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MANAGEMENT OF MELON FLY, *BACTROCERA CUCURBITAE* (COQUILLETT) ON BITTER GOURD (*MOMORDICA CHARANTIA* L.) WITH NEWER INSECTICIDES

B. M. Abhishek[1], G. S. Panduranga[1]*, N. C. Venkateswarlu[1], V. Srilatha[2] and B. Ramanamurthy[3]

[1]Department of Entomology, S. V. Agricultural College (ANGRAU), Tirupati - 517 502, India.
[2]Department of Horticulture, S. V. Agricultural College (ANGRAU), Tirupati - 517 502, India.
[3]Department of Statistics and Computer Application, S. V. Agricultural College (ANGRAU), Tirupati - 517 502, India.
*e-mail : panduento@gmail.com

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ABSTRACT : Exploit of newer insecticides with unique mode of action is a new way for the management of melon fly, *Bactrocera cucurbitae* (Coquillett), a major pest on bitter gourd and experiment was carried out under field condition during *kharif*, 2019. Observation on per cent fruit infestation and larval population per fruit were recorded by picking marketable size fruits at 60 days after sowing. Spinosad 45 SC @ 0.3 ml L^{-1} was the most effective insecticide against melon fly against *B. cucurbitae* with significantly lowest fruit infestation (28.62%), larval population (6.53/fruit) with higher marketable yield of 12.86 tons ha^{-1}. Thiodicarb 75 WP @ 1.0 g L^{-1} was the next best treatment in the order of efficacy against melon fly with 31.72 per cent of fruit infestation, 7.84 of larvae per fruit followed by emamectin benzoate @ 0.4 g L^{-1} (34.32% and 8.82/fruit), flubendiamide @ 0.75 ml L^{-1} (36.39% and 8.54/fruit) and lambda cyhalothrin @ 1.0 ml L^{-1} (36.39% and 8.92/fruit). Per cent reduction of fruit infestation over the control was high in Spinosad 45 SC @ 0.3 ml L-1 (55.49%) followed by thiodicarb 75 WP @ 1.0 g L^{-1} (50.67%). It is concluded that 2 foliar spray of either spinosad 45 EC @ 0.3 ml L^{-1} or thiodicarb 75 WP @ 1.0 g L^{-1} at flowering and fruiting stage of the crop offer better protection against melon fly.

Key words : *Bactrocera cucurbitae,* bitter gourd, fruit infestation, larval population, newer insecticides.

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INTRODUCTION

India is the second largest producer of fruits and vegetables with annual production of 99.06 and 191.76 MT from an area of 6.64 and 10.35 M ha, respectively. Being a large group of vegetables; bitter gourd (*Momordica charantia* L.) is one of the most significantly growing vegetable in India with an annual production of 1.21 MT from 1.01 Lakh ha during 2019-20 (Indiastat, 2019-20). Among all the insect pests species infesting bitter guard; Melon fly, *Bactrocera cucurbitae* (Coquillett) is the one of the most economically important horticultural insect pest inflicting heavy losses in cucurbitaceous vegetables by destroying 70% of cucurbits in India. It attacks 61 plant species belonging to 19 different families, 28 of them are cucrbits, remaining are non-cucurbits hosts. But also its economic impacts are due to its quarantine status (Dey Mayer, 2015). In India, the extent of losses varies from 30 to 100 per cent (Shooker *et al*, 2006). It damages the crop in following ways *viz*., ovipositional injury by female adults, internal feeding on ovaries and fruit pulp by maggots and rottening of fly-damaged fruits (Viraktamath *et al*, 2003). Several researches have been carried out in India on the efficacy of various insecticide against melon fly, but insecticidal resistance, resurgence of pest, hazards on human beings and environment due to insecticidal residue toxicity results in exploitation of newer insecticide with unique mode of action for its management. Also, due to very scanty information is available on the management of melon fly on bitter gourd by the use of newer insecticides, the present investigation was carried out on evaluation of newer insecticides against melon fly on bitter gourd.

MATERIALS AND METHODS

Field trail was conducted in a pendal system at Horticulture Garden, S. V. Agricultural College, Tirupati, Andhra Pradesh during *Kharif*, 2019-2020 using a popular variety Dhanvi Katahi to evaluate the efficacy of newer insecticides against melon fly on bitter gourd. The experiment was laid out in a randomized block design with eight treatments and three replications with plot size of 4 m×3.5 m. Commercial and most popular bitter gourd research variety Dhanvi Katahi seeds were soaked in water over 24 hrs and hermetically sealed in moist muslin cloth for 72 hrs to improve the germination quality of seeds. Sprouted seeds were sowed by dibbling at 1 m × 0.35 m space. Thinning and gap filling was also practiced at 15 days after emergence of seedlings to maintain optimum plant population and crop was raised by following package of agronomic practices recommended by Dr. YSR Horticultural University, Andhra Pradesh except crop protection practices. The insecticidal treatment includes chlorantraniliprole 18.5 EC @ 0.2 ml L^{-1}, flubendiamide 480 SC @ 0.75 ml L^{-1}, lambda cyhalothrin 5 EC 1.0 ml L^{-1}, spinosad 45 EC @ 0.3 ml L^{-1}, emamectin benzoate 5 SG @ 0.4 g L^{-1}, thiodicarb 75 WP @ g L^{-1} and malathion 50 EC @ 2.0 ml L^{-1} and control (water spray).

A total of two foliar sprays were done with hand operated knapsack sprayer at 15 days intervals. First spraying of insecticides was done at the time of fruit setting stage after noticing the oviposition marks on bitter gourd fruits. Spraying was done during morning hours with insecticidal solution prepared by mixing the recommended quantity of insecticide with required quantity of water and stirred well to obtain the desired concentration of spray fluid. Observation on percent fruit infestation and larval population per fruit were recorded by picking marketable size fruits from randomly selected five plants from each plot. Fruits were picked from randomly selected five plants from each treatment at day before spray (Pre-treatment count), 1^{st}, 3^{rd}, 5^{th} and 10^{th} day after spraying (Srinivas *et al*, 2018). Observations on per cent fruit infestation and larval population per fruit were recorded by randomly selection of five infested fruits from each treatment plot and were brought to the laboratory and cut opened to count the larval population per fruit (Dhillon *et al*, 2005). Per cent fruit infestation was worked out by using following formula (Virendra *et al*, 2010).

$$\text{Fruit infestation (\%)} = \frac{\text{Number of infested fruits}}{\text{Total number of fruits harvested}} \times 100$$

Irrespective of healthy and infested fruits, marketable size bitter gourd fruits were harvested and weight of healthy fruit from each plot was noted for every picking. Data was pooled to obtain the yield per plot and expressed as tons ha^{-1}.

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 (Table 1 and Fig. 1). The results revealed that no significant differences in fruit infestation and larval population before the imposition of insecticide treatment (pre-count on melon fly infestation in bitter gourd) that indicates the uniform infestation. After insecticidal application, all the treatments showed significant reduction in fruit infestation over control and significance difference was observed among the treatments. The treatment; 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. 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. Remaining treatments *viz*., 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 inferior than other treatments with lowest reduction of fruit infestation (31.94 and 31.40%) over the control.

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. Thiodicarb @ 1.0 g L^{-1} was the next best treatment 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 in reduction of larval population ranging from 42.69 to 49.58 compare to 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.

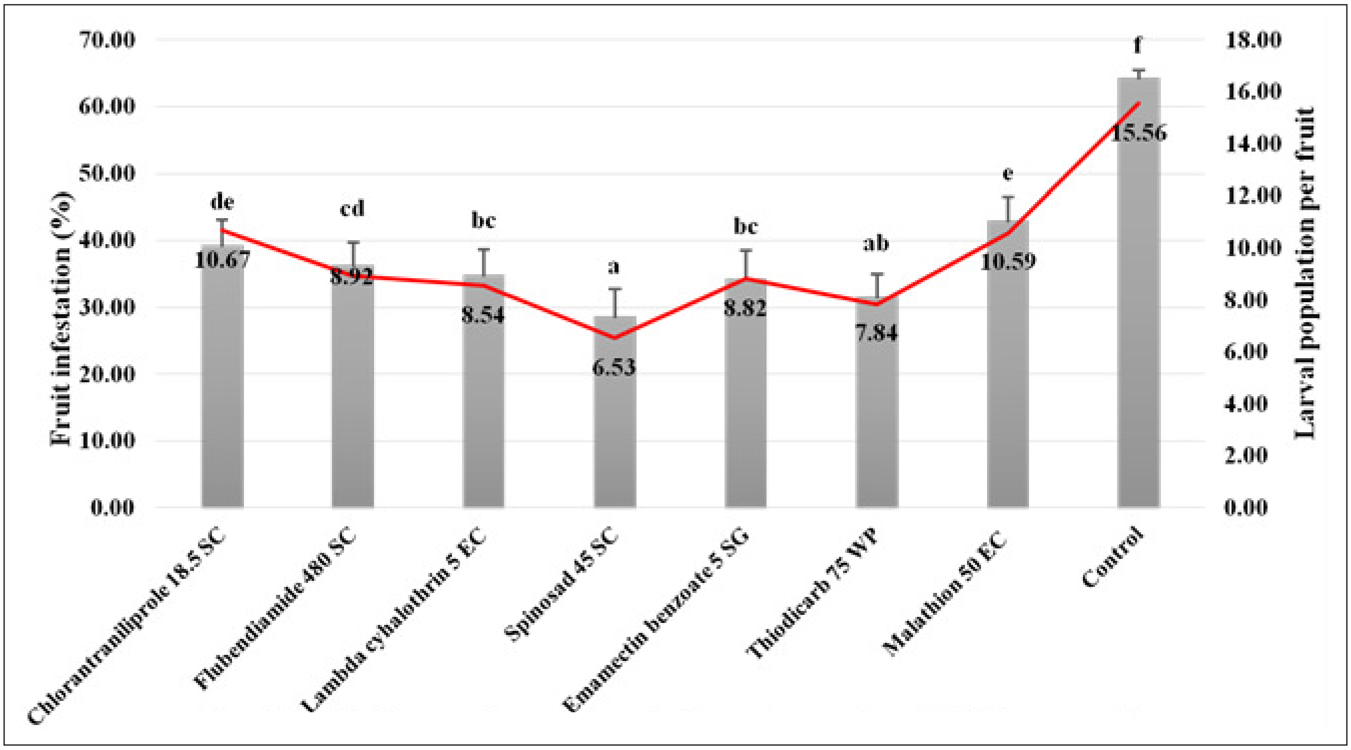

Fig. 1 : Field efficacy of newer insecticide against melon fly in bitter gourd.

Highest fruit yield (12.86 tons ha^{-1}) was recorded from spinosad @ 0.3 ml L^{-1} treated plots followed by thiodicarb @ 1.0 g L^{-1} (12.09 tons ha^{-1}) and emamectin benzoate @ 0.4 g L^{-1} (11.67 tons ha^{-1}). Fruit yield in the remaining treatments *viz*., 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} were ranged from 8.62 to 11.53tons 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 in reducing melon fly infestation by 55.49% with larval population of 6.53/fruit and highest marketable yield of bitter gourd (12.86 tons ha^{-1}). Spinosad is a metabolite of soil actinomycete, *Saccharopolyspora spinosa* contains a mixture of spinosyns A and D. It acts as agonist of AChR and GABA-gated chloride channels. Thus its unique mode of action is responsible for higher toxicity against target insect pest. Salgado (1998) reported that no other class of insecticides showed with same mode of action on insect nervous system and also found that there are no cross resistance to spinosad.

The results of present investigation are in concurred with the findings of Waseem *et al* (2009), who reported the significantly lower fruit infestation of 4.50-9.00 per cent in cucumber with Spinosad 45 SC treatment. Recently, Srinivas *et al* (2018) also concluded that the spinosad 45 EC @ 0.15 ml L^{-1} was found most effective against melon fly in significant 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 reported 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}.

Thiodicarb @ 1.0 g L^{-1} was the next best treatment in reducing the fruit infestation and larval population. Thiodicarb is a *N*-methyl oximidothionate carbamate insecticide act as inhibitor of Ach Ease and glutathione S-transferase. It has ovicidal, larvicidal, adulticidal actions. It has lower ovicidal activity on natural enemies and compatibility with entomopathogenic agent permits to integrate with biological control strategies (Margery *et al*, 2002; Ayubi *et al*, 2013). Nehra *et al* (2019)13 reported the significantly lower fruit infestation of melon fly from thiodicarb 75 WP @ 2 ml L^{-1} (14.82%) treatment in round gourd compares to malathion 50 EC @ 0.05 per cent (17.10%).

Emamectin benzoate @ 0.4 g L^{-1} was the next best treatment after thiodicarb @ 1.0 g L^{-1} with fruit infestation of 34.32 per cent, larval population (8.82) and 11.67 tons of fruit yield per hectare. Emamectin benzoate is the 4-deoxy-4-methylamino derivative of abamectin, produced by fermentation of soil actinomycete, *Streptomyces*

Table 1 : Field efficacy of newer insecticides on incidence of fruit infestation and larval population of melon fly in bitter gourd.

Trt. No.	Treatment	Dose (ml or g/L)	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)q	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 (*-Arc sign 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).

avermitilis. Emamectin benzoate is a mixture of natural avermectin B1a and B1b which activates chloride channel by binding to GABA receptor results in hyperpolarisation. Jun *et al* (2011) reported the superiority of emamectin benzoate over other insecticides is due to its translaminar flow activity, water solubility and higher thermal stability. Similar results were also found by Bharadiya and Bhut (2017) that the emamectin benzoate 5 SG (0.002%) as most effective insecticide against melon fly in reducing the fruit infestation to 20.62 per cent and larval density to 2.19 per fruit in sponge gourd. Melon fly infestation was effectively controlled in cucumber with three foliar sprays of emamectin benzoate 5 SG at 15 days interval (Waseem *et al*, 2009). Recently, Abrol *et al* (2019) reported λ-cyhalothrin (0.004%) as most superior insecticide against *B. cucurbitae* and *B. tau* in bottle gourd. Bhowmik *et al* (2014) and Nehra *et al* (2019) reported the effectiveness of flubendiamide 480 SC @ 2 ml L^{-1} against melon fly.

Chlorantraniliprole @ 0.2 ml L^{-1} (36.92%) and malathion @ 2 ml L^{-1} (35.02%) were found superior over the control with 39.32 and 43.02 per cent of fruit infestation, 10.67 and 10.59 larvae per fruit. These findings are on par with the findings of Srinivas *et al* (2018), who reported that malathion 50 EC@2.0 ml L^{-1} was the least effective against melon fly with 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} > Thiodicarb @ 1.0 g L^{-1} > emamectin benzoate @ 0.4 g L^{-1} > Lambda cyhalothrin @ 1.0 ml L^{-1} >

Flubendiamide @ 0.75 ml L^{-1} > Chlorantraniliprole @ 0.2 ml L^{-1}> Malathion @ 2 ml L^{-1} > Control. It is concluded that 2 foliar sprays of either spinosad 45 EC@0.3 ml L^{-1} or thiodicarb 75 WP @ 1.0 g L^{-1} at flowering and fruiting stage of the crop offer better protection against melon fly in bitter gourd.

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