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Bioefficacy and economics of some insecticides against mustard aphid, *Lipaphis erysimi* (Kalt.) infesting mustard

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ABSTRACT

A field experiment was conducted to evaluate the bioefficacy and economics of certain insecticides against mustard aphid, Lipaphis erysimi (Kalt.) infestation on mustard during rabi season of 2014-15. Among the treatments, imidacloprid 17.8 SL @ 20 g a.i. ha^{-1}, thiamethoxam 25 WG @ 25 g a.i. ha^{-1} and diafenthiuron 50 WP @ 50 g a.i. ha^{-1} were proved to be effective against mustard aphid. Highest seed yield was obtained with imidacloprid 17.8 SL (17.41 q ha^{-1}) followed by thiamethoxam 25 WG (16.96 q ha^{-1}). Thus, imidaclopird 17.8 SL, thiamethoxam 25 WG and diafenthiuron 50 WP may be recommended to control mustard aphid. Additionally, the incremental cost-benefit ratio was found highest in imidacloprid being, 1:14.62 followed by 1:14.35 in thiamethoxam.

***Keywords* :** Bioefficacy, insecticides, mustard aphid, rapeseed-mustard

Oilseeds and edible oils hold a key position in the Indian economy. In terms of vegetable oils, India is the fourth largest oil economy in the world after USA, China and Brazil (http://eands.dacnet.nic.in). The total production of oilseed crops in India was 275.10 lakh tonnes during the year 2014-15 (http://eands.dacnet.nic.in). In India rapeseed-mustard are the second most important oilseed crops next to groundnut and contributes 25 per cent of oilseeds production. The production of rapeseed-mustard per unit area in West Bengal as well as in India is very small and has remained static mainly owing to different biotic and abiotic stresses. One of the major factors for low yield is the susceptibility of most rapeseed-mustard varieties to different insect-pests of which mustard aphid, *Lipaphis erysimi* (Kalt.) is the most important. *L. erysimi* is one of the major pests responsible for reduction in yield of rapeseed-mustard upto 91.3 per cent (Singh and Sachan, 1994) and oil contents upto 15 per cent (Verma and Singh, 1987). Bakhetia (1979) reported that mustard aphid causes yield loss from 66 to 99 per cent in *Brassica campestris* L. and 27 to 28 per cent in *Brassica juncea* L. To boost up oilseed production and to check unfavourable factors like insects, diseases and weeds, integrated pest management (IPM) involving different methods of control measures, is now being practiced against different pests. With the objective of effective pest management system some insecticides were tested to study their efficacy and economics of insecticidal application against mustard aphid, *L. erysimi* under field condition.

The experiment was laid out in a Randomized Block Design with eight treatment combinations including untreated control and three replications having plot size of 5 × 3 m^2 during *rabi* season of 2014–2015 at the RRSS Farm, Sekhampur, BCKV, Birbhum, West Bengal. The crop rapseed-mustard, *Brassica rapa* L. var. yellow sarson (cv. B-9) was sown on November 15, 2014 at a spacing of 30 × 10 cm and raised with recommended agronomic practices except plant protection. Soon after appearance of aphids on the inflorescence or tender shoots, first foliar spray with different insecticides *viz*., daifenthiuron 50 WP @ 50 g *a.i.* ha^{-1}, imidacloprid 17.8 SL @ 20 g *a.i.* ha^{-1}, acephate 75 SP @ 350 g *a.i.* ha^{-1}, fipronil 5 SC @ 50 g *a.i.* ha^{-1}, thiamethoxam 25 WG @ 25 g *a.i.* ha^{-1}, Achook 0.15 EC @ 5 g *a.i.* ha^{-1} and oxydemeton methyl 25 EC @ 250 g *a.i.* ha^{-1} were given with a spray volume @ 500 litres ha^{-1} followed by second application after 15 days. Spraying was done with hand compression sprayer. A buffer area of one meter width was left around each experimental plot to safeguard against the possible drift and contamination during spraying operations. Aphid population was recorded from 10 cm central twig from five plants randomly selected in each plot. Pre and post treatment counts on aphids were taken at 1 day before and 1, 3, 7 days after first and second sprayings. Seed yield from each plot was recorded. The economics of insecticidal application was also calculated. Data were compiled and analyzed statistically by using software SPSS 20.0.

The number of aphids in the pretreatment count was found significant (Table 1). Significant differences between treatments in all the three observation dates were observed. All the insecticidal treatments significantly reduce aphid population over untreated control. The mean aphid population per shoot was minimum with imidacloprid 17.8 SL followed by thiamethoxam 25 WG in all the three post treatment observation dates after first spray except in 1 day after treatment in case of thiamethoxam where diafenthiuron 50 WP was recorded minimum aphid population (598.37 per 10cm twig). After second spray, mean aphid population was found

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Table 1: Pooled data of aphid population per shoot under different insecticidal treatments

Treatment	Initial aphid population per 10 cm twig	Mean aphid population shoot $^{-1}$ after first spray			Mean aphid population shoot $^{-1}$ after second spray			Overall mean	Percent reduction over control
		1 DAT	3 DAT	7 DAT	1 DAT	3 DAT	7 DAT		
T_1	532.57 (23.09)	598.37 (24.47)	412.63 (20.33)	158.67 (12.61)	241.30 (15.55)	169.47 (13.04)	86.20 (9.31)	555.55 (22.93)	67.55
T_2	499.38 (22.35)	553.16 (23.52)	327.40 (18.11)	107.80 (10.40)	210.63 (14.53)	128.67 (11.36)	66.27 (8.17)	464.64 (20.74)	72.86
T_3	579.75 (24.09)	650.70 (25.51)	467.20 (21.63)	209.37 (14.49)	275.23 (16.66)	202.93 (14.26)	104.73 (10.26)	636.72 (24.69)	62.81
T_4	604.63 (24.60)	678.50 (26.06)	492.50 (22.20)	232.10 (15.25)	288.37 (17.00)	218.70 (14.80)	114.67 (10.73)	674.95 (25.47)	60.58
T_5	534.13 (23.12)	609.23 (24.69)	368.43 (19.20)	136.67 (11.71)	229.17 (15.15)	149.10 (12.23)	77.83 (8.85)	523.48 (22.13)	69.42
T_6	618.95 (24.89)	679.07 (26.07)	513.10 (22.66)	257.37 (15.87)	304.13 (17.45)	230.37 (15.19)	127.73 (11.32)	703.92 (26.09)	58.88
T_7	561.20 (23.70)	630.60 (25.12)	436.80 (20.91)	183.20 (13.55)	260.83 (16.16)	187.13 (13.70)	94.53 (9.75)	597.70 (23.84)	65.09
T_8	791.93 (28.15)	692.50 (26.32)	718.23 (26.81)	804.00 (28.36)	969.50 (31.14)	966.53 (31.10)	985.27 (31.40)	1712.01 (41.38)	—
SEm (±)	**0.15**	**0.27**	**0.11**	**0.13**	**0.22**	**0.16**	**0.13**	**1.55**	
LSD (0.05)	**0.44***	**0.81***	**0.34***	**0.38***	**0.66***	**0.48***	**0.39***	**4.69***	

*Note: DAT – day after treatment; Values in parentheses are square root transformed; * Significant at 0.05 level*

T_1 = Diafenthiuron 50 WP @ 50 g *a.i.*ha^{-1} ; T_2 = Imidacloprid 17.8 SL@ 20 g *a.i.*ha^{-1} ; T_3 = Acephate 75 SP @350 g *a.i.*ha^{-1} ; T_4 = Fipronil 5 SC @ 50 g *a.i.*ha^{-1} ; T_5 = Thiamethoxam 25 WG @ 25 g *a.i.*ha^{-1} ; T_6 = Achook 0.15 EC @ 5 g *a.i.*ha^{-1} ; T_7 = Oxydemeton methyl 25 EC @ 250 g *a.i.*ha^{-1} ; T_8 = Untreated control

Table 2: Economics of insecticidal application for the control of *L. erysimi*

Treatment	Mean seed yield (q ha^{-1})	Yield gain over control		Value of increased yield (Rs. ha^{-1})	Quantity of insecticides (ml or g ha^{-1})	Cost of application			Net gain (Rs. ha^{-1})	Incremental Cost Benefit ratio (C:B)
		q ha^{-1}	%			Rate (Rs. L^{-1} or kg^{-1})	Labour (Rs.)	Total cost (Rs. ha^{-1})		
T_1	16.17	8.93	123.34	26790	100	1600	1700	1860	24930	1:13.40
T_2	17.41	10.17	140.47	30510	115	2200	1700	1953	28557	1:14.62
T_3	14.95	7.71	106.49	23130	500	500	1700	1950	21180	1:10.86
T_4	13.72	6.48	89.5	19440	1000	1100	1700	2800	16640	1:5.94
T_5	16.96	9.72	134.25	29160	100	2000	1700	1900	27260	1:14.35
T_6	13.39	6.15	84.95	18450	2500	400	1700	2700	15750	1:5.83
T_7	15.38	8.14	112.43	24420	1000	800	1700	2500	21920	1:8.77
T_8	7.24	- -	-	-	-	-	-	-	-	

*Note: * Price of seed Rs. 3000.00 q^{-1}, * Labour wages Rs. 170 manday^{-1}*

T_1 = Diafenthiuron 50 WP @ 50 g *a.i.*ha^{-1} ; T_2 = Imidacloprid 17.8 SL@ 20 g *a.i.*ha^{-1} ; T_3 = Acephate 75 SP @350 g *a.i.*ha^{-1} ; T_4 = Fipronil 5 SC @ 50 g *a.i.*ha^{-1} ; T_5 = Thiamethoxam 25 WG @ 25 g *a.i.*ha^{-1} ; T_6 = Achook 0.15 EC@ 5 g *a.i.*ha^{-1} ; T_7 = Oxydemeton methyl 25 EC @ 250 g *a.i.*ha^{-1} ; T_8 = Untreated control

minimum in imidacloprid followed by thiamethoxam in all the three post treatment observation dates. The mean aphid population per 10cm twig was maximum in achook 0.15 EC treated plots in all the post treated observation dates after first and second spray. While observing the overall mean figure of the three post treatment observation dates of both sprays it is revealed that the aphid population in all the insecticidal treated plots differed significantly with respect to control. Here, amongst the insecticidal treated plots least mean aphid population was observed with imidacloprid 17.8 SL (464.64 per 10cm twig). Among different insecticidal treatments, the percent reduction of aphids over control was maximum with imidacloprid (72.86%) followed by thiamethoxam (69.42%) treated plots. The results corroborate the findings of Devee *et al*. (2011) and Singh *et al*. (2014) who reported that imidacloprid 17.8 SL was found superior in reducing aphid population than other insecticides tested. Khedkar (2012) also found imidacloprid 17.8 SL as the most effective insecticide against mustard aphid. Ghosal *et al*. (2013) and Konar *et al*. (2013) also reported that imidacloprid 17.8 SL as the best insecticides in reducing aphid population of okra. Thiamethoxam was found second most effective insecticide next to imidacloprid in reducing aphid population. This report is in conformity with the findings of Rohilla *et al.* (2004) whereas Kumar *et al*. (2013) reported that maximum control of mustard aphid was obtained with thiamethoxam 25 WG followed by imidacloprid 17.8 SL.

The highest seed yield (Table 2) was recorded in imidacloprid (17.41 q ha^{-1}) treated plots followed by the plots treated with thiamethoxam (16.96 q ha^{-1}) which is supported by the findings of Khedkar (2012). With regard to insecticidal application (Table 2) the highest net gain (Rs. 28557 ha^{-1}) as well as incremental cost-benefit ratio (1:14.62) were obtained with imidacloprid which was followed by thiamethoxam (Rs. 27260 ha^{-1} and 1:14.35). Gour and Pareek (2003) and Reza *et al.* (2004) stated that higher cost-benefit ratio with above two insecticides in comparison to other insecticides tested. Konar *et al*. (2013) identified imidacloprid 17.8 SL as the most economical insecticides with maximum incremental cost benefit ratio due to low cost of treatment.

Among the different insecticides evaluated for their bioefficacy against mustard aphid, *L. erysimi*, imidacloprid 17.8 SL, thiamethoxam 25 WG and diafenthiuron 50 WP may be recommended for effective and economic management of mustard aphid.

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