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Efficacy of Different Insecticides on Natural Enemies in Maize Ecosystem

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ABSTRACT: The investigation of Efficacy of different insecticides on natural enemies in maize ecosystem. The field experiment was conducted on the field of progressive farmer Shree. Baburao Mhaske Domegoan, Taluka Ambad, Dist. Jalna under the guidance of research guide, college of agriculture Badnapur during *kharif* 2021. The work was carried out in Randomized Block Design with three replications and seven treatments. The net plot size and gross plot size was 3.0 m × 2.2 m and 4.2 m × 3 m respectively with maize crop variety Fourtuner. The studies conclude that the natural enemies for all insecticides were found to be relatively safe except Indoxacarb 15.8 EC (T4) for LBB, Chlorfluazuron 5.4 EC for predatory spider and Emamectin benzoate 5SG for predatory bug. To convince the farmer for layout experiment in already planted crop and to keep watch on the activities of pest and it's response to different treatments were the challenges. The entire research programmed monitored and guided by research guide besides all the inputs were provided by college of agriculture Badnapur and losses occurred in the plant population during layout and losses in the yield caused by untreated control were beared by farmer.

Keywords: Insecticides, Maize, natural enemies, lady bird beetle, predatory spider, predatory bug.

INTRODUCTION

Maize or corn (*Zea mays* L.) is a crop of global importance, which holds a unique position in world agriculture. Maize belongs to the family of Poaceae, originated from South America, from where it was taken to all parts of the world.

In India maize production estimated about 20240 tonnes in *kharif* and 8470 tonnes in rabi. Although in 2018-19 production were decreased by 20220 tonnes in *kharif* and 7580 tonnes in rabi. In Chhattisgarh, it is well informed in an area of 226.79 hec. With productivityof 2458 kg/hec. of *kharif* season. Although 74.45 ha. Area and 1950 kg/ha. Productivity of *rabi* season in 2017-18.Among the maize growing countries India rank 4th in area and 7th in production representing around 4% of the world maize area and 2% of total production. In India, maize is cultivated on an area of 9.89 million ha with 31.65 million tonnes of production and 31.65 quintal per hectares of productivity during 2021-22. (Anonymous, 2021).

Although 139 insect pests cause varying degree of damage to maize crop, only about a dozenof these are quite serious and require control measures like maize stalk borer, pink stem borer, and shoofly are the insects of national importance while the armyworm, jassids, thrips, aphids, pyrilla, grasshoppers, white grub, cut worms, hairy caterpillars, termites, and the leaf miner are more serious regional level insect pests. Amongst the most serious pests shoot fly and maize stem bore, (Chilo partellus Swinhoe, Sesamia inferens Walker) occurs as serious pests in India (Nagarjuna *et al.*, 2015). On maize, if 5% of seedlings are cut or 20% of whorls of small plants (during the first 30 days) are infested, it is recommended that an insecticide be applied on sorghum the pest threshold level is regarded as one (or two) larvae per leaf whorl and two per head (Pitre *et al*., 1983).

Invasive insect pest are one of the major and most rapidly growing threats to agricultural biodiversity, forestry, human and animal health, etc. resulting in huge economic losses. The invasive of the pest in new areas sometimes lead to the outbreak of the pest due to lack of natural enemies. Therefore, exploration should be made in the area of origin of the pest or effort should be made to search some effective natural enemies in the invaded area so that the pest population could be curtailed with ETL. These invasive insect pests can be minimized with use biological control agent or their natural enemies and quarantine set up needs to be upgraded as this could result in the globalization of pest (Gupta *et al*., 2018).

The spraying of insecticides has been taken into our

major consideration in this experiment with the aim to complete destruction of invading pest population to disrupt the scope of the pest to the destructive pest population and to minimize the use of the pesticides for the safety for the natural enemies and the ecosystem.

MATERIALS AND METHODS

A field experiment was conducted on the field of progressive farmer Shree. Baburao Mhaske Domegoan, Taluka Ambad, Dist. Jalna under the guidance of College of Agriculture Badnapur during *kharif* 2021 under field condition to study Efficacy of different insecticides on natural enemies in maize ecosystem. The hybrid of maize variety use for study is Fortuner.

The population of natural enemies (lady bird bettle, predatory spider, predatory bug etc.) was recorded from five randomly selected plants one day before and 3,7,10 and 14 days after

spraying. The average population of natural enemies was presented per plant.

Treatment details:

Sr. No.	Name of the treatment	Dose/10 lit of water
1.	Emamectine benzoate 5 SG	4 gm
2.	Chlorantranilprole 18.5 SC	3 ml
3.	Flubendiamide 49.35 SC	2.5 ml
4.	Indoxacarb 15.8 EC	10 ml
5.	Spinetoram 11.7 SC	10 ml
6.	Chlorfluazuron 5.4 EC	3.0 ml
7.	Untreated control	—

RESULT AND DISCUSSION

Efficacy of different insecticides on ladybird beetle (LBB)

One day before first spraying. The data reported in Table 1 of the first spraying showed that the average number of lady bird beetles per plant ranged from 1.30 to 1.90 LLB/plant with no statically significant differences.

Three days after first spraying. Three days after first insecticidal application the highest population of lady bird was noted in control plot (T7), (2.05 LBB/plant) followed by Emamectin benzoate 5SG (T1) @ 4gm/10L (1.20 LBB/plant), Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L (1.14 LBB/plant), Chlorantaniliprole 18.SC (T2) 3ml/10 L (1.12 LBB/plant), Spinetoram11.7 (T5) SC @ 10ml/10L (1.10 LBB/plant) were safer. The minimum population of the lady bird beetle was observed in Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L of water (0.40 LBB/plant) and Indoxacarb 15.8 EC (T4) @10ml/10L which recorded (0.30 LBB/plant)

According to Galvan *et al.* (2005), Spinosad applied at 10, 25 or 50 FR has less of and sub lethal efficacy on H.axyirids than indoxacarb treated at 10% FR.

Seven days after first spraying. Data recorded on seven day after first spraying revealed that, T7 (2.00 LBB/plant) as proved to be significantly superior and at par with following treatment Emamectin benzoate 5SG (T1) @ 4gm/10L (1.30 LBB/plant), Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L (1.12 LBB/plant), Chlorantraniliprole 18.SC (T2) 3ml/10 L (1.14 LBB/plant), Spinetoram 11.7 (T5) SC @ 10ml/10L (1.15 LBB/plant and proved to safer to moderately safer. Among rest of treatment Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L of water recorded 0.35 LBB/plant. The minimum population of the lady bird was observed in Indoxacrb 15.8 EC (T4) @ 10ml/10L which recorded (0.25 LBB/plant).

Ten days after first spraying. According to the data noted on ten days after first spraying; no significant changes was observed. There were 0.80 to 2.00 LBB/plant on an average.

Fourteen days after first spraying. The efficacy of insecticides on lady bird beetle was observed on fourteen days after first spraying; no significant changes were observed. There were 0.90 to 2.10 LBB/plant.

Efficacy of different insecticides on ladybird beetle (LBB) after second spraying.

Three days after second spraying. The efficacy of newer insecticides on ladybird beetle on three day after second spraying presented in Table 2 revealed that among all treatments, significant reduction exhibited by Indoxacarb 15.8 EC (T4) @ 10ml/10L which recorded (0.40 LBB/plant). While same time maximum population was noticed in untreated control (2.10 LBB/plant) followed by, Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L (1.26 LBB/plant), Chlorantaniliprole 18.SC (T2) 3ml/10 L (1.24 LBB/plant), Emamectin benzoate 5SG (T1) @ 4gm/10L (1.28 LBB/plant), Spinetoram 11.7 (T5) SC @ 10ml/10L (1.20 LBB/plant) at par with treatment T7. The treatment Flubendiamide 49.35 SC (T3) @2.5 ml/10L of water was proved to be second best treatment as it recorded 0.50 LBB/plant

Seven days after second spraying. On seventh day after second spraying, the highest population reduction of ladybird was observed in treatment with the Indoxacarb 15.8 EC (T4) @ 10ml/10L recorded 0.42 LBB/plant. On other hand highest was observed in control plot (T7) (1.90 LBB/plant), followed by Emamectin benzoate 5SG (T1) @ 4gm/10L (1.41 LBB/plant), Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L (1.28 LBB/plant), Chlorantraniliprole 18.EC (T2) 3ml/10 L (1.26 LBB/plant), Spinetoram 11.7 (T5) SC @ 10ml/10L (1.24 LBB/plant). The next better treatment was Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L of water recorded 0.50 LBB/plant.

Wagh *et al*. (2017) carried out field experiment with 8 insecticides and conclude that Spinosad 45 SC @ 125g a.i./ha (1.76), Abamectine 1.9 EC @ 3g a.i./ha (1.69), Chlorantraniliprole 18.5 SC @ 30g a.i./ha (1.62) and Novaluron 10 EC @ 75 g a.i./ha (1.51) were found safer to the predatory coccinellids. Whereas, Flubendamide 39.35 SC @ 60 g a.i./ha was moderately toxic to coccinellids, Cypermethrin 25 EC @ 62.50 ga.i./ha was found detrimental to the natural enemies.

Ten days after second spraying. The efficacy of insecticides on lady bird beetle was observed on ten days after the second spraying: no significant change was observed. There were 1.00 to 1.80 lady bird beetles per plant on an average.

Fourteen days after second spraying. Data recorded fourteen days after the second spraying revealed that

there was statistically non-significant difference between all the treatments. The average numbers of ladybird beetles were ranged from 1.11 to 1.91 LBB/plant.

Efficacy of different insecticides on ladybird beetle (LBB) after third spraying

Third day after third spraying. Data recorded on three days after third spraying revealed that, treatment T7 (2.10 LBB/plant) proved to be significantly superior followed by Emamectin benzoate 5SG (T1) @ 4gm/10L (1.30 LBB/plant), Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L of water (1.28 LBB/plant), Chlorantraniliprole 18.SC (T2) 3ml/10 L (1.26 LBB/plant) and Spinetoram 11.7 (T5) SC @ 10ml/10L (1.24 LBB/plant) were proved to be safer. The minimum populations of LBB were recorded in treatment of Indoxacarb 15.8 EC (T4) @ 10ml/10L (0.50 LBB/plant) and Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L of water.

Seven day after third spraying. The observation presented in Table 3 showed that the minimum population of ladybird beetles observed in Indoxacarb 15.8 EC (T4) @ 10ml/10L recorded 0.45 LBB/plant. Whereas, untreated plot (T7) 1.93 LBB/plant recorded maximum number of lady bird beetle followed by Emamectin benzoate 5SG (T1) @ 4gm/10L of water (1.32 LBB/plant), Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L of water (1.30 LBB/plant), Chlorantaniliprole 18.SC (T2) 3ml/10 L (1.28 LBB/plant) and Spinetoram 11.7 (T5) SC @ 10ml/10L (1.26 LBB/plant). Among rest of treatment Flubendiamide 49.35 SC (T3) @ 2.5ml/10Lof water was recorded (0.60 LBB/plant).

Ten days after third spraying. Almost all insecticide showed non-significant variation and similar trend of the efficacy of insecticides on ladybird beetle ten days after the third application. The average number of ladybird beetles per plant ranged from 1.20 to 1.80 LBB.

Fourteen days after third spraying. Data recorded fourteen days after the third spraying revealed that there were statically non-significant differences between all the treatments. The average number of ladybird beetle was ranged from 1.00 to 2.00spiders/plant.

Alam *et al*. (2020). A field experiment was conducted on maize at the Entomology Field Laboratory, Department of Entomology, Bangladesh Agricultural University (BAU), Mymensigh during Rabi season of 2017-18. The experiment was set up in Randomized Complete Block Design (RCBD) with five treatments (Imidagold 20SL@ 0.1, 0.3 & 0.5ml/L; Ambush 1.8EC@ 1.5, 2.5 & 3.0ml/L; Hadhak 45WP@ 0.2, 0.4 & 0.6g/L; Suspend 5SG@ 0.5, 1.0 & 1.5 g/L and Heron 5EC @ 0.5, 1.0 & 1.5ml/L) and three replications for each treatment. Maize viz. BARI Hybrid Butta-09 was used as experimental crop. With a view to know the toxic efficacy of different insecticides, the percent reduction of population of natural enemies was counted at 2 days, 5 days and 7 days after spraying. In all field trials, the harmful effects of the five insecticides were in the following rank order (least harmful to most harmful): Imidagold 20SL< Hadhak 45WP< Heron 5EC. Hence, based on the percent reduction of plant infestation, yield attributes, benefit cost ratio and compatibility with natural enemies, Imidagold 20SL@ 0.3ml/L proved to be the best among all the tested insecticides.

Efficacy of different insecticides on predatory spider

Efficacy of different insecticides on predatory spider after first spraying One day before first spraying. The data reported in Table 4 of the first spraying indicate that the average number of predatory spiders per plant ranged from 1.90 to 2.40 with the non-significant differences.

Three days after first spraying. Three days after first insecticidal application, the higher population of predatory spiders were noted in control plot T7 (2.60 spiders/plant) followed by Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L (1.60 spiders/plant), Indoxacarb 15.8 EC (T4) @ 10ml/10L (1.55 spider/plant), Spinetoram 11.7 (T5) SC @ 10ml/10L (1.50 spiders/plant) and Chlorantaniliprole 18.EC (T2) 3ml/10 L (1.40 spiders/plant). The minimum population of spiders were observed in Chlorfluazuron 5.4 EC (T6) @ 3ml/10 L of water (0.80 spiders/plant) and Emamectin benzoate 5SG (T1) @ 4gm/10L of water (0.87spiders/plant).

Seven days after first spraying. Data recorded seven days after first spraying revealed that, T7 (2.70 spiders/plant) was significantly superior and at par with following treatments Flubendiamide 49.35 EC (T3) @ 2.5 ml/10L (1.70 spider/plant), indoxacarb 15.8 EC (T4) @ 10ml/10L (1.65 spider/plant), Spinetoram 11.7 (T5) SC @ 10ml/10L (1.55 spiders/plant) and Chlorantaniliprole 18.EC (T2) 3ml/10 L (1.50 spiders/plant) proved to be moderately safer. The lowest population of spiders were observed in Chlorfluazuron 5.4 EC (T6) @ 3ml/10L of water (0.75 spider/plant) and Emamectin benzoate 5SG (T1) @ 4gm/10Lof water (0.82 spider/plant)

Dai-bin *et al.* (2013) conducted a field experiment showed that lambda cyhalothrin was extremely toxic to the hunting spider, *X. ephippiatus* and not suitable to IPM programs Emamcetine benzoate can reduce the population by *X. ephippiatus* by 58.1- 61.4% but the population can recover at the end of the experiment. Chlorantraniliprole was relatively safe to *X. ephippiatus*. It only reduces the population of *X. ephippiatus* by 22.3-33.0%.

Ten days after first spraying. Almost all insecticides showed non-significant variation and similar trend of the efficacy of insecticides on predatory spider after ten days first spraying. The average number of spider per plant ranged from 1.60 to 2.50spiders/plant.

Fourteen days after first spraying. Data recorded fourteen days after the first spraying revealed that there were statistically non-significant differences between all the treatments. The average numbers of spiders were ranged from 1.80 to 2.40 spider/plant.

Singh *et al*. (2021) results revealed that among various insecticides, application of chlorantaniliprole 18.5SC and emamectin benzoate 5SG did not cause any significant reduction in spider population and hence were safe to theses natural enemies. Pyridaly l10 EC was next relatively safer insecticide whereas cypermethrin25 EC, lambda-cyhalothrin5 EC and quinalphos 25EC suppressed spiders population

significantly.

Efficacy of different insecticides on predatory spider after second spraying

Third day after second spraying. On third days after second spraying, the highest population reduction of predatory spider was observed in treatment with Chlorfluazuron 5.4 EC (T6) @ 3ml/10L of water (1.20 spiders/plant) which shows in Table 5. In other hand the highest population was observed in untreated control (T7) (2.60spiders/plant) followed by Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L (1.90spiders/plant), Spinetoram 11.7 SC (T5) @ 10ml/10L (1.80 spiders/plant), Indoxacarb 15.8 EC (T4) @ 10ml/10L (1.60 spiders/plant) and Chlorantaniliprole 18.5 SC (T2) 3ml/10 L (1.55 spiders/plant). The next treatment was Emamectin benzoate 5SG (T1) @ 4gm/10L of water had recorded 1.33 spiders/plant was followed by T6.

Seven days after second spraying. On seven days after the second spraying, non-significant difference among predatory spiders population was observed. The average number of spider varied from 1.70 to 2.40 spider/plant.

Ten days after second spraying. Data recorded ten days after the second spraying revealed that there were statistically non-significant differences between all the treatments. The average number of spider was ranged from 1.90 to 2.60spiders/plant.

Fourteen days after second spraying. On fourteen days after the second spraying, non-significant difference among predatory spider population was observed. The average number of spider varied 2.00 to 2.30 spiders/plant.

Efficacy of different insecticides on predatory spider after third spraying

Three days after third spraying. Data recorded on three days after third spraying revealed that control plot (T7) (2.40 spiders/plant) proved to be significantly superior over other treatments and at par with following treatments Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L (1.65 spiders/plant), Indoxacarb 15.8 EC (T4) @ 10ml/10L (1.60 spiders/plant), Spinetoram 11.7SC (T5) @ 10ml/10L (1.55 spiders/plant), and Chlorantaniliprole 18.SC (T2) 3ml/10 L (1.50 spider/plant) and Emamectin benzoate 5SG (T1) @ 4gm/10L of water (1.20 spiders/plant). Whereas the lowest population of spiders were observed in treatment of Chlorfluazuron 5.4 EC (T6) @ 3ml/10L of water (1.00 spiders/plant).

Seven days after third spraying. On seven days after third spraying, it was observed that there was non-significant variation among all insecticides on spiders. The average number of predatory spiders 1.80 to 2.60 spider/plant.

Ten days after third spraying. Data recorded ten days after the second spraying revealed that there were statistically non-significant differences between all the treatments. The average numbers of spiders were ranged from 2.00 to 2.50 spiders/plant.

Fourteen days after third spraying. On fourteen days after the second spraying, non-significant difference among predatory spider population was observed. The average number of spider varied 2.00 to 2.60 spider/plant.

Efficacy of different insecticides on predatory bug

Efficacy of different insecticides on predatory bug after first spraying

One day before first spraying. The data reported in Table 7 of the first spraying indicate that average number of predatory bug per plant ranged from 0.50 to 0.70 with non-significant differences.

Three day after first spraying. Three day after first spraying, the highest population of predatory bugs were noted in control plot (T7), (0.74 predatory bugs/plant) followed by Chlorfluazuron 5.4EC (T6) @ 3ml/10L 0.52 predatory bugs/plant, Indoxacarb 15.8 EC (T4) @ 10ml/10L (0.52 predatory bug/plant), Spinetoram 11.7 (T5) SC @ 10ml/10L 0.51 predatory bugs/plant, Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L (0.50 predatory bugs/plant) and Chlorantraniliprole 18.5 SC (T2) 3ml/10 L of water (0.30 predatory bugs/plant). The minimum population of predatory bugs were observed in Emamectine benzoate 5SG (T1) @ 4ml/10Lof water which recorded (0.20 predatory bugs/plant).

Seven day after first spraying. At seventh day after first spraying, there was no significant difference with in the predatory bugs populations across all treatments. The average number of predatory bugs/plant ranged from 0.30 to 0.74.

Ten day after first spraying. Almost all insecticides exhibit non-significant variance and similar trend action on predatory bugs ten day after first spraying. The average number of predatory bugs 0.40 to 0.80.

Fourteen day after first spraying. Data recorded fourteenth days after the first spraying revealed that there were statistically non-significant differences between all the treatments observed. The average number of predatory bugs ranged from 0.50 to 0.80predatory bugs/plant.

Efficacy of different insecticides on predatory bug after second spraying

Three days after second spraying. The data recorded in Table 8 population of predatory bugs were observed in all treatments at three days after second spraying and showed significant differences among all treatments. The lower population of predatory bugs were noticed in Emamectin benzoate 5SG (T1) @ 4gm/10L of water which recorded (0.10 predatory bugs /plant). Whereas, T7 recorded maximum number of predatory bugs (0.85 predatory bugs/plant) followed by Chlorfluazuron 5.4 EC (T6) @ 3ml/10L (0.60 predatory bug/plant), Indoxacarb 15.8 EC (T4) @ 10ml/10L (0.55 predatory bugs/plant), and Spinetoram 11.7 (T5) SC @ 10ml/10L (0.50 predatory bugs/plant). Flubendiamide 49.35 EC (T3) @ 2.5 ml/10L (0.30 predatory bugs/plant) was recorded second best treatment. The treatment Chlorantraniliprole 18.EC (T2) 3ml/10 L of water (0.20 predatory bugs/plant) was at par with treatment (T3).

Seven day after second spraying. After the second spraying, the insecticides impact on predatory bugs were essentially non-significant at seventh day and ranged in between 0.20 to 0.75 predatory bugs were present on average per plant.

Ten day after second spraying. There were no statistically significant differences between the treatments at tenth day after the second spraying, according to data tabulated in Table 8. The typical predatory bugs density increased from 0.50 to 0.75 predatory bugs/plant.

Fourteen days after second spraying. Predatory bugs were observed at fourteen days after the second spraying, nearly with non-significant variance. 0.60 to 0.80 predatory bugs were found on an average per plant.

Efficacy of different insecticides on predatory bugs after third spraying

Three day after third spraying. Data recorded on three days after third spraying revealed that control plot (T7) (0.79 predatory bug/plant) proved to be significantly superior over other treatments and at par with the following treatments Chlorfluazuron 5.4 EC (T6) @ 3ml/10L (0.56 predatory bugs/plant), Spinetoram 11.7 SC (T5) @ 10ml/10L (0.55 predatory bugs/plant), Indoxacarb 15.8 EC (T4) @ 10ml/10L (0.50 predatory bugs/plant) and Flubendiamide 49.35 SC (T3) @ 2.5 ml/10L (0.40 predatory bug/plant). The treatment of Chlorantraniliprole 18.SC (T2) 3ml/10 L of water (0.37 predatory bugs/plant) and Emamectin benzoate 5SG (T1) @ 4gm/10L of water (0.30 predatory bugs /plant) recorded minimum number of predatory bugs after third day of third spraying of insecticides.

Table 1: Populations of ladybird beetles on maize after first spraying.

Tr. No.	Name of Treatments	Dose /10 L	Average number of Ladybird beetle/plant				
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectinbenzoate5 SG	4 gm	2.00 (1.34)	1.20 (1.07)	1.30 (1.10)	1.53 (1.20)	1.70 (1.26)
T2	Chlorantraniliprole 18.5 SC	3ml	1.40 (1.16)	1.12 (1.03)	1.14 (1.05)	1.43 (1.17)	1.50 (1.17)
T3	Flubendiamide 49.35 SC	2.5ml	1.30 (1.12)	0.40 (0.62)	0.35 (0.59)	0.80 (0.87)	0.90 (0.94)
T4	Indoxacarb 15.8EC	10ml	1.50 (1.17)	0.30 (0.54)	0.25 (0.49)	1.20 (1.07)	1.30 (1.12)
T5	Spinetoram11.7SC	10ml	1.60 (1.24)	1.10 (1.02)	1.15 (1.05)	1.40 (1.16)	1.44 (1.17)
T6	Chlorfluazuron5.4EC	3.0ml	1.80 (1.31)	1.14 (1.04)	1.12 (1.05)	1.38 (1.15)	1.57 (1.21)
T7	Untreated check	—	1.90 (1.35)	2.05 (1.42)	2.00 (1.39)	2.00 (1.39)	2.10 (1.42)
	SE(m)±		0.086	0.067	0.076	0.072	0.082
	CD at 5 %		NS	0.206	0.234	NS	NS
	CV (%)		11.93	12.04	13.00	10.86	11.93

*Figures in parenthesis are square root transformed values

Table 2: Populations of ladybird beetles on maize after second spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Ladybird beetle/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectin benzoate 5 SG	4 gm	1.28 (1.06)	1.41 (1.18)	1.58 (1.23)	1.60 (1.24)
T2	Chlorantraniliprole 18.5 SC	3ml	1.24 (1.09)	1.26 (1.10)	1.60 (1.24)	1.70 (1.27)
T3	Flubendiamide 49.35 SC	2.5ml	0.50 (0.70)	0.50 (0.70)	1.10 (1.03)	1.11 (1.03)
T4	Indoxacarb 15.8EC	10ml	0.40 (0.62)	0.42 (0.63)	1.00 (0.98)	1.30 (1.12)
T5	Spinetoram 11.7SC	10ml	1.20 (1.07)	1.24 (1.09)	1.35 (1.14)	1.40 (1.16)
T6	Chlorfluazuron5.4EC	3.0ml	1.26 (1.10)	1.28 (1.11)	1.40 (1.16)	1.53 (1.19)
T7	Untreated check	—	2.10 (1.42)	1.90 (1.36)	1.80 (1.31)	1.91 (1.35)
	SE(m) +		0.068	0.069	0.081	0.088
	CD at 5%		0.210	0.214	NS	NS
	CV (%)		11.74	11.76	12.23	12.77

Figures in parenthesis are square root transformed values

Table 3: Populations of ladybird beetles on maize after third spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Ladybird beetle/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectinbenzoate5 SG	4 gm	1.30 (1.12)	1.32 (1.13)	1.60 (1.24)	1.70 (1.28)
T2	Chlorantraniliprole 18.5 SC	3ml	1.26 (1.10)	1.28 (1.11)	1.45 (1.18)	1.60 (1.24)
T3	Flubendiamide 49.35 SC	2.5ml	0.60 (0.76)	0.60 (0.76)	1.30 (1.12)	1.20 (1.07)
T4	Indoxacarb15.8EC	10ml	0.50 (0.69)	0.45 (0.66)	1.20 (1.07)	1.00 (0.98)
T5	Spinetoram11.7SC	10ml	1.24 (1.09)	1.26 (1.10)	1.30 (1.12)	1.45 (1.18)
T6	Chlorfluazuron5.4EC	3.0ml	1.28 (1.11)	1.30 (1.12)	1.40 (1.16)	1.55 (1.22)
T7	Untreated check	—	2.10 (1.45)	1.93 (1.36)	1.80 (1.31)	2.00 (1.38)
	SE(m) +		0.073	0.064	0.080	0.066
	CD at 5%		0.224	0.198	NS	NS
	CV (%)		12.05	10.79	11.90	9.54

*Figures in parenthesis are square root transformed

Table 4: Populations of predatory spiders on maize after first spraying.

Tr. No.	Name of Treatments	Dose /10 L	Average number of Predatory spiders/plant				
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectinbenzoate5 SG	4 gm	2.00 (1.39)	0.87 (0.92)	0.82 (0.89)	1.60 (1.22)	1.90 (1.35)
T2	Chlorantraniprole 18.5 SC	3ml	2.20 (1.47)	1.40 (1.16)	1.50 (1.17)	1.97 (1.37)	2.20 (1.46)
T3	Flubendiamide 49.35 SC	2.5ml	2.26 (1.51)	1.60 (1.24)	1.70 (1.27)	2.00 (1.37)	1.80 (1.30)
T4	Indoxacarb15.8EC	10ml	2.40 (1.53)	1.55 (1.21)	1.65 (1.24)	1.90 (1.34)	2.00 (1.38)
T5	Spinetoram11.7SC	10ml	2.20 (1.46)	1.50 (1.17)	1.55 (1.19)	2.40 (1.53)	2.13 (1.44)
T6	Chlorfluazuron 5.4EC	3.0ml	1.90 (1.19)	0.80 (0.87)	0.75 (0.86)	1.80 (1.31)	1.88 (1.34)
T7	Untreated check	—	2.40 (1.53)	2.60 (1.59)	2.70 (1.62)	2.50 (1.56)	2.40 (1.51)
	SE(m)±		0.095	0.087	0.069	0.086	0.100
	CD at 5 %		NS	0.269	0.213	NS	NS
	CV (%)		11.25	12.98	10.17	10.80	12.40

*Figures in parenthesis are square root transformed values

Table 5: Populations of predatory spiders on maize after second spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Predatory Spiders/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectin benzoate 5 SG	4 gm	1.33 (1.15)	1.90 (1.34)	2.10 (1.42)	2.10 (1.42)
T2	Chlorantraniliprole 18.5 SC	3ml	1.55 (1.24)	2.00 (1.41)	2.40 (1.53)	2.30 (1.50)
T3	Flubendiamide 49.35 SC	2.5ml	1.90 (1.34)	1.80 (1.30)	1.90 (1.34)	2.10 (1.42)
T4	Indoxacarb15.8EC	10ml	1.60 (1.24)	1.70 (1.26)	2.50 (1.56)	2.40 (1.53)
T5	Spinetoram11.7SC	10ml	1.80 (1.31)	1.90 (1.34)	2.00 (1.38)	2.00 (1.39)
T6	Chlorfluazuron5.4EC	3.0ml	1.20 (1.07)	1.80 (1.30)	2.00 (1.38)	2.20 (1.46)
T7	Untreated check	—	2.60 (1.60)	2.40 (1.53)	2.60 (1.59)	2.30 (1.50)
	SE(m) +		0.079	0.092	0.087	0.080
	CD at 5%		0.243	NS	NS	NS
	CV (%)		10.79	11.74	10.36	9.45

*Figures in parenthesis are square root transformed values

Table 6: Populations of predatory spiders on maize after third spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Predatory Spiders/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectin benzoate5 SG	4 gm	1.20 (1.07)	1.80 (1.30)	2.20 (1.46)	2.30 (1.50)
T2	Chlorantraniliprole 18.5 SC	3ml	1.50 (1.17)	2.60 (1.59)	2.30 (1.49)	2.40 (1.53)
T3	Flubendiamide 49.35 SC	2.5ml	1.65 (1.24)	2.20 (1.36)	2.40 (1.53)	2.20 (1.46)
T4	Indoxacab15.8EC	10ml	1.60 (1.24)	2.40 (1.53)	2.00 (1.38)	2.20 (1.46)
T5	Spinetoram11.7SC	10ml	1.55 (1.19)	2.60 (1.59)	2.00 (1.38)	2.00 (1.38)
T6	Chlorfluazuron 5.4EC	3.0ml	1.00 (0.98)	2.00 (1.38)	2.20 (1.46)	2.10 (1.42)
T7	Untreated check	———	2.40 (1.49)	2.13 (1.44)	2.50 (1.56)	2.60 (1.59)
	SE(m) +		0.090	0.105	0.087	0.085
	CD at 5%		0.277	NS	NS	NS
	CV (%)		13.01	12.35	10.32	9.94

*Figures in parenthesis are square root transformed value

Table 7: Populations of Predatory bugs on maize after first spraying.

Tr. No.	Name of Treatments	Dose /10 L	Average number of Predatory bugs/plant				
			1 DBS	3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectinbenzoate5 SG	4gm	0.60 (0.75)	0.20 (0.44)	0.30 (0.55)	0.40 (0.62)	0.50 (0.70)
T2	Chlorantraniliprole 18.5 SC	3ml	0.50 (0.69)	0.30 (0.52)	0.40 (0.62)	0.50 (0.70)	0.60 (0.76)
T3	Flubendiamide 49.35 SC	2.5ml	0.70 (0.81)	0.50 (0.70)	0.60 (0.76)	0.65 (0.79)	0.62 (0.77)
T4	Indoxacarb 15.8EC	10ml	0.65 (0.79)	0.52 (0.71)	0.70 (0.82)	0.70 (0.81)	0.75 (0.84)
T5	Spinetoram 11.7SC	10ml	0.55 (0.73)	0.51 (0.70)	0.60 (0.76)	0.60 (0.76)	0.65 (0.79)
T6	Chlorofluzuron5.4EC	3.0ml	0.75 (0.84)	0.52 (0.71)	0.65 (0.78)	0.65 (0.79)	0.72 (0.83)
T7	Untreated check	——	0.70 (0.81)	0.74 (0.84)	0.74 (0.84)	0.80 (0.87)	0.80 (0.87)
	SE(m)±		0.051	0.043	0.047	0.050	0.047
	CD at 5 %		NS	0.130	NS	NS	NS
	CV (%)		11.29	11.17	11.09	11.26	10.18

***** Figures in parenthesis are square root transformed values.

Table 8: Populations of predatory bugs on Maize after second spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Predatory bugs/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectin benzoate5 SG	4 gm	0.10 (0.31)	0.20 (0.44)	0.50 (0.69)	0.60 (0.76)
T2	Chlorantraniliprole 18.5 SC	3ml	0.20 (0.44)	0.30 (0.54)	0.50 (0.70)	0.65 (0.81)
T3	Flubendiamide 49.35 SC	2.5ml	0.30 (0.54)	0.40 (0.62)	0.60 (0.76)	0.70 (0.81)
T4	Indoxacarb 15.8EC	10ml	0.55 (0.73)	0.60 (0.76)	0.70 (0.81)	0.60 (0.76)
T5	Spinetoram 11.7SC	10ml	0.50 (0.70)	0.55 (0.73)	0.60 (0.76)	0.75 (0.84)
T6	Chlorfluazuron 5.4EC	3.0ml	0.60 (0.76)	0.65 (0.79)	0.70 (0.81)	0.65 (0.79)
T7	Untreated check	——	0.85 (0.90)	0.75 (0.85)	0.75 (0.84)	0.80 (0.87)
	SE(m) +		0.040	0.047	0.054	0.050
	CD at 5%		0.122	NS	NS	NS
	CV (%)		11.02	12.03	12.25	10.69

*Figures in parenthesis are square root transformed values.

Table 9: Populations of predatory bugs on Maize after third spraying.

Tr. No.	Treatments	Dose /10L	Average no. of Predatory bugs/plant			
			3 DAS	7 DAS	10 DAS	14 DAS
T1	Emamectinbenzoate5SG	4 gm	0.30(0.54)	0.40(0.62)	0.60(0.76)	0.70(0.81)
T2	Chlorantraniliprole 18.5 SC	3ml	0.37(0.59)	0.45(0.66)	0.60(0.76)	0.65(0.78)
T3	Flubendiamide 49.35 SC	2.5ml	0.40(0.62)	0.55(0.73)	0.65(0.79)	0.60(0.76)
T4	Indoxacarb 15.8EC	10ml	0.50(0.70)	0.60(0.76)	0.70(0.81)	0.75(0.84)
T5	Spinetoram 11.7SC	10ml	0.55(0.73)	0.70(0.81)	0.80(0.87)	0.80(0.87)
T6	Chlorfluazuron 5.4EC	3.0ml	0.56(0.74)	0.72(0.83)	0.75(0.85)	0.70(0.81)
T7	Untreated check	—	0.79(0.88)	0.70(0.81)	0.75(0.85)	0.70(0.82)
	SE(m) +		0.046	0.053	0.053	0.060
	CD at 5%		0.140	NS	NS	NS
	CV (%)		11.52	12.23	11.23	12.83

*Figures in parenthesis are square root transformed values

Shinde (2020) field investigation showed that Spinetoram 11.7 SC recorded maximum population (0.65 bugs/plant). The next safer treatment was Spinosad 45 SC and Flubendiamide 39.35 SC (0.60 bugs/plant). It was followed by Chlorantraniliprole 18.5% (0.55 bugs/plant), Emamectine benzoate 5% SG (0.20 bug/plant) and lambda- cyhalothrin 5% EC (0.10 bug/plant). The plot treated with thiamethoxam 12.6% + lambda- cyhalothrin 9.5 % ZC recorded nil population. The highest populations of predatory bugs were recorded in untreated plot (0.75bugs/plant).

Seven day after third spraying. On seven day after third spraying, it was observed that there were non-significant variations among all insecticides on predatory bugs. The average number of 0.40 to 0.72 predatory bugs/plant.

Ten day after third spraying. Almost all insecticides exhibit non-significant variation and similar trend action on predatory bugs at ten day after third spraying. The average number of predatory bugs 0.60 to 0.80.

Fourteen day after third spraying. Predatory bugs were observed fourteenth days after the third spraying, nearly with non- significant variation 0.60 to 0.80 predatory bugs were found on an average per plant.

CONCLUSIONS

In case of natural enemies, all insecticides were found safe to relatively safe except Indoxacarb 15.8 EC (T4) and no significant reduction in the population of lady bird beetle observed. The highest population's reductions of predatory spiders were observed in treatment T6 Chlorfluzuron 5.4 EC and incase of predatory bugs in the treatment of Emamectin benzoate 5SG.

FUTURE SCOPE

In future this type of experiment will be carried out so that effective and safer molecules can be identifies for ecofriendly management of insect pests and their natural enemies in various crop ecosystems.

REFERENCES

Anonymous (2021). Area, production and productivity in India. *Indian institute of maize research.*

Alam, J., Chowdhury, A.H., Nahar, Q., Md. Harun -or Rashid, Ahmed, S. K. (2020). Comparative Efficacy of Some Insecticides Against Maize Aphid (Rhopalosiphum Maidis) and its influence on Natural Enemies in Maize Ecosystem. *Tropical Agrobiodiversity, 1*(2), 95-101.

Dai-bin, Y., Z. Lin-na, Y. Xiao-jing, W. Zhen-ying and Y. Hui-zhu (2013). Efficacy of droplets distribution on insecticide on toxicity to corn borers (*Ostrinia furnaealis*) and spider (*Xysticus ephippiatus*), *J. of Integrative Agriculture*.

Galvan, T. L., Koch, R. L. and Hutchison, W. D. (2005). Efficacy of Spinosad and Indoxacarb on survival, development, and reproduction of the multicolored Asian lady bird beetle (Coleoptera: Coccinellidae). *Bio control, 34*, 108-114.

Gupta, N., Verma, S. C., Thakur, M., Sharma, P. and Devi, D. (2018). Status of invasive insect pest of India and their natural enemies. *Journal of Entomology and Zoology studies, 7*(1), 482-489.

Nagarjuna, B., Manjunath, M., Latha M., (2015). Studies on varietal screening of maize hybrid against stem borer, *Seasamia inferens* (Walkar). *Journal of Eco-friendly Agriculture, 10*, 64-66.

Pitre, H. N., Malrooney, J. E., and Hogg, B. D. (1983). Fall armyworm (Lepidoptera: Noctuidae) ovipostion: crop preferences and egg distribution in plant. *Journal of Economic Entomology, 76*(3), 463-466.

Shinde, S. G. (2020). Determination of economic threshold level and management strategies against fall armyworm *Spodoptera frugiperda* (J.E. Smith) on maize. Msc (Agri) thesis VNMKV, Parbhani, India.

Singh, B., Gour, R. M. and Jakhar, A. (2021). Relative safety of newer insecticides to spider in okra ecosystem. *International Journal of Theoretical and Applied Sciences, 13*(2), 42-45.

Wagh, B. M., Pagire, K. S., Thakare, D. P., & Birangal, A. B. (2017). Management of sucking pests by using newer insecticides and their effect on natural enemies in tomato (Lycopersicon esculentum Mill.). *International Journal of Current Microbiology and Applied Sciences, 6*(4), 615-622.

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