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EFFICACY OF READY-MIX INSECTICIDES AGAINST FALL ARMY WORM *SPODOPTERA FRUGIPERDA* (J E SMITH) ON MAIZE

Patil S A[1]*, Kadam D R[1], Deshmukh K V[1], Bankar D R[1] And Parjane N V[1]

[1]Department of Entomology, College of Agriculture, Parbhani,
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani 431402, Maharashtra, India
*Email: sumitpatilagr@gmail.com (corresponding author): ORCID ID 0009-0006-4991-0074

ABSTRACT

During kharif 2019, the efficacy of combined insecticides against the fall army worm *Spodoptera frugiperda* (J E Smith) in maize was assessed. Chlorantraniliprole 9.3%+ lambdacyhalothrin 4.6%ZC was the most effective. Fipronil 4% + acetamiprid 4%SC was less effective. All treatments were effective in increasing the yield- chlorantraniliprole 9.3% + lambdacyhalothrin 4.6 %ZC gave maximum grain yield (40.70 q/ ha) while maximum benefit cost ratio was obtained with thiamethoxam 12.6 + lambdacyhalothrin 9.5%ZC (1:28.33).

Key words: *Spodoptera frugiperda*, maize, combination insecticides, chlorantraniliprole 9.3%+ lambdacyhalothrin 4.6%ZC, fipronil 4% + acetamiprid 4%SC, management, control, grain yield, cost benefit,

The fall army worm (FAW), *Spodoptera frugiperda* (J E Smith) (Lepidoptera: Noctuidae) is a tropical and subtropical pest. It is a major pest of maize, but it is also known to affect over 100 hosts. It was observed for the first time in India on maize in the Shivamogga area of Karnataka during May-June 2018 (Sharanabasappa et al., 2018). Since then it has spread to the majority of India's maize-growing states. In the absence of management practices, this pest can cause yield losses ranging from 8.3 to 20.6 mt/ year in maize (Day et al., 2017). In Maharashtra, the area under maize is 13.03 lakh ha, giving yield of 36.03 lakh mt with a productivity of 2086 kg/ ha. In 2018-19, maize ending stock is 1.42 mmt, down from 2.50 mmt in 2017-18, this drop in production is as a result of 10-20% damage caused by the emerging *S. frugiperda* as well as an increase in domestic consumption, which supported Indian maize prices (Anonymous, 2018). Because this pest is new to the Marathwada region, there is a need for more research. Several studies have suggested using insecticides, but as maize crops are fed to cattle and poultry birds as feed, the safest chemicals for IPM need to be explored. Many combination insecticides are now available for diverse pest management at the same time. In this study, different combinations of insecticides have been evaluated for their efficacy against *S. frugiperda* on maize, to provide guidance in the selection of superior combination insecticides.

MATERIALS AND METHODS

A field experiment was conducted during kharif 2018-19 at two locations in the farm of the Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, During kharif 2019, experiment was laid out in a randomized block design (RBD) with eight treatments in three replications, with plot size of 4.2 x 3.4 m with 1 m replication border and 0.5 m treatment border between the plots. The variety Komal was used at 60 cm spacing, and crop was raised adopting a standard package of practice except plant protection measures. The measured quantity of insecticide was added in two litre of water with sprayings done after appearance of pest, and two sprays were administered using knapsack sprayer; first spray was given at appearance of insect and second after 15 days after first. Incidence of Fall armyworm was recorded in each plot on five randomly selected plants tagged in rows of 1 m length in each treatment. The number of larvae per plant was counted on one day before spray and 3, 7 and 14 days after each spray. Later the data was subjected to statistical analysis. Data obtained from the field and laboratory experiment was converted to appropriate transformations and was subjected to statistical analysis to test the level of significance.

RESULTS AND DISCUSSION

The pooled data given in Table 1 indicate that there was uniform distribution of pest during pretreatment count- ranged from 3.83 to 4.97 larvae/ m row length justifying the need to undertake plant protection interventions. Post treatment all the insecticidal

Table 1. Efficacy of ready-mix insecticides against *S. frugiperda* on maize

Treatments	Dosage (ml/g/l)	Larval incidence- mean of two sprays				% damage- mean of two sprays			
		Larvae/ 1 mrow length				Damage			
		DBS	3 DAS	7 DAS	14 DAS	DBS	3 DAS	7 DAS	14 DAS
Fipronil 4% + acetamiprid 4 %SC	1	4.63 (2.37)*	2.53 (1.35)	3.48 (1.46)	4.71 (1.58)	9.57 (17.94)	4.69 (7.11)	5.48 (7.74)	7.11 (8.81)
Indoxacarb 14.5%+ acetamiprid 7.7%SC	1	4.10 (2.25)	0.93 (1.14)	1.63 (1.24)	2.27 (1.31)	9.20 (17.64)	2.42 (5.06)	2.70 (5.42)	3.81 (6.34)
Novaluron 5.25% + indoxocarb 4.5%SC	1.7	4.29 (2.28)	0.55 (1.08)	1.48 (1.22)	1.78 (1.38)	10.03 (18.06)	1.94 (4.55)	2.63 (5.34)	3.90 (6.46)
Thiamethoxam 12.6 + lambda -cyhalothrin 9.5%ZC	0.5	3.88 (2.11)	0.79 (1.12)	1.10 (1.16)	1.86 (1.27)	8.47 (16.90)	2.19 (4.65)	2.30 (4.87)	3.49 (6.16)
Chlorantraniliprole 9.3% + lambda -cyhalothrin 4.6%ZC	0.5	3.87 (2.19)	0.11 (1.01)	0.69 (1.10)	1.10 (1.15)	8.15 (16.37)	1.22 (3.59)	1.56 (4.13)	2.40 (5.03)
Profenophos 40% + cypermethrin 4%EC	1	4.00 (2.23)	1.97 (1.28)	2.68 (1.37)	4.35 (1.58)	9.55 (17.83)	3.85 (6.42)	4.39 (6.87)	5.87 (7.93)
Chloropyriphos 50 % + cypermethrin 5%EC	1	3.83 (2.18)	2.35 (1.33)	3.25 (1.44)	4.59 (1.58)	9.93 (17.66)	4.34 (6.83)	4.74 (7.14)	6.50 (8.44)
Untreated control	-	4.97 (2.44)	9.57 (2.04)	12.78 (2.28)	14.95 (2.44)	10.95 (19.19)	17.86 (14.11)	20.09 (14.98)	22.28 (15.78)
SE(m)±		0.190	0.060	0.062	0.102	1.605	0.633	0.470	0.721
CD (p=0.05)		N/A	0.183	0.189	0.313	N/A	1.490	1.439	2.209

Incremental cost benefit ratio

Treatment	Yield (q/ ha)	Increase in yield over control (q/ ha)	Cost of treatment		Total cost (Rs/ ha)	Value of additional yield (Rs/a)	Net profit (Rs/ ha)	ICBR
			Cost of insecticide (Rs/ ha)	Labour + sprayer charges				
Fipronil 4% + acetamiprid 4%SC	25.93	10.63	1600	1000	2600	22854.5	20254.5	1:7.79
Indoxacarb 14.5%+ acetamiprid 7.7%SC	30.17	14.87	2250	1000	3250	31970.5	28720.5	1:8.84
Novaluron 5.25 % + indoxocarb 4.5%SC	37.27	21.97	2822	1000	3822	47235.5	43413.5	1:11.36
Thiamethoxam 12.6 + lambda -cyhalothrin 9.5%ZC	35.97	20.67	515	1000	1515	44440.5	42925.5	1:28.33
Chlorantraniliprole 9.3% + lambda -cyhalothrin 4.6%ZC	40.70	25.40	1600	1000	2600	54610	52010	1:20.00
Profenofos 40% + cypermethrin 4%EC	28.67	13.37	1375	1000	2375	28745.5	26370.5	1:11.10
Chloropyriphos 50% + cypermethrin 5%EC	27.93	12.63	870	1000	1870	27154.5	25284.5	1:13.52
Untreated control	15.30							

*Figures in parentheses square root transformed values, NS- Non-significant, DBS- Day before spraying, DAS- Days after spraying; Rates: i) Selling price of maize: Rs 2150/ q ii) Wages of each labour: 300/ day ii) Sprayer charge: Rs 200/ day

treatments significantly reduced the pest up to seven days, significance clearly seen at 14 DAS.- mean of two sprays indicated lowest larval count from the plots treated with chlorantraniliprole 9.3% + lambdacyhalothrin 4.6%ZC (1.10 larvae/ m row length) which was statistically significant over the rest. Novaluron 5.25 % + indoxocarb 4.5%SC, thiamethoxam 12.6% + lambdacyhalothrin 9.5%ZC, indoxacarb 14.5% + acetamiprid 7.7%SC, profenophos 40% + cypermethrin 4%EC and chloropyriphos 50% + cypermethrin 5%EC followed this. The combination insecticides showed no statistical difference in their efficacy. The treatment comprising of fipronil 4%+ acetamiprid 4%SC recorded maximum incidence (4.71 larvae/ m row length).

During kharif 2019, two sprays of combined insecticides significantly reduced infestation over a span of 28 days. At 14 DAS, order of effectiveness was chlorantraniliprole 9.3%+ lambdacyhalothrin 4.6%ZC (2.40%) followed by others. These findings are in conformity with those of Bhusal and Bhattarai (2019) with cholarantraniliprole. Swathi et al. (2019) observed that chlorantraniliprole 9.3% + lambda cyhalothrin 4.6% @ 0.5 ml/ l was very effective on *M. vitrata*. Kamble et al. (2014) revealed that indoxacarb 14.5SC + acetamiprid 77SC gave significantly more yield of healthy fruits of okra followed by profenophos 40EC + cypermethrin 4EC and chlorpyriphos 50EC + cypermethrin 5EC reducing *Earias vitella* infestation. Das et al. (2015) reported that mixed formulation of novaluron 5.25 + indoxacarb 4.5SC @ 80 g a.i./ ha and novaluron 5.25+ fipronil 4SC @ 80 g a.i./ ha, were the most effective against *Helicoverpa*. Maximum yield of maize was recorded in the plots treated with chlorantraniliprole 9.3% + lambda cyhalothrin 4.6%ZC (40.70 q/ ha) (Table 1); it was followed by novaluron 5.25% + indoxocarb 4.5%SC (37.27 q/ ha), and others. The highest benefit cost ratio was obtained with thiamethoxam 12.6 + lambda cyhalothrin 9.5% ZC (1:28.33) followed by chlorantraniliprole 9.3 % + lambda cyhalothrin 4.6%ZC (1:20.00) and others. Swathi et al., (2019) reported that chlorantraniliprole 9.3% + lambdacyhalothrin 4.6% @ 0.5 ml/ l followed by chlorantraniliprole 18.5SC @ 0.0037% and flubendiamide @ 39.35SC 0.00787% led to least pest incidence in pigeonpea but highest cost: benefit (C:B) ratio 1: 17.14 was recorded from chlorantraniliprole 18.5SC and spinosad 45SC.

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AUTHOR CONTRIBUTION STATEMENT

Patil S A and Kadam D R conceived and designed the research, Patil S A conducted research and analysed the data, Deshmukh K V and Bankar D R wrote the manuscript which was guided by Kadam D R

CONFLICT OF INTEREST

No conflict of interest.

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