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MANAGEMENT OF POD FLY, *MELANAGROMYZA OBTUSA* IN A BUSHY LAC HOST, *FLEMINGIA SEMIALATA* FOR QUALITY SEED PRODUCTION

A. K. JAISWAL,* A. K. SINGH, J. P. SINGH** AND P. PATAMAJHI

Transfer of Technology Division, ICAR- Indian Institute of Natural Resins and Gums, Ranchi- 834 010
**Email: jaiswalak59@gmail.com*
***Present Address: Division of Entomology, ICAR-Indian Agricultural Research Institute, New Delhi 110 012*

ABSTRACT

Focus of pest management research in lac production system has been on predators and parasites of lac insect, however increasing incidence of pod fly (*Melanagromyza obtusa*) in *Flemingia semialata* hinders seed production and require more attention on its management. Field evaluation of ten insecticides was carried out to find out their relative performance against this fly for seed protection in *F. semialata* at research farm of ICAR-Indian Institute of Natural Resins and Gums, Ranchi for two consecutive seasons under rainfed conditions. Per cent pod damage and % loss in number of viable seeds were estimated to be 96.8 and 89.6, respectively in unprotected crop. Emamectin benzoate 0.0025%, though, recorded lower pod damage, could not yield higher number of viable seeds. Among the treatments, the best options for pod fly management having respective values of total pod damage % and number of viable seeds per 100 pods, emerged as: lambdacyhalothrin 0.0025% with 63.8 and 67.2, thiacloprid 0.0434% with 70.4 and 139.2, spinosad 0.0075% with 70.8 and 92.2, chlorantraniliprole 0.0093% with values of 74.4 and 122.2, and fipronil 0.0100% with 77.2 and 103.2. Hence, four applications of any one of the five insecticides evaluated starting with the opening of inflorescence at an interval of 15 days will be the best schedule of insecticides for pod fly management in *F. semialata*.

Key words: Pod fly, *Flemingia semialata*, seed production, insecticide, emamectin benzoate, lambdacyhalothrin, pod damage, viable seeds

Lac, due to its use in diversified field and biodegradable nature, has gained a momentum in cultivation in recent times, accounting for about 50–60% of the total world lac production. Total production and export figures of lac in 2012-13 were 19577 and 4361 tons, respectively (Yogi *et al*., 2014). *Flemingia semialata* has emerged recently as one of the most suitable lac hosts, which is bushy in nature and quick growing. More importantly lac cultivation can be started from second year on plantation basis as against 5-12 years gestation period on conventional host trees *viz*., *Butea monosperma* (*palas*), *Ziziphus mauritiana* (*ber*) and *Schleichera oleosa* (*kusum*) found in forest and sub-forest areas. Intensive lac cultivation on bushy host is highly demanding in recent years due to relatively higher market price and awareness. In order to increase plantation quickly, large quantity of seed is required. The major problem in seed production is heavy attack of pod fly *Melanagromyza obtusa* resulting is substantial loss in seed quality and yield.

The pod flies lay eggs in immature pods of *F. semialata* and feed on developing seeds. The infested immature pods do not show external evidence of damage until the fully grown larvae chew exit holes in the pod walls. It damages seeds by boring and tunnels in them. Damaged seeds shrivel and insect excreta lead to development of saprophytic fungus, which further destroys the seed and it does not germinate after sowing. *M. obtusa* is also a serious pest of pigeon pea which is responsible for some of the major damage to the pods experienced during winter and spring (Akhauri *et al*., 1994; Sharma *et al*., 2011). This pest is widely distributed throughout India inhabiting different climatic regions (Ahmad, 1938). The pod fly oviposits in the tender pods and both the larval and pupal stages pass inside the pods. After hatching the larvae mine in the pods and feed on the soft seeds thus making the yield unfit for human consumption (Lal and Yadav, 1994).

Management of pest in lac production system is complicated as two-way pest management approach (plant crop and lac crop) is necessary. Lac crop is affected by many groups of insects with different biology and variable population dynamics occurring throughout year across wider geographical areas. The primary focus of pest management in lac production has so far been on pest management of lac crop. The practice of lac cultivation on *F. semialata* had been standardized (Krishnaswami *et al.*, 1962; Jaiswal and Singh, 2012). Management of pod fly in *F. semialata* for seed protection through insecticidal treatments had been evaluated earlier, but there is need to screen those insecticides which are not harmful to lac insect as sometimes both seed and lac is taken simultaneously from the same plants. Hence, present investigation was carried out to find out the relative performance of some safe insecticides for management of *M. obtusa* in *F. semialata*.

MATERIALS AND METHODS

Field experiment on the evaluation of insecticides for pod fly management was conducted with *F. semialata* (a bushy lac host) under rainfed condition at research farm of ICAR- Indian Institute of Natural Resins and Gums, Ranchi for two consecutive crop seasons (2012 and 2013). The seedlings were raised in poly-bags by sowing seeds during May, and after attaining the height of around 30 cm, these seedlings were transplanted in already prepared pits at a distance of 1 m × 1 m during July after monsoon break. The flowering started during December and insecticidal spray was carried out on inflorescence. Eleven insecticides namely indoxacarb 14.5% SC (Ammate®), fipronil 5% SC (Regent®), spinosad 2.5% SC (Success®), lambdacyhalothrin 5%EC (Karate®), imidacloprid 17.8% SL (Media®), thiacloprid 21.7% SL (Alanto®), chlorantraniliprole 18.5% SC (Coragen®), emamectin benzoate 5% SG (EM-1®), dichlorvos 76% EC (Nuvan®), betacyfluthrin 8.49% + imidacloprid 21% ww (Solomon®) and ethofenprox 10% EC (Bombard®) were, with recommended agronomic practices. Three concentrations of all the insecticides (except ethofenprox) were evaluated and four insecticidal sprays were given starting with opening of inflorescence at the interval of 15 day with a rocking sprayer using 2.5 l water for 10 plants. The first spray was administered in last week of December and successive sprayings 15th days thereafter. Thus, there were 32 treatments including a control. There were twenty plants of each treatment of which for observations, 50 pods/plant were randomly collected from ten plants and pods of two plants were mixed to make it 100 and thus five replications for each treatment. The effectiveness of the treatments was assessed on basis of pod damage and % of viable seeds. Under natural condition, each pod contains two seeds and the weight of viable (healthy) and non-viable (unhealthy) seed is around 24 and 7 mg, respectively. Observations on pod damage and % viable seeds were recorded at physiological maturity of seeds. Each pod was opened for observation on infestation by recording number of puparia and categorized as single infestation, double infestation and without infestation. The number of pods and viable seeds in each category was quantified. The data were subjected to analysis of variance (ANOVA) for the significance of (P= 0.05) and the mean values were compared in accordance to Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Spraying with various concentrations of insecticides brought significant differences in number of viable seeds (Table 1). All the treatments gave higher number of viable seeds (33.2 to 139.2 seeds per 100 pods) as compared to control (20.8). Among various insecticides, the best treatment groups with highest number of viable seeds were thiacloprid 0.0434% (139.2), chlorantraniliprole 0.0093% (122.4) and lambdacyhalothrin 0.0075% (119.6), and % increase in number of viable seed under these over control was 569, 488 and 475, respectively. Numbers of viable seeds recorded with these treatments were at par, but showed superiority over control. Considering the potential yield as 200 seeds from 100 pods (2 seeds/ pod), 89.6% loss in number of viable seeds was estimated in control when no insecticide was applied. It is also evident from the data recorded that imidacloprid 0.0071%, fipronil 0.0075 and 0.0100%, and indoxacarb 0.0218% stood as second best which gave better yield of 110.4, 103.6, 103.2 and 102.8 number of viable seeds from 100 pods, respectively. These treatments resulted in at par number of viable seeds, but differed significantly with earlier group of treatments indicating that these at the mentioned concentration might also be applied for better seed production. The third group of treatments in order of increasing effectiveness, which recorded significantly lesser number of viable seeds than above mentioned two groups, is ethofenprox 0.0200%, dichlorvos 0.1140%, spinosad 0.0075%, indoxacarb 0.0145%, dichlorvos 0.0760%, fipronil 0.0050% and spinosad 0.0100%.

In general heavy incidence was recorded during both the crop seasons and pod damage per cent was

Table 1. Efficacy of insecticides on pod damage and viability of seed of *F. semialata* (2012-2013 pooled data)

Insecticide	Conc (%)	Pod damage (%)			Viable seeds (%)			No. of viable seeds per 100 pods
		Single infestation	Double infestation	Total	Single infestation	Double infestation	No infestation	
Indoxacarb	0.0073	$63.2^{cdefghi}$	29.2^{ef}	92.4	55.77	17.31	26.92	41.6^{ab}
(14.5% SC)	0.0145	73.2^{ijkl}	18.0^{abcd}	91.2	66.95	22.32	10.73	93.2^{ijkl}
	0.0218	76.4^{jkl}	15.6^{abc}	92	72.76	17.51	9.73	102.8^{lkn}
Fipronil	0.0050	60.4^{cdefg}	19.6^{abcde}	80	49.81	20.50	31.38	95.6^{jkl}
(5 % SC)	0.0075	52.4^{bc}	34.0^{f}	86.4	48.12	30.43	27.03	103.6^{lmn}
	0.0100	51.8^{bc}	25.4^{f}	77.2	52.33	23.17	17.25	103.2^{lmn}
Spinosad	0.0050	77.6^{kl}	15.2^{abc}	92.8	73.94	15.43	10.64	75.2^{fghij}
(2.5 % SC)	0.0075	59.0^{cdef}	11.8^{a}	70.8	36.88	11.93	51.19	92.2^{hijkl}
	0.0100	60.6^{cdefgh}	14.2^{ab}	74.8	53.64	17.81	28.54	98.8^{lm}
Lambdacyhalothirn	0.0025	41.4^{b}	22.4^{bde}	63.8	13.39	3.27	83.33	67.2^{cdef}
(5% EC)	0.0050	$68.0^{efghijkl}$	19.2^{abcde}	87.2	64.25	17.62	18.13	77.2^{fghijk}
	0.0075	72.4^{hijkl}	16.0^{abc}	88.4	67.89	16.39	15.72	119.6^{mno}
Imidacloprid	0.0036	$70.4^{fghijkl}$	21.2^{abcde}	91.6	67.44	18.60	13.95	68.8^{defgh}
(17.8% SL)	0.0053	71.6^{ghijkl}	16.0^{abc}	87.6	69.27	11.17	19.55	71.6^{efhim}
	0.0071	71.6^{ghijkl}	16.4^{abcd}	88	71.01	15.58	13.41	110.4^{gln}
Thiacloprid	0.0217	$66.4^{defghijk}$	20.0^{abcde}	86.4	44.76	18.10	37.14	42^{ab}
(21.7% SL)	0.0326	54.0^{cd}	25.2^{cdef}	79.2	42.60	18.34	39.05	67.6^{cdefg}
	0.0434	58.4^{cd}	12.0^{ab}	70.4	52.87	11.21	35.92	139.2^{o}
Chlorantraniliprole	0.0056	71.2^{ghijkl}	26.8^{def}	98	76.32	17.11	6.58	30.4^{ab}
(18.5% SC)	0.0074	78.0^{kl}	13.2^{abf}	91.2	64.49	15.89	19.63	42.8^{ab}
	0.0093	$61.4^{cdefghi}$	13.0^{ab}	74.4	57.68	10.62	31.70	122.4^{no}
Emamectin benzoate	0.0015	$67.6^{efghijkl}$	25.2^{cdef}	92.8	63.81	25.71	10.48	42^{ab}
(5% SG)	0.0020	$67.2^{efghjkl}$	21.2^{abcde}	88.4	71.17	15.32	13.51	44.4^{bc}
	0.0025	5.6^{a}	21.6^{abcde}	27.2	15.05	17.20	67.74	37.2^{ab}
Dichlorvos	0.0380	78.0^{kl}	18.8^{abcde}	96.8	87.95	6.02	6.02	33.2^{ab}
(76% EC)	0.0760	$62.8^{cdefghi}$	18.2^{abcd}	81	50.64	18.09	31.28	94.0^{ijkl}
	0.1140	51.8^{bc}	19.6^{abcde}	71.4	41.63	13.44	44.93	90.8^{ghijkl}
Solomon™	0.06 ml L^{-1}	78.0^{kl}	16.0^{abc}	94	80.77	6.73	12.50	41.6^{b}
(Betacyfluthrin 8.49%	0.07 ml L^{-1}	78.8^{l}	18.4^{abcd}	97.2	80.00	11.30	8.70	46^{bcd}
+ Imidachloprid 21%)	0.08 ml L^{-1}	72.8^{ijkl}	16.8^{abcd}	89.6	61.72	12.50	25.78	51.2^{bcde}
Ethofenprox (10% EC)	0.0200%	$65.2^{defghij}$	13.2^{ab}	78.4	53.78	7.56	38.67	$90.0^{afghijkl}$
Control	-	76.8^{jkl}	20.0^{abcde}	96.8	71.15	19.23	9.62	20.8^{a}
SEd±		5.97	5.27					11.87
df		159	159					159
f		11.44	1.93					13.94
p		0.0	0.006					0.0

recorded at a minimum of 27.2% with emamectin benzoate 0.0025% and maximum of 98% under chlorantraniliprole 0.0056%; pod damage under control where no insecticide was sprayed was 96.8 % pod damage, of which 76.8% pods were infested by single infestation and 20% with double infestation. This indicated that *M. obtusa* mostly oviposits single eggs per pod and occasionally two eggs per pod in *F. semialata*. Though the least pod damage was recorded with emamectin benzoate 0.0025%, it couldn't transform in higher number of viable seeds. But, out of total viable seeds obtained from this, 67.74% were from pods without infestation. Similar trend with other chemical insecticides against *M. obtusa* in pigeonpea had been reported by Ganiger (2000). He reported that the infestation at harvest was minimum in the plots treated with profenophos + cypermethrin 660 g a.i./ ha (6.39%), however, % grain damage was minimum in chlorphyriphos + cypermethrin 440 g a.i./ha (1.69%), followed by triazophos + deltamethrin 360 g a.i./ha (2.16%) and profenophos + cypermethrin 660 g a.i./ha (2.36%).

The next group of treatments which showed lower pod damage compared to emamectin benzoate 0.0025% include: lambdacyhalothirn 0.0025%, thiacloprid 0.0434% and spinosad 0.0075% with 63.8, 70.4 and 70.8% damages, respectively. Number of viable seeds obtained from pod without infestation was highest (83.33%) with lambdacyhalothirn 0.0025%. Various workers had reported management of pigeon pea pod fly with insecticides. Dar *et al.* (2005) could not get significant control with sorghum as intercrop against *M. obtuse* in late pigeon-pea; however chemical option using dimethoate, endosulfan and combination with 5% NSKE gave better control over unsprayed check. Spray of endosulfan (0.07%) at pod initiation stage, followed by monocrotophos (0.04%) proved effective with maximum yield. Das (2001) reported significant reduction in pod borer and pod fly damage with ready mix formulations (Cyperphos, Endophos and Spark). Similarly, Chaudhary *et al.* (2008) reported that chemical based IPM was more effective for pod borer and pod fly management than biologically-based ones.

The overall study in terms of low pod damage and higher number of viable seeds revealed that emamectin benzoate 0.0025%, though, recorded lower pod damage, could not yield higher number of viable seeds. The best options for pod fly management in *F. semialata*, having respective values of total pod damage percentage and number of viable seeds per 100 pods, emerged as lambdacyhalothrin 0.0025% (with values of 63.8 and 67.2), thiacloprid 0.0434% (with values of 70.4 and 139.2), spinosad 0.0075% (with values of 70.8 and 92.2), chlorantraniliprole 0.0093% (with values of 74.4 and 122.2), and fipronil 0.0100% (with values of 77.2 and 103.2). It is to be noted that ethofenprox, indoxacarb, fipronil, spinosad, chlorantraniliprole, emamectin benzoate had been found safe on lac insect and inflict damage to selected pests of lac (Jaiswal *et al.*, 2004; Singh *et al.*, 2009, 2011, 2014).

From present investigations, it is concluded that for the management of pod fly in *F. semialata*, four applications of lambdacyhalothrin 0.0025% or thiacloprid 0.0434% or spinosad 0.0075% or chlorantraniliprole 0.0093% or fipronil 0.0100% starting with the opening of inflorescence at the interval of 15 days is the best schedule of insecticides in terms of low pod damage and higher number of viable seeds.

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