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EFFICACY OF INSECTICIDE ON MELON FRUIT FLIES BACTROCERA CUCURBITAE INFESTATION, IN CUCUMBER CROP.

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Abstract:
This study evaluated the efficacy of different insecticides on cucumber biological parameters, infestation levels of Bactrocera cucurbitae, and yield under field conditions during June-August 2021. The results showed that chemical Parlor was the most effective treatment in reducing fruit infestation, increasing fruit weight, and enhancing fruit length, followed by China clay, Neem oil, and Garlic extract. The highest number of sound fruits and the maximum yield per plant (4.53 kg) and per hectare (16,926 kg) were observed in the Parlor-treated plots. The control plots exhibited the highest infestation levels and the lowest yield. In terms of infestation, Parlor reduced the percent infestation significantly (11.9%), outperforming other treatments such as China clay (36.1%), Neem oil (48.6%), and Garlic extract (60.0%). Overall, the chemical insecticide Parlor demonstrated superior performance in managing Bactrocera cucurbitae and enhancing cucumber yield. The study recommends the use of Parlor insecticide, possibly in combination with China clay, for effective pest management and higher cucumber production.

Key words. Cucumber, insecticides, botanicals and B. cucurbitae.

INTRODUCTION

Cucumber (Cucumis sativus L.) is an important vegetable throughout the world belongs to the family cucurbitaceae. There are 120 genera and 1000 species in Cucurbitaceous family. Cucumber is one of the most vital vegetables after cabbage, tomato and onion in whole Asia. Eifedigi and

Remison (2010). It is used as a salad and since it has a great mandate in different food consequences. Weinberger and Genova (2005). Cucumber has three kinds such as seedless cucumber, pickling cucumber and slicing cucumber. There are different vitamins which are present in the cucumber vegetable like vitamin B1, vitamin B5 and vitamin B7 (biotin). It also contains fiber which can help in losing weight and preventing the skin problems as well Dixing et al., (2016). The fruits of cucumber are the biggest set of vegetables cultivated all over the world in humid as well as in tropical conditions. The area under cultivation of cucumber around the world is about 850,000 hectare and their production is 12.5 million tons according to the report of FAO (2007). In Pakistan, cucumber grown area under cultivation was 1805 ha in 2015 with Production rate of 14221.6 kg/ha FAO (2016). Melon fruit fly (Bactrocera cucurbitae) belongs to the family (Tephritidae) is one of the main pests of cucurbitaceous crops and is broadly circulated in moderate, sub-tropical and humid regions through the world (Chaudhary and Patel, 2012). In Pakistan about 12 species of fruit flies are projecting, but three of them are Bactrocera zonata, B. cucurbitae and B. dorsalis are serious threats to vegetables and fruits. Panhwar (2005). It has been identified on 81 various plants hosts and is a key pest of cucurbitaceous family Dhillon et al., (2005) and Sapkota et al., (2010). The full-size mature larvae come out from the cucumber fruits by creating holes to pupate inside the soil. The larvae pupate at a depth of 0.5 cm to 15 cm in the soil to survive and depend upon the moisture in soil and soil texture. Jackson et al., (1998). The duration of the pupal stage is 7.2 days on cucumber and at 27 ± 1°C.Doharey (1983). Overall, the pupal stage takes about 15 days in the winter season. Narayanan and Batra (1960). The losses in yield of about 30-100% occur due to Bactrocera cucurbitae in vegetables crops Dhillon et al., (2005). In Pakistan farmers face different problems in vegetables fruits and approximately US$200 million losses occur due to B. cucurbitae yearly in Pakistan. The Bactrocera cucurbitae cause the infestation inside or outside the host and ecological situation. Muhammad et al., (2007). The infestation is caused by the larvae of female adult below the upper epidermis Shang et al., (2014). The visits of Bactrocera cucurbitae flies are the indication of damage which starts in field. Weems and Heppner (2004). Eggs that are oviposited by females with pricking the fruits as a result secretion of fluid take place and accumulate over the surface. Later on, visible symptoms; dark spots appear on the surface. The symptoms are a clear sign of larval incidence inside the fruits. Hafiz et al., (2020). The larvae cause damage when the larvae make burrows inside the fruits, the pulp converts to soft form and is contaminated by frass due to feeding action of larvae that indirectly support the development of pathogenic infection. Abro et al., (2017). The fruits become distorted unpleasant and losses the fluid which becomes hard and damaging for the use of human. Dhillon et al., (2005). Different controlling methods i.e. field sanitation; installation of pheromone traps, botanical extracts, trapping of fruits, food baits and chemicals of synthetic insecticides has been accepted against Bactrocera cucurbitae to minimize the pest infestation. Therefore, the synthetic insecticides reduced the integrating with botanical extracts for achieving higher crop production. Akhtaruzzaman et al., (2000). Some plants are used directly or as a synthetic insecticide which contain lethal composites and almost act as insecticides. Singh and Sehgal (2001).

MATERIALS AND METHODS

The research was carried out at Agriculture research institute Mingora-Swat Khyber Pakhtunkhwa, to study the efficacy of synthetic insecticide, botanical extracts and china clay against Melon fruit fly (Bactrocera cucurbitae) under field conditions.

Experimental Design

The experimental design was conducted in randomized complete block design (RCBD) with five treatments and three replications. There were five treatments; Parlor, China clay, Neem oil, Garlic extract and a control plot in each replication. Total field size will be kept 97.82m^2. The whole field was divided into 3 equal parts considered as 3 Replications with size of 29.78m^2each. Each block was further divided into five sub-plots with size of 2.04x2.68$m^{2,}$ considered of one row with row-row and plant-plant distance of 180cm and 30cm respectively. 30 cm buffer zone was left among the

sub-plots. All agronomic practices were applied during the whole experiment for raising good production. Cucumber variety (F1 Vistara) seeds were sown in ridges with seed rate of (recommended) 150 gm per Kanal. The recommended insecticides listed below in (Table 3.1) were used when the pest population reached to the economic threshold level (8-10) pests per plot during harvest time using Knapsack sprayer.

Parlor
Parlor 20SC is a synthetic insecticide tested against B. cucurbitae and was purchased from the local market of Mingora-swat Khyber Pakhtunkhwa and sprayed at recommended dose of 3ml/L of water.

Neem oil
Botanical extract (Neem oil) was purchased from the local market of Mingora-Swat and was applied at recommended rate of 3ml/Liter of water against the infestation of Bactrocera cucurbitae.

China clay
Readymade China clay having the active ingredient (Kaolinite) was obtained from Soil Section; ARI, Mingora-Swat and sprayed at the recommended rate of 50gm/Litre of water to deter the insect pest Bactrocera cucurbitae that sticks to their body parts and encourage them to move on elsewhere. At harvest time, the white film was removed simply by rubbing it off. Hilary et al., (2016).

Garlic extract
Five peeled of garlic pieces were taken of 240 g mixed with 1.5 cup of water and blend it in an electric juicer. The mixture was kept for 24 hrs., then strained and added 10 g of detergent to it. This mixture was transferred into 1 Liter of water for making the solution stock.

The desired concentration was calculated by the equation of Noor (2018).

C1V1=C2V2
Whereas;
C1= Stock solution of concentration
C2= Concentration required
V1= required volume for the solution to make the concentration desired
V2= Volume required

Control
The control treatment was kept untreated and only water was sprayed on the tested area.

Pheromone Traps
Pheromone trap was installed for the collection of Bactrocera cucurbitae and monitoring purposes to check the infestation level of fruit fly. Pheromone trap was prepared by using the following materials. Cue-lure @5ml, Dipterex,2.5cc syringe, Cotton swab, Sugar, Trap box, Water

Data collection
Data was recorded when the insect first appeared on the crop and taken continuously at weekly intervals by counting the number of infested fruits and healthy fruits per plot consisting of single row with total 8 plants; out of which 4 plants were randomly selected by choosing one plant and leaving the other after application of insecticide and bio-pesticides. Onward these infested and healthy fruits were brought to the laboratory into polyethylene bags and observed their symptoms on the basis of dark spots and punctures appeared on the fruits considered as fruit fly infestation Hafiz et al., (2020). The specimen's collection was identified at Entomology section, Agriculture Research institute (ARI) Mingora-Swat, during 2021. Infestation level was recorded on weekly basis after application of synthetic insecticide and botanical extracts in each treated and untreated plot. The

percent infestation was calculated on the basis of total number of damage fruits and healthy fruits per plot. The yield (kg/ha) of healthy fruits and infested fruits was also calculated and compared among the different treatments Khatun et al., (2016).

Number of fruits per plant

The total numbers of fruits in each plant were counted by randomly selecting four plants from each plot at each picking and mean number of fruits per plant was counted.

Fruit weight (g)

Cucumber fruit weight was calculated by weighing individual fruits of four randomly selected plants from each plot and then means weight was calculated.

Fruits length (cm)

Fruit lengths of four randomly selected plants were measured by measuring the length of each fruit with measuring tape in each plot and then mean fruit length was determined.

Number of Infested and healthy fruits

The number of infested and healthy fruits was recorded counted manually on the basis of their signs and symptoms of infestation and their mean numbers were evaluated. The cucumber fruits have no yellow spots and punctures present on the healthy fruits, while infested; having yellow signs were considered as fruits with infestation Khatun et al., (2015).

Percent fruit infestation by number

The number of healthy fruits and infested fruits were counted when it reached maturity stage and mean percent fruit infestation by number was work out by using given formula Srinivas et al., (2018).

$$\%\ \textbf{Fruits infestation (number)} = \frac{\textbf{No. Infested fruits}}{\textbf{Total No. of fruits}} \times 100$$

Yield

Cucumbers were harvested when it reached maturity The data was recorded in kilograms with scale and converted it into kg/ha Gruda et al., (2018).

$$\textbf{Yield (kg/ha)} = \frac{\textbf{Yield per plot}}{\textbf{Total Plot size (m2)}} \times 10000$$

Statistical analysis

The data will be analyzed through ANOVA by using RCBD. Mean for each parameter was separated by using LSD on 0.05% level. For data analysis statistical software version 8.1 was used (Steel and Torrie, 1984).

RESULTS

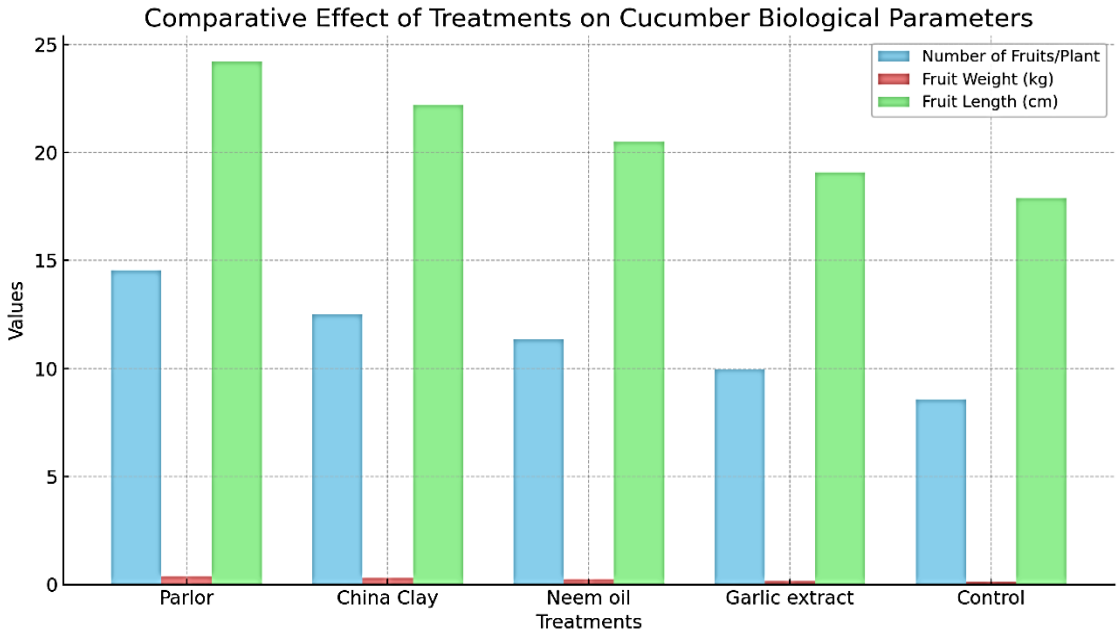
Effect of different treatments application on biological parameters of cucumber under field Conditions during June- August 2021.

The study evaluated the effectiveness of different insecticides on cucumber biological parameters under field conditions. The results showed that the chemical insecticide Parlor performed the best, with the highest mean number of fruits per plant (14.56), the highest fruit weight (0.39 kg), and the longest fruit length (24.2 cm). China clay and Neem oil followed, while Garlic extract and the control plot had the lowest results in all parameters. Parlor was significantly more effective than other treatments in increasing fruit yield and size, making it the best choice for controlling Bactrocera cucurbitae while being safer for bio-control agents.

Table 4.1 Effect of different treatments application on biological parameters of cucumber under field conditions during June- August 2021.

Treatments	Number of fruits/plants	Fruit weight (kg)	Fruit length (cm)
Parlor	14.56a	0.39a	24.2a
China Clay	12.53b	0.32b	22.2b
Neem oil	11.36c	0.25c	20.5c
Garlic extract	9.96d	0.19d	19.1d
Control	8.56e	0.12e	17.9e
LSD value	**0.97**	**0.04**	**0.66**

Mean value followed by different letters are significantly different at 5% significance using LSD test



Effect of different treatments application on infestation level of B. cucurbitae in Cucumber under field conditions.

The study compared the effectiveness of various insecticides on the infestation levels of Bactrocera cucurbitae in cucumber under field conditions. The results showed that the chemical Parlor treatment was the most effective, recording the highest mean number of sound fruits per plant (12.13), followed by China clay (10.93), Neem oil (9.10), and Garlic extract
(6.80). The control plot had the lowest mean number of sound fruits (2.50). Parlor also resulted in the fewest infested fruits (2.20), while the control plot had the highest number (6.20). In terms of fruit weight, the highest weight of sound fruit (2.7 kg) was recorded in the Parlor-treated plots, followed by China clay (2.46 kg), Neem oil (1.70 kg), and Garlic extract (1.36 kg). The control plot recorded the lowest weight of sound fruits (0.73 kg). Parlor-treated plots also had the lowest weight of infested fruits (0.70 kg), indicating its superior efficacy in controlling Bactrocera cucurbitae and promoting cucumber yield. The findings conclude that Parlor insecticide is highly effective against the pest and safer for bio-control agents.

Table- 4.2: Effect of different treatments application on infestation level of B. cucurbitae in Cucumber under field conditions during June- August 2021.

Treatments	Number of sound fruit	Number of infested fruit	Weight of sound fruit (kg)	Weight of infested fruit (kg)
Parlor	12.13a	2.20e	2.76a	0.70e
China Clay	10.93b	2.60d	2.46b	1.06d
Neem oil	9.10c	3.06c	1.70c	1.50c
Garlic extract	6.80d	3.36b	1.36d	1.93b
Control	2.50e	6.20a	0.73e	2.63a
LSD value	**0.5969**	**0.2886**	**0.2640**	**0.3197**

Mean value followed by different letters are significantly different at 5% significance using LSD test

Effect of different treatments application on yield of cucumber.

The study evaluated the impact of different insecticides on cucumber yield, and the results are shown in Table-4.3. The highest mean yield per plant (4.53 kg) was observed in the Parlor-treated plots, significantly outperforming the other treatments. China clay followed with a yield of 4.06 kg per plant, while Neem oil (3.76 kg) and Garlic extract (3.40 kg) were also effective, though less so. The control plot had the lowest yield (2.30 kg). For yield per hectare, the maximum yield (16,926 kg/ha) was recorded in the Parlor-treated plots, followed by China clay (15,145 kg/ha), Neem oil (14,050 kg/ha), and Garlic extract (12,703 kg/ha). The control treatment recorded the lowest yield (8,607 kg/ha). The findings conclude that Parlor insecticide is highly effective in promoting cucumber yield and is superior to the other treatments tested

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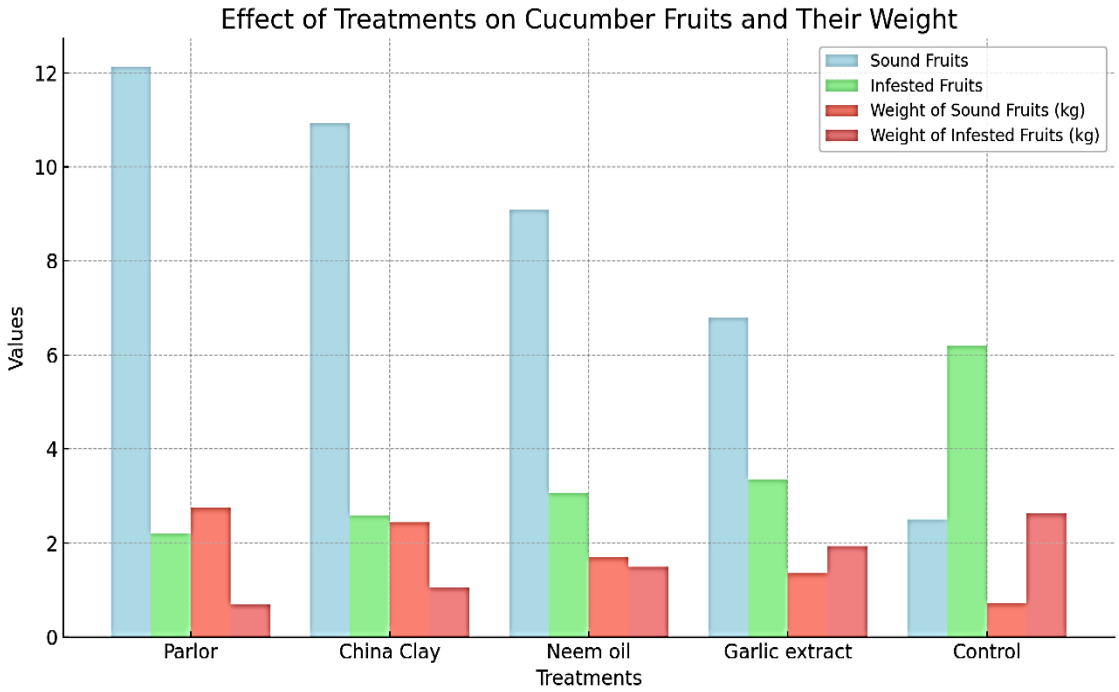

Table 4.3 Effect of different treatments application on yield of cucumber during June-August 2021.

Treatments	Mean yield kg/ Plant	Mean yield kg/ha
Parlor	4.5333a	16926a
China Clay	4.0667b	15145b
Neem oil	3.7667bc	14050c
Garlic extract	3.4000c	12703d

Control	2.3000d	8607e
LSD value	0.3781	33.820

Percent % infestation of Bactrocera cucurbitae in cucumber.

The results regarding percent % infestation of Bactrocera cucurbitae shown in the Figure-4.1which indicated that the minimum mean percent infestation (11.9%) was recorded in a plot treated with Parlor which was highly effective among all the tested insecticides which are significantly different from each other. The next comparatively effective treatment was China clay which was recorded (36.1%) percent infestation which is less effective from parlor but more effective from other two treatments respectively, While the effectiveness of the Neem oil was recorded (48.6%) after Parlor and China clay. The maximum percent infestation (73.9%) was recorded in control plot followed by Garlic extract (60.0%) respectively. Thus, fig-4.1 showed that Parlor insecticide performed better than other treated plots, which vagueness against cucumber insect pest, suppresses insect pest level and also regulated the biodiversity of agro-ecological system

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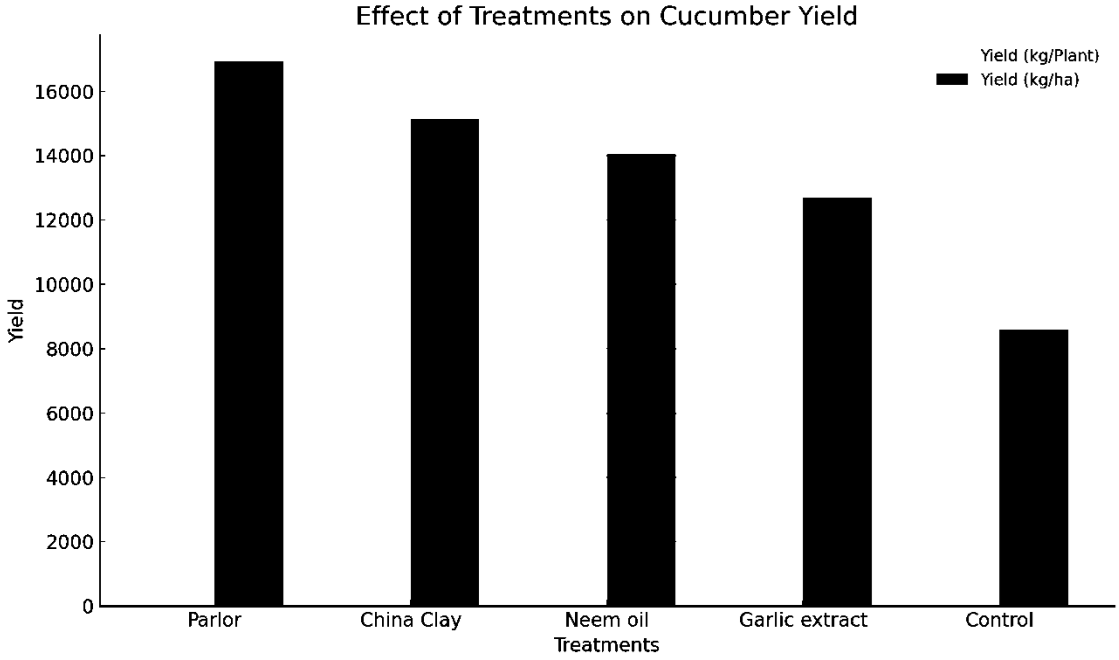

DISCUSSION

Bactrocera cucurbitae is a serious insect pest which can cause loses in yield as well as it significantly damages the quality of crops in cucurbit fields. Various methods are being used to combat this pest Subedi et al., (2021). The extent of damage ranges from 30 to 100% depending upon the season and susceptibility of the crops species and varieties (Dhillon et al., 2005; Amin et al., 2011). The female fruit fly is free-living and visits fruits only at the time of oviposition and inserts ovipositor for egg laying inside young fruits, and upon hatching larvae start feeding on the internal tissues of the fruits, resulting in total loss of harvestable fruit (Sarkar et al., 2017). Farmers have been practicing the use of pheromone traps, application of chemical measures, and field sanitation practices in the open field conditions for Bactrocera cucurbitae management (Jasiwal et al., 1997). During the present investigation, the results of different treatments tested against the infestation due to B. cucurbitae in cucumber based on fruit weight (kg) per plant showed that the maximum total fruits weight (kg) per plant was harvested from plants treated with chemical Parlor followed by China clay, Neem oil, and Garlic extract. While the least fruit weight (kg) per plant was recorded in the control plot respectively. In terms of the weight of infested fruits (kg) per plant, the results revealed that the highest weight of infested fruits was harvested from control plots, while the least damaged fruit based on the weight was recorded from plants treated with Parlor followed by China clay and Neem oil respectively. In case of the weight of healthy fruits (kg) per plant, the results indicated that the highest healthy fruits weight (kg) per plant was recorded in plots treated

with Parlor followed by other tested botanicals (Neem oil and Garlic extracts), while the lowest healthy fruits weight was observed in control plot respectively. The present investigation was in line with Gautam et al. (2021) who evaluated the efficacy of different insecticides and botanicals against the Melon Fruit Fly (Bactrocera cucurbitae) and reported that chemical insecticides and botanicals have a significant effect on the traits observed in cucumber. Thus the effectiveness of insecticide (Parlor) and botanicals (Neem oil and Garlic extract) was recorded after application of spraying and noted that the results of insecticides are comparatively effective as compared to botanicals. The results regarding the number of infested fruits and sound fruits showed that among all the applied treatments the chemical Parlor was recorded best which reduced the number of infested fruits and increased the number of sound fruits followed by China clay, Neem oil, and Garlic extracts respectively. While the control plot provided highest number of infested fruits. The same studies were investigated by Khatun et al. (2016) and Khatun et al. (2015) reported that Parlor was found to be the most effective one followed by China clay and Neem oil against B. cucurbitae. Present findings are supported by those of Waseem et al. (2009), Hanumantappa et al., (2013), and Bhowmik et al., (2014) who founded that the most effective treatment in reducing the fruit infestation by B. cucurbitae was Parlor followed by that of others. They also reported that the efficacy of insecticides is better than that of other botanicals such as Neem oil and Garlic extracts etc. Percent infestation result showed that the minimum percent infestation (18.37%) was recorded in a plot treated with the chemical Parlor which proved to be the most effective treatment among all the tested insecticides. The next effective treatment was China clay which recorded (39.76%) infestation followed by Neem oil (55.23%) and Garlic extract (62.31%) infestation, while the maximum percent infestation was observed (75.12%) in the control plot. The present investigation was similar to the findings of Ranganath et al. (1997) who tested different insecticides and botanicals against Bactrocera cucurbitae on cucumber and observed that the result of chemical insecticide was comparatively effective as compared to botanicals in reducing the damage in cucumber and recorded minimum infestation over control. Sawai. (2013) and Panday et al. (2014) reported that the result of insecticides were effective and recorded minimum percent infestation as compared with botanicals against B. cucurbtitae. Our current results were also in accordance with Pawar et al., (2019) who evaluated different insecticides tested against B. cucurbitae and recorded minimum infestation over control. The effect of different treatments was tested on the yield of cucumber. The results showed that yield was increased with the application of all treatments except control. The highest yield (kg) per plant was obtained from those plants treated with Parlor and showed best result among all the applied treatments followed by other tested treatments. While the lowest yield in kg per plant was obtained from the control plots. In terms of yield in kg/ha, the maximum yield was recorded in the Parlor treated plot followed by China clay, Neem oil and Garlic extract, while the minimum yield kg/ha was observed in the control plot respectively. The similar findings were in line with Khatun et al., (2016) who documented that the efficacy of insecticides was comparatively most effective than that of other tested treatments respectively. The data regarding the cost-benefit ratio of insecticide and botanicals against B. cucurbitae in cucumber, results showed that the highest total income, total cost and net income was recorded in a plot treated with chemical Parlor which was to be comparatively effective followed by China clay, Neem oil and Garlic extract respectively. While the minimum net income and total cost was observed in the control plot. Thus this analysis showed that the plot treated with insecticide parlor gave good results in cost and net income followed by other tested treatments respectively. The similar results were in conformity with Sawai et al., (2014) who found out the CBR values of different treatments against control and studied the Bactrocera cucurbitae infestation in cucumber. They also obtained a high cost-benefit ratio from a plot treated with insecticides followed by other tested treatments respectively. Our findings cannot be strictly compared with the findings of early researchers as the cost of control shows a discrepancy with time and region to region.

Conclusion

In tested insecticides the chemical Parlor showed better effectiveness against B. cucurbitae compared to botanicals by reducing cucumber fruit infestation and obtaining higher yield in cucumber crop.

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