in Table-3.6. It revealed that the highest population of aphid was recorded on 25th January in T-1359. It was 3.24, 3.15 and 3.26 on T-206, Tomato Rio and T-1359 respectively. Therefore, Neem Seed Extract was applied at 2 percent concentrations on 25th January which was continued at 15 days intervals on 9th February and 24th February. The lowest population of 0.03 aphid / leaf was recorded on 19th February and 29th February in T-206 variety which was not significantly different from 0.23, 0.28, 0.18, 0.14 and 0.10 respectively recorded from 4th February to 5th March in all the three varieties. However, the values of 0.23 aphids / leaf in T-206, 0.29 in Tomato Rio on 4th February and 0.28 in T-206 on 9th February were also not significantly different. A comparison of mean number of aphid on three varieties of tomato is presented in Figure-3.5. It revealed that the lowest population of 0.61 aphids / leaf was observed in T-206 which was significantly lower than 0.73 in Tomato Rio and 0.75 in T-1359. However, these two values were not significant different from each other, whereas the highest number of 0.75 aphids / leaf was recorded from T-1359 which was not significantly different from 0.73 aphid recorded in Tomato Rio. A comparison of mean number of aphid on tomato varieties at different dates is presented in Figure-3.6. It revealed that the lowest number of 0.03 aphids / leaf was observed on 19th February which was not significantly different from those values recorded on 14th February to 5th March. However, the highest number of 3.22 aphids / leaf was recorded on 25th January which was significantly different from all other values recorded from 20th January to 5th March. Interaction between all the three varieties indicated that highest and significantly different aphid population was recorded on 25th January which dropped significantly with the application of neem seed extract on 25th January after 15 days intervals. The population of aphids remained lower but significantly different from different varieties.

Table-3.6: Mean number of aphid nymph / leaf on tomato varieties at different observation dates.

Obs. Dates	Tomato varieties		
	V1= T-206	V2= Tomato Rio	V3= T-1359
20-Jan	1.34^{cde}	1.32^{cde}	1.58^{cde}
25-Jan	3.24^{a}	3.15^{ab}	3.26^{a}
30-Jan	0.53^{fgh}	1.20^{def}	0.88^{efg}
4-Feb	0.23^{ijk}	0.29^{ijk}	0.54^{fgh}
9-Feb	0.28^{ijk}	0.61^{fg}	0.51^{fgh}
14-Feb	0.18^{jkl}	0.25^{ijk}	0.18^{jkl}
19-Feb	0.03^{klm}	0.03^{klm}	0.03^{klm}
24-Feb	0.14^{jkl}	0.13^{jkl}	0.24^{ijk}
29 Feb	0.03^{klm}	0.05^{klm}	0.06^{klm}
5-Mar	0.10^{jkl}	0.27^{ijk}	0.21^{jkl}

Note: Mean sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

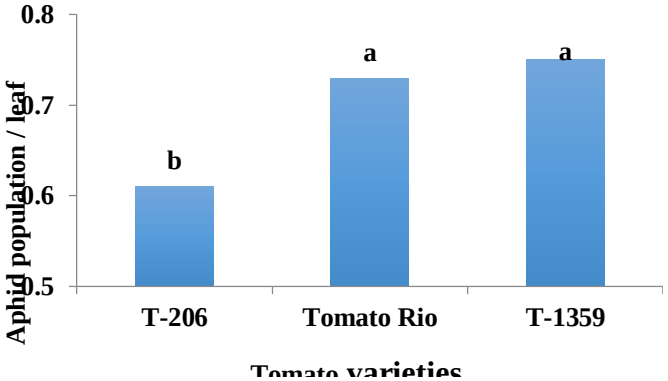

Figure-3.5: Mean number of aphid on tomato varieties.

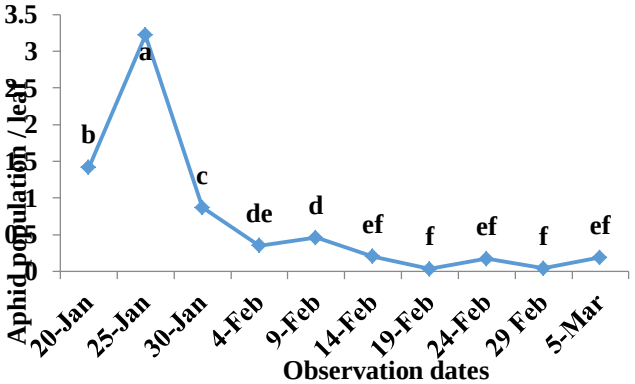

Figure-3.6: Mean number of aphid on tomato varieties at different observation dates.
Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

3.2.4 Fruit borer population on tomato varieties

The result of per plant population of *Helicoverpa armigera* on three tomato varieties at different dates is presented in Table- 3.7. It revealed that tomato fruit borer population was remained absent in tomato field from 20th January to 29th February but in first time fruit borer was appeared as 0.060 / plant individual in variety T-206, 0.045 / plant individual in Tomato Rio and 0.062 / plant individual in T-1359 on 5th March which was not significantly different from each other. A comparison of mean number of fruit borer on three varieties of tomato is presented in Fig. 3.7. It revealed that

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the lowest population of 0.045 fruit borer/ plant was observed in Tomato Rio, whereas significantly higher number of fruit borer 0.062 was observed in T-1359 which was not significantly different from 0.060 recorded in T-206. A comparison of mean number of fruit borer on tomato varieties at different dates is presented in Fig. 3.8. It revealed that in all the observation dates from 20th Jan. to 29th Feb. the fruit borer population was zero. However, the appearance of fruit borer observed was 0.062/ plant in 5th March.

Table-3.7: Mean number of fruit borer on tomato varieties at different observation dates.

Obs. Dates	Tomato varieties		
	V1= T-206	V2= Tomato Rio	V3= T-1359
20-Jan	0.00^{b}	0.00^{b}	0.00^{b}
25-Jan	0.00^{b}	0.00^{b}	0.00^{b}
30-Jan	0.00^{b}	0.00^{b}	0.00^{b}
4-Feb	0.00^{b}	0.00^{b}	0.00^{b}
9-Feb	0.00^{b}	0.00^{b}	0.00^{b}
14-Feb	0.00^{b}	0.00^{b}	0.00^{b}
19-Feb	0.00^{b}	0.00^{b}	0.00^{b}
24-Feb	0.00^{b}	0.00^{b}	0.00^{b}
29 Feb	0.00^{b}	0.00^{b}	0.00^{b}
5-Mar	0.060^{a}	0.045^{a}	0.062^{a}

Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

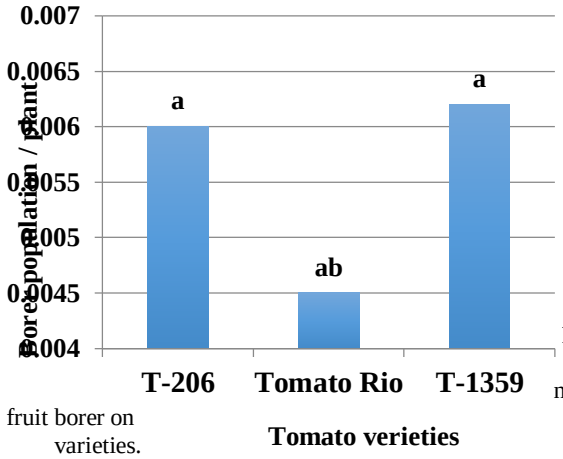

Fig.3.7: Mean number of tomato fruit borer on varieties.

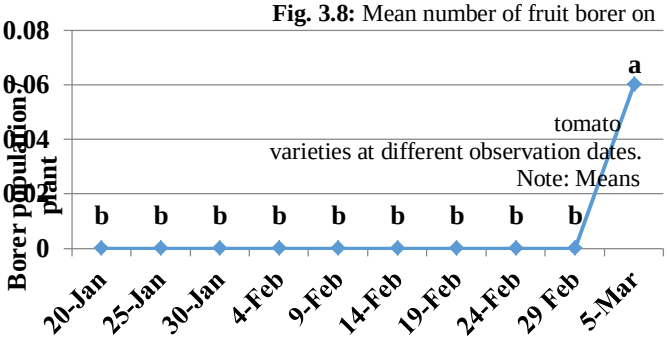

Fig. 3.8: Mean number of fruit borer on tomato varieties at different observation dates. Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

3.2.5 Varieties

The result of per plant population of ladybird beetle *(Coccinella septempunctata)* adults on three tomato varieties at different dates is presented in Table-3.8. It revealed that the highest population of *C. septempunctata* was recorded on 14th February in T-1359. It was 0.76, 0.60 and 1.14 on T-206, Tomato Rio and T-1359 respectively. Therefore, Neem Seed Extract was applied at 2% concentrations on 25th Jan. which was continued at 15 days intervals on 9th Feb. and 24th Feb. The lowest population of 0.03 *C. septempunctata*/ plant was recorded on 19th Feb. in T-206 variety which was not significantly different from all other observation dates except 4th, 9th and 14th Feb. In case of Tomato Rio variety, the lowest number of 0.03 *C. septempunctata*/ plant was observed on 20th Jan., 19th Feb. and 29th Feb. which was not significantly different from 0.06 / plant was recorded on 25th Jan.. In case of T-1359 similar trend was observed, whereas, the lowest number of 0.02 *C. septempunctata*/ plant was observed on 25th Jan. which was not significantly different from 0.06, 0.08 and 0.03 was recorded on 20th Jan., 19th Feb. and 29th Feb. respectively. A comparison of mean number of predators on three varieties of tomato is presented in Fig.3.9. It revealed that the lowest number of 0.28 *C. septempunctata*/ plant was observed in T-206 and Tomato Rio, whereas significantly highest number of 0.40 *C. septempunctata*/ plant was recorded in T-1359 which was significantly higher from 0.28 and 0.28 recorded in varieties Tomato Rio and T-206 respectively. A comparison of mean number of predators on tomato varieties at different dates is presented in Fig. 3.10. It revealed that the lowest population of 0.04 *C. septempunctata*/ plant was observed on 19th Feb. which was not significantly different from 0.05, 0.05 and 0.06 recorded on 20th Jan., 25th Jan. & 29th Feb. respectively. However, the highest number of 0.75 *C. septempunctata*/ plant was recorded on 14th Feb. Interaction between all the three varieties indicated that highest and significantly different predator population was recorded on 14th Feb. which dropped significantly with the third application of neem seed extract on 24th Feb. and after 15 days intervals. The population of predator remained lower on different varieties.

Table -3.7: Mean number of predators on tomato varieties at different observation dates.

Obs. Dates	Tomato varieties		
	V1= T-206	V2= Tomato Rio	V3= T-1359
20-Jan	0.05^{ghi}	0.03^{hi}	0.06^{ghi}
25-Jan	0.07^{ghi}	0.06^{ghi}	0.02^{i}
30-Jan	0.23^{fgh}	0.33^{ef}	0.46^{cde}
4-Feb	0.25^{fg}	0.43^{def}	0.39^{def}
9-Feb	0.49^{cde}	0.60^{bcd}	0.66^{bc}
14-Feb	0.58^{bcd}	0.53^{cde}	1.14^{a}
19-Feb	0.03^{hi}	0.03^{hi}	0.08^{ghi}
24-Feb	0.25^{fgh}	0.43^{def}	0.53^{cde}
29 Feb	0.11^{ghi}	0.03^{hi}	0.03^{hi}
5-Mar	0.76^{b}	0.35^{ef}	0.65^{bc}

Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05

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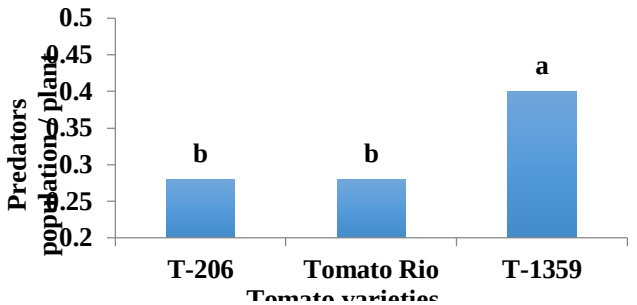

Figure 3.9: Mean number of predators on tomato varieties.

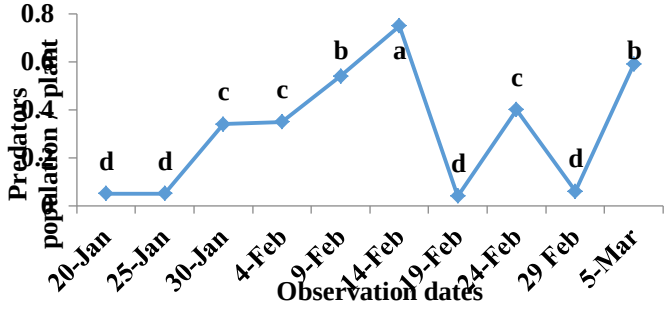

Figure 3.10: Mean number of predators on tomato varieties at different observation dates.

Note: Means sharing similar letters are not significantly different by Fisher's LSD test at P = 0.05.

4. DISCUSSION

The present study was carried out on Comparison of Pest Population and Use of Neem Seed Extract on Different Varieties of Tomato. Repellency of Neem Seed Extract was studied against whitefly on brinjal, chilli and tomato plants by free choice method in the green house of the Faculty of Agriculture, LUAWMS. Three genotypes of each crop *viz* brinjal, chilli, okra & tomato sown separately at Coconut Farm, Uthal.

Tomato crop was sown had sprayed with Neem Seed Extract against whitefly, jassid, aphid, borer and population of these insect pests and predators was compared on three varieties of each crop separately sown in Randomized Complete Block Design (RCBD). Among tested tomato varieties, T-206 showed more relative resistance to whitefly, jassid and aphid as compared to Tomato Rio and T-1359. The highest population of whitefly, jassid and aphid was recorded on 25th January and lowest population of whitefly and jassid on 5th March and lowest population of aphid on 19th February. The borer population remained absent from tomato field from 20th January to 29th February and first appeared on 5th March on all the three varieties of tomato when the tomato season was at its end. During the entire tomato season there was no threat of borer on this crop. Tomato T-1359 variety attracted more predators as compared to T-206 and Tomato Rio varieties. Predators population showed zigzag trend on different observation dates. [10] applied neem Extract, tobacco extract, neem oil and garlic extract resulted in more than 50 percent mortality of aphids. Same effects also been recorded by [11] who showed that the botanical insecticides provided steepest manage of the sucking pests and bollworms. [12] established that the action of neem seed extract was higher opposite fruit borer and jassid than other treatments. Achook and Neem Seed Kernel Extract (NSKE) 3 percent was positive result in managing the fruit borer and jassid. [3] observed the issue of botanical chemicals & their action management on insect pests of *Lycopersicon esculentum*. The botanical pesticide showed that life of life control against *Bemisia tabaci*. The combine use of bio-pesticides with synthetic insecticides in tomato claim that their activity was not changed. [8] showed that whole the botanical pesticide compare to artificial pesticides controlled the infestation of insect pests of tomato then as compared to control. Like to current research data, that was proposed botanical pesticide, properly the materials of neem, tobacco and tooh should be applied against insect pests of tomato, but potential based of neem botanical pesticide stayed apex to research time against whole target pest. The botanical pesticide apply on tomato has no supplied effective control on insect pests, In the tomato fruit the synthetic pesticides residual effect remain that was dangerous for human health, but the artificial pesticides use improper way that has created a serious problem for human health and living organisms. Mode of action of Neem on the sucking insect pests were sufficient due to repellent effect on insect pests. First spray on the crop was in 25th January after this the population of insect pests was decreased and repel from crop but in the 2nd spray of neem seed extract was done in 9th February and 3rd spray in 24th February. Preference and non preference of pests due to biochemicals especially secondary compounds. Predator population is dependent on the availability of pests. In the current research it was deserved that predator population decreased after the decrease of sucking pests but later on it slightly increase due to the availability of less active insect pests in the field. Finally it was deserved that population of all the pests on various crop varieties remained below EIL after the application of 2% NSE on 25th Jan. and later on at fortnightly intervals. These showed that insect pests of all these vegetable crop varieties can be managed with this treatment.

4. CONCLUSIONS

1. The results of present study revealed varietal preference of monitored insect pests differed significantly in tomato varieties.
2. Since pest population increased beyond ETL on 25th Jan. Therefore, 2% neem seed extract was applied on the test vegetables on 25th Jan., 09th and 24th Feb.
3. These applications kept the pest population below ETL till the last observation on 5th Mar. Population of predators were not affected significantly by application of 2% neem seed extract because of predators which are not phytophagous like other pests.

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