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Research Article

Management of drumstick pod fly, *Gitona distigma* (Meigen)

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Abstract

Among the ten treatments evaluated against drumstick pod fly, Emamectin benzoate 5 SG at 0.25 g/l and Spinosad 45 SC at 0.20 ml/l were significantly superior throughout the period of investigation, and they were on par with each other followed by Profenofos 50 EC at 1.0 ml/l, Methomyl 40 SP at 1.0 g/l, Deltamethrin 2.8 EC at 0.50 ml/l, Dichlorvos 76 EC at 0.5 ml/l, Indoxacarb 15.8 EC at 0.3 ml/l, NSKE 5% at 50 g/l, Neem oil 10000 ppm at 3.0 ml/l and Thiamethoxam 25 WG at 0.20 g/l. Significantly maximum pod yield (6.71 t/ha) was obtained from the treatment Emamectin benzoate 5 SG at 0.25 g/l. The next best treatments were Spinosad 45 SC at 0.20 ml/l (5.65 t/ha) and Profenofos 50 EC at 1.0 ml/l (5.38 t/ha) and were on par with each other. The treatment Emamectin benzoate 5 SG at 0.25 g/l recorded maximum additional yield (4233 kg/ha). Net Returns were highest in the treatment Emamectin benzoate 5 SG at 0.25 g/l (Rs. 287844 /ha). However, the highest incremental cost benefit ratio of 223.9 was obtained from the treatment Profenofos 50 EC at 1.0 ml/l followed by Deltamethrin 2.8 EC at 0.50 ml/l (219.0), Emamectin benzoate 5 SG at 0.25 g/l (196.5) and Indoxacarb 15.8 EC at 0.3 ml/l (169.9).

Key words: Drumstick pod fly, *Gitona distigma* (Meigen), Management.

INTRODUCTION

Drumstick is susceptible to many insects pests (Kareem *et al*., 1974; Verma and Khurana, 1974; Pillai *et al*., 1979; Ramachandran *et al*., 1980; Butani and Verma, 1981; Morton, 1991; Parrota, 2009), namely bark eating caterpillar, *Indarbela quadrinotata* (Wlk.), caterpillar pests, *Eupterote mollifera* Walker, and *Noorda blitealis* Walker, bud worm, *Noorda moringae* Tams., stem borers, *Indarbela tetraonis* (Moore), *Diaxenopsis apomecynoides* (Bruning) and *Batocera rubus* L., ash weevils, *Myllocerus viridanus* (Fab.), *Myllocerus discolor var. variegatus* Boheman, *Myllocerus delicatulus* Boheman, aphids, *Aphis craccivora* Koach, leaf eating caterpillar, *Tetragonia siva* Lef., *Metanastria hyrtaca* (Cramer), Tea mosquito bug, *Helopeltis antonii* (Sign.), bud midges, *Stictodiplosis moringae* Mani, scale insects, *Diaspidiotus* sp., *Ceroplastodes cajani* (Mask). Of late, drumstick pod fly, *Gitona distigma* (Meigen) a palaearctic species reported for the first time from India, has become one of the most serious pests of drumstick. Infestation of this pest starts from fruit initiation and persists till harvesting stage. Pod fly has attained a major pest status in Southern India (Kader and Shanmugavelu, 1982). This pest is reported to cause 70 per cent loss under poor management conditions (Ragumoorthi and Arumugum, 1992). Though several workers tested different chemicals against pod fly still the problem continues. Considering the economic importance of the pest, the study was conducted to test the bio-efficacy of selected insecticides and botanicals in the management of pod fly.

MATERIALS AND METHODS

A field experiment was conducted during July 2012 to evaluate the bio-efficacy of insecticides including

botanicals against the pod fly, *G. distigma* (Table 1). The experiment was laid out in a randomized block design with eleven treatments and three replications in an established drumstick garden having 10' x 10' spacing at UHS, Bagalkot, Karnataka. The variety was Bhagya (KDM- 01). Five plants were selected for each treatment. Treatments were applied at initial pod formation stage when pod damage reached 20 per cent. Observations were made before spray, and at five, ten and fifteen days after spray to know the extent of damage in and assess the bio-efficacy of the treatments used. The per cent infestation was calculated by the following formula.

Percent infestation=

$$\frac{\text{Total no. of pods infested per plant (Av.)}}{\text{Total no. of pods per plant (Av.)}} \times 100$$

The insecticides used in the experiment were purchased from the market while the neem seeds were collected from natural source and used for the study. Pod yield at each harvest from the individual plants was converted into the yield in tonne per ha. The data obtained from different experiments were analysed using suitable statistical tools and methods. Bio-efficacy data were analyzed using ANOVA after subjecting the data for suitable transformation. The treatments were applied in the morning hours using high volume sprayer (Gator Rockery Sprayer) and uniform spray distribution was ensured.

Results and discussion

When the studies related to management of pod fly, in terms of bio efficacy of selected insecticides and botanicals were initiated on a drumstick (var. Bhagya), already planted at a spacing of 10 x 10 feet at UHS, Bagalkot, the damage by pod fly, *G. distigma* ranged from 20 to 21.72 per cent before spraying. There was no- significant difference among the treatment plots in respect of per cent pod infestation. The uniform distribution and enough damage prompted to apply the treatments. Further observations, on the pod fly damage after the treatments are presented in table 2.

On the fifth day after the first spray, the efficacy of Spinosad 45 SC at 0.20 ml/l was significantly superior recording least pod damage (2.84 %) over untreated control (22.59 %) and all other treatments namely, Thiamethoxam 25 WG at 0.20 g/l (16.50%), Neem oil 10000 ppm at 3.0 ml/l (15.94%), Indoxacarb 15.8 EC at 0.3 ml/l (15.53%), NSKE 5% at 50 g/l (14.27%), Methomyl 40 SP at 1.0 g/l (12.81%), Dichlorvos 76 EC at 0.5 ml/l (11.11%), Profenofos 50 EC at 1.0 ml/l (10.70%) but was on par with Emamectin benzoate 5 SG at 0.25 g/l (3.07%) and Deltamethrin 2.8 EC at 0.50 ml/l (6.01%). The treatments Profenofos 50 EC at 1.0 ml/l, Dichlorvos 76 EC at 0.5 ml/l, Methomyl 40 SP at 1.0 g/l and NSKE 5% at 50 g/l were found to be on par with each other in their bio-efficacy. The treatments like Indoxacarb 15.8 EC at 0.3 ml/l, Neem oil 10000 ppm at 3.0 ml/l, and Thiamethoxam 25 WG at 0.20 g/l were on par with each other but significantly superior over untreated control.

On the tenth day after the first spray, the efficacy of Emamectin benzoate 5 SG at 0.25 g/l was proved to be significantly superior, recording least pod damage (1.88%) over untreated control (29.91%), Dichlorvos 76 EC at 0.5 ml/l (24.10%), NSKE 5% at 50 g/l (16.78%), Thiamethoxam 25 WG at 0.20 g/l (16.19%), Neem oil 10000 ppm at 3.0 ml/l (15.91%), Indoxacarb 15.8 EC at 0.3 ml/l (13.66%), but on par with Spinosad 45 SC at 0.20 ml/l (2.74%), Profenofos 50 EC at 1.0 ml/l (6.36%), Methomyl 40 SP at 1.0 g/l (10.02%) and Deltamethrin 2.8 EC at 0.50 ml/l (8.03%). The treatments Indoxacarb 15.8 EC at 0.3 ml/l, Neem oil 10000 ppm at 3.0 ml/l and Thiamethoxam 25 WG at 0.20 g/l were on par with each other in their efficacy.

On the fifteenth day after the first spray also, the efficacy of Emamectin benzoate 5 SG at 0.25 g/l was confirmed to be significantly superior recording least pod damage (3.49%) over untreated control (26.96%) and Indoxacarb 15.8 EC at 0.3 ml/l (19.45%), Thiamethoxam 25 WG at 0.20 g/l (18.99%), Neem oil 10000 ppm at 3.0 ml/l (18.82%), NSKE 5% at 50 g/l (16.97%), Dichlorvos 76 EC at 0.5 ml/l (11.41%), Deltamethrin 2.8 EC at 0.50 ml/l (10.79%), but on par with Spinosad 45 SC at 0.20 ml/l (4.08%), Profenofos 50 EC at 1.0 ml/l (4.55%) and Methomyl 40 SP at 1.0 g/l (10.30%). The treatments Indoxacarb 15.8 EC at 0.3 ml/l and Neem oil 10000 ppm at 3.0 ml/l were found to be on par in their bioefficacy.

The second spray was imposed as the damage continued to be there above 20 per cent after 15 days of the initial treatment. On the fifth day after the second spray, the efficacy of Emamectin benzoate 5 SG at 0.25 g/l was significantly superior recording lowest pod damage (3.46) over untreated control (27.50) and NSKE 5% at 50 g/l (16.24) Neem oil 10000 ppm at 3.0 ml/l (17.18), Indoxacarb 15.8 EC at 0.3 ml/l (16.05), Dichlorvos 76 EC at 0.5 ml/l (11.67), Deltamethrin 2.8 EC at 0.50 ml/l (11.09), Thiamethoxam 25 WG at 0.20 g/l (10.71), but on par with Profenofos 50 EC at 1.0 ml/l (3.97), Spinosad 45 SC at 0.20 ml/l (6.53) and Methomyl 40 SP at 1.0 g/l (8.95). Further, the treatments Thiamethoxam 25 WG at 0.20 g/l, Deltamethrin 2.8 EC at 0.50 ml/l, and Dichlorvos 76 EC at 0.5 ml/l were found to be on par with each other in their bioefficacy against pod fly

followed by Indoxacrb 15.8 EC at 0.3 ml/l and NSKE 5% at 50 g/l.

On the tenth day after the second spray, the efficacy of Profenofos 50 EC at 1.0 ml/l was significantly superior recording least pod damage (1.93) over untreated control (26.56) and NSKE 5% at 50 g/l (18.76), Thiamethoxam 25 WG at 0.20 g/l (16.85), Indoxacarb 15.8 EC at 0.3 ml/l (16.68), Neem oil 10000 ppm at 3.0 ml/l (16.19) and followed by Dichlorvos 76 EC at 0.5 ml/l (12.97), but on par with Emamectin benzoate 5 SG at 0.25 g/l (2.24), Spinosad 45 SC at 0.20 ml/l (4.58) and followed by Methomyl 40 SP at 1.0 g/l (5.25) and Deltamethrin 2.8 EC at 0.50 ml/l (8.94). The treatments Neem oil 10000 ppm at 3.0 ml/l, Indoxacarb 15.8 EC at 0.3 ml/l and Thiametoxam 25 WG at 0.20 g/l were found to be on par in their bioefficacy.

On the fifteenth day after the second spray, the efficacy of Spinosad 45 SC at 0.20 ml/l was significantly superior recording least pod damage (6.53) over untreated control (29.51) and NSKE 5% at 50 g/l (24.68), Indoxacarb 15.8 EC at 0.3 ml/l (24.46), Neem oil 10000 ppm at 3.0 ml/l (22.34), Dichlorvos 76 EC at 0.5 ml/l (18.30), Deltamethrin 2.8 EC at 0.50 ml/l (11.09), Thiamethoxam 25 WG at 0.20 g/l (13.71), but on par with Emamectin benzoate 5 SG at 0.25 g/l (6.53), Profenofos 50 EC at 1.0 ml/l (10.77) and Deltamethrin 2.8 EC at 0.50 ml/l (11.43). The treatments Thiamethoxam 25 WG at 0.20 g/l, Dichlorvos 76 EC at 0.5 ml/l, were found to be on par in their bioefficacy followed by Neem oil 10000 ppm at 3.0 ml/l, Indoxacarb 15.8 EC at 0.3 ml/l and NSKE 5% at 50 g/l.

Since the pod damage was more than 20 per cent in untreated control, and it was about 20 percent in all other treatments, the third spray was applied.

On the fifth day after the third spray, the efficacy of Emamectin benzoate 5 SG at 0.25 g/l continued to be significantly superior, recording least pod damage (7.25), over untreated control (35.16) and Neem oil 10000 ppm at 3.0 ml/l (27.16), Indoxacarb 15.8 EC at 0.3 ml/l (26.43), NSKE 5% at 50 g/l (25.57), Thiamethoxam 25 WG at 0.20 g/l (23.80), Profenofos 50 EC at 1.0 ml/l (22.93), Deltamethrin 2.8 EC at 0.50 ml/l (22.30), Methomyl 40 SP at 1.0 g/l (18.74) and Dichlorvos 76 EC at 0.5 ml/l (18.14), but on par with Spinosad 45 SC at 0.20 ml/l (8.69). The treatments Methomyl 40 SP at 1.0 g/l, Deltamethrin 2.8 EC at 0.50 ml/l, Profenofos 50 EC at 1.0 ml/l, and NSKE 5% at 50 g/l were found to be on par with each other in their bio-efficacy. Further observations were stopped as the pods were harvested entirely. Ragumoorthi and Arumugam (1992) reported that all the treatments against *Gitona* sp. (in which 5 pesticides and 3 plant extracts were applied in the form of sprays @3 litres/tree during 50 per cent fruit set) caused significant reduction in the percentage of fruits infested and the mean number of larvae per fruit, as compared with the untreated control. In the present study also, the insecticide treatments recorded lesser pod damage than untreated control.

Muthukrishnan (2009), who imposed treatments during pod setting when the fruit fly incidence crossed economic threshold level (ETL), opined that suggestive IPM module 1 (soil application of Thiamethoxam 25 WG @ 200 g a.i./ on 150, 180, and 210 days after sowing, use of fermented tomato in a trap, collection and destruction of fruit fly damaged pods and foliar spray of Spinosad 45 SC @ 56 g a.i./ ha and Profenofos 50 EC @ 250 g a.i./ha) was the best in minimizing pod damage and increasing pod yield and benefit cost ratio, followed by TNAU module (Raking the soil and applying lindane 1.3 D @ 163 g a.i./ ha use of fermented grape juice and foliar spray of Dichlorvos 76 WSC @ 380 g a.i./ha, followed by Fenthion 100 EC @ 750 g a.i./ha. While Anjeneyamurthy and Regupathy (1989) obtained the best control of the drosophilid *Gitona* sp., the pyralid, *Noorda blitealis* and *Aphis craccivora* by using Dichlorvos at 0.04 per cent and Fenthion at 0.05 per cent. But in the present study, the new molecules like Emamaectin benzoate 5 SG at 0.25 g/l, Spinosad 45 SC at 0.20 ml/l proved better than the Dichlorvos 76 WSC @ 380 g a.i/ha.

The green pod yield ranged between 2.82 to 6.04 kg/tree and 3.13 to 6.71 t/ha per picking. There was no significant difference in the average weight of single pod. Significantly maximum pod yield (6.71 t/ha) was obtained from the treatment Emamectin benzoate 5 SG at 0.25 g/l. The next best treatments were Spinosad 45 SC at 0.20 ml/l (5.65 t/ha) and Profenofos 50 EC at 1.0 ml/l (5.38 t/ha) and were on par with each other. Other treatments Deltamethrin 2.8 EC at 0.50 ml/l (4.76 t/ha), Indoxacarb 15.8 EC at 0.3 ml/l (4.56 t/ha), Methomyl 40 SP at 1.0 g/l (4.41t/ha), Thiamethoxam 25 WG at 0.20 g/l (3.99 t/ha), Dichlorvos 76 EC at 0.5 ml/l (3.98 t/ha), NSKE 5% at 50 g/l (3.56t/ha) and Neem oil 10000 ppm at 3.0 ml/l (3.13 t/ha) produced higher yields and proved superior over untreated control (2.47 t/ha) (Table 3).

The cost economics of various treatments used in the management of drumstick pod fly, *Gitona distigma* are worked out and presented in table 4.

Table 1. Treatments used for the management of drumstick pod fly

Treatment No.	Insecticides	Dosage
T1.	Dichlorvos76 EC	0.5 ml/l
T2.	Indoxacarb 15.8 EC	0.3 ml/l
T3.	Neem oil 10000 ppm	3.0 ml/l
T4.	Neem Seed Kernels Extract (5%)	50 g/l
T5.	Thiamethoxam 25 WG	0.20 g/l
T6.	Spinosad 45 SC	0.20 ml/l
T7.	Profenofos 50 EC	1.0 ml/l
T8.	Methomyl 40 SP	1.0 g/l
T9.	Emamectin benzoate 5 SG	0.25 g/l
T10.	Deltamethrin 2.8 EC	0.50 ml/l
T11.	Untreated control	_

Table 2. Bio-efficacy of different insecticides against drumstick pod fly, *Gitona distigma* during 2012 – 13

Treatments	Dosage	DBS	1 st spray			2 nd spray			3 rd spray
			Per cent infested pods			Per cent infested pods			Per cent infested pods
			5 DAS	10 DAS	15 DAS	5 DAS	10 DAS	15 DAS	5 DAS
1.Dichlorvos 76 EC	0.5 ml/l	21.646 (13.61)	11.117^{c} (3.73)	24.103^{ab} (17.23)	11.414^{cd} (4.63)	11.674^{bcd} (4.76)	12.972^{bcd} (5.88)	18.309^{bcd} (10.46)	18.149^{d} (9.73)
2. Indoxacarb 15.8 EC	0.3 ml/l	20.908 (12.77)	15.531^{b} (7.18)	13.661^{cd} (6.72)	19.459^{b} (11.87)	16.056^{bc} (8.22)	16.683^{bc} (9.61)	24.460^{ab} (17.6)	26.433^{bc} (20.14)
3. Neem oil 10000 ppm	3.0 ml/l	21.721 (13.71)	15.945^{b} (7.56)	15.913^{bcd} (7.62)	18.829^{b} (10.64)	17.181^{b} (8.94)	16.197^{bc} (8.03)	22.341^{abc} (14.63)	27.169^{b} (20.94)
4. Neem Seed Kernels Extract (5%)	50 g/l	20.462 (12.24)	14.271^{bc} (6.09)	16.781^{bc} (9.23)	16.974^{bc} (8.65)	16.248^{bc} (7.92)	18.765^{ab} (10.76)	24.686^{ab} (18.4)	25.573^{bcd} (19.04)
5. Thiamethoxam 25 WG	0.20 g/l	21.549 (13.5)	16.509^{b} (8.08)	16.193^{bcd} (8.32)	18.995^{b} (10.64)	10.716^{cd} (3.57)	16.855^{bc} (9.04)	16.989^{bcd} (9.84)	23.801^{bcd} (16.52)
6. Spinosad 45 SC	0.20 ml/l	20.197 (11.92)	2.848^{d} (0.39)	2.745^{e} (5.66)	4.085^{ef} (0.76)	6.538^{de} (1.31)	4.582^{de} (1.04)	3.503^{f} (1.11)	8.695^{e} (2.39)
7. Profenofos 50 EC	1.0 ml/l	20.634 (12.43)	10.705^{c} (3.50)	6.367^{de} (1.83)	4.554^{def} (0.98)	3.973^{e} (0.73)	1.933^{e} (0.34)	10.774^{def} (3.74)	22.934^{bcd} (15.74)
8. Methomyl 40 SP	1.0 g/l	20.552 (12.34)	12.817b^{c} (4.93)	10.024^{cde} (4.69)	10.304^{cdef} (3.59)	8.958^{de} (2.54)	5.252de (1.29)	13.712^{cde} (6.12)	18.743^{cd} (10.5)
9. Emamectin benzoate 5 SG	0.25 g/l	20.281 (12.03)	3.073^{d} (0.43)	1.882^{e} (0.32)	3.494^{f} (0.55)	3.469^{e} (0.54)	2.248^{e} (0.46)	6.536^{ef} (1.33)	7.256^{e} (1.63)
10. Deltamethrin 2.8 EC	0.50 ml/l	20.017 (11.72)	6.010^{d} (1.65)	8.036^{cde} (2.06)	10.791^{cde} (3.62)	11.097^{bcd} (3.73)	8.494^{cde} (2.2)	11.433^{def} (4.76)	22.306^{bcd} (14.7)
11. Untreated control	_	21.594 (13.59)	22.592^{a} (14.79)	29.914^{a} (25.04)	26.968^{a} (21.46)	27.509^{a} (21.94)	26.561^{a} (20.38)	29.510^{a} (24.91)	35.165^{a} (33.65)
S. Em ±	_	-	1.78	4.87	3.31	2.95	4.21	4.54	3.82
CD= (0.05)	_	NS	3.72	10.17	6.90	6.17	8.79	9.47	7.98

*Means followed by same alphabet do not differ significantly (0.05) by DMRT (p=0.05) NS- Non significant Figures in the parenthesis are actual values DAS- Days after spray DBS- Day before spray

Table 3. Observations made on the yield of marketable drumstick pods during first picking

Treatments	Dosage	Average No. of pods/tree	Average of single pod weight (gm)	Average yield/tree (kg)	Yield (t/ha)
1. Dichlorvos 76 EC	0.5 ml/l	29.93^{ef}	120.19	3.59^{de}	3.98^{de}
2. Indoxacarb 15.8 EC	0.3 ml/l	31.66^{ef}	129.97	4.11^{c}	4.56^{c}
3. Neem oil 10000 ppm	3.0 ml/l	25.60^{g}	110.29	2.82^{f}	3.13^{f}
4. Neem Seed Kernels Extract (5%)	50 g/l	28.0^{fg}	114.95	3.21^{ef}	3.56^{ef}
5. Thiamethoxam 25 WG	0.20 g/l	29.20^{fg}	123.54	3.60^{de}	3.99^{de}
6. Spinosad 45 SC	0.20 ml/l	41.86^{b}	121.80	5.09^{b}	5.65^{b}
7. Profenofos 50 EC	1.0 ml/l	38.53^{bc}	126.13	4.85^{b}	5.38^{b}
8. Methomyl 40 SP	1.0 g/l	33.13^{de}	120.13	3.97^{cd}	4.41^{cd}
9. Emamectin benzoate 5 SG	0.25 g/l	46.66^{a}	129.5	6.04^{a}	6.71^{a}
10. Deltamethrin 2.8 EC	0.50 ml/l	35.66^{cd}	120.49	4.29^{c}	4.76^{c}
11. Untreated control	_	17.46^{h}	128.35	2.23^{g}	2.47^{g}
SEm ±	_	1.71	-	0.21	2.3
CD=(0.05)	_	3.70	NS	0.44	4.8

*Means followed by same alphabet do not differ significantly (0.05) by DMRT (p=0.05) NS- Non significant

Table 4. Economics of management of pod fly, *Gitona distigma* (Meigen) on drumstick

Treatments	Dosage	Yield/tree (kg)	Yield/ha (kg)	Incremental yield over control (kg)/ha	Incremental Benefit over control (Rs/ha)	*Cost of cultivation	Additional Net profit	ICBR
1. Dichlorvos 76 EC	0.5 ml/l	3.59	3988	1511	102748	707.5	102040	145.2
2. Indoxacarb 15.8 EC	0.3 ml/l	4.11	4566	2089	142052	835.7	141216	169.9
3. Neem oil 10000 ppm	3.0 ml/l	2.82	3133	656	44608	716.9	43891	62.2
4. Neem Seed Kernels Extract (5%)	50 g/l	3.21	3566	1089	74052	902.5	73149	82.05
5. Thiamethoxam 25 WG	0.20 g/l	3.60	3999	1522	103496	961.6	102534	107.6
6. Spinosad 45 SC	0.20 ml/l	5.09	5654	3177	216036	2030	214006	106.4
7. Profenofos 50 EC	1.0 ml/l	4.85	5388	2911	197948	884	197064	223.9
8. Methomyl 40 SP	1.0 g/l	3.97	4410	1933	131444	1283	130161	102.4
9. Emamectin benzoate 5 SG	0.25 g/l	6.04	6710	4233	287844	1464.8	286379	196.5
10. Deltamethrin 2.8 EC	0.50 ml/l	4.29	4766	2289	155652	710.5	154941	219.0
11. Untreated control	-	2.23	2477	-	-	-	-	-
SEm±	_	0.21	233	-	-	-	-	-
CD= 5%	_	0.44	488	-	-	-	-	-

(*Market price of pods was Rs 68/kg) *Cost of treatment with insecticide +cost of application)
ICBR= Incremental cost benefit ratio

The treatment Emamectin benzoate 5 SG at 0.25 g/l recorded maximum additional yield (4233 kg/ha). The other treatments *viz*., Spinosad 45 SC at 0.20 ml/l (3177 kg/ha), Profenofos 50 EC at 1.0 ml/l (2911 kg/ha), Deltamethrin 2.8 EC at 0.50 ml/l (2289 kg/ha), Indoxacarb 15.8 EC at 0.3 ml/l (2089 kg/ha), Methomyl 40 SP at 1.0 g/l (1933 kg/ha), Thiamethoxam 25 WG at 0.20 g/l (1522 kg/ha), NSKE 5% at 50 g/l (1089 kg/ha) and Neem oil 10000 ppm at 3.0 ml/l (656 kg/ ha) also produced higher additional yield over untreated control.

Economics of management of drumstick pod fly, *Gitona distigma*

Net Returns were highest in the treatment Emamectin benzoate 5 SG at 0.25 g/l (Rs. 287844 /ha). Other treatments viz., Spinosad 45 SC at 0.20 ml/l (Rs. 216036 /ha), Profenofos 50 EC at 1.0 ml/l (Rs. 197948 /ha), Deltamethrin 2.8 EC at 0.50 ml/l (Rs. 155652 /ha), Indoxacarb 15.8 EC at 0.3 ml/l (Rs. 142052 /ha), Methomyl 40 SP at 1.0 g/l (Rs. 131444/ha) Thiamethoxam 25 WG at 0.20 g/l (Rs. 103496 /ha), NSKE 5% at 50 g/l (Rs. 74052 /ha) and Neem oil 10000 ppm at 3.0 ml/l (Rs. 44608 /ha) recorded higher additional returns. However, the highest incremental cost benefit ratio of 223.9 was obtained from the treatment Profenofos 50 EC at 1.0 ml/l, followed by Deltamethrin 2.8 EC at 0.50 ml/l (219.0), Emamectin benzoate 5 SG at 0.25 g/l (196.5) and Indoxacarb 15.8 EC at 0.3 ml/l (169.9). Even though higher net profits were obtained from the treatments Emamectin benzoate 5 SG at 0.25 g/l and Spinosad 45 SC at 0.20 ml/l, ICBR was low due to higher cost of insecticide (Table 4). Muthukrishnan (2009) obtained increased pod yield and higher benefit cost ratio in IPM module I, having various components, including Spinosad and Profenophos, used in the present study.

CONCLUSION

It is evident from the study that the insecticide treatment which were highly effective against drumstick pod fly produced more marketable pod yield, *viz*., Emamectin benzoate 5 SG at 0.25 g/l, Spinosad 45 SC at 0.20 ml/l and Profenofos 50 EC at 1.0 ml/l may be recommended to drumstick growers to apply at pod initiation stage for the effective management pod fly, and get better marketable pod yield. However, the study related to residual toxicity of the insecticides need to be made further, before recommending.

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