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Efficacy of insecticides against melon fruit fly *Bactrocera cucurbitae* (Coquillett) in bitter gourd

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ABSTRACT: Field experiments conducted to evaluate the efficacy of selected insecticides against melon fruit fly, *Bactrocera cucurbitae* in bitter gourd, revealed that Deltamethrin 2.8 EC + jaggery bait (0.0028 + 0.015 %) was the most effective treatment resulting in minimum fruit infestation (13.15%, 8.61%), as well as lowest number of maggots per fruit (12.58, 9.58). The next superior treatment was deltamethrin 2.8 EC (0.0028 %), azadirachtin 1 EC (0.005 %) and malathion 50 EC (0.1 %) which were on par in terms of reduction of fruit infestation. However, the number of maggots per infested fruits was significantly lower in deltamethrin and azadirachtin treatment as compared to malathion. However, spinosad 45 SC (0.014 %) and dichlorovos 76 SC (0.152 %) were found to be inferior with comparatively lesser reduction in fruit infestation as well as number of maggots per infested fruit as compared to the other treatments, except untreated control. The combination consisting of deltamethrin + jaggery bait (0.0028 + 0.015 %) spray was found to be the most superior.

KEYWORDS: *Bactrocera cucurbitae*, insecticides, jaggery bait, deltamethrin

INTRODUCTION

Fruit flies constitute an important group of pests infesting cucurbitaceous vegetables. Particularly bitter gourd (*Momordica charantia* L.), wherein the fruit fly damage is the major limiting factor in obtaining good quality fruits and high yield. The extent of loss caused by *B. cucurbitae* varies from 30 to 100 per cent depending on the cucurbit species and season (Dhillon *et al*., 2005). The history of fruit fly control with full cover sprays started with inorganic insecticides (eg, lead arsenate) in the early 1900s and spanned the century with a transition to synthetic insecticides such as chlorinated hydrocarbons, organophasphates and synthetic pyrethroids. The advantages of insecticidal cover sprays are that they are affordable, convenient and provide a high level of protection against fruit fly infestation with consistent results (Allwood, 1997). Keeping in view the damage inflicted by melon fly and also residual problems associated with the application of chemicals, there is a need to look at alternative strategies. Hence the present investigation explores emphasises the options for the management of melon fruit fly in bitter gourd with selected insecticides and minimise residual problems.

MATERIALS AND METHODS

Field experiments were conducted on bitter gourd during *kharif* season of 2014 at Division of Horticulture, Gandhi Krishi Vigyana Kendra, University of Agricultural Sciences (UAS),

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Bengaluru, which is located at 12° 58' N, 77° 35' E at an altitude of 930 m MSL. During *rabi* season of 2014-15, the field experiment with the same set of treatments was carried out at Indian Institute of Horticultural Research (IIHR), Hessaraghatta, Bengaluru located at 13° 13' N and 77° 48' E at an altitude of 890 m MSL. Sowing of bitter gourd variety 'Arka Harit' was done in plastic trays containing coconut husk and the seedlings were raised under greenhouse conditions. Transplanting of seedlings was done in the field during second week of August, 2014 during *kharif* at UAS, GKVK, Bengaluru and again during second week of November, 2014-15 during *rabi* season at Entomology Division, IIHR, Hessaraghatta, Bengaluru. The experiments was laid out in Randomised Complete Block Design with plot size of 3.5 m X 3 m. The distance between row to row and plant to plant was maintained at 1.0 m X 60 cm. The recommended dose of fertilizers was applied and hand weeding was done as and when required to keep the weeds under check. The crops were raised as per the recommended package of practices of UAS, GKVK, Bengaluru in both the locations during both *kharif* and *rabi* seasons. The treatments were same in both the experiments conducted during *kharif* and *rabi* season viz., T_1: spray of: deltamethrin + jaggery bait spray @ 0.0028 + 0.015 %, T_2: malathion @ 0.1 %, T_3: spinosad 0.014 %, T_4: dichlorovos 0.152%, T_5: azadirachtin @ 0.005 %, T_6: deltamethrin @ 0.0028 % and T_7: untreated control. Each treatment was replicated thrice. The first foliar spray of each treatment was done at the fruit setting stage of bitter gourd. A total of four such foliar sprays were made in case of each treatment at 10 days interval. At each fruit picking, the healthy and infested fruits were sorted out separately and the data was recorded from which the per cent fruit infestation was calculated. Cumulative per cent fruit infestation for each treatment during the entire cropping season was analysed. In addition, the data on the number of maggots per infested fruits in each treatment was also recorded by cutting open 5 fruits per plot (i.e., @ 15 fruits per treatment), the number of maggots were counted in order to know the treatment effect on the maggot population per fruit. The data were subjected to ANOVA to determine impact of treatments on per cent of fruit fly damage and fruit yield. The cumulative fruit yields that were obtained from both *kharif* and *rabi* seasons in respective location and were analysed statistically. Subsequently, the increase in yield over untreated control was also computed, by using the formula

$$\text{Percent increase over control} = \frac{\text{Yield in the treatment to be assessed} - \text{Yield in the untreated check}}{\text{Yield in the untreated check}} \times 100$$

The cost benefit ratio was calculated by using the formula:

$$\text{Benefit /Cost ratio} = \frac{\text{Gross returns (Rs.ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs.ha}^{-1}\text{)}}$$

RESULTS AND DISCUSSION

The results of the present investigation on the efficacy of selected insecticides against melon fruit fly in bitter gourd crop exhibited variable efficacy in reducing the fruit infestation as well as maggot density over untreated control during *kharif* and *rabi* seasons in UAS, GKVK and IIHR, Hessaraghatta, Bengaluru (Table 1). Among the treatments, spray of deltamethrin + jaggery bait, proved highly effective against melon fruit fly resulting in lower fruit infestation (13.15 %, 8.61 %) as well as number of maggots per infested fruit (12.58, 9.58) and fetched significant higher fruit yield (8240 kg/ha, 8170 kg/ha) as compared to the other treatments. These results are supported by the findings of Ranganath *et al*. (2015) who reported that the spray consisting of deltamethrin @ 1ml/l + jaggery bait @ 15g/l coupled with sanitation and cue lure traps recorded lower fruit damage. The bait spray (deltamethrin + jaggery) is applied to broad-leafed plants that serve as refugia for melon fruit fly adults (Ronald and Jayma, 2007). Bait encourages the adults (especially female) to feed on the spray residue and can provide good rates of kill. The next best treatment in the present study was deltamethrin (22.49 %, 15.62 %), azadirachtin (22.91 %, 16.00 %) and malathion (24.00 %, 18.70 %) which were on par in reducing fruit infestation but deltamethrin (19.17, 17.42) and azadirachtin (23.58, 22.75) recorded lesser number of maggots per fruit as compared to the malathion

Table 1. Effect of insecticides on infestation of *Bactrocera cucurbitae* in bitter gourd

Insecticides	Concentration (%)	Fruit infestation (%)		No. of maggot/fruit		Yield (kg/ha)	
		kharif	*rabi*	*kharif**	*rabi**	*kharif*	*rabi*
Deltamethrin 2.8 EC + jaggery Bait	0.0028 + 0.015	13.15 (21.25)[a]	8.61 (17.04)[a]	12.58[a]	9.58[a]	8240[a]	8170[a]
Malathion 50 EC	0.1	24.00 (29.24)[b]	18.70 (25.59)[bc]	29.25[cd]	26.58[cd]	7320[b]	7020[b]
Spinosad 45 SC	0.014	28.71 (32.19)[bc]	22.73 (28.45)[cd]	31.50[cde]	28.50[de]	6960[bc]	6890[b]
Dichlorovos 76 EC	0.152	31.11 (33.91)[c]	24.94 (29.92)[d]	36.33[e]	33.17[ef]	6550[c]	6550[b]
Azadirachtin 1 EC	0.005	22.91 (28.56)[b]	16.00 (23.58)[b]	23.58[bc]	22.75[bc]	7420[b]	7190[b]
Deltamethrin 2.8 EC	0.0028	22.49 (28.49)[b]	15.62 (23.29)[b]	19.17[b]	17.42[b]	7380[b]	7290[b]
Untreated control	-	40.63 (39.57)[d]	30.33 (33.42)[e]	47.25[f]	39.08[g]	4590[d]	4690[c]
CD (P = 0.05)		4.01	2.94	6.37	5.40	0.71	0.78

Note: Figures in the parentheses are transformed (arc-sine) values
*Values in the table are mean number of maggots (15 fruits per treatment) in respective treatments
Significant at 0.05 level

(29.25, 26.58). In Pakistan, Khan *et al*. (1992) observed that the application of deltamethrin 2.5 EC and malathion 57% EC at 10 days interval (4 sprays in total) significantly reduced infestation of *B. cucurbitae* on melon, as compared with untreated control. The results on the effectiveness of deltamethrin are in conformity with the findings of Doharey (1983) who also reported 100 per cent mortality of *B. cucurbitae* in the 96 h at 0.003 per cent concentration of deltamethrin. In bitter gourd, fruit damage by *B. cucurbitae* was effectively reduced upto 16 days after fruit and second spray of deltamethrin (15 g a.i/ha) as compared to malathion (500 g a.i/ha), (Ravindranath and Pillai, 1986). Ranganath *et al*. (1997) had reported the efficacy of neem based biopesticide against fruit flies in terms of reduction of fruit infestation and antioviposition effect. Sharma and Sinha (2009) also found "neem ban" to be most effective against *B. cucurbitae* in bitter gourd than endosulfan. Hassan (1998) tested neem seed kernel extract on persimmon for its efficacy against developing stages of the queensland fruit fly and found it to be most effective against 1st and 2nd instar larvae. The remaining treatments spinosad and dichlorovos also shown good effectiveness in reducing fruit infestation as well as number of maggots/fruit in both seasons compared to untreated control.

Cost - benefit analysis:

The cost benefit ratios were worked out in Arka Harit variety in *kharif* season of 2014. Accordingly it was maximum in deltamethrin + jaggery @ 0.0028 + 0.015 % (1 : 2.45) followed by deltamethrin alone @ 0.0028 % (1 : 2.26), malathion @ 0.1 % (1 : 2.29), dichlorvos @ 0.152 % (1 : 2.01), spinosad @ 0.014 % (1 : 1.98), azadirachtin @ 0.005 % (1 : 1.95) and least in untreated control (1 : 1.67). Similarly, in *rabi* season of 2014-15 the cost benefit

Table 2. Cost benefit ratio of different treatments evaluated against melon fruit fly in bitter gourd during *kharif* season, 2014 at GKVK, Bengaluru

Treatments	Concentration (%)	Marketable fruit yield (kg/ha	Yield increase over control (%)	Yield increase over control kg/ha	Value of additional yield (Rs/ha)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)		Total cost of cultivation (Rs/ha)	Net return (Rs/ha)	Cost benefit ratio
							Other expenditure	Chemical cost + labour charge			
Deltamethrin 2.8 EC + Jaggery	0.0028 + 0.015	8240	79.52	3650	91250	206000.00	74060.00	10000.00	84060.00	121940.00	1 : 2.45
Malathion 50 EC	0.1	7320	59.47	2730	68250	183000.00	74060.00	5600.00	79660.00	103340.00	1 : 2.23
Spinosad 45 SC	0.014	6960	51.63	2370	59250	174000.00	74060.00	13600.00	87660.00	86340.00	1 : 1.98
Dichlorvos 76 EC	0.152	6550	42.70	1960	49000	163750.00	74060.00	7200.00	81260.00	82490.00	1 : 2.01
Azadirachtin 1 EC	0.005	7420	61.65	2830	70750	185500.00	74060.00	21600.00	95260.00	90240.00	1 : 1.95
Deltamethrin 2.8 EC	0.0028	7380	60.78	2790	69750	184500.00	74060.00	7600.00	81660.00	102840.00	1 : 2.26
Untreated control	-	4590	-	-	-	114750.00	74060.00	-	74060.00	49690.00	1 : 1.55

*Bitter gourd fruits were sold at Rs.25 per Kg; Labour charges @ 200 Rs/day (two labour/ha were used for imposing treatments)

Table 3. Cost benefit ratio of different treatments evaluated against melon fruit fly in bitter gourd during rabi season, 2014 -15 at IIHR, Hesarghatta, Bengaluru

Treatments	Concentration (%)	Marketable fruit yield (kg/ha	Yield increase over control (%)	Yield increase over control kg/ha	Value of additional yield (Rs/ha)	Gross returns (Rs/ha)	Cost of cultivation (Rs/ha)		Total cost of cultivation (Rs/ha)	Net return (Rs/ha)	Cost benefit ratio
							Other expenditure	Chemical cost + labour charge			
Deltamethrin 2.8 EC + Jaggery	0.0028 + 0.015	8170	74.20	3480	87000.00	204250.00	74060.00	10000.00	84060.00	120190.00	1 : 2.42
Malathion 50 EC	0.1	7020	49.68	2330	58250.00	175500.00	74060.00	5600.00	79660.00	95840.00	1 : 2.29
Spinosad 45 SC	0.014	6890	46.90	2200	55000.00	172250.00	74060.00	13600.00	87660.00	84590.00	1 : 1.96
Dichlorvos 76 EC	0.152	6550	39.65	1860	46500.00	163750.00	74060.00	7200.00	81260.00	82490.00	1 : 2.01
Azadirachtin 1 EC	0.005	7190	53.30	2500	62500.00	179750.00	74060.00	21600.00	95260.00	84490.00	1 : 1.90
Deltamethrin 2.8 EC	0.0028	7290	55.43	2600	65000.00	182250.00	74060.00	7600.00	81660.00	100590.00	1 : 2.23
Untreated control	-	4690	-	-	-	117250.00	74060.00	-	74060.00	-	1 : 1.58

*Bitter gourd fruits were sold at Rs.25 per Kg; Labour charges @ 200 Rs/day (two labour/ha were used for imposing treatments)

ratio was maximum in deltamethrin + jaggery @ 0.0028 + 0.015 % (1 : 2.42), followed by deltamethrin @ 0.0028 % (1 : 2.23), malathion @ 0.1 % (1 : 2.20), dichlorvos @ 0.152 % (1 : 2.01), spinosad @ 0.014 % (1 : 1.96), azadirachtin @ 0.005 % (1 : 1.90) and least was in untreated control (1 : 1.58) (Table 2 & 3). Cost benefit ratio forms the ultimate criterion for knowing the superiority of any treatment for crop protection. When jaggery (0.015 %) was used as attractant or bait and mixed with deltamethrin @ 0.0028 % and applied on bitter gourd crop, the cost benefit ratio was highest (1 : 2.45 and 1 : 2.42) in both *kharif* and *rabi* seasons, respectively. This was followed by deltamethrin @ 0.0028 % (1 : 2.26 and 1 : 2.23), malathion @ 0.1 % (1 : 2.29 and 1 : 2.20), dichlorvos @ 0.152 % (1 : 2.01 and 1 : 2.01), spinosad @ 0.014 % (1 : 1.98 and 1 : 1.96), azadirachtin @ 0.005 % (1 : 1.95 and 1 : 1.90) during *kharif* and *rabi* seasons, respectively.

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