Mysore J. Agric. Sci., 50 (4) : 707-711, 2016

An Ecofriendly IPM Module for the Suppression of *Diaphania pulverulentalis* (Hampson) (Lepidoptera : Pyralidae) in Mulberry

K. C. Narayanaswamy, S. Harish Babu, K. S. Jagadish and Manjunath Gowda
Department of Sericulture, College of Agriculture, UAS, GKVK, Bengaluru- 560 065

Abstract

A field investigation was carried out to evaluate the efficacy of an integrated pest management module against *Diaphania pulverulentalis* (Hampson) on mulberry during 2011 and 2012. The IPM module consisting of spray of 4 per cent NSKE at 15 to 20 days after pruning (DAP) + spray of *Dp*NPV @ 27.65 × 10^5 PIBs/ml at 25 to 30 DAP+ release of *Trichogramma chilonis* Ishii @ 1 lakh/acre at 45 to 50 DAP was adopted. The pest infestation of 47.27, 40.13, 32.35, 22.28 and 11.55 per cent was recorded in IPM module imposed gardens in comparison with chemical control treated plots, wherein it was 45.66, 33.75, 23.28, 20.70 and 19.04 per cent, respectively at 15, 25, 35, 45 and 65 days after treatment (DAT). The larval population in the IPM module treated plots was found to be 5.61, 4.10, 2.95, 2.73 and 2.43 larvae per plant, respectively in comparison with chemical treated plots, wherein it was 5.15, 3.53, 2.70, 2.58 and 2.02 larvae per plant, respectively at 15, 25, 35, 45 and 65 DAT. Therefore, the IPM module was evidentially efficient over chemical control at 65 DAT. The cost of IPM intervention was found to be Rs. 350 per acre/crop in comparison with the chemical control (Rs. 500 per acre / crop). The net gain in case of IPM module was found to be Rs. 2,500 per acre / crop, as compared to the chemical control (Rs. 2,350 per acre/crop), thus, the cost-benefit ratio was found to be maximum in case of IPM module (1:7.14) as compared to the chemical control (1:4.70). The present study clearly revealed that the adoption of IPM module *i.e.,* spray of 4 per cent NSKE at 15 to 20 days after pruning (DAP) + *Dp*NPV @ 27.65 × 10^5 PIBs/ml at 25 to 30 DAP+ release of *T. chilonis* @ 1 lakh/ acre at 45 to 50 DAP against mulberry leaf roller was effective in reducing the pest infestation under field conditions, besides being silkworm friendly and eco-friendly as well as cost effective.

Sericulture is an important means of livelihood and socio-economic development of the farming community in general and Karnataka in particular. Insect and non-insect pests cause significant loss to the biomass and quality of mulberry leaf. Among the defoliators, the leaf roller, *Diaphania pulverulentalis* (Hampson) (Lepidoptera: Pyralidae) is causing serious damage to mulberry in South India in recent years (Siddegowda *et al*., 1995; Geethabai *et al*., 1997; Manjunath Gowda *et al*. 2005). The incidence of leaf-roller and mulberry leaf yield loss were recorded to be 70.30 and 25.20 per cent, respectively. It appeared during June and persisted upto February and the disappearance of this pest from March to May focused the possible pupal diapause (Rajadurai *et al*., 1999). In Karnataka, the incidence of *D. pulverulentalis* on mulberry ranged from 0 to 100 per cent, being severe in winter months (October to February) and reduced to 0 to 30 per cent in summer months (March to June) (Siddegowda *et al*., 1995). Indiscriminate application of chemical insecticides for suppression of *D. pulverulentalis* in mulberry is not a viable practice, keeping in view the health of the silkworm. Under the present circumstances, the integrated Pest Management (IPM) is an environmentally safe method that combines biological and non-biological techniques to suppress weeds, insects and diseases (Nordlund, 1997). Hence, the present investigations were taken up with the objective of evaluation of the IPM module against *D. pulverulentalis* under mulberry eco-system in the traditional sericultural districts of Karnataka.

Material and Methods

The material used and methodologies adopted in conducting the studies on the evaluation of integrated pest management (IPM) interventions against mulberry leaf roller, *D. pulverulentalis* during 2010-11 to 2012-13 at selected mulberry gardens (in farmers' field situation) at Ramanagara and Chickballapur Districts. The mulberry plot sizes of 5×5 m, having 30 plants each was considered for imposition of IPM components and also for chemical and absolute controls. Seven such plots were considered for IPM and control as replications. In each replication / plot, 10 plants were randomly selected and labelled for

recording the number of shoots infested and larval population at 15, 25, 35, 45 and 65 DAT. The data was subjected to RCBD statistical analysis to draw the inference.

Results and Discussion

The results pertaining to the effect of eco-friendly IPM module on *D. pulverulentalis* consisting of spray of 4 per cent NSKE at 15 to 20 days after pruning (DAP) + spray of *Dp*NPV @ 27.65 × 10^5 PIBs / ml at 25 to 30 DAP+ release of *T. chilonis* @ 1 lakh / acre at 45 to 50 DAP are presented hereunder. The pooled mean of the data on pest infestation at 15, 25, 35 and 45 DAT revealed that the chemical control (45.66, 33.75, 23.28 and 20.70 per cent, respectively) was found to be significantly superior than IPM treated plots; which was recorded to be 47.27, 40.13, 32.35 and 22.28 per cent, respectively. However, the rate of infestation was 57.44, 62.13, 65.03 and 67.63 per cent in the untreated mulberry gardens (Table I). Thus it is vivid that, the rate of infestation was reduced as DAT increased in both chemical and IPM treated mulberry plots, the difference between the latter two was not significant.

Pooled mean of the data on pest infestation from both the locations at 65 DAT revealed significantly minimum pest infestation in IPM module (11.55%),

Table I

Effect of IPM module on infestation of D.pulverulentalis under field conditions

Location	Treatment	Per cent Infestation					
		Before treatment	15 DAT	25 DAT	35 DAT	45 DAT	65 DAT
	IPM module	65.02 b	51.64 a	43.57 b	32.80 b	20.15 a	8.92 a
	Chemical control	66.23 b	51.68 a	37.70 a	25.70 a	22.63 b	20.60 b
	Absolute Control	158.00 a	63.58 b	68.10 c	70.54 c	73.09 c	75.68 c
CSH	F - Test	*	*	*	*	*	*
	SEm±	1.16	1.23	0.92	0.66	0.65	0.44
	CD (P=0.05)	3.77	4.00	3.01	2.14	2.13	1.42
	CV (%)	4.10	4.93	4.15	3.42	3.77	2.78
	IPM module	48.32 a	42.90 b	36.69 b	31.78 b	24.40 b	14.18 b
	Chemical control	49.52 a	39.64 c	29.75 c	20.86 c	18.78 c	17.47 b
	Absolute Control	44.11 b	51.29 a	56.15 a	59.52 a	62.18 a	71.44 a
JSH	F - Test	*	*	*	*	*	*
	SEm±	0.40	0.41	0.35	0.29	0.33	1.03
	CD (P=0.05)	1.31	1.34	1.14	0.94	1.08	3.36
	CV (%)	1.90	2.06	1.91	1.73	2.12	6.70
	IPM module	56.67 b	47.27 b	40.13 b	32.35 b	22.28 b	11.55 a
	Chemical control	57.87 b	45.66 a	33.75 a	23.28 a	20.70 a	19.04 b
	Absolute Control	51.06 a	57.44 c	62.13 c	65.03 c	67.63 c	73.56 c
Pooledmean	F - test	*	*	*	*	*	*
	SEm±	0.38	0.45	0.36	0.26	0.26	0.37
	CD (P=0.05)	1.25	1.46	1.17	0.85	0.85	1.22
	CV (%)	1.55	2.00	1.77	1.45	1.58	2.41

Note: *5 per cent level of significance

Means followed by the same alphabet are not significantly different

IPM module – 4% NSKE spray at 15 - 20 DAP + *Dp*NPV spray @ 27.65 × 10^5PIBs / ml at 25 – 30 DAP + *T. chilonis* release @ 1 lakh / acre at 45 – 50 DAP

DAP – Days of pruning; DAT – Days after treatment; CSH-Chikkasadenahalli; JSH-Jangamaseegenahalli

followed by that in case of chemical control (19.04%). However, significant maximum infestation was recorded in absolute control (73.56%). The pooled analysis of the data of both the locations revealed the significant superiority of IPM module over chemical control at 65 DAT (Table I). The present findings are similar to those of Muthuswami (2004), who reported that an IPM module consisting of irrigation of mulberry garden (on the day of pruning), releasing *Tetrastichus howardii* @ 50,000/ha (one day after pruning) and *T. chilonis* @ 5cc/ha (10 days after pruning), spraying of dichlorvos @ 1ml/lit (30 days after pruning), mechanical clipping and burning of affected shoots (40 days after pruning) was effective in leaf roller management. Similarly, demonstration of IPM practice against *D. pulverulentalis* taken up in farms of Karnataka, adopting three IPM components *viz*., spray of DDVP 0.076 %, release of egg parasitoid and pupal parasitoid resulted in suppression of pest incidence by 47 to 53 per cent over the control (Anon. 2008). Similarly at RSRS, Chamarajanagara, Karnataka and RSRS, Salem (Tamil Nadu), 2.54 to 7.35 per cent and 3.0 to 16.22 per cent reduction in the pest incidence was achieved when IPM package was adopted (Anon. 2000). Further, Gururaj and Choudhury (2001) reported that percentage reduction was significantly highest in IPM (79 %), followed by chemical control (67 %) and least in physical control (35 %) and they opined that IPM module can be advocated for management of leaf roller in mulberry.

Analysis of the pooled data on larval population as influenced by the effect of IPM module, in both the locations, revealed that larval population of 15, 25, 35 and 45 DAT was 5.61, 4.10, 2.95 and 2.73 larvae / plant, respectively as against chemical control (5.15, 3.53, 2.70 and 2.58 larvae / plant, respectively) and absolute control (5.82, 6.15, 6.00 and 6.95 larvae / plant, respectively) (Table II). In the IPM and chemical treated mulberry plots, the larval population was decreased as the DAT increased, as compared to larval population before imposition of treatments as well as in absolute control.

Pooled mean analysis of the data of both the locations at 65 DAT, revealed that significant differences existed between the three treatments. Significantly minimum larval population of *D. pulverulentalis* was recorded in chemical control (2.02 larvae/plant), whereas, it was significantly maximum in case of absolute control (7.58 larvae/ plant). It was slightly higher in IPM module when compared to chemical control (2.43 larvae/plant) (Table II), but chemical control was superior than IPM module. Earlier workers like Velavan (2001) reported that when the parasitoids, *Tetrastichus howardii* and *Trichogramma chilonis* were integrated with spray of propoxur (0.1%), the larval population was reduced to 2.46 larvae / plant, as against 60.37 in untreated control. Integration of natural enemies *viz*., egg parasitoids at 5 cubic centimeter / ha (@ 30 days after pruning (DAP)) and pupal parasitoid at 0.25 million adults/ha (53 DAP) with chemical propoxur 20 EC at one per cent (45 DAP) showed significant reduction in leaf webber larval population by 61.38 per cent as well as shoot damage by 41.39 per cent over control. Similarly, Manjunath Gowda *et al*. (2005) reported that clipping and burning of affected plant parts and spraying 0.2 per cent dichlorvos (76% EC) reduces the larval population of leaf roller. Installation of light traps and providing bird perches in mulberry garden has been recommended for the suppression of the pest. Other insecticides like monocrotophos (0.072%), neem seed kernel extract and neem oil have also been found to be effective against the pest.

The cost of IPM intervention was found to be Rs. 350 per acre/crop in comparison with the chemical control (Rs. 500 per acre/crop) (Table III). The net gain in case of IPM module was found to be Rs. 2,500 per acre/crop, as compared to the chemical control (Rs. 2,350 per acre/crop). Therefore, the cost - benefit ratio was found to be maximum in case of IPM module (1:7.14) as compared to the chemical control (1:4.70).

Therefore, the IPM module evaluated against *D. pulverulentalis* has proved to be on par with chemical control, not only in its efficacy, besides safeguarding the health of silkworm. However, IPM module has proved its cost-worthiness by virtue of its higher cost-benefit ratio than chemical control.

TABLE II

Effect of IPM module on larval population of D. pulverulentalis under field conditions

Location	Treatment	Larval population (No. / plant)					
		Before treatment	15 DAT	25 DAT	35 DAT	45 DAT	65 DAT
	IPM module	9.85 b	3.45 a	1.75 a	0.58 a	1.92 b	3.11 b
	Chemical control	9.97 b	3.81 a	1.55 a	0.50 a	1.18 a	2.03 a
	Absolute Control	4.55 a	5.81 b	6.11 b	6.28 b	6.65 c	7.31 c
CSH	F - Test	*	*	*	*	*	*
	SEm±	0.11	0.11	0.11	0.11	0.12	0.17
	CD (P=0.05)	0.37	0.36	0.34	0.36	0.39	0.54
	CV (%)	3.17	5.73	7.47	10.00	8.23	8.97
	IPM module	9.12 b	7.78 c	6.48 b	5.31 b	3.55 a	1.75 a
	Chemical control	9.23 b	6.47 b	5.51 a	4.96 a	3.98 b	2.01 b
	Absolute Control	4.78 a	5.82 a	6.18 b	6.75 c	7.25 c	7.85 c
JSH	F - Test	*	*	*	*	*	*
	SEm±	0.12	0.10	0.10	0.09	0.10	0.08
	CD (P=0.05)	0.40	0.31	0.31	0.29	0.33	0.25
	CV (%)	3.53	3.22	3.53	3.52	4.56	4.48
	IPM module	9.48 b	5.61 b	4.10 b	2.95 a	2.73 a	2.43 b
	Chemical control	9.60 b	5.15 a	3.53 a	2.70 a	2.58 a	2.02 a
	Absolute Control	4.67 a	5.82 b	6.15 c	6.00 b	6.95 b	7.58 c
Pooledmean	F - Test	*	*	*	*	*	*
	SEm±	0.12	0.10	0.09	0.10	0.11	0.11
	CD (P=0.05)	0.38	0.33	0.30	0.32	0.35	0.35
	CV (%)	3.33	4.06	4.54	5.33	5.81	5.91

Note : *5 per cent level of significance

Means followed by the same alphabet are not significantly different

IPM module – 4% NSKE spray at 15 - 20 DAP + *Dp*NPVspray @ 27.65 × 10^5 PIBs / ml at 25 – 30 DAP + *T. chilonis* release @ 1 lakh / acre at 45 – 50 DAP

DAP – Days of pruning; DAT – Days after treatment; CSH-Chikkasadenahalli; JSH-Jangamaseegenahalli

TABLE III

Economics of application of IPM module for mulberry leaf-roller management under field conditions

Particulars	IPM module (per acre / crop)	Chemical control (per acre / crop)
Yield loss due to pest attac	475 kg*	475 kg*
Monetary loss due pest attack (@ Rs.10/kgmulberry leaf)*	Rs.2850	Rs.2850
Cost of management	Rs.125+175+ 50= 350	Rs. 250 × 2 sprays = 500
Net gain (2-3)	Rs. 2500	Rs.2350
Cost benefit ratio (4/3)	1:7.14	1:4.70

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(*Received :* August, 2016 *Accepted :* November, 2016)