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Evaluation of different plant leaf extracts against mustard aphid [*Lipaphis erysimi* (Kalt.)] in rapeseed field

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Abstract

Rapeseed is highly vulnerable to attack by various insect pests. The use of botanicals for control of insect pests is an eco-friendly practice, more compatible with the environmental components, and non-hazardous to human beings. This experiment was conducted to evaluate the effects of different plant leaf extracts against Mustard aphid (*Lipaphis erysimi* Kalt.) from November 2016 to March 2017 at research field of Institute of Agriculture and Animal Science, Lamjung Campus, Lamjung, Nepal. Five different plant leaf extracts derived from Neem, Bakaino, Hattibar, Khirro, and Bojho, along with Cypermethrin 10% EC@ 1.5 mL/L of water; and control (without treatment) were evaluated against Mustard aphids. The experiment was conducted in a randomized complete block design with three replications. Morang-2 variety of Rapeseed was planted in the field and the Rapeseed plant was sprayed with prepared plant leaf extracts on 30 days after sowing (DAS), 45 DAS and 60 DAS, and aphid number was counted after 5, 10 and 15 days of each spray from 10 cm apical shoot. The results showed that the application of Cypermethrin 10% EC @ @ 1.5 mL/L of water significantly reduced the aphid population followed by the Complete mixture and the mixture without Khirro. The highest grain yield (1436.75 kg/ha) was found in Complete mixture treated plots. It was concluded that all these plant leaf extracts showed insecticidal properties against aphid in rapeseed crops and successfully be integrated as a part of Integrated Pest Management.

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Introduction

Rapeseed (*Brassica campestris* L.var. *tori*; Family: Brassicaceae) is the best oilseed crop and has the highest acreage among all the oilseed crops grown in the country, i.e.85% (Ghimire et al., 2000). In Nepal, the total area under Rapeseed cultivation is 173254 ha, its production is 152263 mt and productivity is 879 kg/ha (CBS, 2014). In spite of the importance of oilseed crops, the average productivity (0.87 t/ha) in Nepal is low as compared to that of the world of 1.28 t/ha (NORP, 2014). Among many factors responsible for low yield,

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insect pests play a significant role in reducing the yield and this crop is attacked by about 25 species of insect pests resulting in both quantitative and qualitative losses varying from 45-50% (Pradhan et al., 1960). Among them Mustard aphid is the most destructive insect pest (Biswas et al., 2000). The yield losses of 27-69% due to attack of aphid (Bakhetia and Brar, 1983) and 15% reduction in its oil content (Verma and Singh, 1987).

Chemical insecticides still remain the key tool for the control of this pest. Farmers spray insecticides in their fields indiscriminately which causes phytotoxicity, resistance in pest, destruction of beneficial organisms, disruption of agro-ecosystem, human health hazards, and environmental pollution (McIntyre et al., 1989). With several investigations, application traditional organic insecticides recommended as the best alternative to control Mustard aphid (Khurana et al., 1989). Botanicals are comparatively less toxic, less expensive, and also safe for beneficial organisms. Among 2400 species of Bio-active plants in the world, almost 324 are found in Nepal (Neupane, 2005). These abundant naturally occurring biologically active plants appear to have a prominent role in the development of future commercial pesticides in Nepal, not only for increased productivity but for the safety of the environment and public health.

The objective of this experiment was to evaluate the insecticidal properties of different plant leaf extracts against Mustard aphid in Lamjung, Nepal.

Materials and Methods

Experimental site

The experiment was conducted at the horticultural farm of Institute of Agriculture and Animal Science (IAAS), Lamjung Campus, Lamjung, Nepal. This place has a humid tropical climate with an annual rainfall of 280 cm. The geographical position of the farm is at the latitude of 28° 8' 41"N and longitude of 84° 24' 43" E and elevation of 610 masl.

Experimental design, treatments and crop management

The experiment was conducted during the winter season of 2016/17. The field was prepared by plowing, disking and leveling and seeds were sown in each plot with spacing of 30 cm row to row and 10 cm plant to plant spacing. Seeds of Rapeseed variety Morang-2 were sown on 21st November in 2m×2.1m size plots in a randomized complete block design with 7 treatments and 3 replications. All the crop management practices were followed as recommended by the National Oilseed Research Program, Nawalpur, Sarlahi.

Table 1. Detail of treatments used in the experiment

S.N.	Detail of treatments
1	T1: Complete mixture: Mixture of all plants leaf extract derived from Neem, Bakaino, Hattibar and Khirro
2	T2: Mixture of all plants leaf extract without Neem
3	T3: Mixture of all plants leaf extract without Bakaino
4	T4: Mixture of all plants leaf extract without Hattibar
5	T5: Mixture of all plants leaf extract without Khirro
6	T6: Chemical i.e. Cypermethrin 10% EC
7	T7: Control (Water spray)

Preparation of leaf extracts

The leaves of Neem (*Azadiractin indica*), Bakaino (*Melia azedirach*), Hattibar (*Agave americana*), Khirro (*Sapium insigne*), Bojho (*Acorus calamus*), and Tobacco (*Nicotiana tabaccum*) were chopped separately of 1-2 cm long. These chopped leaves of Neem, Bakaino, Hattibar, Khirro @ 150 g while Bojho and Tobacco leaf @ 75g were used for the preparation of extracts in fresh cow urine (3 litres in each extract). Total five extracts were prepared, one by mixing all the leaf while the remaining four extracts were prepared excluding one ingredient in each mixture but keeping Tobacco and Bojho in all five extracts. The prepared extracts were decomposed for 1 month period by mixing it once in each week.

Preparation of spray

The well-decomposed plant extract was filtered with the muslin cloth and then mixed the filtrate with water at a 1:4 ratio while Cypermethrin 10% EC @ 1.5 mL/L of water and then sprayed with the help of hand sprayer (2 lit capacity) at 15 days interval after 1 month (30 days) of sowing three times i.e. 30DAS, 45DAS, and 60DAS.

The spray was prepared as below;

- First spray (30 DAS):1200 mL water and 300 mL plant leaf extract
- Second spray (45 DAS):1600 mL water and 400 mL plant leaf extract
- Third spray (60 DAS):2000 mL water and 500 mL plant leaf extract.

Similarly, Chemical i.e. Cypermethrin was prepared as below;

- First spray (30 DAS):1.5 mL chemical/ 1 litre of water
- Second spray (45 DAS): 3 mL chemical / 2 litre water
- Third spray (60 DAS):4 mL chemical/2.5 litre water

Data observation

The population of Mustard aphid was observed and recorded at 5^{th}, 10^{th} and 15^{th} days of each spray from 10 cm apical twig (centre branch) of randomLy selected 5 plants of each plot.

Statistical analysis

Data were statistically analyzed. Analysis of variance for all data was analyzed using the GENSTAT (version 14^{th} edition; VSN International, Hemel Hempstead, UK). The significant differences between genotypes were determined using the least significant difference (LSD) test at 1% or 5% level of significance (Gomez and Gomez, 1984; Shrestha, 2019).

Results and Discussion

Effect of Plant extracts on reduction of aphid after first spray

The effects of different plant leaf extract on aphid population after the first spray was given in Table 4. During the first spray, the chemical treated plot was found to be almost free from the attack of mustard aphid while the control plot showed the highest incidence of aphid in all readings. Among plant extracts, the Complete mixture reduced the aphid number statically the same as chemical. At 15 days after spraying, the application of Cypermethrin 10% EC @ @ 1.5mL/L of water significantly reduced the aphid population (0.07) followed by the Completemixture (1.20) and mixture without Khirro (2.73). Biswas (2013) was also found that the chemical treated plot has a minimum number of aphid than locally prepared plant extracts and control treatments.

Table 1. Effects of different plant leaf extracts on aphid population after first spray

Treatments	Number of aphid/plant (10 cm apical shoot)		
	5DASp	10DASp	15DASp
Complete Mixture	1.60^{ab}	1.73^{ab}	1.20^{a}
Mixture without Neem	4.67^{ab}	7.20^{b}	10.67^{bc}
Mixture without Bakaino	4.53^{ab}	6.00^{ab}	5.13^{ab}
Mixture without Hattibar	3.53^{ab}	4.53^{ab}	3.87^{ab}
Mixture without Khirro	2.47^{ab}	3.53^{ab}	2.73^{ab}
Cypermethrin 10% EC	0.00^{a}	0.20^{a}	0.07^{a}
Control	9.27^{b}	14.27^{c}	14.87^{c}
Grand Mean	3.72	5.35	5.5
F test	*	**	**
SEm ±	1.58	1.26	1.6
LSD (0.05)	4.87	3.87	4.94
CV (%)	73.6	40.7	50.5

*DASp: Days after spraying, *significant at 0.05 level, ** significant at 0.01 level*

Effect of Plant extracts on reduction of aphid after second spray

The effects of different plant leaf extract on aphid population after the second spray was given in Table 2. During Second Spray, altogether of aphid count in each treatment increases as compare to the previous spray reading. The trend of aphid incidence was the same which reflects that the complete mixture can better control mustard aphid than other selected extracts. Along with this, it was also analyzed that the effectiveness of plant extracts decreased with passing time of spray which can be justified by an increased in aphid count from 5 DASp to 15 DASp. Bhatt and GC (2005) also reported that the effectiveness of botanicals to reduce the aphid population was significantly higher until 5 days of spray and decreases gradually after that. Kafle (2015) also found that the effectiveness of insecticides decreased with increasing time of spray.

Table 2. Effects of different plant leaf extracts on aphid population after second spray

Treatments	Number of aphid /plant(10 cm apical shoot)		
	5DASp	10DASp	15DASp
Complete Mixture	0.20[a]	0.66[a]	0.20[a]
Mixture without Neem	4.80[b]	9.47[b]	9.66[b]
Mixture without Bakaino	3.60[ab]	4.33[ab]	5.20[ab]
Mixture without Hattibar	1.73[ab]	2.53[a]	3.73[a]
Mixture without Khirro	0.80[a]	1.67[a]	1.13[a]
Cypermethrin 10% EC	0.07[a]	0.67[a]	0.00[a]
Control	9.87[c]	18.47[c]	18.00[c]
Grand Mean	3.01	5.31	5.42
F test	**	**	**
SEm ±	0.80	1.09	1.10
LSD (0.05)	2.48	3.35	3.40
CV (%)	46.5	35.5	35.3

*DASp: Days after spraying, ** significant at 0.01 level*

Effect of Plant extracts on reduction of aphid after third spray

The effects of different plant leaf extract on aphid population after the third spray was given in Table 4. During the third spray also chemical and complete mixture resulted in maximum aphid reduction than other treatments and had statically similar effect while mixture without Neem and control-treated plots showed least effectiveness, remaining other extracts had statically similar effects. The result revealed that excluding Neem from the extract mixture (i.e. without Neem), the effect was the same as the control which signifies that Neem in the mixture must be needed for effective results.

Table 3. Effects of different plant leaf extracts on aphid population after third spray

Treatments	Number of aphid /plant (10 cm apical shoot)		
	5DASp	10DASp	15DASp
Complete Mixture	0.13[ab]	0.13[a]	0.20[a]
Mixture without Neem	4.40[bc]	5.93[bc]	4.20[b]
Mixture without Bakaino	2.60[ab]	1.8[ab]	2.66[ab]
Mixture without Hattibar	0.53[ab]	1.13[ab]	1.60[ab]
Mixture without Khirro	0.00[a]	0.46[a]	0.06[ab]
Cypermethrin 10% EC	0.00[a]	0.00[a]	0.00[a]
Control	7.80[c]	7.80[c]	8.20[c]
Grand Mean	2.21	2.47	2.56
F test	**	**	**
SEm ±	0.86	1.10	0.64
LSD(0.05)	2.67	3.39	1.99
CV (%)	68	77.4	43.7

*DASp: Days after spraying, *significant at 0.05 level, ** significant at 0.01 level*

Saikia et al. (2000) also reported that leaf extract of Neem in the plant extracts caused significant mortality of aphid which results in almost the same effect as chemical. The earlier works on the use of plant extracts have been also concluded the same result by Pandey et al. (1987).

Effect of plant extracts on grain yield of Rapeseed

The effects of different plant leaf extracts on grain yield of rapeseed were given in Figure 1. The application of the complete mixture produced the highest grain yield (1436.75 kg/ha) and the control plot produced the lowest grain yield (1126.90 kg/ha). This finding was supported by Biswas (2013) and Bhatta et al. (2019) who found the use of plant leaf extracts reduced the aphid population and increased the grain yield of rapeseed. The complete mixture produced a higher yield (but not statically different) even though the chemical which was highly effective to reduce aphid population, because of more pollinators and availability of nutrients through the complete mixture. The plots treated with plant extracts and chemical showed that yield was statically at par, it was because of less no of aphid than ETL (15 aphids/plant of 10 cm twig) in those plots during all the spray which leads to almost similar yield.

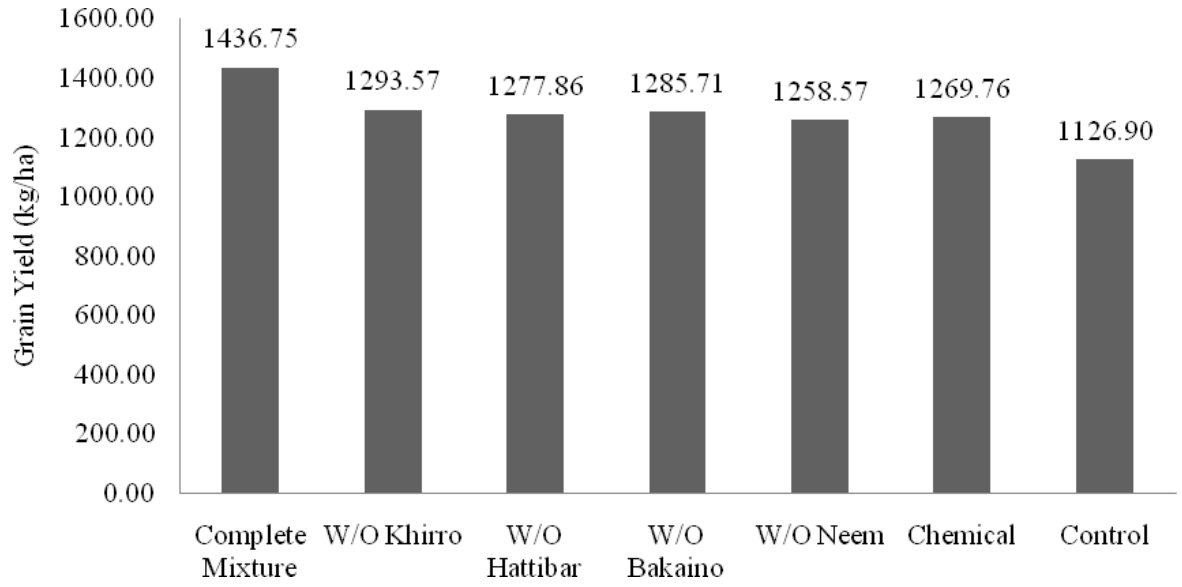

Figure1. Effect of different plant leaf extracts on mean grain yield of Rapeseed. (W/O: mixture without)

Conclusion

The incidence of Mustard aphids can be managed by spraying the mixture of plant leaf extracts derived from Neem, Bakaino, Hattibar, Khirro, and Bojho. The Complete mixture gave the best results next to the chemical in term of aphid number reduction and higher yield of Rapeseed. The use of the Complete mixture is an eco-friendly management practice; it is as emerging solution against Mustard aphid. This information would be helpful to the Mustard growers in Nepal.

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