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Aphidicidal potential of *Azadirachta indica, Adhatoda vasica, Vitex negundo, Parthenium hysterophorus* and *Lantana camara* against mustard aphid, *Lipaphis erysimi* Kaltenbach (Hemiptera:Aphididae)

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Abstract: Use of eco-friendly naturally occurring plant products in the management of the mustard aphid, Lipaphis erysimi Kaltenbach (Hemiptera:Aphididae) under laboratory conditions was carried out. The results revealed that the nymphs and adults mortality of mustard aphid varied significantly with three different concentrations (0.5, 1.0 and 2.0%) of five plant products. The mortality was high with seed kernel extracts of neem, Azadirachta indica killed nymphs and adults of L. erysimi (70.82 %) followed by leaves extracts of lagundi, Vitex negundo Linn. (69.40 %), leaves extract of Parthenium hysterophorus Linn. (65.38 %), leaves extract of arusa, Adhatoda vasica Nees. (55.81%), aerial parts of aripple, Lantana camara Linn. (51.70%) and untreated control (1.5 %), respectively. The seed kernel extracts of A. indica differed significantly from the remaining ones except V. negundo from which it does not differ significantly to one another. The effects of carrot grass, *P. hysterophorus* was recorded moderate aphidicidal action while *L. camara* caused the lowest mortality of nymphs and adults of *L. erysimi* among all treated natural products. Of the five plant products tested *A. indica* performed better under all the experimental conditions where as untreated control gave only 01.5% aphid mortality. The concentrations 2.0% are superior to concentration 1.0% and 0.5% concentrations. Similarly maximum aphid mortality was observed after 24 hours of exposure and minimum after 6 hours. The exposure periods of 24 hours was significantly superior to 12 hours and 6 hours in both control and plant products.

Keywords: *Adhatoda vasica,* Aphid mortality, *Azadirachta indica, Lipaphis erysimi*, *Parthenium hysterophorus, Vitex negundo*

INTRODUCTION

Plant - derived extracts and photochemical have been intensively investigated for the past thirty years in an effort to develop alternative to conventional insecticides but with reduced health and environmental impacts. Synthetic insecticides can leave potentially toxic reduces in food products and can be deleterious to non- target organisms in the environment (Isman, 2006). Among the plant families studied, the Meliaceae, Asteraceae, Annonaceae, Achanthaceae, Verbenaceae, Rutaceae, Pipraceae, are among the most promising : Roomi and Ariquiddin (1977), Joshi *et al.* (1978), Graingage *et al.* (1985), Devakumar *et al.* (1986), Zehnder and Warthen (1988), Jacobson (1989), Bathal *et al.*(1991), Nichol and Schmutterer (1991), Gujar (1997), Muthukrishna *et al.* (1997), Ranganath *et al.* (1997). Breuer and De (1999), Das *et al.* (2001), Mandal and Bhattacharya (2003), Tripathi and Singh (2003), Pinto *et al.* (2005), Mumtaz *et al.* (2006), Isman (2006), Singh and Yadav (2007), Nazrussalam *et al.* (2008), Pande *et al.* (2008), Raghuraman *et al.* (2008), Yadav and Ali (2008), Lalnuntluanga *et al.* (2008), Bhagwati *et al.* (2009).

Family crucifereae provides some of the most important oil and vegetable yielding crops in the country. Mustard was a common spice in ancient Greek and Egyptian civilizations, where it was often eaten raw, chewed with meat to mask off flavors, to aid digestion, and for its antimicrobial properties. Romans recorded mustard application as a preservative and its use in sauces with meat, fish and vegetables. There are more than twenty-four insect-pest damaged the mustard at its various stages of crop growth (Kundu and Pant, 1967). Among them mustard aphid, *Lipaphis erysimi* is polyphagous insect- pests and causes severe damage to most of plant of economy importance which may cause yield losses of 66.00% to 99.00% in *Brassica compestris* Linn. and 27.00 to 68.00 % in *B. juncia* Linn. (Gupta and Rawat, 2004). This insect-pest of mustard and rapeseed cultivated during the rabi season October to March has been reported to serious damage on vegetables like cabbage, cauliflower, turnip, radish, broccoli, kale and pulses, bean, spinach, cucumber, jute, sweet potato and many other important crops (Tripathi, 1982). Keeping this in view, use of some naturally occurring plant products under laboratory conditions was carried out

in the management of the mustard aphid, *L. erysimi* Kaltenbach (Hemiptera: Aphididae).

MATERIALS AND METHODS

Experiment was conducted to test the efficacy of five plant products with three replications in the research laboratory, Department of Zoology, D.B.S.College, Kanpur, during winter seasons of 2009-2010 against mustard aphid, *L. erysimi* Kalt. infesting mustard crop. Seed kernel extracts of neem, *Azadirachta indica*, leaves extracts of lagundi, *Vitex negundo* Linn., leaves extracts of carrot grass, *Parthenium hysterophorus* L., leaves extract of arusa, *Adhatoda vasica* Nees. and aerial parts of aripple, *Lantana camara* Linn. were prepared in the laboratory by using the standard method suggested by Chandel *et al.* (2009).

The fresh leaves of mustard were taken from unsprayed field and washed thoroughly with tap water. The different concentrations of five botanicals were tested by dry film technique. The spraying of the insecticides was done in glass petridishes (10cm diameter) by potters spray tower, using 1.0 ml. of insecticidal preparation per petridish. Three concentrations (0.5, 1.0, 2.0 %) were tested in three replications, along with over control (emulsified water). To record the mortality, the spray petridishes were gently shaken under an electric fan until the liquid phase evaporated leaving behind a uniform coat (dry) film of herbal extract on the glass surface. The spray tower was thoroughly rinsed with the insecticide solution. The stock of mustard aphid, *L. erysimi* Kaltenbach was maintained under laboratory conditions. Ten known aged nymphs and adults of *L. erysimi* were released inside each pair of petridishes and allow remaining their upto two hours. After which, they were transferred to the fresh petridishes containing fresh food for feeding. These petridishes were kept as such under control conditions (16 ± 2^{o}C temp. 80 ± 10% relative humidity) and mortality count was taken after 6, 12, 24 hours of exposure. The observed mortality %age of nymphs and adults were converted into angular transformed values, which were statistically analyzed to test the significance and compared the respective three concentrations of selected plant extracts and period with the control (Abbott, 1925). Based on the %age reduction of the nymphs and adults, the detail of each laboratory experiment against *L. erysimi* Kalt. are summarized in Table 1.

RESULTS

The data recorded on the mustard crop and vegetable damage by cabbage aphid, *L. erysimi* Kalt. as effected by different treatments revealed that all the treatments were found superior over the control in reducing the aphid population. The maximum aphid mortality (70.82 %) was observed in the treatment petridish consisting of *A. indica* seed kernel extracts (0.5,1.0 and 2.0% concentration) while the minimum aphid mortality was recorded in untreated control (07.04%) during 2008-2009 and their average, respectively.

Table 2 indicated the effect of different concentration of plant extract on mortality %age of nymphs and adults of *L. erysimi* after 6,12,24 hrs of treatment in the laboratory condition. It was observed that 6 hrs of treatment, maximum mortality (67.86 %) was with 2.0 % of *V. negundo,* followed by *A. indica* (66.14) and *P. hysterophorus* (61.92).Twelve hrs after maximum mortality (90.00%) was noted with 2.0 % *A. indica*. After 24 hrs the value was highest (83.85 %) with 2.0% of *A. indica* and *V. negundo* followed by 2.0% of *P. hysterophorus* (83.85 %).

The analysis of variance indicated that control vs. treated, insecticides used, concentrations used, periods, Periods **x** control were highly significant. However, insecticides x control and period x insecticides x control was not significant.

The Table 3 revealed that insecticide A. indica A. Juss. gave the best results when compared to other phyto-extracts. Seed kernel extracts of neem , *A. indica* killed (70.82%) of nymphs and adults of *L. erysimi* followed by leaves extracts of lagundi, *V. negundo* (69.40 %), leaves extracts of carrot grass, *P. hysterophorus* (65.38 %), leaves extract of arusa, *A. vasica* Nees (55.81%), aerial parts of aripple , *L. camara* Linn. (51.70%) and control (1.5 %) respectively. The seed kernel extracts of *A. indica* are differs significantly from the remaining ones except *V. negundo* and, *P. hysterophorus* from which it does not differ significantly to one another. Among all the phyto-extracts, *L. camara* prove the least toxic giving moderate mortality (51.70 %) of nymphs and adults of L. erysimi where, as untreated control gave only (01.5%) aphid mortality.

The mortality %age of nymphs and adults of *L. erysimi* with plant extracts (Table 3; Fig. 2) are arranged in

Table 1. List of selected herbal plant materials and their respective parts.

S. No.	Botanical name	Common name	Family	Part used
1.	*Adhatoda vasica* Nees.	Arusa	Achanthaceae	Leaves Extracts
2.	*Azadirachta indica* A.Juss	Neem	Meliaceae	Seeds kernel
3.	*Lantana camara* Linn.	Aripple	Verbenaceae	Aerial parts
4.	*Parthenium hysterophorus* L.	carrot grass	Asteraceae	Leaves
5.	*Vitex negundo* Linn.	Lagundi	Verbenaceae	leaves

Table 2. Effect of phyto-chemicals on mean mortality %age of *L. erysimi* Kalt. in the laboratory.

Treatments Herbal products	Con. %	Mean mortality % after 6 hrs.		12 hrs.		24 hrs.		Mean (%)	
		T_1	TBV_1	T_2	TBV_2	T_3	TBV_3	MT	TBV_M
A. vasica	0.5	37.22	36.6	48.84	56.7	59.00	73.5	44.45	49.0
A. vasica	1.0	41.14	43.3	50.85	60.1	70.07	88.4	54.37	66.1
A. vasica	2.0	54.09	67.1	63.44	80.0	77.70	95.4	68.92	87.1
A. indica	0.5	43.07	46.6	59.00	73.5	77.70	95.5	52.69	63.2
A. indica	1.0	48.84	56.7	66.14	83.6	83.85	98.8	77.71	90.1
A. indica	2.0	66.14	83.6	90.00	100.0	90.00	100.0	83.85	98.8
L. camara	0.5	35.00	32.9	46.92	53.4	50.85	60.1	44.89	49.8
L. camara	1.0	46.92	53.4	52.77	63.4	59.21	73.8	52.23	62.5
L. camara	2.0	52.77	63.4	57.00	70.3	63.93	80.7	57.99	71.9
P. hysterophorus	0.5	48.93	56.8	57.00	70.3	63.93	80.7	55.21	67.5
P. hysterophorus	1.0	54.78	65.7	61.92	77.8	75.00	93.3	66.68	84.3
P. hysterophorus	2.0	61.92	77.8	81.14	97.6	83.85	98.9	74.06	92.5
V. negundo	0.5	48.93	56.8	61.92	77.8	63.93	80.7	56.58	69.7
V. negundo	1.0	61.92	77.8	67.86	85.8	81.14	97.6	78.35	95.9
V. negundo	2.0	67.86	85.8	81.14	97.6	90.00	100.0	69.33	87.5
Control		00.00	00.0	00.00	00.0	21.14	13.04	07.04	01.5

(i) C.D. for control vs. treated = 5.0499, (ii) C.D. for insecticide means= 4.3879; (iii) C.D. for concentration means= 2.0977,(iv) C.D. for period means = 2.0813; (v) C.D. for insecticide and concentration means at the same period= 8.3183

descending order as: *A. indica* (70.82) > *V. negundo* (69.40) > *P. hysterophorus* (65.38) > *A. vasica* (55.81) > *L. camara* (51.70) > control (01.5), respectively.

Table 4 revealed that all the three concentrations differ from each other. Concentration 2.0 % was superior to concentration 1.0, and 0.5 %, respectively. The mean mortality %age was was observed to be 53.48 %, 61.49% and 72.06% with 0.5%, 1.0% and 2.0% concentrations respectively. The observation of concentration means taken over all of extracts, which indicated that all the three concentrations (0.5 %, 1.0 % and 2.0 %) differed significantly from one another.

The Table 4 revealed that the concentration 2.0 % gave the maximum (60.55 %) mean mortality to the nymphs and adults of *L. erysimi* Kalt., followed by 1.0 % concentration which gave the mean mortality %age (50.72 %) of aphids, whereas 0.5 % concentration gave only (42.63 %) mean mortality %age of *L. erysimi* after 6 hours exposure periods. After 12 hour exposure period aphid mortality incread in 2.0 % concentration (74.54 %), 1.0 % concentration (59.90 %) and 0.5 % concentration it was(54.73 %). Whereas in 24 hour exposure period 2.0. 1.0 and 0.5% concentration showed 81.09,73.85 and 63.08% aphid mortality. It can be concluded that concentrations 2.0 % are superior to concentration 1.0 % and 0.5 % concentrations.

Table 5 indicated that the maximum mean nymphs and adults mortality %age (38.60 %) of *L. erysimi* noticed was after 24 hrs and minimum after 6 hr. (29.56 %). In 6hrs. 59.13 % larvae were killed and 18 hrs later the %age

Table 3. Effect of phyto-chemicals on mean mortality % of *L. erysimi* Kalt. in the laboratory.

Treatments Herbal products	Mean mortality % after 6 hrs.		12 hrs.		24 hrs.		Mean (%)	
	T_1	TBV_1	T_2	TBV_2	T_3	TBV_3	MT	TBV_M
A. vasica	44.15	48.5	54.37	66.1	68.92	87.1	55.81	68.4
A. indica	52.67	63.2	71.71	90.2	87.18	99.7	70.82	89.2
L. camara	44.89	49.8	52.23	62.5	57.99	71.9	51.70	61.6
P.hysterophorus	55.2`1	62.5	66.68	84.3	74.26	92.6	65.38	82.6
V. negundo	59.57	74.4	70.30	88.6	78.35	95.9	69.40	87.6
Control	00.00	00.0	00.00	00.0	21.14	13.04	07.04	01.5

(I) C.D. for periods means at the same insecticide = 5.4097,(II) C.D. for insecticide means at the same periods = 4.4142

Table 4. Effect of phyto-chemicals on mean mortality %age of *L. erysimi* Kalt. in the laboratory.

Concentration	Mean mortality % after						Mean (%)	
	6 hrs.		12 hrs.		24 hrs.			
	T_1	TBV_1	T_2	TBV_2	T_3	TBV_3	MT	TBV_M
0.5	42.63	45.9	54.73	66.7	63.08	79.5	53.48	64.4
1.0	50.72	59.9	59.90	74.8	73.85	92.3	61.49	77.2
2.0	60.55	75.8	74.54	92.9	81.09	97.6	72.06	90.5

(i) C.D. for concentration means = 5.7633,(ii) C.D. for period concentration x period means for = 3.2367

increase was just by 11.36 %.

DISCUSSION

The finding of the study is in conformity with the earlier findings of various workers who conducted experiments in varied conditions. Ranganath *et al.* (1997) have reported Neem oil (1.2%) and Neem cake (4.0%) to be as effective as dichlorvos (0.2%) the application of molasses + Malathion and water (in ratio of 1:0.1:100) provided good control of melon fruit fly (Akhraruzzaman *et al.* 2000).

Several reports have shown toxic effect of plants on insects (Grainage *et al.*, 1985) This has been possible because the plant kingdom is a store house of diversified chemicals, which has evolved in the course of evaluation (Maxwell and Jennings, 1980 and Singh, 2003). Seenivasan and Sundra Basu (2000) tested the efficacy of new insecticides against *Phyllocnistis citrella* Stainton and compared with commonly used insecticides along with neem- based formulations. Among different inseciticides evaluated neem formulations viz., neem seed kernel and azadirachtin were found in causing high mortality of the larvae. Singh and Kanaujia, (2003) evaluated certain biopesticides against third instar larvae of *Spilosoma obliqua* Walk. on castor. Out of which NSKE (5.0 %) exhibited 1.44 % residual toxicity.

Similarly several reports have appeared on the toxic effect of neem on various insect pests of crop and stored grains as Dhingra *et al.* (2007) found that *Caesalpinia crista* and neem oil extract and other derivatives act as antifeedant and insecticides. Hexane and methanol extracts of *C. crista* were 2.0 and 2.6 times less effective than neem oil, and 1.75 and 1.3 times more effective than NSKE, correspondingly. Chandel *et al.* (2009) tested some plant insecticides against *Spilarctia obliqua* and reported that 2.00 % *A. vasica* leaf extract gave 93.33 % larval mortality followed by *A. indica* seed kernel extracts (89.99 %) and *Curcuma longa (*87.77 %). Viswakarma *et al.* (2009) tested five plant products and two synthetic insecticides against larvae of *Spodoptera litura*. Among them *Beauveria bassiana,* Vanguard, neemarin and Multineem gave 18.8, 17.7, 13.3 and 10.0 % mean mortality, respectively. There fore a successful and environmentally acceptable pest management system can be developed of these bio-chemicals are identified and exploited as inset control agent. The experiment gives higher yield and posed less hazards to natural enemies and there fore indicate their suitability for inclusion in the integrated pest management.

Thus, considering the various aspects as discussed above, it is obvious that so many plant products have been investigated for their toxic effect, but information about selected phyto-products for their insecticidal properties against the nymph and adults of *L. erysimi* Kalt., which are the serious pest of cruciferous vegetable crops, is not available. It can be concluded that the mortality was high with seed kernel extracts of neem, *A. indica* killed nymphs and adults of *L. erysimi* (70.82 %) followed by leaves extracts of lagundi, *V. negundo* Linn. (69.40 %), leaves extract of *P. hysterophorus* Linn. (65.38 %), leaves extract of arusa, *A. vasica* Nees. (55.81%), aerial parts of *L. camara* (51.70%) and control (01.5%), respectively.

It can be concluded that the mortality was high with seed kernel extracts of neem, *A. indica* killed nymphs and adults of *L. erysimi* (70.82 %) followed by leaves extracts of lagundi, *V. negundo* Linn. (69.40 %), leaves extract of *P. hysterophorus* Linn. (65.38 %), leaves extract of arusa, *A. vasica* Nees. (55.81%), aerial parts of aripple, *L. camara* Linn. (51.70%) and untreated control (1.5 %),

Table 5. Effect of phyto-chemicals on mean mortality %age of *L. erysimi* Kalt. in the laboratory.

Treatments	Mean mortality % after						Mean (%)	
	6 hrs.		12 hrs.		24 hrs.			
	T_1	TBV_1	T_2	TBV_2	T_3	TBV_3	MT	TBV_M
Plant Extracts	49.24	57.4	57.95	71.8	69.09	87.3	58.89	73.3
Control	55.31	67.6	64.05	80.9	76.56	94.6	65.70	83.1

(Figures in parenthesis represent the transformed back values) i) C. D. for period means at control=5.2769,(ii) C.D. for period means at treated = 2.1273 (iii) C.D. for control vs. treated at the same period = 6.3128,(iv) C.D. for period means= 2.0913.

respectively., *L. camara* Linn. (51.70%) and untreated control (1.5 %), respectively. No physical injury was noticed during experiments.

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