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Incidence and management of mustard aphid (*Lipaphis erysimi* Kaltenbach) in West Bengal

S.K. Sahoo

Pulses and Oilseeds Research Station, Government of West Bengal, Berhampore, Murshidabad, West Bengal, India, E-mail: shyamalsahoo@yahoo.co.in

A B S T R A C T

Mustard aphid, *Lipaphis erysimi* (Kalt.), is the most serious insect-pest of rapeseed- mustard and responsible for causing the yield losses ranging from 35.4 to 96 per cent depending upon weather condition. The experiment was carried out to assess it's incidence and their management during the winter seasons of 2009-10, 2010-11 and 2011-12 at the Pulses and Oilseeds Research Station, Berhampore, West Bengal (India). The natural appearances of the aphid on the yellow sarson variety, Binoy (B-9) was observed from 52nd standard week, with the peak population on 6th standard week and the aphid disappeared after 10th standard week. Among the different chemical insecticides evaluated for their bio-efficacy against *L. erysimi*, Dimethoate 30EC and Oxydemeton-methyl 25EC were proved to be more effective. The plots treated with Dimethoate and Oxydemeton-methyl recorded minimum aphid infestation in most of the observations, there by produced more yield ranging from 1151.6 to 1310.3 kg seed/ha. Incremental cost benefit ratio indicated that most favourable return was obtained under Dimethoate 30EC (1:20.8 & 1:13.3) followed by Oxydemeton-methyl 25EC (1:16.8 & 1:9.1), while poor incremental cost-benefit ratio was observed in Fipronil 5SC (1:5.8 & 1:2.1) and Acephate 75 SP (1:7.1& 1:4.3) during the year 2010-11 and 2011-12, respectively.

***Keywords*:** Mustard aphid, incidence, weather parameters, synthetic insecticides, economics

Introduction

Rapeseed-mustard (*Brassica* sp.) is a major group of oilseed crop of the world being grown in 53 countries across the six continents, with India being the third largest producer after China and Canada (FAO 2009). It is also important *rabi* oilseed crop of West Bengal cultivated in about 410.793 thousand ha with total production of about 419.58 thousand tones and average productivity of 1021 kg/ha (Anon 2011). Among various biotic factors responsible for reducing the yield of rapeseed-mustard, insect pests are the major one. Thirty eight insect pests are known to be associated with rapeseed-mustard crop in India (Bakhetia & Sekhon 1989). Among them mustard aphid, *Lipaphis erysimi* (Kalt.) is the key pest in all the mustard growing regions of the country. Nymphs and adults of the mustard aphid suck cell sap from the leaves, inflorescences and immature pods resulting into very poor pod setting and yield. On the other hand, aphid produces a good amount of honey dew which facilitates the growth of the fungus that makes the leaves and pods appear dirty black (Awasthi 2002). *Lipaphis erysimi* causes 35.4 to 96 % yield loss, 30.9 per cent seed weight loss and 2.75 per cent oil loss (Bakhetia & Sekhon 1989, Singh & Premchand 1995, Bakhetia & Arora 1986). In view of combating the notorious pest, the present investigation was undertaken to study the incidence and management of mustard aphid.

Materials and Methods

To study the incidence of mustard aphid, seeds of B-9 (*Brassica rapa* L. var. yellow sarson) were sown during the *rabi* season of 2009-10, 2010-11 and 2011-12 in the plot size of 4 x 2.8 m^2 with three replications at Pulses and Oilseeds Research Station (PORS), Berhampore, Murshidabad (West Bengal). In each plot the row to row distance was 40 cm and plant to plant 10 cm, which was maintained by thinning. A fertilizer dose of 100 kg N, 50 kg P and 50 kg K/ha was given to all the plots uniformly. Other recommended agronomic practices were followed in raising the crop. No plant protection measure was taken throughout the crop season. Aphid populations were counted from 10 randomly selected plants in each plot on top 10 cm twig at 7 days interval from appearance to final disappearance. The meteorological data were also considered during the period of study for correlation calculation.

The experiment on aphid management was laid out in a randomized block design with three replications having plot size of 4x3 m^2 during *rabi* season of 2010-11 and 2011-12 at PORS, Berhampore. Yellow sarson variety, Binoy (B-9) was sown at spacing of 40 x 10 cm with recommended agronomic practices for raising the crop. Application of insecticides namely, Fipronil 5 SC @ 50 g a.i./ha, Thiamethoxam 25 WG @ 25 g a.i./ha, Imidacloprid 17.8 SL @ 20g a.i./ha, Acetamiprid 20 SP @ 10 g a.i./ha, Acephate 75 SP @ 350 g a.i./ha, Dimethoate 30 EC @ 300 g a.i./ha and Oxydemeton-methyl 25 EC @ 250 g a.i./ha were done at ETL level of mustard aphid (30-35 aphids/twig) using manually operated knapsack sprayer having duromist nozzle. Aphid population was counted from 10 apical twigs/plot each of 10 cm length at 1 day prior to spraying and 3, 7 & 10 days after spraying. The yield of seed from each plot was weighed separately. Data were complied and analyzed statistically. Incremental cost benefit ratio (ICBR) for each treatment was calculated by dividing net gain over control by total cost of plant protection. Finally, net ICBR for each treatment was evaluated by dividing net profit by total cost of plant protection measure.

Results and Discussion

Incidence of mustard aphid

During the year 2009-10 and 2011-12, the initial appearance of aphid was recorded from last week of December whereas during 2010-11, it appeared from 1st week of January (Table-1). The aphid population reached the peak on the same time i.e., 6th standard week (5 to 11th February) in all the years (Table 1). The correlation coefficient between aphid population and weather parameters could not establish a clear cut trend in relationship of aphid population with weather factors (Table 2). The observations are in conformity with the findings of Choudhury & Pal (2009), Singh & Lal (1999) and Dogra *et al*. (2001). Contrary to the present finding, Desh *et al*. (2002) observed that aphid population registered significantly negative correlation with maximum and minimum temperature while

with rainfall showed positive correlation. In the present study none of the weather parameters alone was responsible for the multiplication and growth of the aphid. It is assumed that for a major part of the *rabi* season, the weather factors remained conducive for the rapid multiplication of aphid. Moreover, the aphid population reached peak level coinciding with the flowering stage of the crop.

Chemical control

The data on aphid population before and after spray during 2010-11 was presented in table 3. Pre-treatment aphid population was found to be uniformly distributed in all the treatments and ranged from 261.00 to 288.1 aphids/10 cm apical twig. After 3, 7 & 10 days of spray most of the insecticidal treatments significantly reduced the aphid population than untreated control plot. Dimethoate 30EC and Oxydemeton-methyl 25EC were found to be most effective in reducing the aphid population. Fipronil 5 SC and Acephate 75 SP were found least effective and significantly inferior to remaining insecticides. Significantly higher yield (639.67 to 1310.3 kg/ha) was recorded in all the treatments than the untreated control (324.67 kg/ha).The highest seed yield was recorded from the plots treated with Oxydemeton-methyl 25EC which was statistically at par with the Dimethoate 30EC. Plots treated with Acephate 75SP showed the lowest seed yield. The chronological order of various insecticides based on reaction on aphid infestation and seed yield was Oxydemeton-methyl 25 EC> Dimethoate 30 EC> Acetamiprid 20SP> Thiamethoxam 25WG> Imidacloprid 17.8SL > Fipronil 5SC > Acephate 75SP. While, no significant difference in yield was observed in the treatment with Acetamiprid 20SP, Thiamethoxam 25WG and Imidacloprid 17.8SL.

Results of the insecticidal treatment during 2011-12 were presented in the table 4. In terms of effect of insecticides on aphid population and yield the treatments may be ranked as Dimethoate 30EC > Oxydemeton-methyl 25EC > Imidacloprid 17.8SL > Thiamethoxam 25WG > Acetamiprid 20SP > Acephate 75SP > Fipronil 5SC with little fluctuation.

ICBR was worked out for each treatment during 2010-11 by calculating prevailing market prices of insecticides, mustard seed and cost of labourers (Table 5). The economics of various synthetic insecticides revealed that the highest net realization (Rs.29568/ha) was obtained from the treatment with Oxydemeton - methyl followed by Dimethoate (Rs.27753ha), Acetamiprid (Rs.20550/ha), Thiamethoxam (Rs.20440/ha), Imidacloprid (Rs.20170/ha), Fipronil (Rs.9936/ha) and Acephate (Rs.9450/ha). Most favourable net ICBR (NICBR) was registered from Dimethoate (1:19.8) followed by Oxydemeton-methyl (1:15.8), while poor NICBR was observed in Fipronil (1:4.8) and Acephate (1:6.1).

The economics of various insecticides used during 2011-12 revealed that Dimethoate was the most economic insecticides like the previous year with cost benefit ratio of 1:13.3 followed by Oxydemeton-methyl, Thiamethoxam, Imidacloprid, Acetamiprid, Acephate and Fipronil (Table 6).

In both the years, Dimethoate 30EC and Oxydemeton methyl 25 EC were found to be most effective insecticides in reducing aphid population as well as registering the optimum yield. This report is in conformity with the findings of Singh & Lal (2011), Gami *et al*. (1980) and Sekhon *et al*. (2008). Whereas, Gour & Pareek (2003) found maximum seed yield by spraying Imidacloprid 0.05% (14.9 q/ha) followed by Dimethoate 0.03% (11.9 q/ha) and Acephate 0.05% (11.1 q/ha).

Yield enhancement with aphid management is observed which have potential to reduce or even stop the oil dependence in this region. However, further detailed study on surveillance whether any development of the biotype of mustard aphid, development of biotechnological approaches of aphid management and development of resistance variety are required for sustained oilseeds production in this region.

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Table 1.
Incidence of *Lipaphis erysimi* Kalt. on yellow sarson and weather data during 2009-12 at Berhampore, West Bengal

Year 2009-10								Year 2010-11							Year 2011-12					
Std. week	Aphid/ twig	Rain-fall (mm/ week)	Temperature (^{0}C)		RH (%)		Wind speed (km/hr.)	Aphid/ twig	Rain-fall (mm/ week)	Temperature (^{0}C)		RH (%)		Wind speed (km/hr.)	Aphid/ twig	Rain-fall (mm/ week)	Temperature (^{0}C)		RH (%)	
			Max.	Min	Max	Min				Max.	Min	Max	Min				Max	Min.	Max	Min.
51	0	0	26.3	14.1	82	46	1.4	0	0	24.3	10.7	84	42	1.6	0	0.0	22.1	12.3	89.0	34.0
52	3	0	24.0	12.0	77	61	1.5	0	0	25.9	10.2	89	44	0.8	0.7	0.0	22.5	12.0	88.0	30.0
1	2.3	0	21.7	10.3	94	52	3.9	1.7	0	24.4	10.6	89	43	2.7	7.4	1.0	23.6	10.8	93.0	62.0
2	4.3	0	21.5	9.9	92	55	2.7	9.7	0	20.5	7.7	94	54	2.7	4.4	0.0	21.8	9.5	91.0	65.0
3	5.7	0	19.4	10.8	96	68	3.2	21.6	6.4	23.5	9.5	84	43	1.6	10.4	0.0	23.7	11.8	92.0	42.0
4	8.7	0	25.7	10.5	89	42	2.3	27.3	0	25.4	12.0	90	43	1	8	1.0	24.1	10.3	88.0	24.0
5	30.7	0	26.9	11.6	81	37	1.5	29.5	0	24.5	12.8	95	47	1.2	33.6	0.0	25.5	10.8	81.0	31.0
6	49.5	0	26.7	13.7	81	40	1.2	38	0	28.5	12.4	89	38	1.1	82	0.0	27.6	13.2	84.0	37.0
7	22.1	0.8	28.3	17.7	81	42	1.9	23	0.8	30.5	13.7	86	38	1.3	51	0.0	27.2	14.5	87.0	44.0
8	19.4	0	28.9	15.7	89	42	1.5	18.7	1.2	26.6	15.2	85	45	1.6	43.4	0.0	30.7	16.8	85.0	41.0
9	15	0	32.6	18.4	70	34	1.6	18.2	0	30.0	15.3	64	33	1.5	5.8	0.0	31.0	15.2	75.0	33.0
10	2.3	0	34.3	19.7	66	27	2	1.7	0	33.9	18.4	61	33	2	1	0.0	33.3	17.1	70.0	37.0

Table 2.
Correlation coefficient between aphid population and weather parameters

Year of study	Rainfall (mm)	Temp (^{o} C)		RH (%)		Wind speed (km/hr)
		Max	Min	Max	Min	
2009-10	0.181	0.214	0.131	-0.117	-0.365	-0.498
2010-11	0.178	0.059	0.094	0.271	-0.044	-0.473
2011-12	-0.231	0.284	0.233	-0.033	-0.053	-

Table 3.
Bioefficacy of various synthetic insecticides against mustard aphid, *Lipaphis erysimi* Kalt. during 2010-11

Treatment	Aphid population/10cm apical twig				Yield (kg/ha)
	Before spray	3 DAS	7 DAS	10 DAS	
T_1=Fipronil 5SC @ 50g a.i./ha	263.5 (5.57)*	84.23 (4.43)	121.23 (4.80)	10.83 (2.38)	655.87 (6.49)
T_2=Thiamethoxam 25WG @ 25g a.i./ha	271.0 (5.60)	27.47 (3.31)	16.30 (2.79)	7.90 (2.07)	1006.00 (6.91)
T_3=Imidacloprid 17.8 SL@ 20g a.i./ha	263.1 (5.57)	20.63 (3.03)	14.80 (2.69)	6.30 (1.84)	997.00 (6.90)
T_4=Acetamiprid 20 SP @ 10g a.i./ha	288.1 (5.66)	60.40 (4.10)	22.03 (3.09)	13.43 (2.60)	1009.67 (6.92)
T_5=Acephate 75 SP @ 350g a.i./ha	261.0 (5.56)	109.20 (4.69)	120.07 (4.79)	19.23 (2.96)	639.67 (6.46)
T_6=Dimethoate30EC@300g a.i./ha	280.7 (5.64)	14.30 (2.66)	5.33 (1.67)	2.50 (0.92)	1249.77 (7.13)
T_7=Oxydemeton-methyl 25EC @ 250g a.i./ ha	284.7 (5.65)	14.97 (2.71)	5.40 (1.69)	2.40 (0.88)	1310.33 (7.18)
T_8=Control	275.7 (5.62)	240.00 (5.48)	160.60 (5.08)	63.43 (4.15)	324.67 (5.78)
SEm (±)	0.14	0.10	0.31	0.21	0.09
CD (P=0.05)	NS	0.20	0.67	0.44	0.20

Figures in the parentheses are logarithmic transformed value, DAS-Days after spray, NS-Non-significant

Table 4.
Bioefficacy of various synthetic insecticides against mustard aphid, *Lipaphis erysimi* Kalt. during 2011-12

Treatment	Aphid population/ 10cm apical twig				Yield (kg/ha)
	Before spray	3 DAS	7 DAS	10 DAS	
T_1=Fipronil 5SC @ 50g a.i./ha	172.0 (5.1)*	51.7 (3.9)	25.3 (2.8)	4.4 (1.3)	734.1 (6.6)
T_2=Thiamethoxam 25WG @ 25g a.i./ha	105.3 (4.6)	36.7 (3.5)	10.0 (2.2)	3.1 (1.0)	898.0 (6.8)
T_3=Imidacloprid 17.8 SL@ 20g a.i./ha	139.7 (4.9)	26.0 (3.1)	10.7 (2.3)	6.7 (1.7)	901.6 (6.8)
T_4=Acetamiprid 20 SP @ 10g a.i./ha	103.7 (4.6)	25.5 (3.2)	10.0 (2.2)	7.1 (1.8)	886.7 (6.8)
T_5=Acephate 75 SP @ 350g a.i./ha	118.7 (4.7)	22.9 (2.9)	7.5 (2.0)	3.3 (1.2)	803.7 (6.7)
T_6=Dimethoate30EC@300g a.i./ha	119.3 (4.8)	14.3 (2.6)	5.3 (1.6)	3.7 (1.1)	1208.8 (7.1)
T_7=Oxydemeton-methyl 25EC @ 250g a.i./ha	109.3 (4.7)	16.8 (2.7)	6.7 (1.9)	4.4 (1.3)	1151.6 (7.0)
T_8=Control	108.7 (4.6)	143.0 (4.9)	131.3 (4.8)	78.1 (4.3)	615.3 (6.4)
SEm (±)	0.3	0.3	0.5	0.4	0.02
CD (P=0.05)	NS	0.6	1.1	0.9	0.05

Figures in the parentheses are logarithmic transformed value, DAS-Days after spray, NS-Non-significant

Table 5.
Economics of various synthetic insecticides used for control of mustard aphid, *Lipaphis erysimi* Kalt. during 2010-11

Treatment	Quantity of insecticides (ml/g per ha)	Rate of insecticides (Rs/ Lor kg)	Total cost of insecticides & labour per ha (P)	Yield (kg/ ha)	Avoidable losses (%)	Gross realization (Rs./ha)	Net realization over control (Rs./ ha)(A)	Net Profit (Rs/ha)	ICBR (A/P)	NICBR
Fipronil 5SC	750	900	1725	655.9	50.5	19676	9936	8211	1:5.8	1:4.8
Thiamethoxam 25WG	125	2000	1300	1006.0	67.7	30180	20440	19140	1:15.7	1:14.7
Imidacloprid 17.8SL	125	2400	1350	997.0	67.4	29910	20170	18820	1:14.9	1:13.9
Acetamiprid 20SP	100	2200	1270	1009.7	67.8	30290	20550	19280	1:16.2	1:15.2
Acephate 75SP	500	550	1325	639.7	49.2	19190	9450	8125	1:7.1	1:6.1
Dimethoate 30EC	1000	285	1335	1249.8	74	37493	27753	26418	1:20.8	1:19.8
Oxydemeton-methyl 25EC	1000	710	1760	1310.3	75.2	39310	29568	27808	1:16.8	1:15.8
Control	-	-	-	324.7	-	9740	-	-	-	-

Labour charge Rs. 150/ labour/ day, Mustard seed @ Rs.30/ kg, Water necessary for spray 500 L/ha, ICBR- Incremental cost benefit ratio, NICBR- Net incremental cost benefit ratio

Table 6.
Economics of various synthetic insecticides used for control of mustard aphid, *Lipaphis erysimi* Kalt. during 2011-12

Treatment	Quantity of insecticides (ml/g)	Rate of insecticides (Rs/L or kg)	Total cost of insecticides and labour (P)	Yield (kg/ ha)	Avoidable losses (%)	Gross realization (Rs./ha)	Net realization over control (Rs./ ha)(A)	Net Profit (Rs/ ha)	ICBR (A/P)	NICBR
Fipronil 5SC	750	900	1725	734.1	16.2	22023	3564	1839	1:2.1	1:1.1
Thiamethoxam 25WG	125	2000	1300	898	31.5	26940	8481	7181	1:6.5	1:5.5
Imidacloprid 17.8SL	125	2400	1350	901.6	31.8	27048	8589	7239	1:6.4	1:5.4
Acetamiprid 20SP	100	2200	1270	886.7	30.6	26601	8142	6872	1:6.4	1:5.4
Acephate 75SP	500	550	1325	803.7	23.4	24111	5652	4327	1:4.3	1:3.3
Dimethoate 30EC	1000	285	1335	1208.8	49.1	36264	17805	16470	1:13.3	1:12.3
Oxydemeton-methyl 25EC	1000	710	1760	1151.6	46.6	34548	16089	14329	1:9.1	1:8.1
Control	-	-	-	615.3	-	18459	-	-	-	-