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Evaluation of insecticide molecules for their efficacy on mango leaf webber, *Orthaga exvinacea* Hampson (Pyralidae: Lepidoptera)

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Abstract
Field experiment was conducted at College of Horticulture Farm, Munirabad, Koppal during *Kharif* 2017-18, 2018-19 and 2019-20 to evaluate relative efficacy of existing insecticide molecules against mango leaf webber in the established mango orchard. The cumulative mean of pest incidence of three seasons of two sprays revealed that all the treatments showed comparative decrease in spread of the mango leaf webber infestation, but the treatment of Lambda-cyhalothrin 5 % EC @ 1 ml/l was found effective in reducing the larval population with highest yield of 61.88 q/ha with B: C ratio of 4.42 followed by Quinalphos 25 % EC @ 2 ml/l which was recorded the yield of 57.74 q/ha with B: C ratio of 4.08.

Keywords: Bioefficacy, Insecticides, leaf webber, *Orthaga exvinacea*, Mango.

Introduction
The Mango (*Mangifera indica* L.) is considered as the "King of fruits". In India, mango being grown over an area of 2262.77 thousand ha (3 5% of total fruit-growing area) with an annual production of 19,687 thousand MT, which accounts for 60 per cent of the total world mango production with the productivity of 8.70 MT per hectare. In Karnataka, mango being cultivated in an area of 192.61 thousand hectares with an annual production of 1829.21 thousand MT and productivity of 9.49 MT per hectare during 2016-17 (Anon., 2017) [1]. More than 400 insect pests have been listed attacking this king fruit. Out of these, about two dozen insect pests severely damage different parts of mango tree. The major pests of mango are leaf hoppers, *Idioscopus clypealis*, *I. nitidulus*, *Amritodus atkinsoni*; mango mealybug, *Drosicha mangiferae*; gall midge, *Erosomia indica*, *Dasyneura amaramanjarae*, *Procistiphora indica*; stone weevil, *Sternochetus mangiferae*; leaf webber, *Orthaga euadrusalis*; fruit fly, *Bactrocera* spp., mango stem borer, *Batocera* spp., termites, *Odontotermes* spp.; shoot borer, *Chlumetia transversa*; bark eating caterpillar, *Indarbela quadrinotata* and scale insect, *Pulvinaria poligonata* (Srivastava, 2000) [8].

Mango leaf webber *Orthaga exvinacea* Hampson is considered to be a pest of occasional significance in the mango ecosystem. *O. euadrusalis* in the recent years are attaining a major pest status (Prabhakara *et al.*, 2011; Rajkumar *et al.*, 2013) [4, 5]. The extent of damage caused by this pest under favorable condition was estimated as 35 per cent (Srivastava and Tandon, 1980) [7]. The heavily infested trees appear to be burnt like when observed from a distance wherein the leaves are dried, webbed and filled with its excreta. The early instar (*i.e.*, 1st and 2nd instars) larvae scrape the chlorophyll content of the leaves and later stage larvae start forming the webs by webbing 3-4 leaves together and are very active in their movement inside the web where they will have tunnels made up of silken webs to escape, hide and pupate inside the webbings itself in a silken cocoon like case covered with its excreta outside. So, this severe infestation results in complete failure in flower initiation and finally the yield will be affected (Anon, 2017) [1]. Even though it is an occasional pest, in recent years it has become one of the major insect pest during flowering season in mango growing different mango growing areas of Karnataka.

Considering the economic position of mango in Indian agriculture, its increased area under and subsequent change in pest status, the investigation was undertaken on "Efficacy of new molecules against mango leaf webber" is need of the hour.

Materials and Methods

The field experiment was conducted at College of Horticulture Farm, Munirabad, Koppal, during *Kharif,* 2017-18, 2018-19 and 2019-20 to evaluate the efficacy of insecticides against mango leaf webber in the established mango orchard with Alphanso variety planted at a spacing of 7.5 X 7.5 m. The experiment was laid out in simple Randomized Completely Block Design. The total number of treatments were seven with three replications. Each tree was considered as one treatment.

Observations were recorded on infested trees with minimum of 10 to 15 webbings were selected and tagged. Observations were recorded a day prior to application of treatments as pre-count and recorded number of webs per tree and number of larvae per web. Post treatment counts were taken for the presence of larvae in the web at 3, 7 and 14 days after treatment. On the basis of number of active webs per tree and number of larvae per web, the data were analyzed to arrive at conclusion regarding efficacy of various insecticidal treatments. Similarly, second spray was imposed after one-month of first spray. The fruit yield per tree was also recorded from each treatment separately and economics for each treatment was computed on the basis of fruit yield per hectare and market price. The data of three years *viz*., 2017-18, 2018-19 and 2019-20 was pooled for both first and second spray of all the days of observation and analysed. Statistically analysis data on management of mango leaf webber was analyzed (ANOVA) by applying Randomized Block Design using the Excel-STAT software.

Results and Discussions

Among the treatments ate day before first spray population of leafwebber ranged between 20.01 and 22.57 larvae per five webs and were found non significant. At three days after spray, the lowest larval population (1.96 larvae/ 5 webs) was observed in Dichlorvos 76 % EC @ 1ml/l and which was followed by Quinalphos 25 % EC @ 2 ml/l (2.87 larvae/ 5 webs) and Lambdacyhalothrin 5 % EC @ 1 ml/l (3.39 larvae/ 5 webs). The later treatments were on par with each other. The treatments Profenophos 50 % EC @ 2ml/l and Chlorpyrifos 20 % EC @ 2ml/l recorded larval population of 4.24 and 4.29 larvae/ 5 webs, respectively and in untreated control, the larval population was highest with 23.01 larvae/ 5 webs. At seven days after spray, the larval population in the treatments Lambdacyhalothrin 5 % EC @ 1 ml/l, Quinalphos 25 % EC @ 2 ml/l and Dichlorvos 76 % EC @ 1ml/l were found on par with each other with recorded values of 3.24, 3.79 and 3.87 larvae/ 5 webs, respectively and were on par with each other followed by the treatments Chlorpyriphos 20 % EC @ 2ml/l and Profenophos 50 % EC @ 2ml/l. At 14 days after treatment imposition, the larval population in all the treatments increased significantly but the lowest population of leaf webber was observed in Lambdacyhalothrin 5 % EC @ 1 ml/l (3.60 larvae/ 5 webs) and was superior among the treatments.Quinalphos 25 % EC @ 2 ml/l (4.31 larvae/ 5 webs) and Dichlorvos 76 % EC @ 1ml/l (4.32 larvae/ 5 webs)were on par with each other and the highest population was observed in untreated control (27.72 larvae/ 5 webs) (Table 1). The present studies are in line with Ranjeet Bhatia and Divender Gupta (2002) [6], Similarly, lambda cyhalothrin 5 EC at 0.5 ml per liter + Azadirachtin 10000 ppm at 1.0 ml per liter exhibited net returns (Rs. 289230/ha) with a B: C ratio (5.18) and suggesting these two combinations were more cost effective and thereby practically feasible (Poornima *et al.,* 2019) [3].

Similarly, after second application at three days after spray, the lowest larval population (0.39 larvae/ 5 webs) was recorded in Dichlorvos 76 % EC @ 1ml/l followed by Lambdacyhalothrin 5 % EC @ 1 ml/l (0.57 larvae/ 5 webs) and Quinalphos 25 % EC @ 2 ml/l (0.74 larvae/ 5 webs) which were on par with each other. Profenophos 50 % EC @ 2ml/l (1.60 larvae/ 5 webs) and Chlorpyriphos 20 % EC @ 2ml/l (1.65 larvae/ 5 webs) were on par with each other. At seven days after spray all the three treatments *viz.*, Dichlorvos 76 % EC @ 1ml/l followed by Lambdacyhalothrin 5 % EC @ 1 ml/l (0.57 larvae/ 5 webs) and Quinalphos 25 % EC @ 2 ml/l were on par with each other and recorded larval population of 0.77, 0.86 and 0.87 larvae per five webs, respectively and were on par with each other. Highest larval population was observed in the untreated control with 28.23 larvae per five webs. Fourteen days after treatment imposition Lambdacyhalothrin 5 % EC @ 1 ml/l maintained superiority in recording the lowest larval population of 0.89 larvae per five webs and highest in the untreated control (Table 1).

Highest yield was recorded in the treatment Lambdacyhalothrin 5 % EC @ 1 ml/l (61.88 q/ha) and highest net returns of 1915531 with B: C ratio 4.42 followed by Quinalphos 25 % EC @ ml/l which recorded 57.74 q/ha (Net returns-174327, B: C ratio of 4.08) and was on par with Dichlorvos 76 % EC @ 1 ml/l (56.82 q/ha) (Net returns-171047, B: C ratio of 4.04). The treatments Chlorpyrifos 20 % EC @ 2 ml/l and Profenophos 50 % EC @ 2 ml/l recorded yield of 54.85 and 53.75 q/ha, respectively and were on par with each other. Untreated control recorded lowest yield of 40.16 q/ha (Table 1 & 2). The results are in line with Ranjeet Bhatia and Divender Gupta (2002) [6] reported that Cypermethrin (0.01%) proved most effective insecticide while BT the least out of the seven insecticides tested in the study for mango leaf webber. Further, Mallikarjun *et al.* (2020) [2] also revealed that cyantraniliprole 10.26 % OD recorded fruit yield of 68.20 q/ha with B: C ratio (4.37), lambda cyhalothrin 5 % EC and flubendiamide 20 % WG were next best insecticides and quite promising for the management of leaf webber.

Table 1: Pooled analysis of Relative efficacy of insecticides against mango leaf webber, *Orthaga exvinacea* (Pyralidae: Lepidoptera)

Treatments	Dose (ml /lit)	Pooled analysis of Kharif (2017-18, 2019-20 and 2020-21), Mean incidence (No. of larvae / 5 webs)							
		First application				Second application			Yield (q /ha)
		DBS	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS	
T_1 – Chlorpyrifos 20 % EC	2 ml	21.03	4.49(2.33)^c	4.81(2.39)^d	6.10(2.64)^d	1.40(1.54)^c	1.65(1.62)^d	1.91(1.70)^d	54.85^c
T_2 - Lambdacyhalothrin 5 % EC	1 ml	21.77	3.39(2.08)^{de}	3.24(2.05)^e	3.60(2.14)^f	0.57 (1.25)^{de}	0.77(1.33)^e	0.89(1.37)^f	61.88^a
T_3 – Azadirachtin 1500 ppm	5 ml	22.17	6.06(2.65)^b	7.39(2.89)^b	8.66(3.10)^b	2.59(1.89)^b	3.87(2.20)^b	4.45(2.32)^b	49.23^d
T_4 - Dichlorvos 76 % EC	1 ml	22.57	1.96(1.71)^e	3.87(2.19)^e	4.32(2.29)^e	0.39(1.17)^e	0.86(1.36)^e	1.08(1.44)^e	56.82^b
T_5 - Quinalphos 25 % EC	2 ml	22.12	2.87(1.96)^d	3.79(2.17)^e	4.31(2.29)^e	0.74(1.32)^d	0.87(1.37)^e	1.12(1.45)^e	57.74^b
T_6 - Profenofos 50 % EC	2 ml	20.01	4.24(2.28)^c	5.69(2.57)^c	7.01(2.80)^c	1.18(1.48)^c	1.60(1.61)^c	2.20(1.79)^c	53.75^c

T_7 - Control		20.81	23.01(4.90)[a]	26.54(5.24)[a]	27.72 (5.35)[a]	27.03 (5.29)[a]	28.23 (5.40)[a]	29.80 (5.55)[a]	40.16[e]
S.EM±		1.63	0.06	0.18	0.07	0.06	0.04	0.07	1.5
CD @ 5%		NS	0.19	0.55	0.21	0.19	0.12	0.20	4.51

Table 2: Cost Economics influenced by the relative efficacy of the insecticides against mango leaf webber, *Orthaga exvinacea* (Pyralidae: Lepidoptera)

Treatments	Dose (ml /lit)	Cost Economics Analysis					
		Cost of plant Protection	Other Cost of Cultivation	Total Cost of cultivation	Gross Returns	Net Returns	B:C
T_1 – Chlorpyrifos 20 % EC	2 ml	1787	55000	56787	219400	162613	3.86
T_2 - Lambdacyhalothrin 5 % EC	1 ml	989	55000	55989	247520	191531	4.42
T_3 - Azadirachtin 1500 ppm	5 ml	2867	55000	57867	196920	139053	3.40
T_4 - Dichlorvos 76 % EC	1 ml	1233	55000	56233	227280	171047	4.04
T_5 - Quinalphos 25 % EC	2 ml	1633	55000	56633	230960	174327	4.08
T_6 - Profenofos 50 % EC	2 ml	2433	55000	57433	215000	157567	3.74
T_7 - Control		0	55000	55000	160640	105640	2.92

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