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SPRAY SCHEDULES FOR MANAGEMENT OF LEAF WEBBER *CROCIDOLOMIA BINOTALIS* (ZELLER) IN MUSTARD

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ABSTRACT

The efficacy of five insecticidal spray schedules against leaf webber, *Crocidolomia binotalis* (Zeller) in mustard was evaluated. The results revealed that schedule 3 consisting of thiamethoxam 25 WG @ 0.006 % at seedling stage, emamectin benzoate 5 WG @ 0.0025 % at pre-flowering stage, *Nomuraea rileyi* @ 2.5 kg/ha at 50% flowering stage and chlorpyriphos 16% + alphamethrin 1% EC @ 0.055 % (S_3) at 50% pod formation stage were superior. The schedule S_4 (flonicamid 50 WG + flubendiamide 480 SC + azadirachtin 1500 ppm + acephate 25 + fenvalerate 3 EC) proved next best. The maximum yield was obtained with this schedule 3. Schedule S_2 (imidacloprid 17.8 SL + indoxacarb 14.5 SC + *Lecanicillium lecanii* @ 2.5 kg/ha and trizophos 35 + deltamethrin 1 EC) and S_3 (thiamethoxam 25 + emamectin benzoate 5 WG + *N. rileyi* @ 2.5 kg/ha and chlorpyriphos 16 + alphamethrin 1 EC) could be suggested against mustard leaf webber.

Key words: *Crocidolomia binotata*, insecticides. *Nomuraea rileyi*, azadirachtin, *Lecanicillium lecanii*, thiamethoxam, emamectin benzoate, chlorpyriphos, alphamethrin

Mustard is an important oilseed crop in India (Kalasariya and Parmar, 2018), with a productivity of 987 kg/mt (Anonymous, 2018), which is significantly lower. The major factor responsible for this is the damage due to insect pests and diseases (Bakhetia and Sekhon, 1989). More than 43 pests infest rapeseed-mustard, of which about a dozen are major pests (Purwar et al., 2004). Of these, mustard leaf webber *Crocidolomia binotalis* (Zeller) is an important pest (Rai, 1976; Singh, 2008). Damage is caused mainly by the caterpillars, forming silken web around the leaves, and skeletonizing them. They also feed on flower buds and bore into pods, and about 13.2 to 81.8% loss in yield had been reported (Kalasariya et al., 2019). A single insecticide will not provide effective control of such pests. At flowering stage honey bees play vital role in pollination and increase yield (Kalasariya, 2016). There is need to develop such insecticidal modules, which can provide safety to honey bee. In the present study insecticides selected according to activity of pests and stages of the crop are evaluated to get the most effective schedule.

MATERIALS AND METHODS

A field experiment was conducted at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat (21.5018 °N,70.4495 °E) during *rabi* 2012-13 and 2013-14. Gujarat mustard-3 variety was sown at spacing of 45 x 15 cm following recommended package of practices except plant protection. There were four replications and 6 insecticidal spray schedules.

During the seedling stage i.e. 20 to 25 days after sowing, the schedule of the insecticides was in order of acetamiprid 20 SP (S_1), imidacloprid 17.8 SL (S_2), thiamethoxam 25 WG (S_3), flonicamid 50 WG (S_4) and monocrotophos 36 SL (S_5) while during pre-flowering stage i.e., 45 to 55 days after sowing, the schedule of the insecticides was in order of spinosad 45 SC (S_1), indoxacarb 14.5 SC (S_2), emamectin benzoate 5 WG (S_3), flubendamide 480 SC (S_4) and quinalphos 25 EC (S_5). At the time of 50% flowering stage i.e. 60 to 65 days after sowing, the insecticides were applied in schedule of *Beauveria bassiana* @ 2.5 kg/ha (S_1), *Lecanicillium lecanii* @ 2.0 kg/ha (S_2), *Nomuraea rileyi* @ 2.5 kg/ha (S_3), azadirachtin @ 0.15% (S_4) and NSKE 5% (S_5). Further, another spray of insecticides was applied in schedule of profenophos 40 + cypermethrin 4 EC (S_1), deltamethrin 1 + triazophos 35 EC (S_2), chlorpyriphos 16 + alphamethrin 1 EC (S_3), acephate 25 + fenvalerate 3 EC (S_4) and ethion 40 + cypermethrin 5 EC (S_5) at 50% pod formation i.e. 70 to 75 days after sowing. For deciding the quantity of spray fluid required, control plots were sprayed with water. Spray fluid was prepared by mixing measured quantity of water and insecticides. All necessary care was taken to prevent the drift of insecticides to reach the adjacent plots. When population of insect-pests was crossed its ETL level (2 larvae/plant, Maity et al., 2001), the first spray schedule was given on 25th December at seedling stage in both the years. Similarly, the second, third and fourth spray schedule was given at twenty days interval, i.e. on 15th January at pre-flowering stage, 5th February at 50% flowering stage and 26th February at 50% pod formation stage during 2012-13 and 2013-14.

The observations were recorded visually during early morning from five randomly selected plants/ plot. A pre spray observation was taken and subsequently the observations on larval population were recorded at 1, 3 and 7 days after spray from each treatment. The larval population of leaf webber obtained was converted to per cent mortality by using the following formula given by Henderson and Tilton (1955) and the data thus obtained were subjected to appropriate transformation and analyzed statistically. The grain yield obtained from each net plot of insecticidal treatments was converted on hectare basis and were subjected to statistical analysis. The yield increase and avoidable yield loss were worked out by using the formula given by Pradhan (1969).

RESULTS AND DISCUSSION

The mortality of leaf webber at seedling stage during 2012-13 showed that the thiamethoxam 25 WG (S_3) is significantly superior, and did not differ significantly with flonicamid 50 WP (S_4); imidacloprid 17.8 SL (S_2) was found next in order. Acetamiprid 20 SP (S_1) and monocrotophos 36 SL (S_5) were found least effective. During 2013-14, more or less similar results were obtained. Pooled data of 2012-13 and 2013-14 revealed that thiamethoxam 25 WG schedule (S_3) gave maximum efficacy. Looking to the effectiveness of treatments the chronological order of treatments is flonicamid 50 WG (S_4) > imidacloprid 17.8 SL (S_2) > acetamiprid 20 SP (S_1) and monocrotophos 36 SL (S_5) (Table 1).

At the pre-flowering stage, during 2012-13 emamectin benzoate 5 WG (S_3) proved to be most effective, and statistically at par with flubendiamide 480 SC (S_4); indoxacarb 14.5 SC (S_2) was moderately effective, and spinosad 45 SC (S_1) and quinalphos 25 EC (S_5) were found least effective. During 2013-14, more or less same results were obtained. Pooled data indicated that the order of efficacy as: emamectin benzoate 5 WG (S_3) > flubendiamide 480 SC (S_4) > indoxacarb 14.5 SC (S_2) > spinosad 45 SC (S_1) and quinalphos 25 EC (S_5) (Table 1).

At 50% flowering stage, maximum reduction was obtained with azadirachtin 1500 ppm (S_4) which was statistically at par with *N. rileyi* @ 2.5 kg/ha (S_3); *L. lecanii* @ 2.0 kg/ha (S_2) was found next in order, while, *B. bassiana* @ 2.5 kg/ha (S_1) and NSKE 5% (S_5) were the least effective. During 2013-14, similar results were obtained. Pooled data concluded that the schedule (S_3) i.e. *N. rileyi* @ 2.5 kg/ha was the effective one (Table 1).

At 50% pod formation stage, acephate 25 + fenvalerate 3 EC (S_4) was the most effective, at par with chlorpyriphos 16 + alphamethrin 1 EC (S_3), followed by deltamethrin 1 + triazophos 35 EC (S_2); profenophos 40 + cypermethrin 4 EC (S_1) and ethion 40 + cypermethrin 5 EC (S_5) were the least effective. In 2013-14, more or less the same result was obtained. Pooled data revealed the order of efficacy as: S_4 (acephate 25 + fenvalerate 3 EC) > S_3 (chlorpyriphos 16 + alphamethrin 1 EC) > S_2 (deltamethrin 1 + triazophos 35 EC) > S_1 (profenophos 40 + cypermethrin 4 EC) > S_5 (ethion 40 + cypermethrin 5 EC) (Table 1).

Thus, the results indicated that thiamethoxam 25 WG at seedling stage, emamectin benzoate 5 WG at pre-flowering stage, *N. rileyi* @ 2.5 kg/ha at 50% flowering stage and chlorpyriphos 16 + alphamethrin 1 EC at 50% pod formation stage are the significantly most effective ones.

The present findings are in close agreement with Krishnaiah et al. (1978) who reported that insecticidal treatments of chlorpyriphos and acephate proved most effective. Fullerton (1979), Srinivasan and Krishnakumar (1986), Mohan (1987) and Kakade (2007) observed that treatment of fenvalerate 0.015% was the best. Krishnaiah and Mohan (1983) revealed that chlorpyriphos 0.04% and acephate 0.05% were significantly effective, and Sontakke and Das (1996) observed chlorpyriphos 0.05% as the best.

The data revealed that amongst the six spray schedules, S_4 recorded highest grain yield i.e. 1302 kg/ha with 160.4 % increase. The gross realization assessed by multiplying the yield revealed that it was maximum with the schedule S_4 (48174 Rs/ha), followed by schedule S_3 (45066 Rs/ha). The effectiveness of spray schedules evaluated by overall rank method also revealed that the schedule S_4 was the most effective.

Table 1. Effectiveness of spray schedules against *C. binotalis* at different stages

Stages	Treatments	Mortality (%) Periods 2012-13	2013-14	Pooled over years	Overall pooled	ICBR	Yield of grain (kg/ha)
Seedling stage	**S_1** Acetamiprid 20% SP	49.51	50.24	49.88	46.01	1:3.1	917
		(57.75)	(59.00)	(58.37) d	(51.75) d		
	S_2 Imidacloprid 17.8% SL	50.98	50.64	50.81	49.54	1:6.7	1011
		(60.16)	(59.66)	(59.91) c	(57.75) c		
	S_3 Thiamethoxam 25% WG	63.66	64.76	64.21	61.93	1:6.3	1218
		(79.66)	(81.00)	(80.33) a	(76.90) a		
	S_4 Flonicamid 50% WG	62.27	63.60	62.93	61.09	1:6.3	1302
		(77.75)	(79.83)	(78.79) b	(75.90) b		
	S_5 Monocrotophos 36% SL	47.31	47.56	47.43	43.83	1:3.1	1172
		(54.00)	(54.41)	(54.20) e	(48.01) e		
	S.Em. ±	1.29	1.50	0.45	1.16	--	500
	C.D. at 5 %	3.69	4.28	1.33	3.51	--	61.7
	C.V. %	9.84	11.28	2.41	2.79	--	185.8
							12.1
Pre-flowering stage	**S_1** Spinosad 45% SC	44.46	44.00	44.23			
		(49.08)	(48.33)	(48.70) d			
	S_2 Indoxacarb 14.5% SC	49.48	51.86	50.67			
		(57.58)	(61.66)	(59.62) c			
	S_3 Emamectin benzoate 5%WG	65.42	71.29	68.35			
		(81.91)	(89.33)	(85.62) a			
	S_4 Flubendamide 480% SC	64.38	68.77	66.58			
		(80.66)	(86.58)	(83.62) b			
	S_5 Quinalphos 25% EC	43.68	44.60	44.14			
		(47.75)	(49.33)	(48.54) e			
	S.Em. ±	1.40	1.58	0.86			
	C.D. at 5 %	3.99	4.52	2.55			
	C.V. %	10.89	11.75	4.65			
50% flowering stage	**S_1** *B. bassiana* 2.5 kg/ha	44.71	43.55	44.13			
		(49.50)	(47.50)	(48.50) d			
	S_2 *L. lecanii* 2 kg/ha	48.55	47.76	48.15			
		(56.00)	(54.75)	(55.37) c			
	S_3 *N. rileyi* 2.5 kg/ha	55.22	51.69	53.46			
		(67.08)	(61.33)	(64.20) a			
	S_4 Azadirachtin 1500 ppm	55.66	50.05	52.85			
		(68.08)	(58.58)	(63.33) b			
	S_5 NSKE 5%	41.42	42.11	41.76			
		(43.83)	(45.00)	(44.41) e			
	S.Em. ±	1.39	1.49	1.18			
	C.D. at 5 %	3.98	4.26	4.32			
	C.V. %	11.84	13.22	2.29			
50% pod formation stage	**S_1** Profenophos 40 + cypermethrin 4% EC	47.88	43.74	45.81			
		(55.00)	(47.91)	(51.45) d			
	S_2 Deltamethrin 1 + triazophos 35% EC	48.63	48.49	48.56			
		(56.25)	(56.00)	(56.12) c			
	S_3 Chlorpyriphos 16 + alphamethrin 1% EC	61.18	62.23	61.71			
		(76.69)	(78.18)	(77.48) b			
	S_4 Acephate 25 + fenvalerate 3% EC	61.22	62.80	62.01			
		(76.75)	(78.98)	(77.86) a			
	S_5 Ethion 40 + cypermethrin 5% EC	42.23	41.80	42.02			
		(45.25)	(44.58)	(44.91) e			
	S.Em. ±	1.48	1.54	0.84			
	C.D. at 5 %	4.24	4.40	2.49			
	C.V. %	11.84	12.39	4.78			

Figures in parentheses retransformed values, those outside arcsine values; DAS = Days after spraying, : * Labour charges @ Rs. 200/ha spray; ** Market value of mustard @ Rs. 37/kg; Cost in Rs. S1= 4225.2, S2= 2035.4, S3= 3427, S4= 3926, S5= 7139.7; S1 = acetamiprid 20% SP + spinosad 45% SC + *b. bassiana* @ 2.5 kg/ha + profenophos 40 + cypermethrin 4% EC; S2= imidacloprid 17.8% SL + indoxacarb 14.5% SC + *l. lecanii* @ 2.0 kg/ha + triazophos 35 + deltamethrin 1% EC; S3 = thiamethoxam 25% WG + emamectin benzoate 5% WG + *n. rileyi* @ 2.5 kg/ha + chlopyriphos 16 + alphamethrin 1%EC; S 4 = flonicamid 50% WG + flubendamide 480% SC + azadirachtin 1500 ppm + acephate 25 + fenvalerate 3% EC; S 5 = monocrotophos 36% SL + quinalphos 25% EC + NSKE 5% + cypermethrin 5 + ethion 40% EC; S 6 = control -water spray

REFERENCES

Anonymous 2018. Http://The solvent extractors association of India. Productivity- the way forward for doubling farmers' income. 9 pp.

Fullerton R A. 1979. Use of the synthetic pyrethroids, fenvalerate and cypermethrin to control diamondback moth, *P. xylostella* and the large cabbage moth, *C. binotalis* in Rarotonga, Cook Is. Journal of Fiji Agriculture 41(1): 49-51.

Henderson C F, Tilton E W. 1955. Test with acaricides against the brown wheat mite. Journal of Economic Entomology 48(2): 157-161.

Kalasariya R L. 2016. Management of aphid, *Lipaphis erysimi* in mustard with different spray schedules. Indian Journal of Plant Protection 44(1): 16-33.

Kalasariya R L, Katariya B B, Parmar K D. 2019. Impact of weather parameters on population fluctuations of mustard leaf webber, *Crocidolomia binotalis* (Zeller) in reference to path co-efficient analysis. Journal of Entomology and Zoology Studies 7(5): 1088-1091.

Kalasariya R L, Parmar K D. 2018. Effect of weather factors on population fluctuations of mustard aphid (*Lipaphis erysimi* Kaltenbach) using path co-efficient analysis. Journal of Agrometeorology 20(1): 46-49.

Kakade G D. 2007. Biology, population dynamics, varietal screening and chemical control of leaf webber, *Crocidolomia binotalis* (Zeller) on Mustard. M.Sc. (Agri.) Thesis. JAU, Junagadh. 133 pp.

Krishnaiah K, Mohan N J, Bagle B G. 1978. Control of major insect pests of cabbage by new insecticides. Indian Journal of Plant Protection 6(2): 44-47.

Krishnaisah K, Mohan N J. 1983. Control of cabbage pests by new insecticides. Indian Journal of Entomology 45(3): 222-228.

Maity B K, Tripathy M K, Panda S K. 2001. Estimation of crop loss due to *Crocidolomia binotalis* (Zell) in Indian rapeseed and determination of its economic threshold level. Indian Journal of Agricultural Research 35(1): 52-55.

Mohan N J. 1987. Evaluation of new insecticides for the control of cabbage pests. Pesticides 21(1): 49-54.

Pradhan S. 1969. Insect pests of crops. National Book Trust, New Delhi. 80 pp.

Purwar J P, Singh R K, Mall P. 2004. Ecofriendly management of insect pests in rapeseed- mustard. Indian Farmers Digests 37(10): 34-35.

Rai B K. 1976. Pests of oilseed crops in India and their control. Indian Council of Agricultural Research Publication, New Delhi. 121 pp.

Singh S P. 2008. Insect pest management in oilseed crops. Indian Farming 58(7): 29-33.

Sontakke B K, Dash A N. 1996. Studies on the effects of insecticides and neem formulation against major insect pests of mustard and their safety to honey bees. Indian Journal of Environment Toxicology 6(2): 87-88.

Srinivasan K, Krishnakumar N K. 1986. Evaluation of insecticides for the control of major insect pest complex of radish. Madras Agricultural Journal of 73(3): 134-139.

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