Andhra Pradesh J Agril. Sci : 6(4): 211-216, 2020

EVALUATION OF NEWER INSECTICIDES AGAINST MELON FLY, *Bactrocera cucurbitae* (Coquillett) ON BITTER GOURD (*Momordica Charantia* L.)

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Date of Receipt: 28-08-2020 Date of Acceptance: 29-10-2020

ABSTRACT

Efficacy of newer insecticides was tested against melon fly in bitter gourd under field conditions during *kharif*, 2019. Observations on fruit infestation (%) and larval population per fruit were recorded at 1, 3, 5 and 10 days after spraying of insecticides. Total of 2 sprays were done at 15 days interval after noticing the ovipositional injuries on bitter gourd fruits during fruiting stage of the crop. Among the seven newer insecticides evaluated, spinosad 45 SC @ 0.3 ml L^{-1} was the most effective insecticide with fruit infestation of 28.62 per cent and larval population of 6.53 per fruit. It was followed by thiodicarb 75 WP @ 1.0 g L^{-1} and emamectin benzoate @0.4 g L^{-1} with fruit infestation of 31.69 and 34.32 per cent with larval density of 7.48 and 8.82 larvae per fruit, respectively. Per cent reduction of fruit infestation was high in spinosad 45 SC @ 0.3 ml L^{-1} (55.49%), thiodicarb @ 1.0 g L^{-1}, (50.67%), emamectin benzoate @ 0.4 g L^{-1} (46.83%) and lambda cyhalothrin @ 1.0 ml L^{-1} (45.52%) over the control (64.30%). Spinosad 45 SC @ 0.3 ml L^{-1}, thiodicarb @ 1.0 g L^{-1}, lambda cyhalothrin @ 1.0 ml L^{-1} and emamectin benzoate @ 0.4 g L^{-1} were the most promising insecticides in reducing the larval population to 58.00, 49.58, 45.10 and 43.33 per cent over the control. It is concluded that 2 foliar sprays of wither spinosad 45 SC @ 0.3 ml L^{-1} or thiodicarb @ 1.0 g L^{-1} at fruiting stage of the crop is most effective against melon fly in bitter gourd.

KEY WORDS: *Bactrocera cucurbitae,* fruit infestation, larval population and newer insecticides.

INTRODUCTION

India is the second largest producer of fruits and vegetables with an area of 6.64 and 10.35 M ha with annual production of 99.06 and 191.76 MT, respectively (Anonymous, 2019). In India, both major and minor cucurbits are being cultivated in area of 0.54 M ha with 7.10 MT production in 2017-18 sharing about 6.0 per cent of the total vegetable production (Annual report, National Horticulture Board, 2018). Being a large group of vegetables, cucurbits provide better scope to enhance overall production and productivity. Among the cucurbits, bitter gourd is one of the major growing vegetables where, area under cultivation of bitter gourd has gradually increased from 0.99 (2018-19) to 1.01 Lakh ha (2019-20) with a production of 1.21 MT during 2019-20 (Indiastat, 2019-20). In Andhra Pradesh, bitter gourd is being cultivated in an area of 0.02 Lakh hectares with annual production of 0.17 Lakh tonnes (Indiastat, 2018-19). Among the various biotic problems that constrain the production of cucurbits, pests and diseases are responsible for huge economic loss.

The melon fly, *Bactrocera cucurbitae* (Coquillett) is the foremost important fruit fly that attacks 61 plant species belonging to 19 different families, twenty-eight of them are cucurbits and remaining are non-cucurbit hosts (De Meyer *et al.,* 2015).

In India, Lefroy (1907) reported the melon fly, *B. cucurbitae* for the first time as the major pest of cucurbitaceae causing yield loss up to 70 per cent. It damages over 60 per cent of cucurbit crops in India (Kapoor, 2005) and the extent of losses vary from 30 to 100 per cent (Shooker *et al.,* 2006). The pest damage crop by means of ovipositional injury, larval feeding on ovaries, fruit pulp, and rottening of fly-damaged fruits (Viraktamath *et al.,* 2003). In addition to the direct losses, its economic impacts result in the loss of export markets as well as costly requirement of quarantine restrictions and eradication measures (Badii *et al.,* 2015).

Resistance development and resurgence of pest due to intensive use of insecticides creating nuisance in pest management. Also, most of the insecticides are potentially toxic to humans where, their residues on vegetables causes

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various health hazards. The availability of newer insecticide with unique mode of action provides a new way for its management. But, the information on the use of newer insecticides to manage fruit fly on bitter gourd is very scanty. With these observations in view, the present investigation is carried out to identify the most promising and effective insecticide against melon fly in bitter gourd.

MATERIAL AND METHODS

The exeriment was conducted in a pendal system at Horiculture garden of S.V. Agriculture college, Tirupati in RBD with eight treatments (Table 1.) and three replications with plot size of 4 m × 3.5 m. Seedlings of 4-5 leave stage (Variety: Dhanvi Ktahi) were transplanted at plant spacing of 1 m × 0.35 m. Crop was raised by following package of practices recommended by Dr. YSR Horticulture University, Andhra Pradesh except crop protection practices.

Recording of observations

Pre-treatment count of fruit infestation and larval population per fruit were recorded at one day before the impose of first foliar spray. First spraying was done at the time of fruit setting stage after noticing the oviposition marks on bitter gourd fruits. Second spray was done at 15 days after first spray. Fruits were picked from randomly selected five plants from each treatment at 1st, 3rd, 5th and 10th day after spraying (Srinivas *et al.,* 2018). Observations on per cent fruit infestation and larval population per fruit were recorded by following the methodology given by Dhillon *et al.* (2005).

Fruit infestation (%) =

$$\frac{\text{Number of infested fruits}}{\begin{array}{c}\text{Total number of fruits picked from}\\ \text{randomly selected 5 plants}\end{array}}\times 100$$

Effectiveness of the treatments were also assessed by working out the per cent reduction of fruit infestation as well as larval density per fruit over the control.

Per cent reduction over control =

$$\frac{\begin{array}{c}\text{Per cent fruit infestation in control - Per cent fruit infestion in treatment}\end{array}}{\text{Per cent fruit infestation in control}}\times 100$$

Fruit yield from all the treatments including control was also recorded to know the impact of insecticide on crop yield. In each plot, irrespective of healthy and infested, marketable sized bitter gourd fruits were harvested. At each fruit picking, the healthy and infested fruits were sorted out separately, weighed and noted. The weight of the healthy fruits from all the fruit pickings in each plot was pooled to get yield per plot (kg) and was converted to yield per hectare (tonnes).

Statistical analysis

The data were analysed using one-way ANOVA. The mean values for all the parameters were calculated and the analysis of variance was accomplished. Means were separated by Duncan's Multiple Range Test (DMRT) using SPSS 16 software.

RESULTS AND DISCUSSION

The results of present investigation on efficacy of newer insecticides against melon fly in bitter gourd conducted during *kharif*, 2019 were showed significant variation in reduction of fruit infestation presented in Table 1 and Fig. 1. The results revealed the no significant differences in fruit infestation and larval population among the treatments during record of pre count on melon fly infestation in bitter gourd which indicate uniform infestation. After insecticidal application, all the treatments showed significant reduction in fruit infestation over control and significance difference was observed among the treatments.

From the experimental result, the spinosad @ 0.3 ml L^{-1} was found significantly most effective insecticide in minimizing the fruit infestation to 28.62 per cent with higher per cent reduction of fruit infestation (55.49%) over control. And it was statistically on par with thiodicarb @ 1.0 g L^{-1} which was recorded with lower fruit infestation (31.72%) and 50.67 per cent reduction of fruit infestation over control. The emamectin benzoate @ 0.4 g L^{-1}, lambda cyhalothrin @ 1.0 ml L^{-1} and flubendiamide @ 0.75 ml L^{-1} were the next best insecticides with fruit infestation of 34.32, 35.09 and 36.39 per cent, respectively. Relatively higher fruit infestation of 39.32 and 43.02 per cent was recorded in chlorantraniliprole @ 0.2 ml L^{-1} and malathion @ 2 ml L^{-1}, respectively which were found inferior with lowest reduction of fruit infestation (31.94 and 31.40%) over the control.

Table 1. Effect of newer insecticides on cumulative incidence of fruit infestation and larval population of melon fly in bitter gourd during *kharif*, 2019

Treatment	Dose (ml or g L^{-1})	Fruit infestation (%)*	Reduction over control (%)*	Larval population / fruit**	Reduction over control (%)*	Yield (tons ha^{-1})
T_1 : Chlorantraniliprole 18.5 SC	0.2	39.32^{de} (38.77)	38.85 (27.35)	10.67^{c} (3.41)	31.40 (16.08)	9.81
T_2 : Flubendiamide 480 SC	0.75	36.39^{cd} (37.03)	43.40 (30.61)	8.92^{b} (3.14)	42.69 (22.77)	10.95
T_3 : Lambda cyhalothrin 5 EC	1.0	35.03^{bc} (36.07)	45.52 (32.40)	8.54^{b} (3.08)	45.10 (23.84)	11.53
T_4 : Spinosad 45 SC	0.3	28.62^{a} (32.10)	55.49 (39.84)	6.53^{a} (2.71)	58.00 (33.32)	12.86
T_5 : Emamectin benzoate 5 SG	0.4	34.32^{bc} (35.69)	46.83 (33.12)	8.82^{b} (3.07)	43.33 (23.09)	11.67
T_6 : Thiodicarb 75 WP	1.0	31.72^{ab} (34.12)	50.67 (36.06)	7.84^{ab} (3.00)	49.58 (27.53)	12.09
T_7 : Malathion 50 EC	2.0	43.02^{e} (40.95)	33.09 (23.26)	10.59^{c} (3.40)	31.94 (16.45)	8.62
T_8 : Control		64.30^{f} (53.36)		15.56^{d} (4.07)		6.83
SEm±		1.15		0.43		0.39
CD@5%		3.92		1.48		1.21
CV (%)		4.17		6.39		6.47

Values in the parentheses are retransformed values (*-Arcsign transferred values; **- square root retransformed values); Within a row, means followed by the same letter are not significantly different by DMRT (P=0.05, LSD)

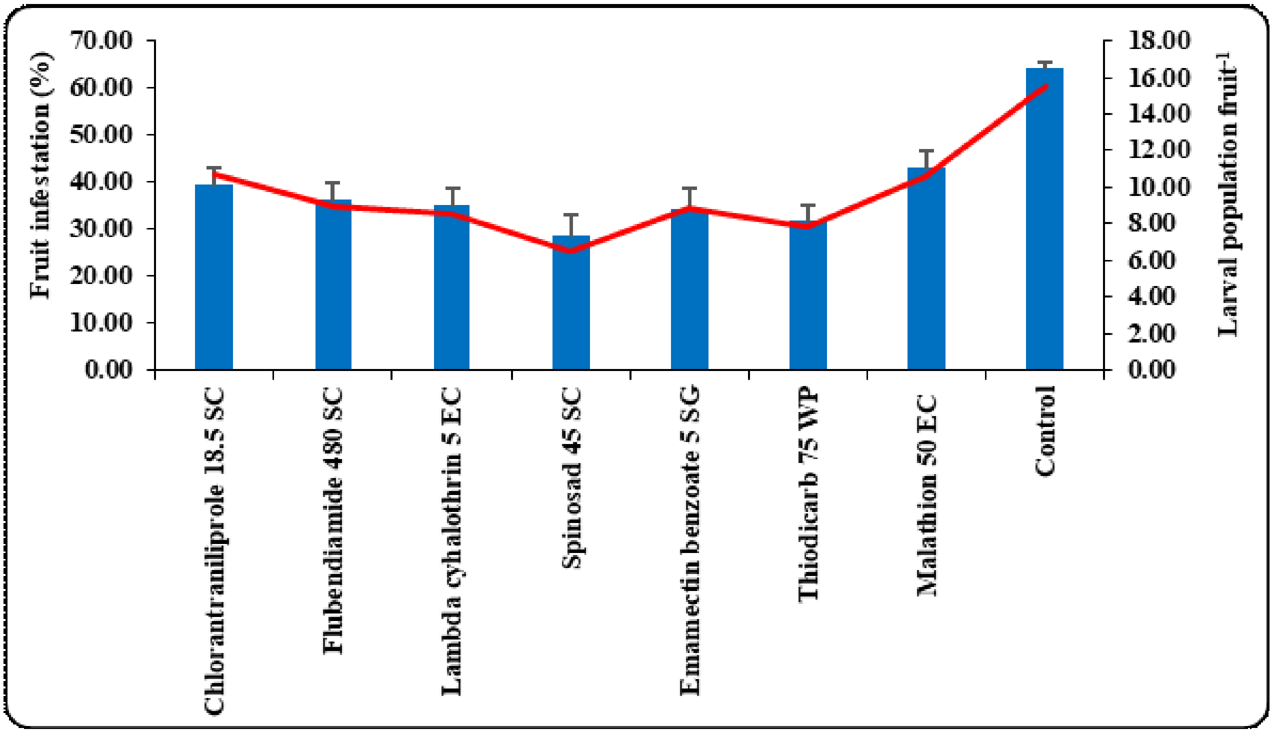

Fig. 1. Field efficacy of newer insecticide against melon fly in bitter gourd.

The spinosad @ 0.3 ml L^{-1} has showed the greater effect in per cent reduction of larval population (58.00%) over the control with lowest larval population of 6.53 per fruit. And thiodicarb @ 1.0 g L^{-1} was the next best insecticide with 7.84 larval population per fruit followed by lambda cyhalothrin @ 1.0 ml L^{-1} (8.54 / fruit), emamectin benzoate @ 0.4 g L^{-1} (8.82) and flubendiamide @ 0.75 ml L^{-1} (8.92 / fruit) which are statistically on par with significant per cent reduction of larval population ranging from 42.69 to 49.58 over control. Higher larval population of 10.67 and 10.59 per fruit was recorded in chlorantraniliprole @ 0.2 ml L^{-1} and malathion @ 2 ml L^{-1}, respectively were found inferior with lowest reduction (36.92 and 35.02%) of larval population over the control.

Effect of insecticidal treatments against melon fly on fruit yield of bitter gourd revealed the significantly higher marketable fruit yield of the all the treatment over the control. Higher marketable fruit yield of 12.86 tons ha^{-1} harvested from spinosad @ 0.3 ml L^{-1} treatment followed by thiodicarb @ 1.0 g L^{-1} (12.09 tons ha^{-1}). Fruit yield was evidently higher (11.67 tons ha^{-1}) in emamectin benzoate @ 0.4 g L^{-1} followed by lambda cyhalothrin @ 1.0 ml L^{-1}, flubendiamide @ 0.75 ml L^{-1}, chlorantraniliprole @ 0.2 ml L^{-1} and malathion @ 2 ml L^{-1} ranging from 8.62-11.53 t ha^{-1}.

The investigation on efficacy of newer insecticides against melon fly in bitter gourd revealed that two sprays of spinosad @ 0.3 ml L^{-1} at 15 days interval was found significantly superior over rest of the insecticides tested in reducing melon fly infestation. Spinosad 45 EC 0.3 ml L^{-1} was recorded with significantly highest per cent reduction of fruit infestation (55.49%) over control with lowest fruit infestation (28.62%), larval population per fruit (6.53 / fruit) and highest marketable yield of bitter gourd (12.86 t ha^{-1}). Our results are in concurred with the findings of Waseem *et al.* (2009) reported the significantly lower fruit infestation of 9.00, 5.00 and 4.00 per cent of melon fly in cucumber with Spinosad 45 SC treatment during first, second and third spray, respectively. Recently, Srinivas *et al.* (2018) conclude that the spinosad 45 EC @ 0.15 ml L^{-1} was found most effective against melon fly insignificant reduction of fruit infestation (14.92 and 17.90%), larval population (8.0 and 8.93/fruit) with maximum yield (15.63 and 16.49 ton ha^{-1}) of cucumber during both *Kharif* and summer seasons, respectively. Vinutha and Kotikal (2018) also opined the higher efficacy of spinosad 45 EC @ 0.3 ml L^{-1} against melon fly in reducing the fruit infestation to 4.83 per cent in melons with yield of 18.16 tons ha^{-1}.

The spinosad 45 EC treatment was statistically on par with thiodicarb @ 1.0 g L^{-1} with fruit infestation 31.72 per cent of, larval population of 7.84 / fruit and 12.09 t ha^{-1} of marketable yield was recorded. Nehra *et al.* (2019) reported the significantly lower fruit infestation melon fly from the thiodicarb 75 WP @ 2 ml L^{-1} (14.82%) treatment in round gourd when compare to malathion 50 EC @ 0.05 per cent (17.10%).

While, emamectin benzoate @ 0.4 g L^{-1} was the next best treatment with fruit infestation of 34.32 per cent, larval population (8.82) and 11.67 tons of yield per hectare followed by flubendiamide @ 0.75 ml L^{-1} and lambda cyhalothrin @ 1.0 ml L^{-1}. Similar results were also found by Bharadiya and Bhut (2017) that the emamectin benzoate 5 SG (0.002%) as most effective insecticide in reducing the fruit infestation to 20.62 per cent and larval density to 2.19 per fruit followed by lambda-cyhalothrin 5 EC (0.005%) (25.52% and 2.31/fruit) against melon fly in sponge gourd. Recently, Abrol *et al.* (2019) conclude that ›-cyhalothrin (0.004%) was found superior over the control in reduction of *B. cucurbitae* and *B. tau* infestation to 14.62 and 17.38 per cent in bottle gourd, respectively. Bhowmik *et al.* (2014) and Nehra *et al.* (2017) reported the significant higher effectiveness of flubendiamide 480 SC @ 2 ml L^{-1} against melon fly management compared to malathion.

Chlorantraniliprole @ 0.2 ml L^{-1} (36.92%) and malathion @ 2 ml L^{-1} (35.02%) were found superior over the control but inferior over the other insecticide as they recorded with 39.32 and 43.02 per cent of fruit infestation, 10.67 and 10.59 larvae per fruit with 9.81 and 8.62 tons ha^{-1} of marketable yield, respectively. Present findings are supported by Srinivas *et al.* (2018) that malathion 50 EC @ 2.0 ml L^{-1} was found to be least effective against melon fly with highest higher fruit infestation (27.43%), larval population (11.11 / fruit) and ovipositional punctures (1.40 / fruit).Where, cyantraniliprole 10.26 OD @ 1.8 ml L^{-1} which belongs to the same group of chlorantraniliprole with similar mode of action was found relatively less effective with 26.40 per cent fruit infestation, 11.09 maggots per fruit and 1.40 ovipositional punctures per fruit.

Based on mean incidence fruit infestation recorded during two foliar spray, the efficacy of newer insecticides are organised in descending order as follows:

Spinosad @ 0.3 ml L^{-1} (28.62% and 6.53 / fruit) > Thiodicarb @ 1.0 g L^{-1} (31.72% and 7.84 / fruit) > emamectin benzoate @ 0.4 g L^{-1} (34.32% and 8.82 / fruit) > Lambda cyhalothrin @ 1.0 ml L^{-1} (35.09% and 8.54 / fruit) > Flubendiamide @ 0.75 ml L^{-1} (36.39% and 8.92 / fruit) > Chlorantraniliprole @ 0.2 ml L^{-1} (39.32% and 10.67 / fruit) > Malathion @ 2 ml L^{-1} (43.02% and 10.59 / fruit) > Control (64.30% and 15.56 / fruit).

CONCLUSION

Field experiment on efficacy of newer insecticides against melon fly in bitter gourd revealed that two foliar spray of Spinosad @ 0.3 ml L^{-1} at 15 days interval resulted in significant reduction of fruit infestation over rest of the treatments with lowest fruit infestation, larval population per fruit and highest fruit yield. Thiodicarb @ 1.0 g L^{-1} found as next best treatment in the order of efficacy against melon fly followed by emamectin benzoate @ 0.4 g L^{-1}, flubendiamide @ 0.75 ml L^{-1} and lambda cyhalothrin @ 1.0 ml L^{-1}.

ACKNOWLEDGMENT

I am very much grateful to Acharya N.G Ranga Agricultural University, LAM, Guntur and Indian Council of Agricultural Research, New Delhi for the assistance provided in the form of stipend partly supporting my PG studies.

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