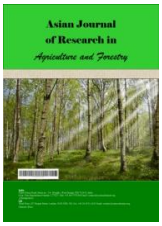

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Evaluation of Insecticide-treated Sugarcane Setts against Subterranean Termites at Sargodha

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Termites contribute significantly to most of world's ecosystems. They are of great importance in recycling woody and other plant materials and their tunnelling efforts help to aerate the soil. The present study was done to evaluate the efficacy of insecticides against the termites in a sugarcane field. The dipping of setts in insecticides solution @ 1%, 0.50%, 0.25% was carried out and the planted setts was observed for damage/infestation. In order to select a site for an experiment in village Dhero Sial of Sargodha District. Five samples were taken from field at 4 different places. Area of sample was one sq. meter and population of termites was noted. Later on, poplar stakes were erected to confirm the population of termites after 10-15 days. As the chemical treatment is the only remedy for the crops attacked by subterranean termites available to the farmers in Pakistan the evaluation of these six insecticides showed that most effective is the Fipronil both in reducing the population density and damage on the cones.

Keywords: Sugarcane; termite; insecticide; Pakistan.

1. INTRODUCTION

Pakistan atmosphere favours population of termites. There are 2,600 termite species in the world but 300 are considered pest. In sugarcane termites are serious one in District Faisalabad, Mardan, Peshawer and Sargodha causing 20-30% damage [1]. Chemical control only remedies

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for effective management of termites. Six pesticides i.e. cypermethrine, imidacloprid, bifenthrin, basudin, chlorpyrifos and fipronil were evaluated at 100%, 0.50% and 0.25% against termites at Sargodha. Fipronil was considered most effective following chlorpyrifos against damage and population of termites. When the concentration was evaluated 1.00% gave the best results following 0.50% and 0.25%. Hence Fipronil 1.00% was most effective.

Pakistan lies between 24°N and 37°N latitudes and 61°E and 71°E longitudes. It stretches from Indus delta from South to Himalayas from North. Except for narrow belt in North, which falls under Sub-Humid climate the whole Pakistan has an arid to semi-arid climate. Annual precipitation is highest (15000 millimeter) on Southern slope of Pakistan and gradually decreases to Southwest. In all arid areas pattern of rainfall is can be quite variable. For the most Pakistan, rainfalls primarily (70-80%) in July, August and September. Summer temperature is very high with severe winter months. All these conditions favour the existence of termites.

Termites contribute significantly to most of world's ecosystems. They are of great importance in recycling woody and other plant materials and their tunneling efforts help to aerate soil. Termite activity results in an improvement to soil composition and fertility (Anonymous, 2000). In 1985 complaints were published in newspaper that termites had damaged sugarcane in different parts of Peshawer District. The attack was so severe that 90% damage was recorded in "Mera Village" of Noushera District [2]. Further damage of 30-60 percent to setts resulting in 34-50 percent damage to the crop has also been recorded in Punjab [3]. Termites caused about 20-30% damage to sugarcane crop in different mills zones of Sargodha District [4].

Termites management comprises on three steps.

1. Prevent termite-gaining access to the plants.
2. Reduce termite member in vicinity of plants.
3. Render the plants themselves less susceptible to attack by termites.

Seven insecticides tested in India for the control of termites, Durmet 20 EC and Endosulfan 35 EC gave better control of termites. The highest mean incidence of termite was 69.80 percent in the untreated control. Every insecticide tested against termites decreases the incidence to a considerable level over the control. Yield too was harvested highest when applied at planting time [5]. Heptachlor 20 EC, Chlorpyrifos 20 EC, Chlordane 20 EC, Sevidol 4 G and Quinalphos 5G were applied at planting at Karnal in India. Germination was significantly greater following insecticide treatments than in control plots. Chlorpyrifos was most effective insecticides against termites and improved number of mill able canes and yield per acre [6]. The present study was done to evaluate the efficacy of insecticides against the termites in a sugarcane field. The dipping of setts in insecticides solute on at 1%, 0.50%, 0.25% was carried out and the planted setts were observed for damage/ infestation.

2. MATERIALS AND METHODS

2.1 Selection of Site for Experiment

To select a site for an experiment in village Dhero Sial of Sargodha District. Five samples were taken from field at 4 different places. Area of the sample was one sq. meter and population of termites was noted. Later on, poplar stakes were erected to confirm the population of termites after 10-15 days.

2.2 Solution of Insecticides

Solution of insecticides was prepared by mixing insecticides in water, Imidacloprid 70 WS, Cypermethrin 10 EC, Fipronil 10 EC, Basudin 10 G and Chlorpyrifos 40 EC was used. Three concentrations (0.25%, 0.50% and 1%) of each insecticide was made. Setts were dipped in the solution for 5 minutes. The setts were sown in a plot of 10 × 30 ft. in the field with R× R distance 2 × 2 ft.

2.3 Method of Counting Population

The population of termite was noted from five places in the field. Each point will consist of ft^3 and a number of termites be noted.

2.4 Method of Percentage Damage

2.4.1 On eyes

After sowing setts in the field damage of termite on eyes of setts (25 in number) was noted while walking diagonally in the field. The damaged eyes will be counted, and their percentage will be calculated.

Table 1. Damage on sugarcane eye/seedlings after sowing dipped setts in the field at Sargodha 2003

Treatments		Mean damage on sugarcane eye after			Mean damage on sugarcane seedlings after		
		15-days	30-days	45-days	60-days	75-days	90-days
T_1	Bifenthrin (1.00%)	1.933	3.467	4.000	3.467	4.200	4.733
T_2	Bifenthrin (0.50%)	2.933	4.333	5.300	4.133	4.867	5.100
T_3	Bifenthrin (0.25%)	3.467	4.867	6.133	4.233	5.533	5.700
T_4	Basudin (1.00%)	3.433	4.467	4.800	3.100	5.367	5.767
T_5	Basudin (0.50%)	3.100	5.333	5.767	3.400	6.100	6.233
T_6	Basudin (0.25%)	4.800	6.333	6.300	3.567	6.500	6.167
T_7	Chlorpyrifos (1.00%)	0.900	1.367	1.967	1.833	3.000	3.433
T_8	Chlorpyrifos (0.50%)	1.433	1.733	2.000	2.733	3.900	3.900
T_9	Chlorpyrifos (0.25%)	1.600	1.900	2.167	3.400	4.300	4.333
T_{10}	Cypermethrin (1.00%)	3.900	5.033	5.333	4.267	5.233	6.200
T_{11}	Cypermethrin (0.50%)	4.467	6.367	7.067	5.033	5.967	6.300
T_{12}	Cypermethrin (0.25%)	4.833	7.267	7.333	5.800	6.300	6.333
T_{13}	Imidacloprid (1.00%)	3.900	4.700	5.567	6.300	7.100	7.267
T_{14}	Imidacloprid (0.50%)	4.967	5.900	6.200	7.067	7.367	7.500
T_{15}	Imidacloprid (0.25%)	6.000	6.500	6.600	7.500	7.600	7.700
T_{16}	Fipronil (1.00%)	0.667	0.600	0.900	0.900	1.000	1.800
T_{17}	Fipronil (0.50%)	0.667	0.867	1.133	1.467	1.433	2.000
T_{18}	Fipronil (0.25%)	0.600	0.967	1.167	3.100	1.967	2.467
T_{19}	Control	10.667	12.000	12.333	11.333	11.333	12.000

2.4.2 Percentage damage on seedlings

After emergence, the percent damage on seedlings of sugarcane was noted and percentage infestation was calculated. The data was taken from March 2003 to June 2003. The data for air temperature, Relative Humidity and soil temperature was also collected.

2.5 Statistical Analysis

The population density of termites was analyzed by two way of ANOVA and compared by DMR at 5% level of probability.

2.6 Effect of Pesticides on Sugarcane Eyes after 15-Days of Treatments

All the treated plots showed significantly different sugarcane eye damage. T_{19} (control) showed maximum damage. However , T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%), T_{18} (Fipronil 0.25%) showed minimum damage as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%), T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%), T_7, T_8, T_9, (Chlorpyrifos 1.00,0.50 and 0.25%), T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, T_{18}, (Fipronil) showed lowest eye damage as compared to control T19 (10.67).

2.7 Effect of Pesticides on Sugarcane Eyes after 30-Days of Treatments

All the treated plots showed significantly different sugarcane eye damage. T_{19} (control) showed maximum damage (12.000%). However, T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%), T_{18} (Fipronil 0.25%) showed minimum damage followed by T_7, T_8, T_9, (Chlorpyrifos 1.00,0.50 and 0.25%) with damage (1.367%), (1.733%) and (1.900%) as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%), T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%), T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%) damage regarding concentrations. When compared Fipronil (1.00%) and Chlorpyrifos (1.00%) showed minimum damage.

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, T_{18}, (Fipronil) followed by T_7, T_8, T_9, (Chlorpyrifos) showed lowest eye damage as compared to control T_{19} (12.000).

2.8 Effect of Pesticides on Sugarcane Eyes after 45-Days of Treatments

It can be concluded from the data that after 45-days of sowing treated setts in the field, T_{19} (control) showed maximum damage (12.333%). However, T_{16} (Fipronil 1.00%), T_{17} (Fipronil

0.50%), T_{18} (Fipronil 0.25%) showed minimum damage followed by T_7, T_8, T_9, (Chlorpyrifos 1.00,0.50 and 0.25%) with damage (1.967%), (2.000%) and (2.167%) as compared to all others T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%), T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%), T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

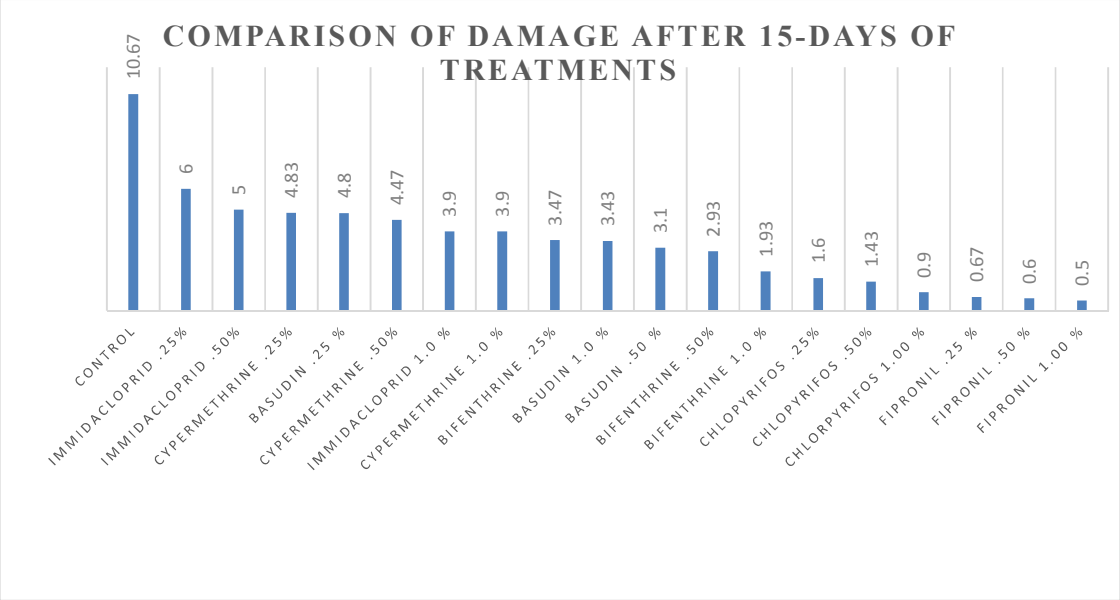
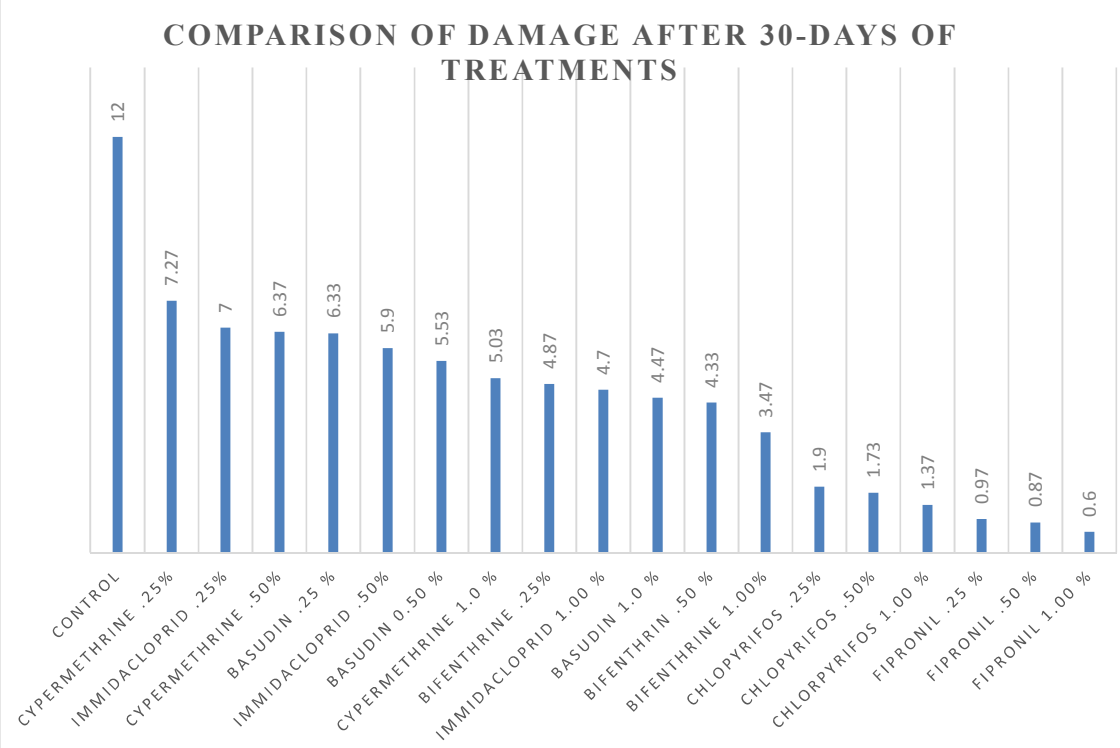


Fig. 1.



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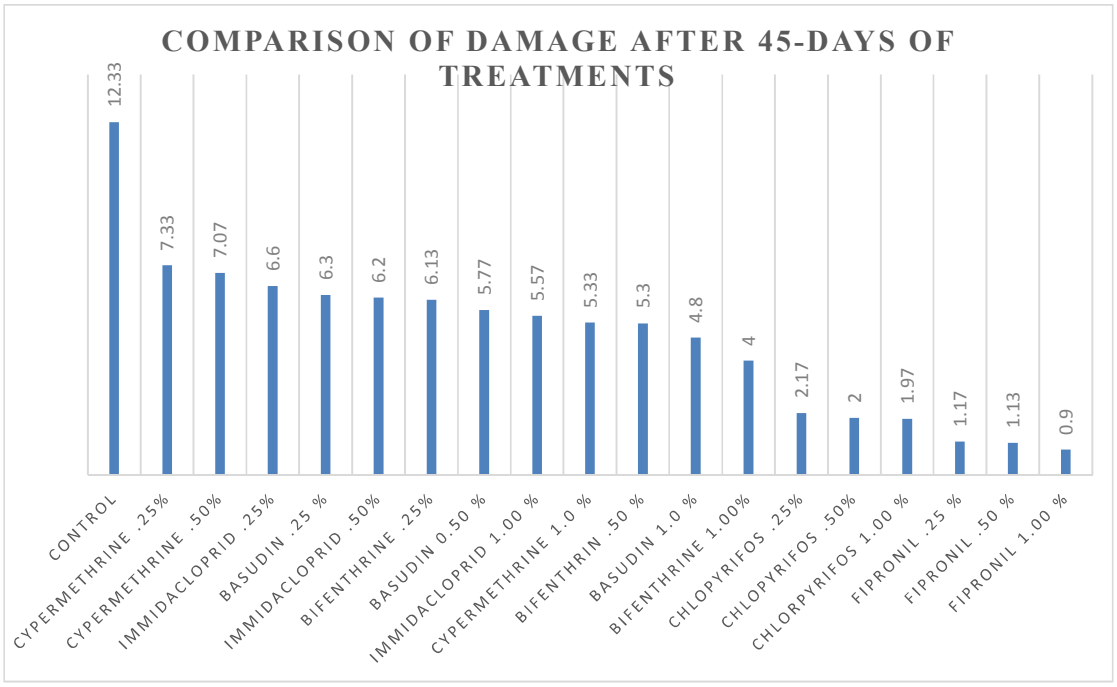
COMPARISON OF DAMAGE AFTER 45-DAYS OF TREATMENTS
12.33
7.33
7.07
6.6
6.3
6.2
6.13
5.77
5.57
5.33
5.3
4.8
4
2.17
2
1.97
1.17
1.13
0.9
CONTROL
CYPERMETHRINE .25%
CYPERMETHRINE .50%
IMMIDACLOPRID .25%
BASUDIN .25 %
IMMIDACLOPRID .50%
BIFENTHRINE .25%
BASUDIN 0.50 %
IMMIDACLOPRID 1.00 %
CYPERMETHRINE 1.0 %
BIFENTHRIN .50 %
BASUDIN 1.0 %
BIFENTHRINE 1.00%
CHLOPYRIFOS .25%
CHLOPYRIFOS .50%
CHLORPYRIFOS 1.00 %
FIPRONIL .25 %
FIPRONIL .50 %
FIPRONIL 1.00 %

Fig. 3.

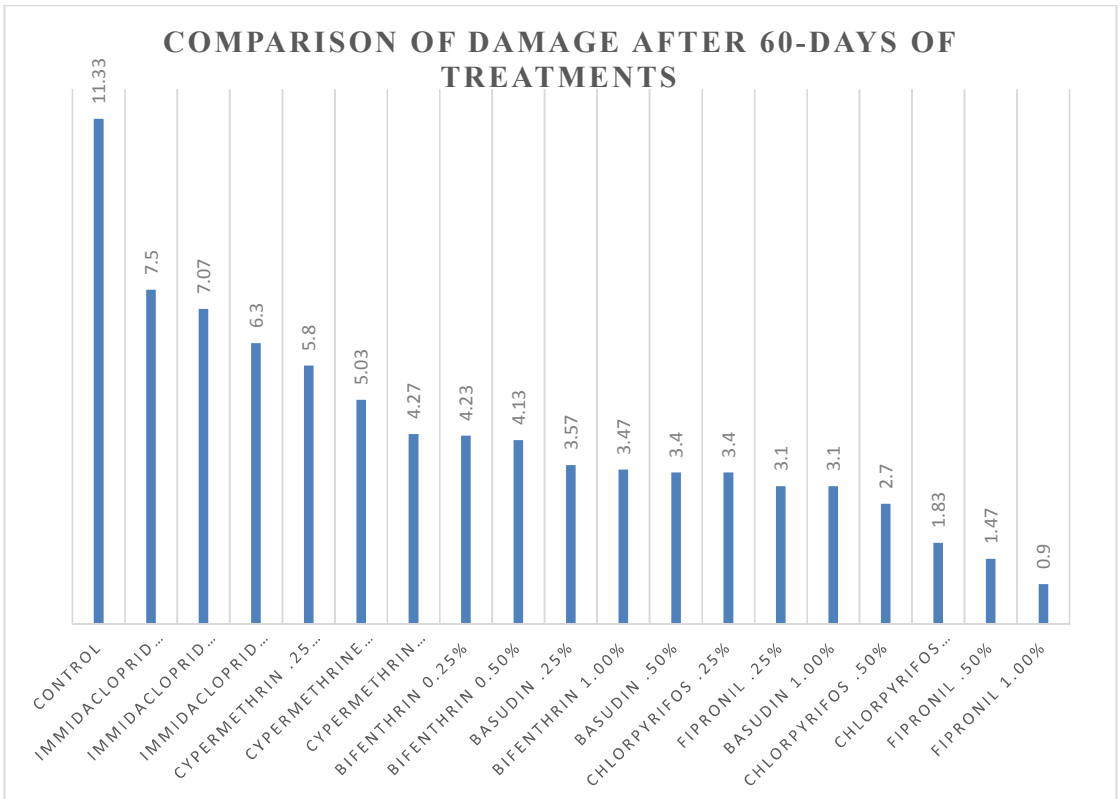
COMPARISON OF DAMAGE AFTER 60-DAYS OF TREATMENTS
11.33
7.5
7.07
6.3
5.8
5.03
4.27
4.23
4.13
3.57
3.47
3.4
3.4
3.1
3.1
2.7
1.83
1.47
0.9
CONTROL
IMMIDACLOPRID...
IMMIDACLOPRID...
IMMIDACLOPRID...
CYPERMETHRIN .25...
CYPERMETHRINE...
CYPERMETHRIN...
BIFENTHRIN 0.25%
BIFENTHRIN 0.50%
BASUDIN .25%
BIFENTHRIN 1.00%
BASUDIN .50%
CHLORPYRIFOS .25%
FIPRONIL .25%
BASUDIN 1.00%
CHLORPYRIFOS .50%
CHLORPYRIFOS...
FIPRONIL .50%
FIPRONIL 1.00%

Fig. 4.

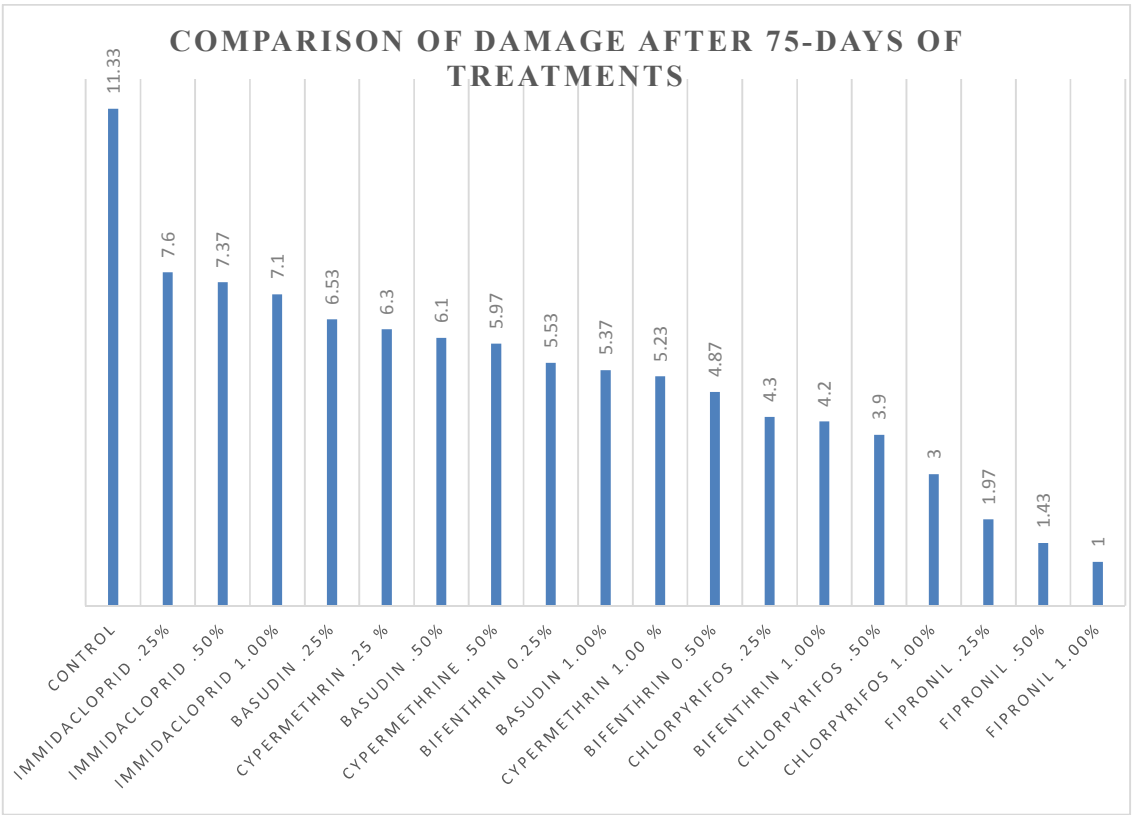
COMPARISON OF DAMAGE AFTER 75-DAYS OF TREATMENTS
11.33
7.6
7.37
7.1
6.53
6.3
6.1
5.97
5.53
5.37
5.23
4.87
4.3
4.2
3.9
3
1.97
1.43
1
CONTROL
IMMIDACLOPRID .25%
IMMIDACLOPRID .50%
IMMIDACLOPRID 1.00%
BASUDIN .25%
CYPERMETHRIN .25 %
BASUDIN .50%
CYPERMETHRINE .50%
BIFENTHRIN 0.25%
BASUDIN 1.00%
CYPERMETHRIN 1.00 %
BIFENTHRIN 0.50%
CHLORPYRIFOS .25%
BIFENTHRIN 1.00%
CHLORPYRIFOS .50%
CHLORPYRIFOS 1.00%
FIPRONIL .25%
FIPRONIL .50%
FIPRONIL 1.00%

Fig. 5.

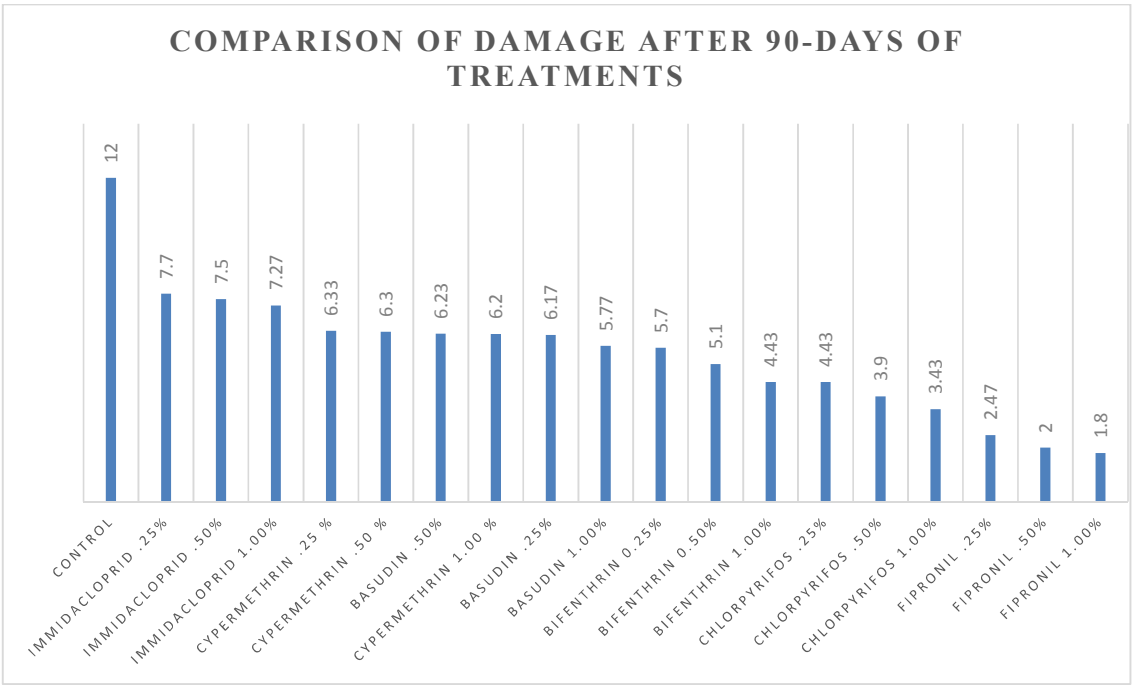
COMPARISON OF DAMAGE AFTER 90-DAYS OF TREATMENTS
12
7.7
7.5
7.27
6.33
6.3
6.23
6.2
6.17
5.77
5.7
5.1
4.43
4.43
3.9
3.43
2.47
2
1.8
CONTROL
IMMIDACLOPRID .25%
IMMIDACLOPRID .50%
IMMIDACLOPRID 1.00%
CYPERMETHRIN .25 %
CYPERMETHRIN .50 %
BASUDIN .50%
CYPERMETHRIN 1.00 %
BASUDIN .25%
BASUDIN 1.00%
BIFENTHRIN 0.25%
BIFENTHRIN 0.50%
BIFENTHRIN 1.00%
CHLORPYRIFOS .25%
CHLORPYRIFOS .50%
CHLORPYRIFOS 1.00%
FIPRONIL .25%
FIPRONIL .50%
FIPRONIL 1.00%

Fig. 6.

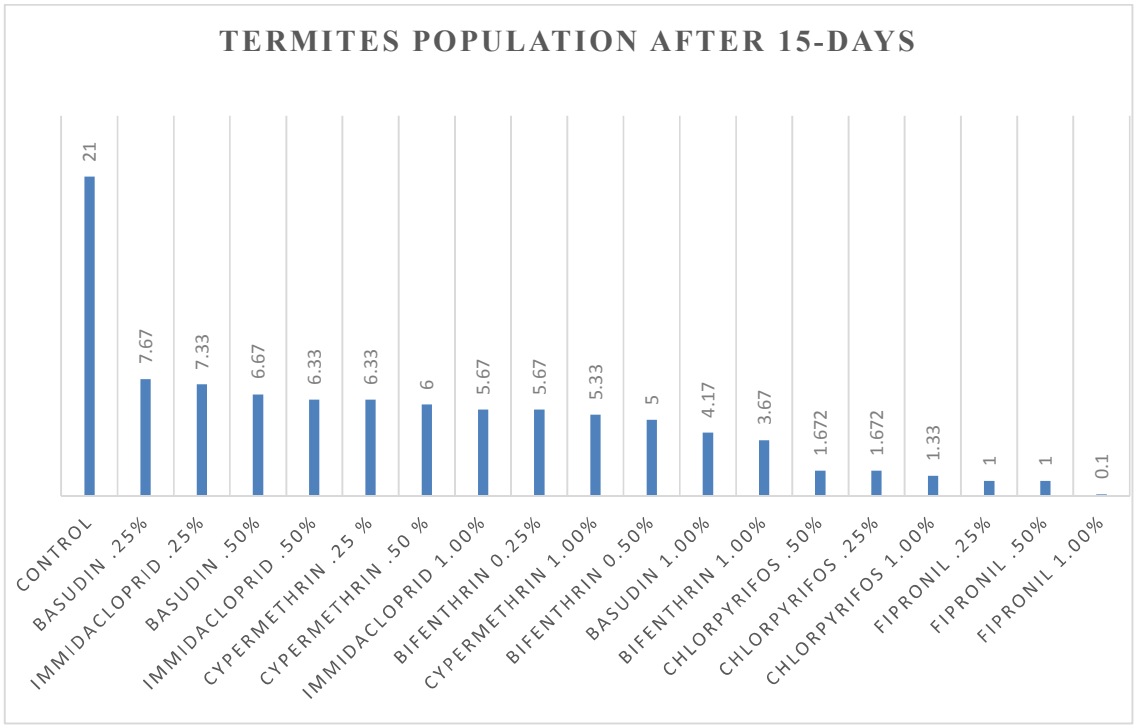
TERMITES POPULATION AFTER 15-DAYS
21
7.67
7.33
6.67
6.33
6.33
6
5.67
5.67
5.33
5
4.17
3.67
1.672
1.672
1.33
1
1
0.1
CONTROL
BASUDIN .25%
IMMIDACLOPRID .25%
BASUDIN .50%
IMMIDACLOPRID .50%
CYPERMETHRIN .25 %
CYPERMETHRIN .50 %
IMMIDACLOPRID 1.00%
BIFENTHRIN 0.25%
CYPERMETHRIN 1.00%
BIFENTHRIN 0.50%
BASUDIN 1.00%
BIFENTHRIN 1.00%
CHLORPYRIFOS .50%
CHLORPYRIFOS .25%
CHLORPYRIFOS 1.00%
FIPRONIL .25%
FIPRONIL .50%
FIPRONIL 1.00%

Fig. 7.

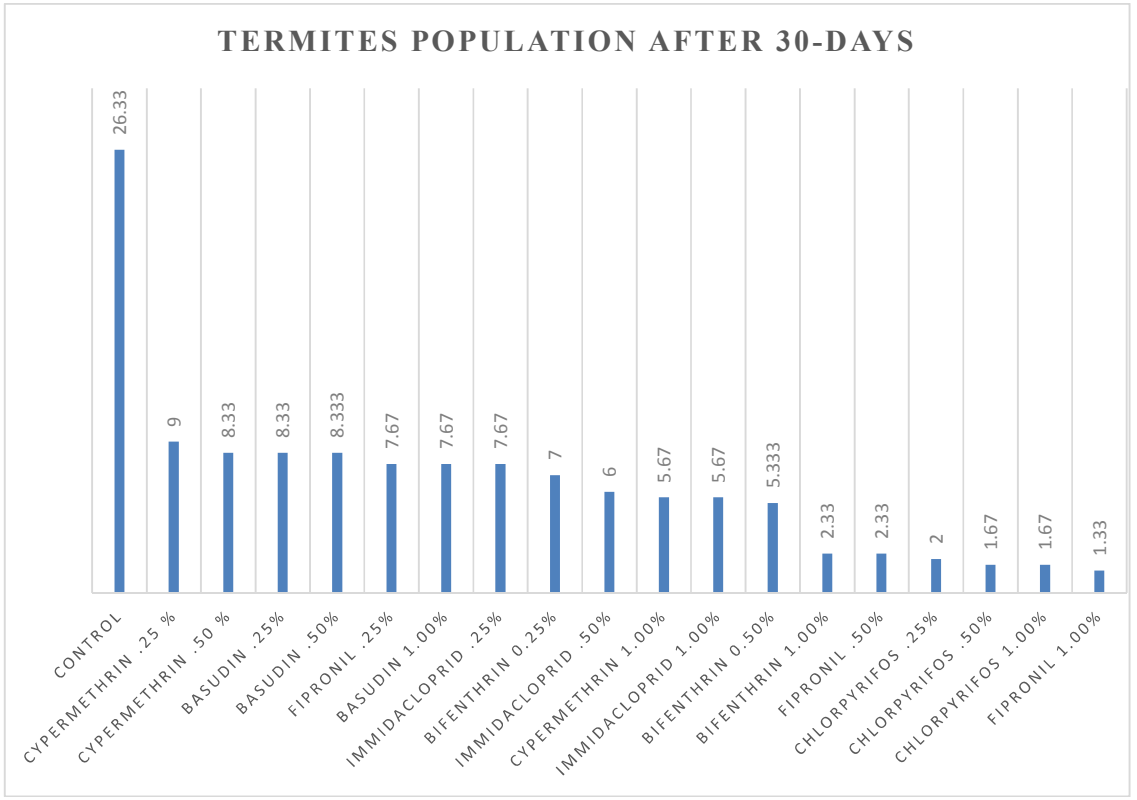
TERMITES POPULATION AFTER 30-DAYS
26.33
9
8.33
8.33
8.333
7.67
7.67
7.67
7
6
5.67
5.67
5.333
2.33
2.33
2
1.67
1.67
1.33
CONTROL
CYPERMETHRIN .25 %
CYPERMETHRIN .50 %
BASUDIN .25%
BASUDIN .50%
FIPRONIL .25%
BASUDIN 1.00%
IMMIDACLOPRID .25%
BIFENTHRIN 0.25%
IMMIDACLOPRID .50%
CYPERMETHRIN 1.00%
IMMIDACLOPRID 1.00%
BIFENTHRIN 0.50%
BIFENTHRIN 1.00%
FIPRONIL .50%
CHLORPYRIFOS .25%
CHLORPYRIFOS .50%
CHLORPYRIFOS 1.00%
FIPRONIL 1.00%

Fig. 8.

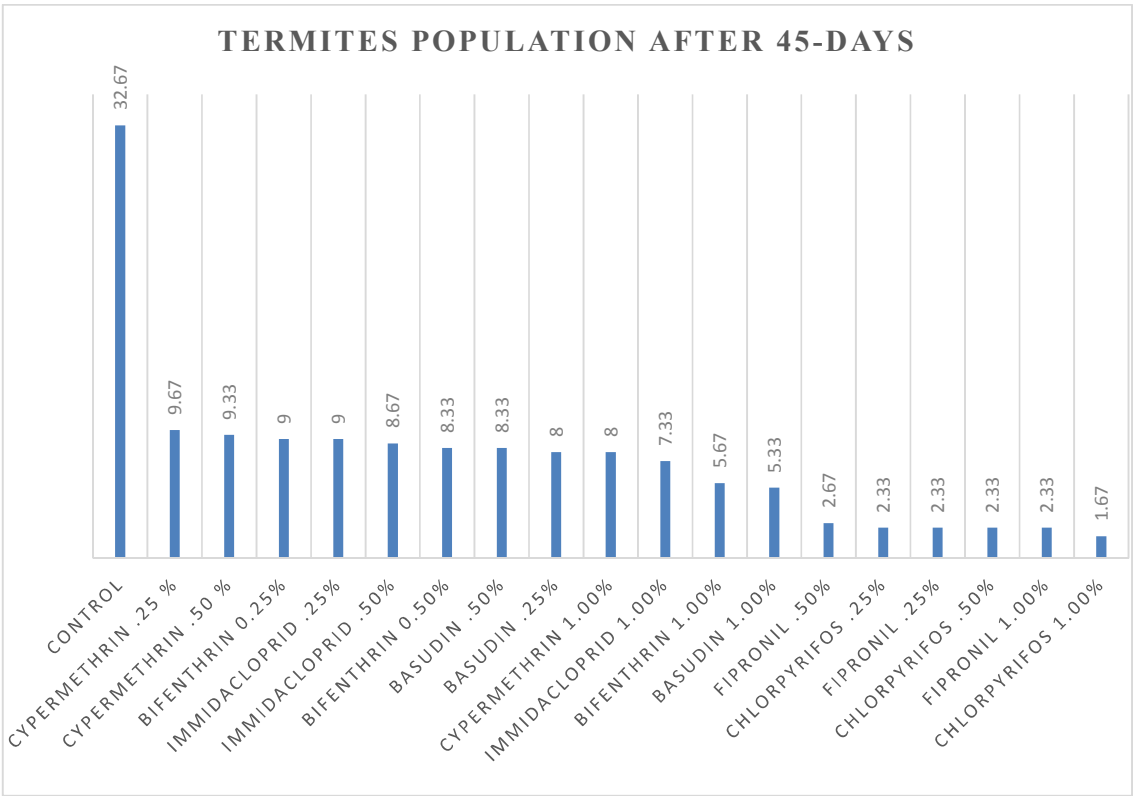
TERMITES POPULATION AFTER 45-DAYS
32.67
9.67
9.33
9
9
8.67
8.33
8.33
8
8
7.33
5.67
5.33
2.67
2.33
2.33
2.33
2.33
1.67
CONTROL
CYPERMETHRIN .25 %
CYPERMETHRIN .50 %
BIFENTHRIN 0.25%
IMMIDACLOPRID .25%
IMMIDACLOPRID .50%
BIFENTHRIN 0.50%
BASUDIN .50%
BASUDIN .25%
CYPERMETHRIN 1.00%
IMMIDACLOPRID 1.00%
BIFENTHRIN 1.00%
BASUDIN 1.00%
FIPRONIL .50%
CHLORPYRIFOS .25%
FIPRONIL .25%
CHLORPYRIFOS .50%
FIPRONIL 1.00%
CHLORPYRIFOS 1.00%

Fig. 9.

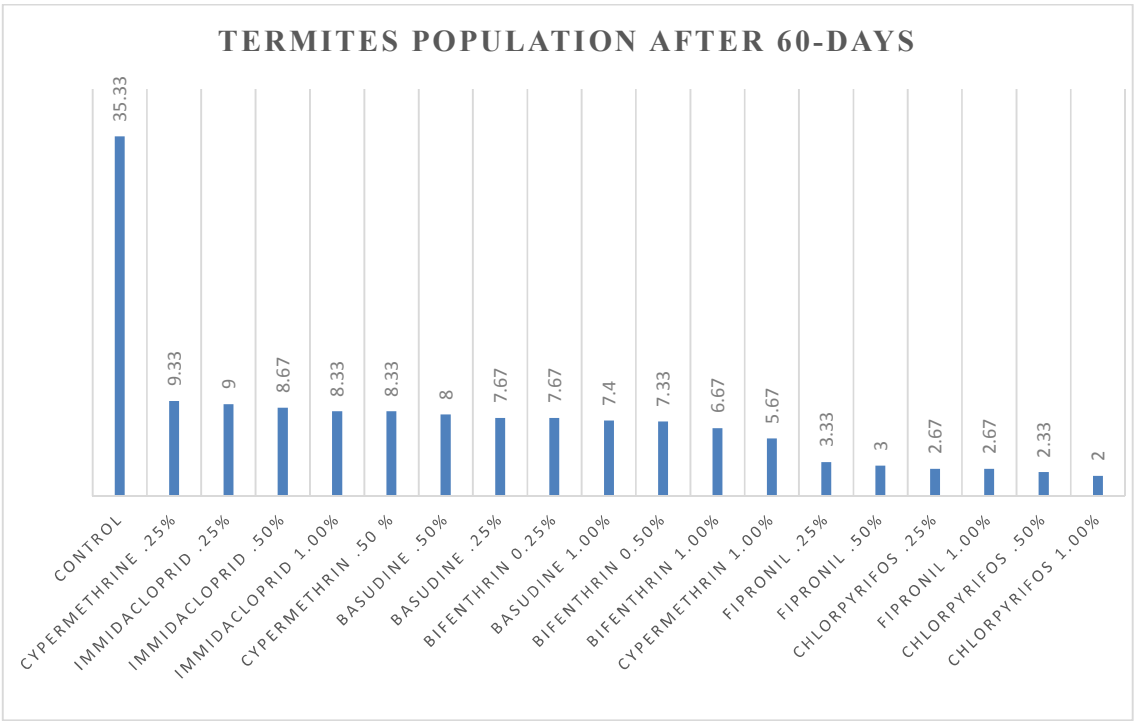
TERMITES POPULATION AFTER 60-DAYS
35.33
9.33
9
8.67
8.33
8.33
8
7.67
7.67
7.4
7.33
6.67
5.67
3.33
3
2.67
2.67
2.33
2
CONTROL
CYPERMETHRINE .25%
IMMIDACLOPRID .25%
IMMIDACLOPRID .50%
IMMIDACLOPRID 1.00%
CYPERMETHRIN .50 %
BASUDINE .50%
BASUDINE .25%
BIFENTHRIN 0.25%
BASUDINE 1.00%
BIFENTHRIN 0.50%
BIFENTHRIN 1.00%
CYPERMETHRIN 1.00%
FIPRONIL .25%
FIPRONIL .50%
CHLORPYRIFOS .25%
FIPRONIL 1.00%
CHLORPYRIFOS .50%
CHLORPYRIFOS 1.00%

Fig. 10.

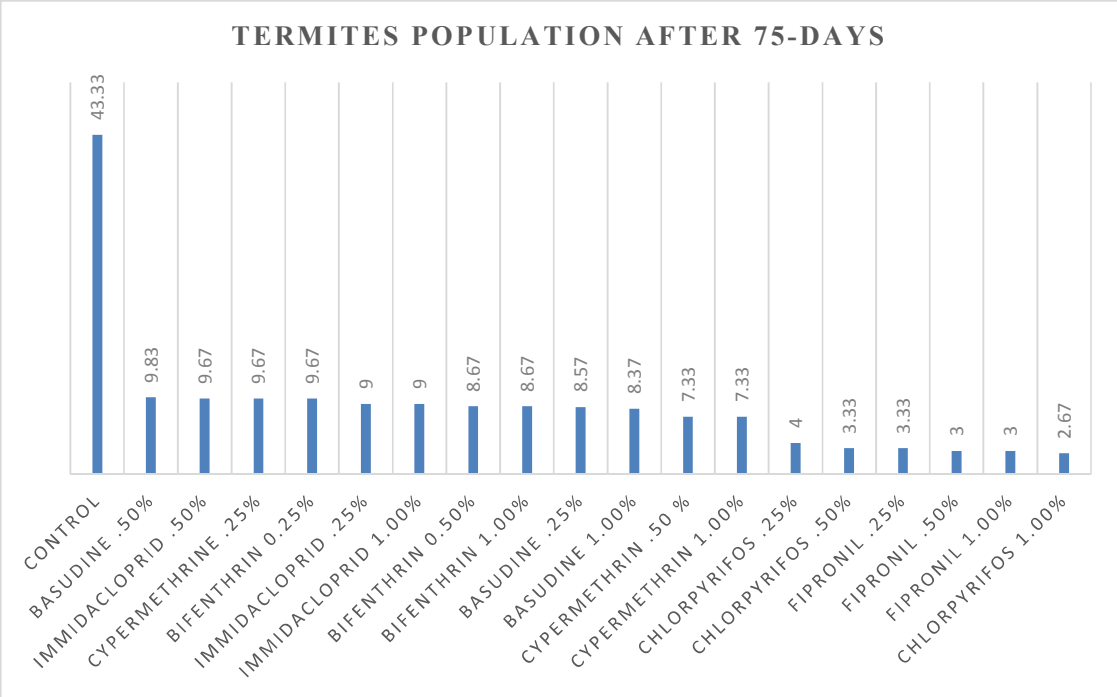

Fig. 11.

Table 2. Termite population after sowing dipped setts in the field at Sargodha 2003

Treatments		Means termite population in treated sugarcane field after					
		15-days	30-days	45-days	60-days	75-days	90-days
T_1	Bifenthrin (1.00%)	3.667	5.333	5.667	6.667	8.667	8.333
T_2	Bifenthrin (0.50%)	5.000	5.667	8.333	7.333	8.667	9.333
T_3	Bifenthrin (0.25%)	5.667	7.667	9.000	7.667	9.667	9.000
T_4	Basudin (1.00%)	4.167	7.667	5.333	7.400	8.367	9.433
T_5	Basudin (0.50%)	6.667	8.333	8.333	8.000	9.833	9.167
T_6	Basudin (0.25%)	7.667	8.333	8.000	7.667	8.566	7.533
T_7	Chlorpyrifos (1.00%)	1.333	1.667	1.667	2.000	2.667	2.667
T_8	Chlorpyrifos (0.50%)	1.667	2.000	2.333	2.333	3.333	3.667
T_9	Chlorpyrifos (0.25%)	1.667	2.333	2.333	2.667	4.000	4.000
T_{10}	Cypermethrin (1.00%)	5.333	6.000	8.000	5.667	7.333	9.667
T_{11}	Cypermethrin (0.50%)	6.000	8.333	9.333	8.333	7.333	9.333
T_{12}	Cypermethrin (0.25%)	6.333	9.000	9.667	9.333	9.667	9.333
T_{13}	Imidacloprid (1.00%)	5.667	5.667	7.333	8.333	9.333	9.667
T_{14}	Imidacloprid (0.50%)	6.333	7.000	8.667	8.667	9.667	10.000
T_{15}	Imidacloprid (0.25%)	7.333	7.667	9.000	9.000	9.000	10.333
T_{16}	Fipronil (1.00%)	1.000	1.333	2.333	2.667	3.000	3.667
T_{17}	Fipronil (0.50%)	1.000	2.333	2.667	3.000	3.000	4.333
T_{18}	Fipronil (0.25%)	1.000	1.667	2.333	3.333	3.333	4.333
T_{19}	Control	21	26.333	32.667	35.333	43.333	42.333

When damage regarding concentrations was 1.00% concentration gave best results as compared to 0.50% and 0.25%.

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, T_{18}, (Fipronil) followed by T_7, T_8, T_9, (Chlorpyrifos) showed lowest eye damage

(0.9000, 1.130, 1.170 and 1.970, 2.000, 2.170) as compared to control T_{19} (12.330 A).

2.9 Effect of Pesticides on Sugarcane Seedlings Damage after 60-Days of Treatments

Data after 60-days of sowing treated setts in the field, T_{19} (control) showed maximum seedlings damage (11.333%). However, T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%), T_{18} (Fipronil 0.25%) showed minimum damage followed by T_4 Basudin 1.00%, T_7, T_8, T_9, (Chlorpyrifos 1.00, 0.50 and 0.25%) with damage (1.833%), (2.733%) and (3.400%) as compared to all others T_1, T_2, T_3, (Bifenthrin 1.00, 0.50 and 0.25%) , T_5, T_6, (Basudin 0.50 and 0.25%), T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00, 0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

When effect of concentrations (1.00%, 0.50% and 0.25%) compared 1.00% give best results.

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, T_{18}, (Fipronil) give best results followed by T_7, T_8, (Chlorpyrifos) and T_4 Basudin 1.00 %. However, control T_{19} showed maximum damage (1.330 A).

2.10 Effect of Pesticides on Sugarcane Seedlings Damage after 75-Days of Treatments

Data after 75-days of sowing treated plots were significantly different from T_{19} control (11.333%). However , T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%), T_{18} (Fipronil 0.25%) showed minimum damage (1.000, 1.433, 1.967) followed by T_7, T_8, (Chlorpyrifos 1.00 and 0.50%), T_1 Bifenthrin with damage as compared to T_2, T_3, (Bifenthrin 0.50 and 0.25%) , T_4, T_5, T_6, (Basudin 1.00 , 0.50 and 0.25%), T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00, 0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

When effect of concentrations (1.00%, 0.50% and 0.25%) compared 1.00 % give best results.

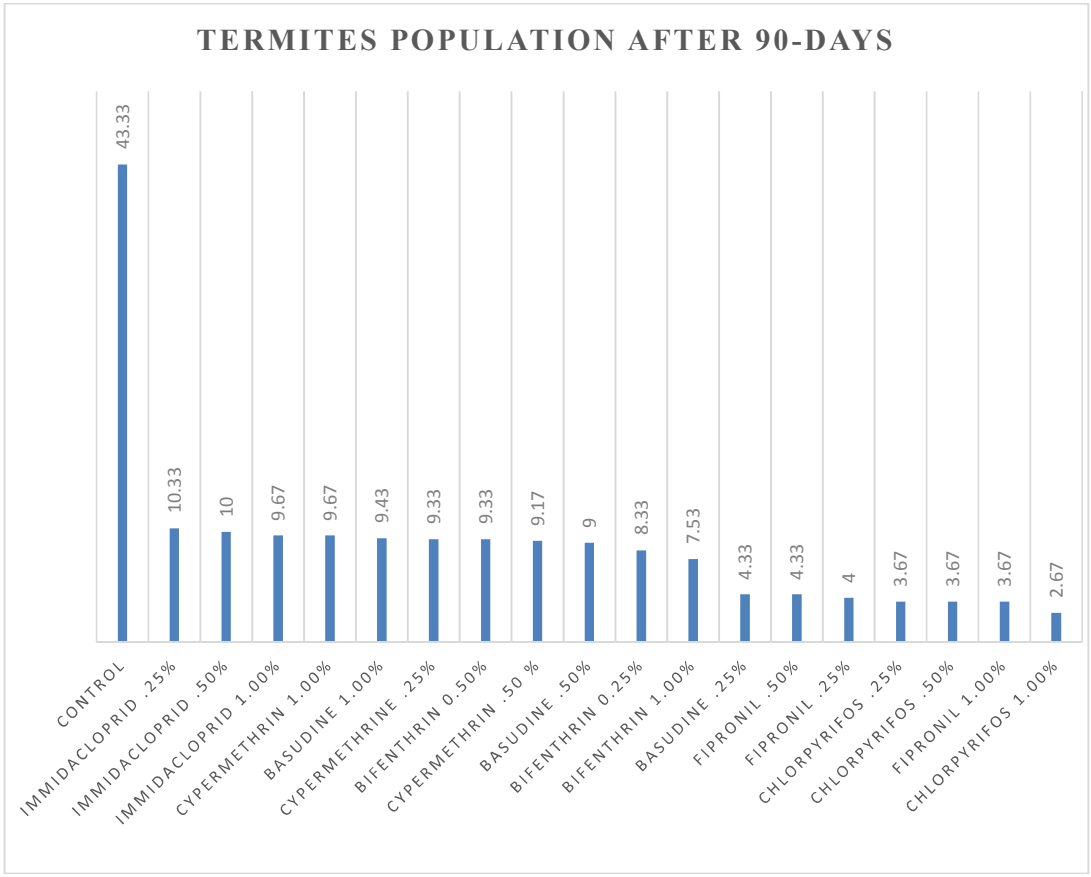

Fig. 12.

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, $T_{18,}$ (Fipronil) give best results (1.000, 1.430, 1.970%) followed by T_7, T_8, T_9 (Chlorpyrifos) and T_1 Bifethrin 1.00% (4.200). Control T_{19} showed maximum damage (11.330 A).

2.11 Effect of Pesticides on Sugarcane Seedlings Damage after 90-Days of Treatments

Data after 90-days of sowing treated setts in the field. The treated plots were significantly different from T_{19} control (12.000%). However, T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%), T_{18} (Fipronil 0.25%) showed minimum damage (1.800, 2.000, 2.4607) followed by T_7, T_8, T_9 (Chlorpyrifos 1.00 and 0.50%) and T_1 Bifenthrin with damage (4.433%) as compared to T_2, $T_{3,}$ (Bifenthrin 0.50 and 0.25%) , T_4, T_5, $T_{6,}$ (Basudin 1.00, 0.50 and 0.25%), T_{10}, T_{11}, $T_{12,}$ (Cypermethrin 1.00, 0.50 and 0.25%) and T_{13}, T_{14}, $T_{15,}$ (Imidacloprid 1.00,0.50 and 0.25%). When effect of different concentrations (1.00%, 0.50% and 0.25%) compared one percent give the best result.

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, $T_{18,}$ (Fipronil) give best results (1.800, 2.000, 2.470%) showed minimum damage as compared to T_{19} Control which showed maximum damage (12.00 A).

2.12 Effect of Pesticides on Sugarcane Termite Population after 15-Days of Sowing Treated Setts in the Field

It can be concluded from the data after 15-days of sowing dipped setts in the field all the treated plots showed significantly different from the T_{19} (control) where maximum termite population was noted that was (21.000 individuals / ft^3.) However , T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%), T_{18} (Fipronil 0.25%) showed minimum number of individuals of termites (1.000 individuals / ft^3.) followed by T_7, T_8, $T_{9,}$ (Chlorpyrifos 1.00,0.50 and 0.25%) as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%), T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%) and T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

However, when Duncan Multiple Range test was applied T_{16}, T_{17}, T_{18}, (Fipronil) showed lowest population of termites as compared to chlorpyrifos, Bifenthrin, Basudin, Cypermethrin and Imidacloprid.

2.13 Effect of Pesticides on Sugarcane Termite Population after 30-Days of Sowing Treated Setts in the Field

It can be concluded from the data after 30-days of sowing dipped setts in the field all the treated plots showed significantly different from the control T_{19}. Maximum termite population was noted in T_{19} control that was (26.333 individuals / ft^3). However, T_{16} (Fipronil 1.00%), T_7 (Chlorpyrifos 1.00%), T_{18} (Fipronil 0.25%) showed minimum termite (1.333, 1.667, 1.667 individuals / ft^3) respectively as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%) , T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%) and T_{10}, T_{11}, $T_{12,}$ (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%) when different concentrations were compared.

However, when Duncan Multiple Range test was applied maximum population noted in T_{19} (control) 26.330 individuals / ft^3 and minimum T_{16} (Fipronil 1.00%) that was 1.330 individuals / ft^3).

2.14 Effect of Pesticides on Sugarcane Termite Population after 45-Days of Sowing Treated Setts in the Field

It can be concluded from the data after 45-days of sowing dipped setts in the field all the treated plots showed significantly different from the control T_{19}. Maximum termite population was noted in T_{19} control that was (32.667 individuals / ft^3). However, T_7 (Chlorpyrifos 1.00%), T_{16} (Fipronil 1.00%), T_8 (Chlorpyrifos 0.50%) treated plot showed (1.667%, 2.333%, 2.333% individuals / ft^3) respectively as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%), T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%) and T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

However, when Duncan Multiple Range test was applied maximum population noted in T_{19} (control) showed maximum termite population (32.670 A) and T_7 Chlorpyrifos 1.00% showed minimum termite populations (1.670 F).

2.15 Effect of Pesticides on Sugarcane Termite Population after 60-Days of Sowing Treated Setts in the Field

It can be concluded from the data after 60-days of sowing dipped setts in the field all the treated plots showed significantly different from the control T_{19}. Maximum termite population was noted in T_{19} control that was (35.333 individuals / ft^3). However, T_7 (Chlorpyrifos 1.00%), T_8

(Chlorpyrifos 0.50%), T_{16} (Fipronil 1.00%) showed minimum termite population (2.000, 2.333, 2.667 individuals / ft^3) respectively as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%) , T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%) and T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%) and T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%).

When effect of concentrations (1.00%, 0.50% and 0.25%) compared 1.00% give best results to others.

However, when Duncan Multiple Range test was applied T_7 (Chlorpyrifos 1.00%) showed minimum termite populations and maximum population noted in T_{19} control (2.000 and 35.333 individuals / ft^3).

2.16 Effect of Pesticides on Sugarcane Termite Population after 75-Days of Sowing Treated Setts in the Field

It can be concluded from the data after 75-days of sowing treated setts in the field all the treated plots were significantly different from untreated control T_{19}. Maximum termite population was noted in T_{19} control 43.333 individuals / ft^3). However, T_7 (Chlorpyrifos 1.00%), T_{16} (Fipronil 1.00%), T_{17} (Fipronil 0.50%) treated plots showed minimum termite population (2.667, 3.000 and 3.333 individuals / ft^3) respectively as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%), T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%), T_8, T_9, (Chlopyrifos 0.50 and 0.25%) and T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25%), T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%) and 1.00% concentrations give best results to others.

However, when Duncan Multiple Range test was applied T_7 (Chlorpyrifos 1.00%) treated plot showed minimum termite populations 2.670 and T_{19} control with a maximum population (43.333 A).

2.17 Effect of Pesticides on Sugarcane Termite Population after 90-Days of Sowing Treated Setts in the Field

Maximum termite population was noted in T_{19} (control) 42.333 individuals / ft^3). However, T_7 (Chlorpyrifos 1.00%), T_{16} (Fipronil 1.00%), T_8 (Chlorpyrifos 0.50%) treated plots showed minimum termite population (2.667, 3.667 and 3.667 individuals / ft^3) as compared to T_1, T_2, T_3, (Bifenthrin 1.00,0.50 and 0.25%) , T_4, T_5, T_6, (Basudin 1.00,0.50 and 0.25%), T_9, (Chlopyrifos 0.25%), T_{10}, T_{11}, T_{12}, (Cypermethrin 1.00,0.50 and 0.25 %), T_{13}, T_{14}, T_{15}, (Imidacloprid 1.00,0.50 and 0.25%) and 1.00% concentrations give best results to others.

However, when Duncan Multiple Range test was applied T_7 (Chlorpyrifos 1.00%) and T_{16} (Fipronil 1.00%) treated plot showed minimum termite populations (2.670 and 3.670) T_{19} (control) with a maximum population (42.33 A individuals / ft^3).

3. DISCUSSION

Heptachlor 20 EC, Chlorpyrifos 20 EC, Chlordane 20EC, Sevidol 4G and Quinalphos 5G were applied at planting at Karnal in India. Germination was significantly greater following insecticide treatments than in control plots. Chlorpyrifos was most effective insecticides against termites and improved member of mill able canes and yield per acre [6]. Termite fauna in Pakistan is well known as 50 species have been recorded so for responsible for most of ravages to the crops [7]. Subterranean termites are well adjusted in agro-eco system of Pakistan and dine upon a wide range of crops e.g. upon sugarcane, cotton, wheat, maize, groundnut and tree crops [3]. Assessment of Rodents (rat) and termite damage in various sugar mills zone of Punjab (Pakistan) recorded up to 50 percent damage by termites in different zones (Anonymous 1990). Integrated pest management studies on termites to check the most effective control method revealed that minimum population of termite found where insecticide such as Chlorpyriphos, Furadan and Bifenthrin was applied as compared to other control methods. Seed and soil treatments of seven insecticides on sugarcane at the time of planting revealed Durmet 20 EC provided maximum protection to the sugarcane crop from termite. Every insecticide tested against termites decreased the incidence to a considerable level over the control. Yield too was harvested highest when applied at planting time. The seed and soil treatment of sugarcane at the time of planting must be done with insecticides to save the crop from attack of termite and got a bumper crop of sugarcane [5]. Monocrotophos, Diazinan, Carbofuran were applied to sugarcane in Nigeria to know their efficacy. Diazinan was most effective in controlling termite density and for controlling stalk damage [5]. Lorshan, Confidor and Regent were evaluated for the control of termites on sugarcane crop. The result was noted after 33 and 65 days. It showed that minimum stool infestation was observed by Regent and maximum in Confidor [8]. Screening

out of termicides such as Regent EC, Regent G and Mospilan showed none of these gave 100% eradication of live wood termite in Sri Lanka. Regent EC gave more eradication of termite colony [9]. In the management of scavenging termites in Sri Lanka on tea lands by applying fipronil (G). fipronil (suspension) in different suspension repelled the termites most. There were no differences between two dosages of liquid suspension. In Haryana India, Chlorpyrifos, Sevidol and Quinalphos were evaluated on sugarcane at planting. Germination was significantly greater following insecticide treatments than in control plots. Chlorpyrifos was most effective insecticides against termite and improved the number of mill able canes yield per area [6].

As the chemical treatment is the only remedy for the crops attacked by subterranean termites available to the farmers in Pakistan the evaluation of these six insecticides showed that most effective is the Fipronil both in reducing the population density and damage on the cones. The germination also increased with the Fipronil and Chlorpyriphos, which resemble with the results ([9, Abey Singhe, et al. 2001 and [4]).

4. CONCLUSION

Pakistan atmosphere favours population of termites. There are 2,600 described species in the world but 300 are considered pest. In sugarcane, termites are a serious one in District Faisalabad, Mardan, Peshawer and Sargodha causing 20-30% damage. Chemical control only remedies for effective management of termites. As the chemical treatment is the only remedy for the crops attacked by subterranean termites available to the farmers in Pakistan the evaluation of these six insecticides showed that most effective is the Fipronil both in reducing the population density and damage on the cones. Every insecticide tested against termites decreased the incidence to a considerable level over the control. Yield too was harvested highest when applied at planting time.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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