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Bio-activity of Cabbage (Brassica Oleracea Var Capitata) Plant Product as Insecticides to Control Mustard Aphid, *Lipaphis Erysimi Kaltenbach* (Aphididae : Homoptera)

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ABSTRACT

Three botanical pesticides, *Azadirachta indica* leaves extract, *Acacia catechu* leaf and bark extract, *Carica papaya* seed extract and three chemical pesticides Indocarb 15 SC, 0.006%, @30 a.i./ha, 200 ml / g / ha, Fipronil 5EC 0.005%, 25-50 g ai / ha, 500 ml / g / ha and Endosulfan 35 EC, 0.05-0.07 %, 250-500 a.i. / ha 700-1004 ml / g / h were tested against 2nd and 4th instar larvae of the *L. erysimi* on field cabbage under both laboratory and field conditions. In square dip experiment a highly significant difference was recorded amongst the different treatments for mean mortality of *L. erysimi*. The maximum mean mortality was obtained at NLE2.5% >NLE5%> NSE 10% >AcLE 2.5%> AcSE 2.5%. The order was found to be descending. Repellency test through square dip experiments showed that the significant difference was recorded amongst the different treatments for mean mortality of larvae. During larval immersion method NLE2.5% was proved to be most significant followed by NLE 5%> AcLE 2.5% > ASE (2.5-5%) > Fipronil 0.0005%. However, NLE was found superior than botanicals in both square dip and larval immersion methods. The field spray schedule showed the significant results with the spray of NSE (10%) > ALE (10%) >ASE10% CpLE5% > CpLE-10% while, the second spray was significantly effective against CpLE 10% > Endosulfan 35EC@0.05-0.07% > NLE5% while the spray by CpLE10%and Endosulfan 35EC@0.05-0.07 were found significant and most promising.

Keywords: *Lipaphis erysimi*, Carica seed, Carica leaf, Neem leaf, Acacia bark, Acacia leaf, Extract, Repellent.

I. INTRODUCTION

Today the rapid increase in population and demand of food materials has initiated the large use of insecticides and pesticides. These toxic chemical insecticides and pesticides are resulting in harmful effects and biomagnifications which is continuously polluting fertile lands and acquiring infertility. No doubt they provide results in eradication of insects, pests and diseases but are also killing useful organism the soil and affects soil fertility. The conventional farming practices based on chemical methods broadly kill arthopods, resulting in the malfunctioning of food chain and food web.

Bio-control is the best method to cope with the losses done by the chemicals. In these method insects, pests and pathogens are removed using biological methods without harming the environment and other organism. This is based on natural predation rather than introduced chemicals. The use of bio-insecticides and pesticides also comes under this category. Today due to awareness about the harmful effects of the chemical insecticides and pesticides, most of the farmers are diverting towards the organic farming. In our local area many such plants, waste matter etc. are available from which these bio-insecticides and pesticides can be prepared by using natural means only. Conventional pesticides are generally synthetic materials that directly kill or inactivate the pest. Being single chemical entity, chemical pesticides have resulted in increased resistance in pests.

Biological Pesticides are pesticides derived from natural materials as animals, plants, bacteria, and certain minerals. Bio pesticides are less toxic and also reduce the pollution problems caused by conventional pesticides. The use of bio-insecticides and bio-

pesticides also fall under this category only. Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs. Organic farming generally produces somewhat lower yields but sustains better yields during drought years, allowing it to reap higher yields in some cases. Studies thus far have shown that organic farming requires less water, uses few and always natural pesticides, prevents soil erosion, leaches dramatically fewer nitrates, and has been shown to have improved nutrient qualities including as much as double the flavonoids, an important antioxidant. "Biopesticides include naturally occurring substances that control pests (biochemical pesticides) , microorganisms that control pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (plant-incorporated protectants) or PIPs." Agriculture has had to face the destructive activities of numerous pests like fungi, weeds and insects from time immemorial, leading to radical decrease in yields. With the advent of chemical pesticides, this crisis was resolved to a great extent. But the over dependence on chemical pesticides and eventual uninhibited use of them has necessitated for alternatives mainly for environmental concerns. Degraded soils and groundwater pollution has resulted in nutritionally imbalanced and unproductive lands. Violative pesticide residues also sometimes raise food safety concerns among domestic consumers and pose trade impediments for export crops. Therefore, an ecofriendly alternative is the need of the hour. Biopesticides or biological pesticides based on plant extracts specific to a target pest offer an ecologically sound and effective solution to pest problems. They pose less threat to the environment and to human health. The potential benefits to agriculture and public health programmes through the use of biopesticides are considerable. The interest in biopesticides is based on the advantages associated with such products which are: (i) inherently less harmful and less environmental load,(ii) designed to affect only one specific pest or, in some cases, a few target organisms, (iii) often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems and (iv) when used as a component of Integrated Pest Management (IPM) programs, biopesticides can contribute greatly.

Lipaphis erysimi is regarded as the most important pest of cruciferous crops worldwide (Prasad and Phadke 1988; Bonnemaison 1965).It causes considerable yield loss to late season cabbage crop. Several insecticides have been recommended for its control (Murthy et al., 1982; Yadava et al., 1988., Dhura and Hameed., 1990; Zhu et al., 1996; Lal et al., 1999). In addition to the damage it does as a sapsucker, it is also a vector of several viral diseases (Guan and Wang 1980; Ahlawat and Chenulu 1982; Castleeta.1992; Kennedy and Abou-Ghandir1987; Liu et al.1997; Liu and Yue2001; Bridge et al.2001).Mohan et al; (1981) found that *L .erysimi* and *Crocidolomia binotalis*, are major pest of cabbage, Methamidophos at 0.25 or 0.5 kg/h gave a excellent control of both pests. Pandey et al(1987) evaluated the 3 concentrations (0.5,1.0 and 1.5%) of Neem seed kernal extract against *L. erysimi* under laboratory conditions and found that 80 percent was given by1.5% concentration.1.0% concentration was also effective.

Insect-pests are known to cause significant damage to crops and affect agricultural productivity. The environmental hazards posed by synthetic pesticides. Due to high cost of protecting crops from these pests with chemical pesticides and the increasing resistance and resurgence to many chemical pesticides (Armes et al. 1992; Brewer & Trumble 1994) there is growing interest in the use of biological products such as bacterial and viral-based insecticides, and parasitoids (Nagarkatti 1982), predators (King et al., 1982) and botanical pesticides (Rao et al. 1990). These groups have different mode of action from conventional products (Thompson et al. 1999) and their properties may differ considerably from the conventional chemicals with which growers are familiar. It is therefore important to generate information on the likely differences in the performances of these products to educate growers and facilitate adoption.

The objective of this study was to evaluate commercially available biological and botanical pesticides both individually and partly in combination against mustard aphid species on cabbage to determine their effects under laboratory and field conditions. So, this additional information would make existing IPM programmes more effective and sustainable, while decreasing the reliance on synthetic insecticides.

II. METHODS AND MATERIAL

Extraction of Plant Materials

(A) **Azadirchata Indica :** The shade dried leaves of different neem plants were ground in an electrical grinder to make a fine powder. For extraction, 10gm powder of each plant leaves were weighed for extraction through petroleum ether (40-600C) and then another sample of 10 gm each was taken for obtaining alcoholic extracts with the help of soxhlet apparatus. The extraction was completed within 4 hours. The extracts obtained in the reservoir of the soxhlet apparatus evaporated on a water bath till they remained about 15 ml and then transferred to pre-weighed 50 ml beakers, through filtration from a thick layer of anhydrous sodium sulphate made on silica jel on glass wool plugged funnels. The extracts were again dried over water bath so as to obtain a semi-solid extractive of each plant. The extractives were used to make the stock solution. One percent stock solutions of all the fractions in methanol were prepared from the residues obtained at each stage of the purification process and the fractions were tested at different concentrations.

(B) **Acacia catechu:** One kg of the dried leaves and bark Acacia catechu was taken in an aluminium pot to which ten litres of water were added so that the chips completely immersed under water. It was boiled over an open fire for four hours and allowed to stand for 24 hours so that more catechu might diffuse into the water. The extract was decanted off in a pot and was filtered through a fine muslin cloth to remove wood chips and other suspended materials. The filtrate was evaporated and the residue obtained was air dried and weighed (180g). Yield of catechu was 18%. Isolated catechu (150g) was taken in a five-litre stainless steel beaker containing one litre distilled water. It was boiled with constant stirring for complete dissolution and filtered through a filter paper. Then it was evaporated to 500 ml and allowed to stand for 24 hours. The obtained precipitate was filtered using a filter paper. The aqueous filtrate was rejected. The residue was dissolve in ethanol and filtered. The ethanolic solution was evaporated to dryness and the residue was dissolved into hot water (500 ml). It was allowed to stand for 24 hours. The precipitate was filtered and dried in air (m.p. 95-6ºC, yield 37.5g, 25%).

(C) **Carica papaya** : papaya fruit was obtained from market. Seeds were shade-dried for a minimum of 15 days. Powdered seeds (1 kg) were extracted with chloroform (3.0 L), under reflux, for 4 h; the extract was cooled to room temperature and filtered. Solvent was removed under reduced pressure by rotatory evaporator and the extract was dried in a vacuum oven at room temperature for 12 h (yield, 7.2% by weight). Fatty acid methyl esters were prepared according to the AOAC-IUPAC Method 969.33 [18].Chloroform extract (90 mg) and 1 N solution of NaOH in methanol (4 mL) were placed in a round-bottomed flask, and the mixture was heated at boiling point with stirring for 15 min. Next,BF3-MeOH (5 mL, 15% w/w) were added and heating continued for 5 min. Iso-octane (2 mL) was added; the mixture was stirred for 5 min, more and extracted with hexane (2 mL). The organic phase was dried over anhydrous Na2SO4. The fatty acid methyl esters were analyzed on an Agilent Technologies 6890N GC equipped with an HP-5MS column (30 m in length;25 mm internal diameter; 0.25 μm film thickness) equipped with an Agilent EM 5973 detector, at 150 °C. The carrier gas was helium, at a flow rate of 1 mL/min; the split ratio was 2:1. The column temperature was initially 60 °C (for 3 min) and was gradually increased to 170 °C, at 3 °C/min; this temperature was held for 1 min. Next, the temperature was raised to 330 °C, at a rate of 10 °C/min; this temperature was held for 10 min. The injector temperature was 330 °C and 1 μL of organic phase were injected by duplicate.

Insects

The larvae used for the study were collected from the host plants of different vegetables in the fields and brought to lab, under laboratory conditions. The culture of L.erysimi was maintained in the laboratory on semi synthetic diet as suggested by Nagarkatti and Prakash (1974) with some modifications at a temperature of 27± 1^{o}C and relative humidity 60 ± 1 percent. They were reared on artificial diet in small round plastic vials (3.5x2.0Cm) till pupation under laboratory conditions. Studies were carried out using I-VI instar larvae of L. erysimi against the leaf extract of A.indica. The percentage mortality was calculated after a period of 24h. Generally, second and fourth-stage larvae were used in various experiments and they were starved for 12 h before all experiments.

Bioefficacy Evaluation

The various botanical and synthetic preparations used in laboratory and field are listed in Table 1 (Figure 1). The host plants (Brassica oleracea var. capitata) used for the spraying tests in the laboratory and field were 3 to 5 weeks old and with 7-8 branches. Under laboratory conditions, the tests were carried out in petri dishes (8.5 cm diameter).

In Square Dip Experiment, design was CRD with three replications. The medium sized test leaves were collected from unsprayed fields. A total of 30 equal sized squares were dipped into each treatment for 20 seconds as shown in Table 1, and then air dried for 60 minutes. Weight of each larva was recorded before treatment application using sensitive balance. The treated leaves were placed into the Petri dishes on moistened filter paper (one larvae per petri dish) with the adaxial surface uppermost. L. erysimi larvae were then placed onto the leaf disc and then a cover was put onto the dish. For control treatments the leaves were dipped in water only.

In larval immersion experiment, the larvae were immersed into the respective treatments for 20 seconds and then transferred to paper padded tray in order to remove excessive liquid from the body of the larvae. The purpose of this experiment is to evaluate the contact effect of pesticides on insects. The design in this experiment is CRD with three replications. Like in the square dip experiment, a total of 30 larvae were tested in each treatment. Third instar larvae were weighed before treatment application.

The experiments were conducted in the laboratory with a temperature of 25 ± 1 °C light regime of 14 h light 10 h dark and relative humidity of 65 ± 1 %. Mortality was assessed every 24 h, 48 h, and 72 h in all the experiments.

For the experiments under field conditions, the plants of Brassica oleracea var. capitata were grown 3-5 weeks prior to conducting the experiments in plots. The planting distances were 70 cm x30cm on plots that measured 4.2mx4.0m. When the plants attained about 7-8 branches, the solutions of various treatments were applied with a trigger sprayer, misting to run-off level. Water was used as a control. The spray equipment was drained and triple rinsed after each treatment to avoid any contamination. Second and third instars of L. erysimi were placed on each plant and ten plants were used in each treatment (30 larvae per treatment) and observations were recorded before and after 4 hrs, 8 hrs, 24 hrs and 32 hrs from the time of spray. In the experimental field trial three replication for each treatment were performed.

Statistical Analysis

For statistical analysis of efficacy of insecticides to L. erysimi mortality due to the different insecticides was analysed using the Tukey 's Studentized Rang (HSD) Test.

III. RESULT AND DISCUSSION

Toxicity of insecticides to L. erysimi

Our results show significant differences in the mortality recorded from the different treatments under laboratory and field conditions. The lowest mean mortality was recorded by CpLE-10% and control water treatment as shown in Table1(figure1). S ignificantly higher mortality was detected in all the treatments compared with the untreated controls as shown in Table 2 (Figure 2 and Figure 2 continued) and Table 3 (Figure 3). The effect of feeding on larvae found highly significant at 72 hours after treatment in *Carica papaya* leaf extract 2.5% followed to 48 hours after treatment in Neem Leaf extract 2.5%, 48 hours after treatment in Neem Seed Extract2.5%,24 hours after treatment in Neem Seed extract 5%, 24 hours after treatment in *Carica papaya* leaf extract 2.5%, 24-72 hours after treatment in *Carica papaya* leaf extract 5% while, other treatment were not found significant. Bhatal et al.,(1993) studied the effects of AZT-VR-K(an Azadirachtin rich acetone extract of Neem seed kernel extract)and commercial Neem products and reported that development, reproduction and mortality of mustard aphid (*L. erysimi*) reduced. Sontakke and Das (1996) used Neem formulations for the control of *L. erysimi* infesting mustard and found that quinolphos was the most effective followed by Chlorpyrifos and Endosulfan and result in the highest seed yield. The results obtained on the effect of repellency, feeding larvae, their weight loss through square dip and larval immersion methods were found in conformity of Klocke (1987). Azadirachtin- rich diets lead to decreased feeding and weight gain, as well as biomass conversion rates.

The field spray schedule for I, II, III spray showed the significant results on I spray by Neem Seed Extract 10% followed to Acacia leaf extract 10%,Acacia Seed Extract10%,*Carica papaya* leaf extract (5-10%) while, the II spray was significantly effective against CpLE10%, Endosulfan35@ 0.05-0.07% ,NLE5% while the spray by CpLE 10% and Endosulfan 35 EC@0.05-0.07 were found significant and most promising. These findings were found in conformity of Kabir and Mia (1987), who found Neem reduced the infestation and increased the yield.

Table 1 : Repellency Test, Mean number of *Lipaphis erysimi* larvae died (Square Dip and Larval Immersion Method)

S.N.	Botanicals Treatment	Square Dip Method Mean ± SE	Larval Immersion Method Mean ± SE
01	NLE 2.5%	8.183±0.093^{a}	9.700±0.050^{b}
02	NLE 5.0 %	7.467±0.174^{b}	8.417±0.167^{c}
03	NLE 10.0%	5.833±0.083^{de}	6.417±0.167^{g}
04	NSE 2.5%	4.583±0.220^{g}	5.667±0.220^{h}
05	NSE 5.0 %	4.000±0.144^{h}	5.250±0.144^{h}
06	NSE 10.0%	6.833±0.083^{c}	8.083±0.083^{cd}
07	AcLE 2.5%	6.167±0.083^{d}	8.183±0.093^{c}
08	AcLE 5.0 %	5.167±0.083^{f}	7.500±0.144^{f}
09	AcLE 10.0%	4.750±0.144g	6.333±0.220^{g}
10	AcSE 2.5%	6.083±0.083^{d}	8.250±0.144^{c}
11	AcSE 5.0 %	5.583±0.083^{e}	8.583±0.083^{c}
12	AcSE 10.0%	4.917±0.083^{fg}	8.083±0.083^{cd}
13	CpLE 2.5%	4.167±0.083^{h}	7.167±0.083^{cdf}
14	CpLE 5.0 %	3.500±0.144^{i}	6.583±0.300^{g}
15	CpLE 10.0%	3.233±0.145^{i}	5.583±0.083^{h}
16	Indoxacarb .006%	4.167±0.083^{h}	7.250±0.144^{f}
17	Fipronil .005%	4.917±0.083fg	8.583±0.300^{c}
18	Endosulphan .05-07%	4.567±0.067g	7.417±0.300^{f}
19	Control	4.833±0.083fg	7.583±0.167^{df}

Mean followed by the same letter within the column are not significantly different from each other at P < 0.05, Tukey 's Studentized Rang (HSD) Test. NLE = Neem Leaf Extract,; AcLE = Acacia leaf Extract; CpLE =Carica Papaya leaf Extract

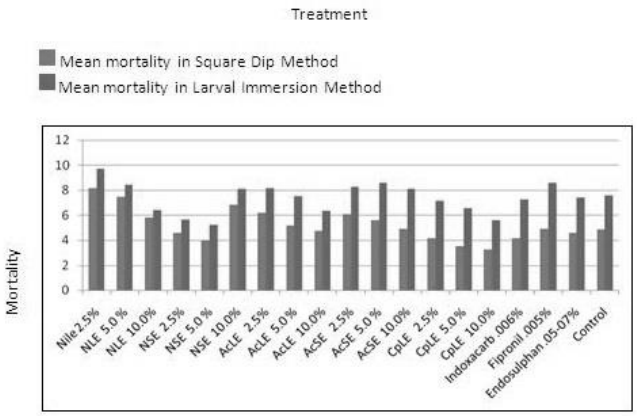

Figure 1: Repellency Test, Mean number of *Lipaphis erysimi* larvae died (Square Dip and Larval Immersion Method)

Table 2: Effect on Feeding: Mean number of *Lipaphis erysimi* damaged square within 24, 48, 72 hrs after treatment in square dip method

S.N.	Hours After Treatments	Mean of artificial Diet Square Damaged Mean ± SE	
01	NLE 2.5%		
	24HAT	3.667±	0.333^{def}
	48HAT	3.000±	0.577^{efgh}
	72HAT	2.667±	0.333^{fghi}
02	NLE 5.0 %		
	24HAT	2.667±	0.333^{fghi}
	48HAT	3.333±	0.333^{defg}
	72HAT	1.667±	0.333^{ij}
03	NLE 10%		
	24HAT	4.333±	0.333^{d}
	48HAT	3.667±	0.333^{def}
	72HAT	3.333±	0.333^{defg}
04	NSE 2.5%		
	24HAT	5.667±	0.333^{c}
	48HAT	4.333±	0.333^{d}
	72HAT	3.000±	0.000e^{fgh}
05	NSE 5.0 %		
	24HAT	4.333±	0.333^{d}
	48HAT	3.667±	0.333^{def}
	72HAT	2.667±	0.333^{fghi}
06	NSE 10.0%		
	24HAT	4.000±	0.000^{de}
	48HAT	3.333±	0.333^{defg}
	72HAT	2.000±	0.000^{hij}

S.N.	Hours After Treatments	Mean of artificial Diet Square Damaged Mean ± SE
07	ACLE 2.5%	
	24HAT	3.000± 0.000^{efgh}
	48HAT	2.333±0.333^{ghij}
	72HAT	1.667±0.333^{ij}
08	ACLE 5.0 %	
	24HAT	2.667±0.333^{fghi}
	48HAT	1.667±0.333^{ij}
	72HAT	1.333±0.333^{J}
09	ACLE 10.0%	
	24HAT	4.333±0.333^{d}
	48HAT	3.667±0.333^{def}
	72HAT	3.333±0.333^{defg}
10	ACSE 2.5%	
	24HAT	3.333±0.333^{defg}
	48HAT	2.667±0.667^{fghi}
	72HAT	2.333±0.333^{ghij}
11	ACSE 5.0 %	
	24HAT	4.000±0.000^{de}
	48HAT	3.333±0.333^{defg}
	72HAT	2.667±0.333^{fghi}
12	ACSE 10.0%	
	24HAT	2.667±0.333^{fghi}
	48HAT	2.333±0.333^{ghij}
	72HAT	2.333±0.333^{ghij}
13	CPLE 2.5%	
	24HAT	2.333±0.333^{ghij}
	48HAT	2.333±0.333^{ghij}
	72HAT	2.000±0.000^{hij}
14	CPLE 5.0 %	
	24HAT	2.000±0.577^{hij}
	48HAT	2.000±0.000^{hij}
	72HAT	1.333±0.333j
15	CPLE 10.0%	
	24HAT	2.000±0.000hij
	48HAT	1.667±0.333^{ij}
	72HAT	1.333±0.333j
16	Indoxacarb	
	24HAT	6.333±0.333^{bc}
	48HAT	7.000±0.000^{ab}
	72HAT	5.667±0.333^{c}
17	Fipronil	
	24HAT	6.333±0.333^{bc}
	48HAT	5.667±0.333^{c}
	72HAT	5.333±0.333^{c}
18	Endosulphan	
	24HAT	7.333±0.333^{a}
	48HAT	5.667±0.333^{c}
	72HAT	5.333±0.333^{c}
19	Control	
	24HAT	0.000±0.000^{k}
	48HAT	0.000±0.000^{k}
	72HAT	0.000±0.000^{k}

Mean followed by the same letter within the column are not significantly different from each other at P < 0.05, Tukey 's Studentized Rang (HSD) Test. NLE = Neem Leaf Extract,; AcLE = Acacia leaf Extract; CpLE =Carica Papaya leaf Extract

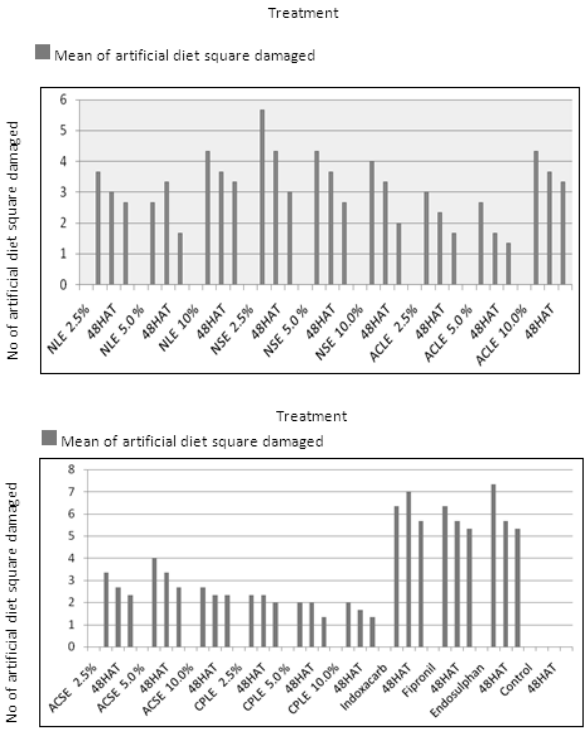

Figure 2 : Effect on Feeding: Mean number of *Lipaphis erysimi* damaged square within 24, 48, 72 hrs after treatment in square dip method

Table 3 : Effects of Different field treatment on *Lipaphis erysimi* at *Brassicae* crop

S.N.	Treatments	Pre-count	I spray larvae died/ 10 Plants	II Spray larvae died/ 10 Plants	III Spray larvae died/ 10 Plants	Fruit damage (%)
01	NLE 2.5%	10.	3.000±0.577^{de}	1.667±0.333 ^{def}	0.333±0.333 ^{f}	2.50%
02	NLE 5.0 %	10.	3.000±0.577^{de}	04.000±0.577^{c}	1.667±0.333 ^{bde}	3.50%
03	NLE 10.0%	12.	3.000±1.528^{de}	00.667±0.333^{f}	0.333±0.333 ^{f}	2.50%
04	NSE 2.5 %	12.	2.333±0.333^{e}	1.333±0.333 ^{def}	0.333±0.333 ^{f}	2.50%
05	NSE 5.0	10.	3.667±0.333^{de}	2.333±0.333 ^{de}	0.333±0.333 ^{f}	2.50%
06	NSE 10.0%	10.	2.667±0.667^{de}	1.667±0.333 ^{def}	0.333±0.333 ^{f}	2.50%
07	AcLE 2.5%	10	3.333±0.333^{de}	2.000±0.577 ^{def}	0.667±0.333^{ef}	2.50%
08	AcLE 5.0%	10	3.333±0.882^{de}	1.333±0.333 ^{def}	0.333±0.333 ^{f}	2.50%
09	AcLE 10.0	10	1.667±0.667^{e}	00.667±0.333 ^{f}	0.333±0.333 ^{f}	2.50%
10	AcSE 2.5 %	11	3.000±0.577^{de}	2.333±0.333 ^{de}	1.333±0.333^{def}	3.75%
11	AcSE 5.0 %	9.	3.000±0.577^{de}	1.667±0.333 ^{def}	0.667±0.333^{ef}	3.00 %
12	AcSE 10.0%	10	2.333±0.333^{e}	1.333±0.333 ^{def}	0.333±0.333^{f}	2.50%
13	CpLE 2.5 %	10	3.000±0.577^{de}	2.000±0.000 ^{def}	1.000±0.000 ^{def}	3.25%
14	CpLE 5.0%	11	02.333±0.882^{e}	00.667±0.333 ^{f}	0.333±0.333 ^{def}	2.50%
15	CpLE 10.0	11	6.000±0.577^{bc}	05.667±0.333 ^{b}	2.667±0.333^{b}	3.00%
16	CpFE 2.5 %	10	4.667±0.882^{cd}	02.667±0.667 ^{d}	2.000±0.577 ^{bcd}	2.75%
17	Indoxacarb	09	3.000±0.577^{de}	1.667±0.333 ^{def}	1.000±0.000^{def}	3.25%
18	Fipronil	10	2.333±0.882^{e}	01.000±0.577 ^{ef}	0.333±0.333 ^{def}	2.50%
19	Endosulphan	10	7.333±0.333^{b}	05.667±0.333 ^{b}	2.667±0.333^{b}	3.00%
20	Control	11	13.67±0.333^{a}	11.00±0.577 ^{a}	6.330±0.333^{a}	8.00%

Mean followed by the same letter within the column are not significantly different from each other at P < 0.05, Tukey 's Studentized Rang (HSD) Test. NLE = Neem Leaf Extract,; AcLE = Acacia leaf Extract; AcSE = Acacia Seed Extract; CpLE =Carica Papaya leaf Extract

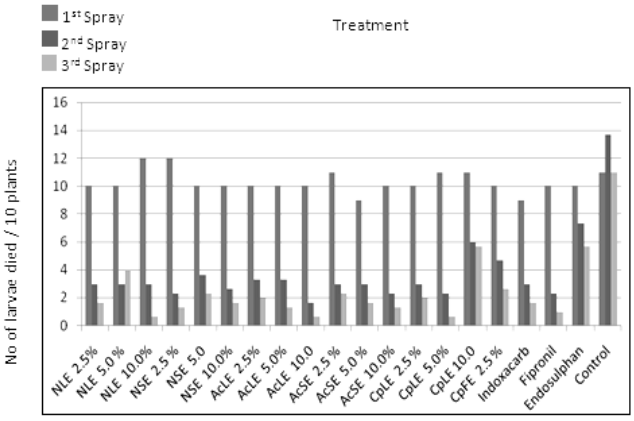

Figure 3. Effects of Different field treatment on Lipaphis erysimi at Brassicae crop

IV. CONCLUSION

A chemical pesticide is used to protect crops and to kill pests. Use of synthetic pesticides causes some unfortunate consequences like environmental pollution, pest resistance and toxicity to other non-target organisms. To ally the fear of the hazardous effect of chemical residues to human and animal health, several studies were conducted to determine the most effective control methods without using insecticides. In this research work we have used various botanicals against one of the most notorious pest Lipaphis erysimi, Kalt (Mustard: Aphid) belonging to order Homoptera: Aphididae) is a serious pest on several cruciferae and other economically important crops and is widely distributed worldwide.

The results of our study indicate that the plant products could be the best alternatives for the sustainable management of L.erysimi on cabbage with less impact on the naturally occurring predatory arthropods. Few botanicals have been reported as effective managers of insect-pests and commercialized. Much knowledge and experience of using these is treasured in farmer's traditional knowledge. Derived from the Neem tree (Azadirachta indica), this contains several chemicals, including 'Azadirachtin', which affects the reproductive and digestive process of a number of important pests. Recent research carried out in India and abroad has led to the development of effective formulations of Neem, which are being commercially produced. As Neem is non-toxic to birds and mammals and is non-carcinogenic, its demand is likely to increase.

Our view has been supported by Lal (1996) Nimbicidine and NeemMark caused 20-26%mortality of winged adult aphid after 2 days application while NeemGold and Jawan gave about 15% mortality. Patel et al., (1996) Endosulfan (0.035%, Chlorpyriphos (0.02%) and Neem Seed Kernal Suspension (NSKS 0.3%) were most effective in controlling the pest.

It is widely recognized that we face a major challenge continuing to increase agricultural productivity to keep pace with a population racing toward 9 billion within the next few decades. Agricultural practices developed and honed in the 20th century, from the development of synthetic nitrogen fertilizers by Fritz Haber in the early nineteenth century (Smil 2004) to the invention of synthetic pesticides in the decades following, (Casida & Ousted 1998, Knight et al. 1997) have greatly improved crop productivity which has helped cope with an ever-increasing global population to date. While crop production has certainly benefited, technological improvements have unfortunately also led to unexpected consequences for non-target organisms, soil and water quality. The development of synthetic pesticides has additionally resulted in challenges related to pest resistance which further complicates the drive towards improving yields. Growers struggle against a variety of pests during the crop season. Plant pathogens, for example, are responsible for dramatic yield losses. The Crop Life Foundation's 2005 study reviewed and endorsed by 38 commodity groups (including the National Cotton Council and United Soybean Board) says if left untreated, yields of most fruit and vegetable crops would plunge 50 to 95 percent (Gianissi 2005). Weeds and insect damage contribute to substantial impact on crop losses. In early agricultural practices, fungicides such as sulfur and copper were used to cope with plant diseases. These products have been used for centuries and are still heavily relied upon today. However, a step change in approach was experienced with the discovery of single site mode of action fungicides, often with systemic properties. These highly potent molecules provided exceptional disease control with much lower use rates.

Unfortunately, the ever-evolving pathogen population has been able to adapt to these new chemical classes quickly because of their selective modes of action. It is found that more recently developed chemical fungicides also correlate with more rapid reports of resistance in the field (adapted from Thind, 2011). One of the greatest challenges to agriculture today is the paucity of new active ingredients with new modes of action unrelated to previously introduced chemistries. Since the use of agrochemicals with single site modes of action became widespread in the last fifty years, this has become of greater and greater concern. In recent years, interest in the use of biopesticides in conventional agricultural practices, both by growers and the agrichemical companies, has grown (Reiter 2011). Biopesticides are appealing for a number of reasons. According to the EPA, biopesticides are usually less toxic than conventional pesticides, generally affect only the target pest and closely related organisms, often are effective in very small quantities and decompose quickly, and can greatly decrease the use of conventional pesticides while crop yields remain high. Growers and agrichemical companies also see biopesticides as potentially important tools in their efforts to stave off the development of pesticide resistance. Biopesticides are often complex in their activities and modes of action, offering new tools in the quest to develop programs that can manage resistance. For example, products based on the Bacillus Subtilis strain QST 713, including Serenade ASO® fungicide, Serenade Max® fungicide and Serenade Soil® fungicide have been demonstrated to have several modes of activity. These include complex secondary metabolite profiles responsible for both anti-fungal and anti-bacterial activity. Detailed studies of the biophysical interaction of the lipopeptide class of compounds produced by this strain have shown complex membrane interactions (Patel et al. 2011).

These require somewhat greater application rates (as high as 1% active ingredient) and may require frequent reapplication when used out-of-doors. It is known that these extracts contain Azadirachtin in Neem, Catechin in Acacia catechu and Palmitic acid in Carica papaya. The management efficacy of these compounds in comparison to the chemical pesticides was also remarkable and cost effective. Neem pesticides do not leave any residue on the crop. They also work as systemic pesticide; absorbed into the plant, transported to all the tissues and are ingested by plant feeding insects. Azadirachtin is considered nontoxic to mammals, fish and pollinators, having low mammalian toxicity with LD50 of>5000 mg/kg for rat. It is classified by Environment Protection Agency (EPA) as class IV. It is felt that none of the synthetic pesticides developed so far has the excellent virtues of Neem in pest management Thus, opens opportunity for their commercialization on large scale without any adverse effects on crop and soil.

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