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Effect of Different Sowing Dates and Application of Selective Pesticides against Aphids (*Lipaphis erysimi*) Population in Mustard (*Brassica juncea*)

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A B S T R A C T

A field study was conducted to evaluate the effect of different sowing dates and application of selective pesticides against aphids (*Lipaphis erysimi*) population in mustard (*Brassica juncea*). Acephate 50 WG at 700 g. ha.$^{-1}$ T_3 (D_3C_3) was found to be most effective pesticide to control the mustard aphid population followed by Acetamiprid 20 % SP at 100 g. ha.$^{-1}$ and Imidacloprid 200 SC at 300 ml. ha.$^{-1}$ is moderately effective. Application of pesticide significantly controlled the aphid population which suggested that acephate 50 WG at 700 g. ha.$^{-1}$ could restrain the aphid infestation in mustard.

Introduction

Indian mustard (*Brassica juncea*) commonly known as raya, rai or laha is an important oilseed crop, among the Brassica group of oilseeds in India. It possesses a higher potential of production per unit area than other oleiferous members of the family Cruciferae. It is an annual plant or biennial herb. Rape seed and mustard are the major rabi oil seed crops of India. The origin of Indian mustard has been reported to be in China, it made its way into India through north eastern route.

The area, production and productivity of rape seed mustard in the world was 34.19 m. ha, 63.09 m. t, and 1850 Kg. ha^{-1} respectively, during the year 2012-2013. Globally India accounts for 19.29 % and 11.127 % of the total acreage and production (USDA, 2014).

In India, *Brassica* oil seeds are next to groundnuts in importance. Jammu and Kashmir, Punjab, Haryana, Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Odisha, West Bengal, Bihar and Assam are the important states growing mustard. Among these states, Rajasthan and Uttar Pradesh contribute the major share of mustard production in India (Gurujaran *et al*., 2008).

Oilseed crop does not require any special emphasis as these contribute a large share in

the export of the commodities after meeting the international demands for industry and domestic condition. A small portion of the total production of the oilseed was retained by the cultivar for seed and domestic consumption, while the remaining is sold out. The oil extracted, beside being consumed in our diet, are used for non edible purposes such as the manufacture of vanaspati, soaps, paints varnishes, lubricants, greases, hair oils and tooth paste etc., the oil cakes obtained are used as cattle feed as well as manure. Mustard plays an important role in the oil seed economy of the country. It has 38 to 42% oil and 24% protein (Maurya *et al*., 2012). Mustard is rich in minerals like Calcium, Manganese, Copper, Iron, Selenium, Zinc, Vitamin (A, B and C) and proteins.

The yield losses of mustard per year are one factor responsible for such loss is due to the ravage of insect pest attacking at various stages of the crop. Among them, Mustard aphids (*L. erysimi*) were the most devastating pest (Rouf and Kabir, 1997). The yield loss due to aphid infestation in mustard ranged from 87.16 to 98.16% (Anonymous, 1995). Abiotic factors seem to influence the aphid infestation due to large variation in the date of sowing, aphid infestation and its progress under favorable weather conditions. The average maximum and minimum relative humidity had a positive relationship with mean aphid infestation index. A minimum relative humidity of 30 to 35% and average maximum relative humidity of 85 to 88% were found to be the most congenial conditions for increase in aphid population (Narjary *et al.*, 2013).

Amongst the various insect pests invading mustard crops, mustard aphid, *Lipaphis erysimi* is considered the most serious and responsible for a yield loss ranging from 35.4 to 96 percent depending upon seasons (Firake *et al*., 2013). The Aphid is the most serious pest of the mustard crop in North India causing yield loss up to 93% (Verma and Singh, 1987). The uses of insecticides have been recommended for the effective control of this pest (Prasad, 1997). Keeping in view the above facts the present study was conducted to evaluate the effect of different sowing dates and pesticides application against aphids.

Materials and Methods

The present investigation was carried out in the research field of the School of Forestry and Environment, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, during the period from October 2014 to March 2015, Rabi season. Allahabad is located in the South-East part of Uttar Pradesh India. The experimental site (Research field) is at an elevation of 98 MSL, at 25.57º N latitude, 81.51º E longitude. All the required materials and facilities necessary for the cultivation readily available in the department. This region has a subtropical climate with extreme of summer and winter. These locations receive the mean annual rainfall ranges from 500 mm to 1500 mm. More than 70 per cent rains are received during S-W monsoon season 5 to 10 per cent rains are received in winter, 10-15 per cent in summer and 5-10 per cent during post monsoon season. Normal rainy days exceed 40 per annum. Summer monsoonal rainfall comes in downpours while winter rainfall comes in light drizzles and is easily absorbed in soils. Temperatures vary greatly in these regions. May and June are the hottest and December and January is the coldest. Monthly mean temperature more than 25 °C prevails during 8-10 months of the year. During May and June maximum temperature rises above 40 °C and hot dry winds are common features. In January, the normal mean minimum temperature remains around 8 to 10°C. Frost for one or two days may also

occur during winter months (Patra *et al.*, 2016). Pre-sowing operations i.e., the experimental field was prepared by cleaning and ploughing with the help of casual labours. The weeds were picked up in order to get clean and after that, it was leveled. For fertilizer application, the uniform dose of phosphorus and potash at 60, 40 kg ha^{-1} through DAP, MOP respectively and 40 kg N ha^{-1} through urea, were applied at the sowing time. The remaining amount of nitrogen (40 kg ha^{-1}) was applied at 41st day after each date sowing in all plots. The Mustard variety used was Parsamani-8, make seeds as seeds were sown in rows at 30 cm apart at a depth of 2.5 - 3 cm in the soil. The seed rate taken was 4.5 kg ha^{-1}. Post sowing operation i.e. Gap Filling were done after seed germination was observed on the 6th, 7th, 8th day of 1st, 2nd, 3rd sowing date respectively. Seeds were re-sown in the gaps where the previous seeds failed to germinate. Thinning was done at 25 days after every sowing when the crop has attained of 6 - 8 leaves. This operation was done for maintaining a proper plant to plant distance and standard plant population. Weeding was done by labours over on at 24th November, 5th and 22 December, 2014. This was done to maintain weed free environment during the initial crop growth stages.

Inter- cultivation was done by loosening the soil and earthing up was done while weeding for soil aeration for proper growth and development of plants and to protect from lodging. Irrigation was done on 45 days after the date of sowing for proper growth of plants. Second irrigation was done 75 days before pre-flowering of each sowing dates. The top dressing was done with the remaining half dose of nitrogen as urea at 47 days after sowing. Nitrogen was applied by furrow placement method at a distance of about 10 cm from the crop rows. The weather data were collected from the Meteorological observatory, SHIATS, Allahabad during the experimental period (Table 2). The experiment was carried out in a factorial design laid out as randomized block design with three replications (Gomez and Gomez, 1984). Each replication was divided into sixteen plots in the lengthwise direction, and the different treatments were allocated randomly in each replication. The experiment has two factors 1). Date of sowing- D_1 -First sowing date: 9th October, D_2- Second sowing date: 19th October, D_3- Third sowing date: 29th October; 2). Insecticide- C_1- Control, C_2- Imidacloprid 200 SC at (300 ml / ha.), C_3- Acetamiprid 20 % SP (100 g / ha.), C_4- Acephate 50 WG (700 g / ha.). The treatments details as follows (Table 1).

The observation on population dynamics of mustard aphids was recorded on the first day of every standard week between 09.00 to 13.30 hrs for untreated plots throughout the stand of a crop. When its appearance was first noticed, 5 plants were selected randomly and tagged to record aphids population in treated and untreated plots of each replication. The population was recorded from a 15 cm long top portion of central twig on a white paper sheet causing least possible disturbance as suggested by Singh and Singh (1982) and for treated plots observation recorded at 09.00 hrs to 13:00 hrs as on 1st Spraying one day before 1st Spraying, 3rd day after 1st spraying, 7th day after 1st spraying and 15th day after spraying. Similarly, the data were recorded after the second spraying in same manner.

Results and Discussion

The data on number of aphids per plant presented in table 3 reveal that, one day before spraying, the maximum number of aphids per plant was found in T_4 (Second sowing date / Control) with 33.90 and minimum number of aphids per plant was observed in T_9 (Third sowing / Imidacloprid 200 SC) with 16.20. It was found that there

was non-significant effect by different sowing treatments. There was no significant effect of different sowing dates.

Three days after spraying it was found that there was significant effect by different sowing treatments. The maximum number of aphids per plant was found in T_4 (Second sowing date / Control) with 1.64 and no aphids per plant was observed in T_3 (First sowing / Acephate 50 WG), T_7 (Second sowing / Acephate 50 WG), T_9 (Third sowing / Imidacloprid 200 SC), T_{10} (Third sowing/ Acetamiprid 20 % EC), T_{11} (Third sowing / Acephate 50 WG). Because of application of pesticides and also due to heavy rainfall the aphids are washed of 2 days after spraying. The present findings were in accordance of Bhatia and Sharma, (2014) who reported that among the insecticide Acephate 75 SP at 350 g a.i./ ha. is most effective for destruction of aphids, followed by Acetamiprid 20 SP at 10 g a.i./ ha after spraying of chemicals. Seven days after spraying it was found that there was significant effect by different sowing treatments. The maximum number of aphids per plant was found in T_0 (First sowing date / Control) with 15.57 and a minimum number of aphids per plant was observed in T_{11} (Third sowing / Acephate 50 WG) with 1.00. On 15 days after spraying it was found that there was significant effect by different sowing dates. The maximum number of aphids per plant was found in T_0 (First sowing date / Control) with 8.97 and minimum number of aphids per plant was observed in T_{11} (Third sowing / Acephate 50 WG) with 0.34 (Table 4). The decrease in temperature in January month also has significant negative effect on number of aphids without pesticides application (Nirmala *et al*., 2001).

Table.1 Treatment combinations of the experiment

S. No.	Treatment	Treatment Combination	Code
1	T_0	First sowing date / Control	$D_1 C_1$
2.	T_1	First sowing date / Imidacloprid 200 SC	D_1C_2
3.	T_2	First sowing date / Acetamiprid 20 % SP	D_1C_3
4.	T_3	First sowing date / Acephate 50 WG	D_1C_4
5.	T_4	Second sowing date / Control	D_2C_1
6.	T_5	Second sowing date / Imidacloprid 200 SC	D_2C_2
7.	T_6	Second sowing date / Acetamiprid 20 % SP	D_2C_3
8.	T_7	Second sowing date / Acephate 50 WG	D_2C_4
9.	T_8	Third sowing date / Control	D_3C_1
10.	T_9	Third sowing date / Imidacloprid 200 SC	D_3C_2
11.	T_{10}	Third sowing date / Acetamiprid 20 % SP	D_3C_3
12.	T_{11}	Third sowing date / Acephate 50 WG	D_3C_4

Table.2 Mean weekly weather parameters during crop growing season (Rabi 2014-2015)

Standard week	Temperature		Relative humidity		Rainfall (mm)	Sun shine hours (hrs)	Wind speed (km/hr)
	T_{max}	T_{min}	7 a.m	2 p.m			
October							
41	30.63	25.82	84.14	49.42	0	7.6	1.07
42	32.01	21.81	87	62.42	15.8	6.08	1.91
43	33.24	20.14	87	53.28	0	8.42	0.69
44	32.6	20.31	85.71	52.57	0	8.28	0.55
November							
45	33.17	19.57	86.28	45.71	0	8.18	0.81
46	32.25	16.57	87	46.71	0	8.25	0.6
47	29.71	12.02	85	45.28	0	8	0.66
48	30.57	11.14	82.28	43.14	0	8.1	0.55
December							
49	30.54	12.37	82.85	44	0	8.38	0.6
50	29.08	8.2	86	47.28	0	8.21	0.7
51	24.68	9.45	89	60.42	1.2	5.08	1.28
52	19.17	7.9	94.57	58.71	0	0.64	1.15
January							
1	17.62	10.85	93.42	64	4.71	0	1.31
2	22.62	11.82	91	57.42	0	0	1.47
3	15	7.7	93.71	72.14	0	0	1.34
4	18.82	9.24	93.71	64.85	1.16	0	0.28
5	19.65	13.04	91.14	63.14	1.76	1.2	4.57
February							
6	27.22	12.37	89.57	54.28	1.85	3.4	0.28
7	26.48	11.31	89.14	49.57	1.44	4.54	0.45
8	30.54	12.62	86.28	47.42	1.25	6.82	0
9	30.81	14.65	87.28	50.71	1.92	6.86	0
March							
10	28.62	14.68	93.57	62	2.26	4.61	4.17
11	31.6	15.8	85.42	45.14	1.25	7.74	0

Table.3 Effect of different sowing dates and application of pesticides one before and three days after 1st spraying on number of aphids plant^{-1}.

	One day before					3 days after spraying				
	Name of Pesticide (C)					**Name of Pesticide (C)**				
Date of sowing (D)	Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)	**Mean (D)**	Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)	**Mean (D)**
1st date of sowing (D_1)	19.68	18.84	30.68	29.26	**24.62**	2	1.33	0.66	0	**1**
2nd date of sowing (D_2)	33.90	28.48	25.79	23.78	**27.99**	1.64	0.66	0.33	0	**0.66**
3 rd date of sowing (D_3)	22.69	16.20	16.81	16.95	**18.16**	1.33	0	0	0	**0.33**
Mean (C)	**25.42**	**21.17**	**24.43**	**23.33**		**1.66**	**0.66**	**0.33**	**0**	
		F-test	S. Em. (±)	C.D. at 5%			F-test	S. Em. (±)	C.D. at 5%	
Date (D)		NS	3.781	8.09			S	0.26	0.41	
Pesticide (C)		NS	4.384	9.341			S	0.282	0.455	
Int. (D x C)		NS	7.681	16.18			S	0.4	0.701	

Table.4 Effect of different sowing dates and application of pesticides seven days and fifteen days after 1st spraying on number of aphids plant^{-1}

	7 days after 1st spraying					15 days after 1st spraying				
Date of sowing (D)	**Name of Pesticide (C)**				**Mean (D)**	**Name of Pesticide (C)**				**Mean (D)**
	Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)		Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)	
1st date of sowing (D_1)	15.57	3.64	2.34	2.00	**5.89**	8.97	2.64	1.00	0.34	**3.24**
2nd date of sowing (D_2)	10.31	2.64	2.00	1.64	**4.15**	7.63	2.00	1.64	1.33	**3.15**
3 rd date of sowing (D_3)	4.51	1.34	1.36	1.00	**2.05**	3.86	2.00	1.66	0.34	**1.97**
Mean (C)	**10.13**	**2.54**	**1.90**	**1.55**		**6.82**	**2.21**	**1.43**	**0.67**	
		F-test	S. Em. (±)	C.D. at 5%			F-test	S. Em. (±)	C.D. at 5%	
Date (D)		S	0.756	1.439			S	0.614	1.145	
Pesticide (C)		S	0.854	1.643			S	0.691	1.303	
Int. (D x C)		S	1.392	2.758			S	1.108	2.17	

Table.5 Effect of different sowing dates and application of pesticides one day before and three days after 2nd spraying on number of aphids plant^{-1}

	1 day before 2nd spraying					3 days after 2nd spraying				
Date of sowing (D)	**Name of Pesticide (C)**				**Mean (D)**	**Name of Pesticide (C)**				**Mean (D)**
	Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)		Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)	
1st date of sowing (D_1)	35.56	14.35	10.66	16.06	**19.16**	15.59	2.34	1.00	0.66	**4.90**
2nd date of sowing (D_2)	31.56	15.50	18.32	21.34	**21.68**	59.89	3.34	1.67	0.34	**16.31**
3rd date of sowing (D_3)	39.45	13.54	20.33	23.32	**24.16**	96.46	3.34	2.34	0.64	**25.70**
Mean (C)	**35.52**	**14.46**	**16.44**	**20.24**		**57.31**	**3.01**	**1.67**	**0.55**	
		F-test	S. Em. (±)	C.D. at 5%			F-test	S. Em. (±)	C.D. at 5%	
Date (D)		S	1.734	3.725			S	3.218	6.803	
Pesticide (C)		S	2.021	4.319			S	3.734	7.874	
Int. (D x C)		NS	3.588	7.569			S	6.556	13.725	

Table.6 Effect of different sowing dates and application of pesticides seven days and fifteen days after 2nd spraying on number of aphids plant^{-1}

Date of sowing (D)	7 days after 2nd spraying					15 days after 2nd spraying				
	Name of Pesticide (C)				Mean (D)	Name of Pesticide (C)				Mean (D)
	Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)		Control (C_1)	Imidacloprid 200 SC (C_2)	Acetamiprid 20% SP (C_3)	Acephate 50 WG (C_4)	
1st date of sowing (D_1)	3.34	0.00	0.00	0.00	**0.84**	0.00	0.00	0.00	0.00	**0.00**
2nd date of sowing (D_2)	31.66	2.67	2.34	1.66	**9.58**	0.00	0.00	0.00	0.00	**0.00**
3rd date of sowing (D_3)	130.40	21.78	11.24	8.08	**42.88**	7.08	2.66	1.67	0.34	**2.94**
	55.13	**8.15**	**4.53**	**3.25**		**2.36**	**0.89**	**0.56**	**0.11**	
		F-test	S. Em. (±)	C.D. at 5%			F-test	S. Em. (±)	C.D. at 5%	
Date (D)		S	3.477	7.341			S	0.248	0.386	
Pesticide (C)		S	4.034	8.495			S	0.268	0.428	
Int. (D x C)		S	7.075	14.802			S	0.377	0.653	

In the case of second spraying the data on number of aphids per plant presented in tables 5 and 6 revealed that: On one day before spraying, it was found that there was a significant effect in different date of sowing. The maximum number of aphids per plant was found in T_8 (Third sowing date / Control) with 39.45 and a minimum number of aphids per plant was observed in T_2 (First sowing date / Acetamiprid 20% SP) with 10.66 numbers. Three days after spraying it was found that there was a significant difference within the treatments. The maximum number of aphids per plant was found in T_4 (Second sowing date / Control) with 96.46 and a minimum number of aphids per plant was observed in T_3 (Second date of sowing / Acephate 50 WG) with 0.34. Khedkar *et al.* (2012) also reported that the application of Imidacloprid 17.8 SL (0.008%), Acetamiprid 20 SP (0.01%) and Acephate (0.075%) was most effective for to control of the population of mustard aphids. In case of seven days after spraying it was observed that the maximum number of aphids per plant was found in T_8 (Third sowing date / Control) with 130.40 and no aphids per plant was observed in T_1 (First sowing date / Imidacloprid 200 SC) T_2 (First sowing date / Acetamiprid 20% EC) T_3 (First sowing date / Acephate 50 WG). This may be due to the gradual increase in temperature (32^0 C) and the crop was forced to maturity further it reduced to zero number of aphids.

15 days after spraying found that there was significant effect by different sowing treatments. The maximum number of aphids per plant was found in T_8 (Third sowing date / Control) with 7.08 and no aphids per plant was observed in all treatments of first sowing and second sowing dates. Because of gradually increase in temperature (32.6^0 C) and also crop is forced to maturity further it reduced to zero number of aphids. Hugar and Pratiba (2008) aslo found that the with the increase in temperature there is decrease in population of aphids. All the findings are more or less in agreement with the findings of the present study. Few variation were found which might be due to the variation of doses of insecticides and place (Maula *et al.* 2010).

It was concluded that all of the three sowing dates with the application of Acephate 50 WG at 700 g. $ha.^{-1}$ T_3 (D_3C_3) is most effective to control the mustard aphid population followed by Acetamiprid 20 % SP at 100 gm. $ha.^{-1}$ and Imidacloprid 200 SC at 300 ml. $ha.^{-1}$ are moderately effective.

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