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Evaluation Of Synthetic Insecticides For The Control Of Maize Stem Borer, Chilo Partellus (Swinhoe) (Crambidae: Lepidoptera) In D. I. Khan, Khyber Pakhtunkhwa, Pakistan

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Abstract

The present research was carried out at the farm of the faculty of agriculture, Gomal University, Dera Ismail Khan during the summer, 2021. The experiment was conducted for the management of C. partellus in maize crops under field and it was laid down in Randomized Complete Block Design with three replications. An experiment was conducted to evaluate the efficacy of different insecticides against maize stem borer. Six insecticides, viz. Emamectin benzoate 1.9 EC, Phorate 5G, Chlorpyrifos 40EC, Fipronil 3G, Lambda-cyhalothrin 2.5EC, and Carbofuran 3G were tested against the pest. The selected insecticides were applied to the crop twice during the whole cropping season. The results revealed that Carbofuran 3G and Emamectin benzoate 1.9EC were found effective against the maize stem borer and recorded minimum infestation of 6.56 and 7.33% after the first application and 5.09 and 6.41% infestation after the second application respectively. Similarly, in agronomic parameters, both Carbofuran 3G and Emamectin benzoate 1.9EC treatments produced the highest cobs per plant (1.57 and 1.43), grain yield (6113.3 and 6059.3 kg ha^{-1}), 1000-grain weight (282.00 and 268.67gm), and grains per cob (400.53 and 396.40) respectively.

Keywords: Maize, insecticides, Chilo partellus, efficacy, grain yield.

Introduction

Maize Zea mays (Graminae) is an important cereal crop. It ranks third after wheat and rice in Pakistan. The crop can successfully be grown in temperate, subtropical and tropical regions of the world [23]. The major maize producing countries of the world are India, Argentina, Mexico, Indonesia, Ukraine, Canada and France [23]. Maize is a rich source of nutritive food. Its grains provide vitamin A (3%), starch (72%), proteins (10%), fiber (5.8%), vitamin B (5%), oil (4.8%), ash (1.7%) and sugar (3.0%) [4]. Out of total maize produced, 55% is used for food purpose, 18% for poultry feed, 14% for livestock, 1% as seed and 12% for starch [20]. The crop is also a rich source of calories and extensively used in animal feed [24].

Maize crop suffers severely from the attack of insect pests. About 140 insect species feed on this crop and cause annual loss of over 1 billion in semi-arid Tropics [16]. They feed on every stage of the plant from roots to the tasseling stage [19]. The insect pests of maize crop are categorized into root feeders, leaf feeders, phloem feeders and borers. At early stage of the crop, damage is caused by root feeders, like wireworms (Agroites mancus), rootworms (Diabrotica virgifera) and corn seed maggots (Delia platura). They damage to young maize plants by feeding on the central whorls and making small holes and irregular cuts on the leaf margins [19]. Stem borers damage to maize plants by making small tunnels in the stem. They include spotted stem borer, Chilo partellus, eastern corn borer, Busseola fusca, pink stem borer, Sesamia inferens (Walker.) and asian corn borer, Ostrinia furnacalis [31]. They cause severe yield losses by damaging photosynthetic tissues, nutrient movement, stem logging and leaf wilting [19].

Maize stem borer (C. partellus) is a major pest of this crop [22, 10]. It is a cosmopolitan in nature and has also been reported from African and Asian countries [3]. The pest causes huge losses (20 - 90%) to this crop [13]. The newly hatched larvae start feeding soft leaves and enter into stem and reach at growing point of the young plants. The larvae make extensive galleries by feeding inside the stem. Pupation occurs inside the stem [33]. Adult emergence takes place either in evening or late afternoon. Adults are nocturnal and rest on the plants or plant debris during the day. Adults mate soon after emergence. A single female lays 300-600 scale like eggs in 10-80 separate batches on the undersides of leaves, mostly nearly the mid rib. Egg hatch in 4 - 8 days. Larvae become full grown in 2 to 4 weeks. They pupate inside the stem. Adults emerge in 5 - 10 days. Under normal conditions, the pest completes 5-6 generations. The whole life cycle takes 30 - 50 days to complete under favorable environmental conditions [27].

Integrated pest management is a broad approach to control this pest. In pest management, different control tactics are applied to suppress the pest population below economic threshold level [8]. Different control measures have been practiced for the control of this pest. Each has its own merits and demerits. These tactics include release of bio-control agents, modification in normal cultural practices, installation of pheromone traps and application of insecticides. The common practice among farmers to control this pest is through the use of synthetic insecticides [6].

Chemical control is the most effective tool in pest management. Insecticides are broad spectrum and have wide range of insect pests with excellent control. A single application of an insecticide may control different pest species [26]. Many insecticides are available in different formulations, like liquid, dust or granules [13, 32]. Insecticides provide quick solution of the pest problem [1, 17]. Granular formulations of insecticides are usually recommended for the control of this pest [11].

The present study was, therefore, carried out to evaluate performance of different maize varieties and synthetic insecticides against stem borer, C. partellus.

Objectives: To investigate the most effective synthetic insecticide to control this pest.

Materials and Methods

The research was initiated at the farm of Faculty of Agriculture, Gomal University, Dera Ismail Khan during summer, 2021. Experiment, viz. Evaluation of some selected synthetic insecticides were conducted to find out the most effective insecticides against C. partellus.

Layout of experiment

Experiment was carried out to investigate the efficacy of selected insecticides for the control of maize stem borer. Randomized complete block design was laid, consisting of seven treatments (including control). Treatment size was maintained 3×4 m^2. Each treatment was replicated thrice. Recommended cultural practices were performed uniformly in all the treatments. Seed of most commonly grown variety, Azam was sown manually in rows keeping 75 cm row to row and 20 cm plant to plant distance respectively. One meter of buffer zone was maintained among treatments to isolate them from each other.

Insecticides

Six different insecticides, viz. Emamectin benzoate 1.9 EC, Phorate 5G, Chlorpyrifos 40EC, Fipronil 3G, Lambda cyhalothrin 2.5EC and Carbofuran 3G were applied at recommended doses, i.e. 500 mL ha^{-1}, 25 kg ha^{-1}, 2500 mL ha^{-1}, 20 kg ha^{-1}, 625 mL ha^{-1} and 20 kg ha^{-1} respectively. There were two applications of selected insecticides during whole cropping season. First application of insecticides was done at economic threshold level (ETL) of borer population, while second after 15 days of 1^{st} application. Insecticides in granular formulation were applied by broadcast method, while that of liquid formulations were applied by spraying using knapsack sprayer. The plants in control plot were treated with the same amount of water only. Data on percent infestation were recorded from germination up to maturity of the crop. Post treatment data were recorded after 3, 7 and 15 days of insecticides application.

Percent infestation

Data on percent infestation was recorded on weekly interval, starting from germination up to maturity of crop. Ten plants were randomly selected in each treatment. The selected plants were examined and the plants showing infestation were recorded.

Using the following formula, the percent infestation was calculated.

$$\text{Percent Infestation} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \times 100$$

No. of cobs plant^{-1}

Ten plants were selected randomly in each treatment. Number of cobs plant^{-1} was recorded on these selected plants.

No. of grains cob^{-1}

Ten cobs were selected randomly from each treatment. Grains were separated from the cobs and kept in separate pre-labeled plastic bag. Finally, the grains cob^{-1} were counted and recorded.

1000-grain weight (gm)

1000-grains were taken from each treatment and counted. The selected grains were weighed using digital balance.

Grain yield (kg/ha)

Data on grain yield was recorded in each treatment. Grain yield obtained from each treatment was weighed and converted into yield hac^{-1} using the given formula.

$$\text{Yield per hectare} = \frac{\text{Grain yield}}{\text{Area harvested}} \times 10000$$

Statistical Analysis

Data was statistically analyzed using Statistics 8.1 software program. Means were separated using LSD test [30].

Table 1. List of insecticides tested against maize stem borer

Treatment	Insecticides	Recommended Dose
T1	Emamectin benzoate 1.9 EC	500 mL ha^{-1}
T2	Thimet 5G	25 kg ha^{-1}
T3	Chlorpyrifos 40EC	2500 mL ha^{-1}
T4	Fipronil 3G	20 kg ha^{-1}
T5	Lambda cyhalothrin 2.5EC	625 mL ha^{-1}
T6	Carbofuran 3G	20 kg ha^{-1}

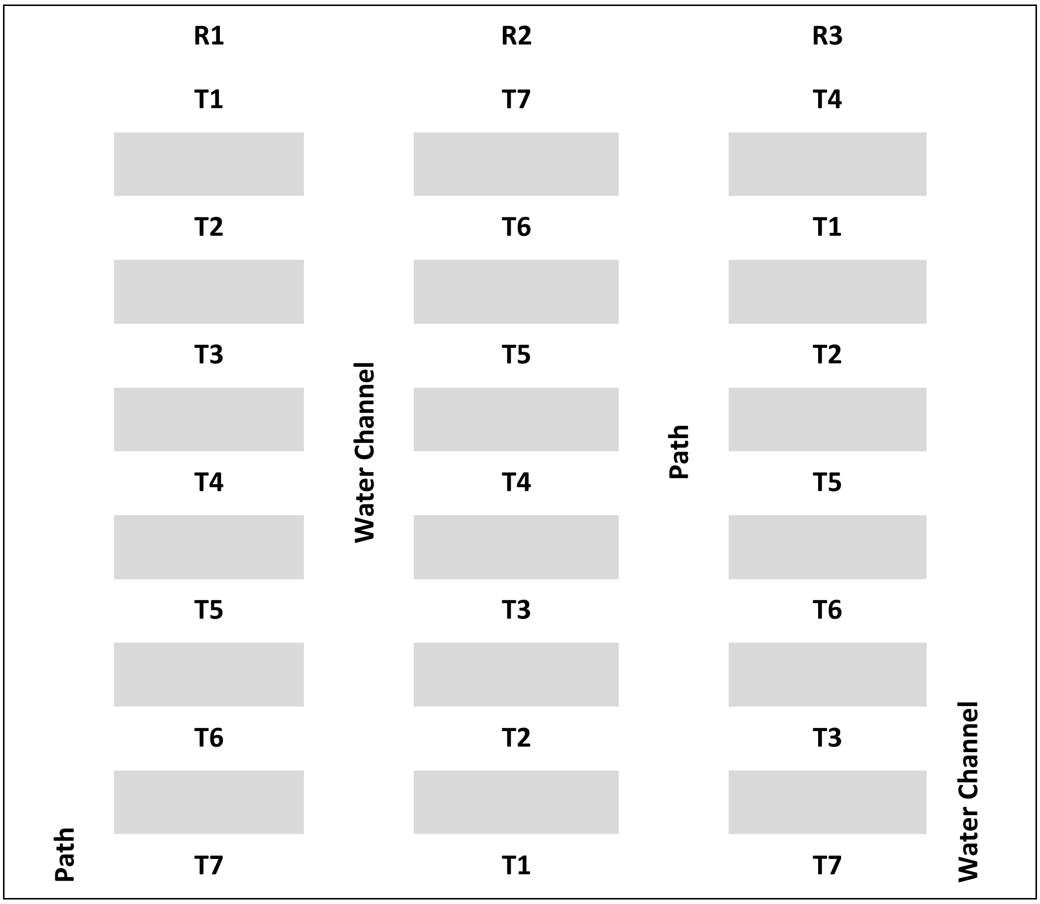

Figure 1. Field layout plan

Where

T1 = Emamectin benzoate 1.9 EC T2 = Thimet 5G

T3 = Chlorpyrifos 40EC T4 = Fipronil 3G

T5 = Lambda cyhalothrin 2.5EC T6 = Carbofuran 3G

T7 = Control

Results and Discussion

Effect of synthetic insecticides on maize stem borer infestation after 1st application

Data recorded before 24 hours of insecticides application showed that pest infestation was statistically similar in all the treatments, which ranged from 9.67 to 12.33% among treatments (Table 2).

Data recorded after three days of insecticide application showed lowest (8.00%) pest infestation in Carbofuran 3G treated plot, and was found non-significantly different from 8.00% infestation in the Emamectin benzoate 1.9 EC the treated plot (Table 4.3). Highest (15.00%) infestation was noted in un-treated control plot, which was statistically at par with 14.00, 13.33, 13.33 and 13.00% infestation in Chlorpyrifos 40EC, Thimet 5G, Lambda cyhalothrin 2.5EC and Fipronil 3G treated plots, respectively.

After seven days of insecticide application, lowest (6.00%) infestation was recorded in plots treated with Carbofuran 3G, which was statistically similar with 7.00% infestation in Emamectin benzoate 1.9 EC treated plot. The plots treated with Fipronil 3G, Lambda cyhalothrin 2.5EC, Chlorpyrifos 40EC and Thimet 5G showed 13.00, 12.67, 13.00 and 12.33% infestation respectively and were found statistically similar with each other at 5% level of significance. Significantly highest (21.00%) infestation was recorded in untreated plot (Table 2).

The results obtained after fifteen days of insecticide applications showed lowest (2.67%) infestation in Carbofuran 3G treated plot, which was non significantly different from 3.67% infestation in Emamectin benzoate 1.9 EC treated plot. The plots treated with Thimet 5G and Fipronil 3G showed statistically similar (9.00 and 8.67%) infestation respectively. Chlorpyrifos 40EC and Lambda cyhalothrin 2.5EC were also found statistically similar with each other showing 12.33 and 11.33% infestation respectively. Significantly highest (22.33%) infestation was recorded in control (Table 2).

Overall mean of data revealed that lowest (6.56%) infestation was recorded in Carbofuran 3G treated plot, followed by 7.33% with application of Emamectin benzoate 1.9EC. 5% level of significance was noted in Thimet 5G and Fipronil 3G with 11.41 and 11.50% infestation, respectively. The untreated control plot showed maximum (17.16%) infestation which was statistically at par with 12.91 and 12.25% infestation noted in the plot treated with Chlorpyrifos 40EC Lambda cyhalothrin 2.5EC.

Table 2. Effect of synthetic insecticides on maize stem borer infestation after 1st application

Treatments	Pre-Spray Data	Post-Spray Data: Percent infestation after different intervals of insecticide application			Mean
	Before 24 Hours	After 3 Days	After 7 Days	After 15 Days	
Emamectin benzoate 1.9 EC	10.67 $^{N.S}$	8.00 ^{c}	7.00 ^{c}	3.67 ^{d}	7.33 ^{cd}
Thimet 5G	11.00	13.33 ^{ab}	12.33 ^{b}	9.00 ^{c}	11.41 ^{bc}
Chlorpyrifos 40EC	12.33	14.00 ^{ab}	13.00 ^{b}	12.33 ^{b}	12.91 ^{ab}
Fipronil 3G	12.33	13.00 ^{b}	12.00 ^{b}	8.67 ^{c}	11.50 ^{bc}
Lambda cyhalothrin 2.5EC	11.67	13.33 ^{ab}	12.67 ^{b}	11.33 ^{b}	12.25 ^{b}
Carbofuran 3G	9.67	8.00 ^{c}	6.00 ^{c}	2.67 ^{d}	6.56 ^{d}
Control	10.33	15.00 ^{a}	21.00 ^{a}	22.33 ^{a}	17.16 ^{a}
$LSD_{0.05}$	3.25	1.87	1.86	1.92	4.31

Significantly different means followed by different letter(s) in a respective column

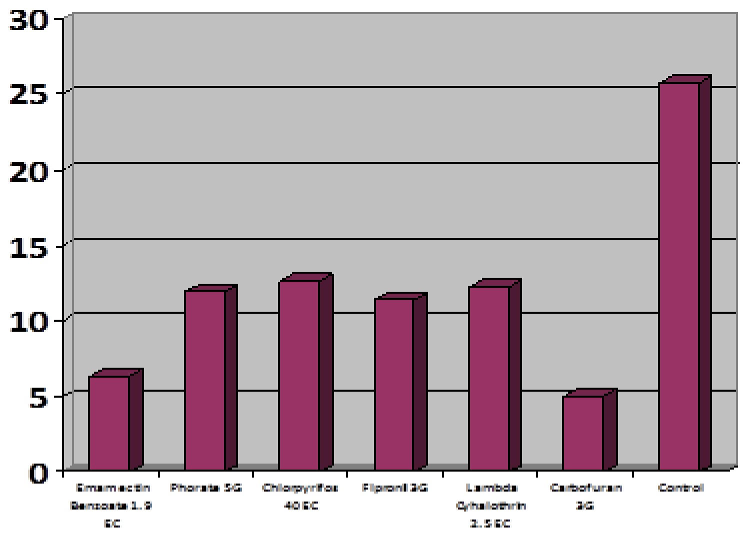

Figure 2. Mean percent infestation of maize stem borer after 1st application of insecticides

Effect of synthetic insecticides on maize stem borer infestation after 2nd application

Data recorded before 24 hours of insecticides application indicated that the plots treated with Carbofuran 3G and Emamectin benzoate 1.9EC showed minimum (7.00%) infestation. The plots treated with Chlorophrifos 40EC and Fipronil 3G showed 12.67 and 12.00% infestation respectively and showed non-significant different from each other. These were followed by 11.67 and 13.33% infestation with application of Thimet 5G and Lambda cyhalothrin 2.5EC respectively. Significantly highest (23.00%) infestation was recorded in control.

The results obtained after three days of insecticide application showed that minimum (6.00%) infestation was recorded with application of carbofuran 3G. It was followed by 7.67% infestation in Emamectin benzoate 1.9 EC treated plot. The plots treated with Thimet 5G and Lambda cyhalothrin 2.5EC showed 13.33% infestation. Similarly, the plots treated with Chlorpyrifos 40EC and Fipronil 3G exhibited 14.00 and 12.33% infestation respectively. Significantly highest (23.67%) infestation was recorded in untreated plot (Table 3).

Data recorded after seven days of insecticide application showed minimum (5.00%) infestation in Carbofuran treated plot, followed by 7.00% with application of Emamectin benzoate 1.9 EC. The plots treated with Thimet 5G, Chloropyrifos 40EC, Fipronil 3G and Lambda cyhalothrin 2.5EC showed 12.33, 13.00, 11.33 and 12.00% infestation respectively and showed non-significant difference from each other at 5% level of significance. Significantly highest (26.67%) infestation was observed in untreated plot (Table 3).

Results obtained after fifteen days of insecticides application showed lowest (2.33%) infestation in the Carbofuran 3G treated plot, and was found statistically similar with 4.00% infestation in plot treated with Emamectin benzoate 1.9EC. Insecticidal treatment of maize plants with Thimet 5G, Chloropyrifos 40EC, Fipronil 3G and Lambda cyhalothrin 2.5EC showed statistically similar (10.33, 11.00, 10.00 and 10.33%) infestation respectively. Significantly highest (29.67%) infestation was recorded in untreated plot (Table 3).

Overall mean of data revealed that minimum (5.09%) infestation was found in Carbofuran 3G treated plot. Similarly, plot treated with Emamectin benzoate 1.9EC recorded 6.41%

infestation. Application of Thimet 5G, Chloropyrifos 40EC, Fipronil 3G and Lambda cyhalothrin 2.5EC showed statistically similar (11.91, 12.67, 11.41 and 12.24%) infestation respectively. Significantly highest (25.75%) infestation was recorded in untreated plot (Table 3).

Table 3. Effect of synthetic insecticides on maize stem borer infestation after 2nd application

Treatment	Pre-Spray Data	Post-Spray Data: Percent infestation after different intervals of insecticide application			Mean
	Before 24 Hours	After 3 Days	After 7 Days	After 15 Days	
Emamectin benzoate 1.9EC	7.00 d	7.67 d	7.00 c	4.00 c	6.41 c
Thimet 5G	11.67 c	13.33 bc	12.33 b	10.33 b	11.91 b
Chlorpyrifos 40EC	12.67 bc	14.00 b	13.00 b	11.00 b	12.67 b
Fipronil 3G	12.00 bc	12.33 c	11.33 b	10.00 b	11.41 b
Lambda cyhalothrin 2.5EC	13.33 b	13.33 bc	12.00 b	10.33 b	12.24 b
Carbofuran 3G	7.00 d	6.00 e	5.00 d	2.33 c	5.09 c
Control	23.00 a	23.67 a	26.67 a	29.67 a	25.75 a
$LSD_{0.05}$	1.67	1.23	1.73	1.80	2.58

Significantly different means followed by different letter(s) in a respective column

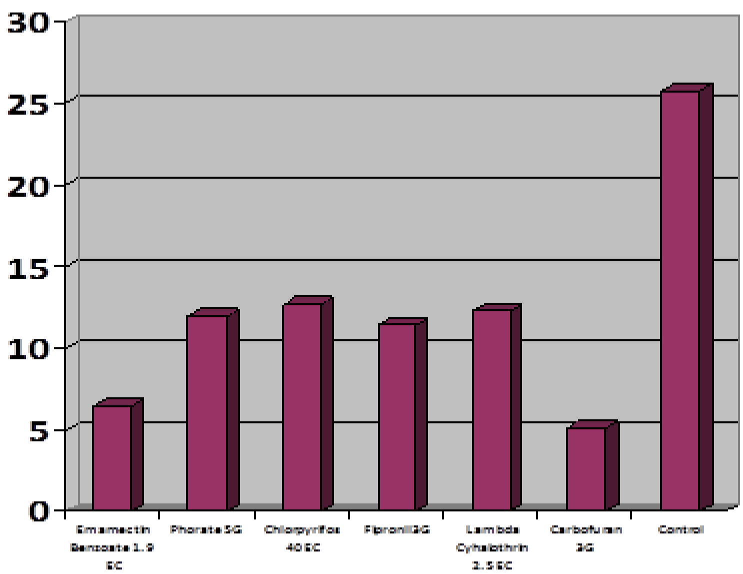

Figure 3. Mean percent infestation of maize stem borer after 2nd application of insecticides

Effect of synthetic insecticides on agronomic characteristics of maize crop

No. of cobs plant^{-1}

Data presented in table 4 showed that maximum (1.57) cobs per plant were noted in Carbofuran 3G treated plot. It was followed by 1.43 and 1.30 cobs per plant in Emamectin benzoate 1.9EC and Fipronil 3G treated plots, respectively. Minimum (1.00) cobs per plant were found in untreated plot, which were statistically similar with 1.07, 1.07 and 1.03% cobs per plant in the plots treated with Thimet 5G, Chlorpyrifos 40EC and Lambda cyhalothrin 2.5EC respectively.

No. of grains cob^{-1}

Data in table 4 presented that maximum grains per cob of 400.53 were recorded in Carbofuran 3G treated plot, which showed statistically similar results of 396.40 grains per cob in Emamectin benzoate 1.9EC treated plot. The plots treated with Thimet 5G, Chlorpyrifos 40EC, Fipronil 3G and Lambda cyhalothrin 2.5EC produced 323.17, 311.53, 329.43 and 301.13 grains per cob respectively. Significantly untreated plot showed lowest (295.50) grains per cob.

1000-grain weight (gm)

Results presented that maximum (282.00g) 1000-grain weight was noted in Carbofuran 3G treated plot. Which was followed by 268.67g 1000-grain weight noted in Emamectin benzoate 1.9 EC treated plot. The plots treated with Thimet 5G, Chlorpyrifos 40EC, Fipronil 3G and Lambda cyhalothrin 2.5EC were statistically similar with each other by registering 228.67, 232.33, 238.33 and 234.33g 1000-grain weight respectively. Significantly untreated plot recorded lowest (213.00g) 1000-grain weight compared to other treatments (Table 4).

Grain yield (kg ha^{-1})

Results presented that maximum grain yield of 6113.3 kg ha^{-1} was recorded with Carbofuran 3G application, which was non-significantly different from 6059.3 kg ha^{-1} recorded in Emamectin benzoate 1.9 EC treated plot. The plots treated with Thimet 5G, Chlorpyrifos 40EC, Fipronil 3G and Lambda cyhalothrin 2.5EC produced 5322.3, 5239.3, 5662.7 and 4914.7 kg ha^{-1} grain yield respectively. Untreated plot recorded minimum (4417.0 kg ha^{-1}) grain yield compared to other treatments (Table 4).

Table 4. Effect of synthetic insecticides on agronomic characteristics of maize crop

Treatments	Cobs Plant^{-1}	Grains Cob^{-1}	1000-grain weight(g)	Grain yield (Kg ha^{-1})
Emamectin benzoate 1.9 EC	1.43 ^{b}	396.40 ^{a}	268.67 ^{b}	6059.3 ^{ab}
Phorate 5G	1.07 ^{d}	323.17 ^{bc}	228.67 ^{c}	5322.3 ^{cd}

Chlorpyrifos 40EC	1.07 [d]	311.53 [cd]	232.33 [c]	5239.3 [de]
Fipronil 3G	1.30 [c]	329.43 [b]	238.33 [c]	5662.7 [bc]
Lambda cyhalothrin 2.5EC	1.03 [d]	301.13 [de]	234.33 [c]	4914.7 [e]
Carbofuran 3G	1.57 [a]	400.53 [a]	282.00 [a]	6113.3 [a]
Control	1.00 [d]	295.50 [e]	213.00 [d]	4417.0 [f]
LSD $_{0.05}$	0.12	15.52	11.50	404.41

Significantly different means followed by different letter(s) in a respective column

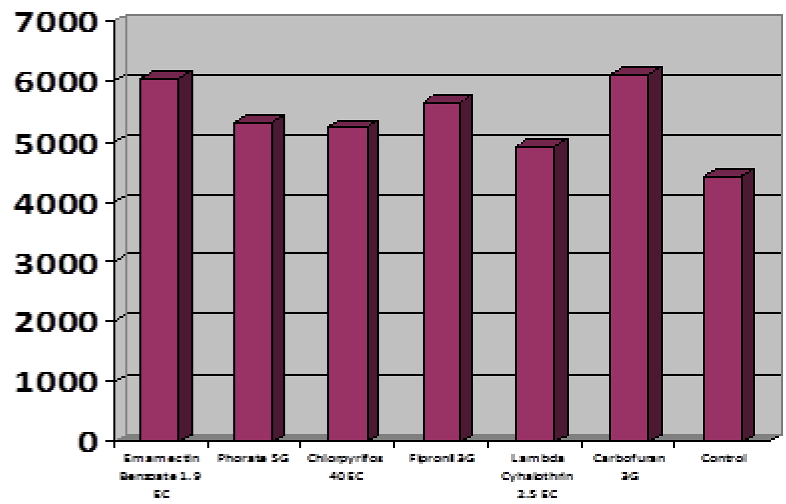

Figure 4. Effect of synthetic insecticides on grain yield (Kg hac^{-1}) of maize crop

Discussion

The results indicated that, tested insecticides showed varied degree of efficacy for the control of maize stem borer (C. partellus). However, Carbofuran 3G and Emamectin benzoate 1.9EC were found most effective against the pest. The plots treated with these insecticides showed significantly lowest infestation compared to rest of the tested insecticides. The reduction in infestation was due to systemic action of these insecticides. The present results are comparable with [14]. They have also found carbofuran 3G and Emamectin benzoate 1.9EC as highly effective against maize stem borer.

Carbofuran 3G showed highest efficacy against the pest and resulted in lowest (6.56% and 5.09%) infestation during both applications. [12] also recorded 5.52% infestation with application of Furadan 3G. Similar results were reported by [5], as as they stated that Carbofuran 3G was superior over other insecticides, showing lowest infestation (6.62%). [9] also reported lowest (3.12 and 6.00%) infestation and leaf injury rating respectively by applying Furadan 3G (Table 4).

A significant increase in efficacy of Carbofuran 3G was observed after 15th days of application. It registered minimum (2.67 and 2.33%) infestation after 1st and 2nd application respectively. Similar results were described by [34], who reported that Furadan 3G was very efficient in controlling maize stem borer and resulted in lowest damage after 4th, 8th and 15th days of application. Similarly, [28] found 86.32% reduction in plant damage with application of Carbofuran 3G after 7th day of 2nd application.

The plots treated with Carbofuran 3G produced maximum cobs per plant (1.57), 1000-grain weight (282.00g) and grains per cob (400.53). [12] also achieved significantly similar with this product compared to control.

The plants treated with Carbofuran 3G produced significantly highest (6113.3 kg ha^{-1}) grain yield as compared to other insecticides. [14] achieved highest grain yield of 95.22 q ha^{-1} with the same insecticide (Carbofuran 3G). Similarly, [15] obtained maximum yield (42.72 q ha^{-1}) by applying this product. [5] found that Carbofuran 3G ranked first in controlling maize stem borer and enhancing grain yield (958.89 q ha^{-1}).

Emamectin benzoate 1.9 EC was also found effective. The plants treated with this product showed minimum (7.33 and 6.41%) infestation after 1st and 2nd spray respectively. However, Chlorpyrifos 40EC and Lambda cyhalothrin 2.5EC were found least effective against C. partellus with 12.67 and 12.14% infestation respectively. The findings of [12] also supported the present results.

Application of Emamectin benzoate 1.9 EC recorded high grain yield of 6059.3 kg ha^{-1} as compared to the plots treated with Thimet 5G (5322.3 kg ha^{-1}), Chlorpyrifos 40EC (5239.3 kg ha^{-1}) and Lambda cyhalothrin 2.5EC (4914.7 kg ha^{-1}). The plot sprayed with Emamectin benzoate 1.9 EC also produced maximum cobs per plant (1.43) and grains per cob (396.40). The findings of [7] also witnessed the present results. They recorded maximum grain yield (64.38 q ha^{-1}) with application of Emamectin benzoate 1.9EC.

Significantly highest (25.75%) infestation and lowest grain yield (4417.0 kg ha^{-1}) was observed in untreated plot. Similar findings were also stated by [18], who recorded 50% infestation in control. Similarly, minimum cobs per plant (1.00), 1000-grain weight (213.00g) and grains per cob (1295.50) were also recorded in untreated plot. Our results can be compared with the findings of [2] and [29].

Overall mean of percent infestation showed that Thimet 5G and Fipronil 3G recorded 9.00 and 8.67% infestation after 1st application. The present findings are in agreement with [9]. They reported 10.34% infestation in the plot treated with Thimet 5G. Similarly, [25] found 7.98% infestation in the plot treated with Fipronil 3G after 14th days of applications.

The plots treated with Fipronil 3G produced comparatively maximum grain yield of 5662.7 kg ha^{-1}, as compared to plot treated with Thimet 5G (5322.3 kg ha^{-1}). The findings of [14] also supported the present results. They recorded lowest grain yield in the plot treated with Thimet 5G.

Lowest grain yield was noted in the Chlorpyrifos 40EC treated plot with 5239.3 kg ha^{-1}. Whereas, Lambda cyhalothrin 2.5EC treated plots recorded 4914.7 kg ha^{-1} of grain yield compared to plots treated with Carbofuran 3G and Emamectin benzoate 1.9 EC. However, [21] reported maximum grain yield (4.23 t ha^{-1}) with application of Chlorpyrifos 50EC. This might be due to the difference in formulation of the product.

Conclusion and recommendations

The experiment was conducted for the management of C. partellus in maize crops under field and it was laid down in Randomized Complete Block Design with three replications. C. partellus causes serious damage to maize crop from germination to the tasseling stage. At seedling stage, Carbofuran provided high efficacy in killing C. partellus larvae. The application of carbofuran 3G should be done after the 2nd and 3rd irrigation. Carbofuran has a high potential for leaching into groundwater. After the applicaition, Carbofuran breaks down in the presence of sunlight. Similarly, Emamectin benzoate 1.9 EC also provided high efficacy in controlling the pest. It penetrates leaf tissues (translaminar activity) and forms a reservoir within the leaf. Emamectin benzoate having Contact & stomach action provided strong activity against the pest. Pest was active throughout the crop maturity stage but with very low population. It is best to control it in initial stages when the crop is on seedling stage. Insecticides having contact posion is not applicable on this pest as the pest larvae live inside the stems. The pest causes dead hearts in the initial stage of crop by making holes inside the stem. Older larvae tunnel broadly in stems and in maize cobs, weakening the stems, which may break and lodge. It was seen that damage to inflorescences may interfere with grain formation causing chaffy heads in maize. The number of dead hearts and leaf damage was decreased after the 1st and 2nd spray of Carbofuran 3G and Emamectin benzoate 1.9EC.

It was concluded from the present research that Carbofuran 3G and Emamectin benzoate 1.9EC showed significantly highest efficacy against maize stem borer compared to rest of the tested insecticides. Hence, application of any of these insecticides is recommended for the management of maize stem borer (Chilo partellus).

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Author Contribution

Muhammad Umair Sardar and Muhammad Mamoon-ur-Rashid conceived, designed and conducted the Experiments, Saqib Ali and Muhammad Naeem analyzed the data, Muhammad Saad and Abuds Samee Khan helped in manuscript writing.

Conflict of Interest The authors have no conflicts to declare.

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