Insecticidal Activity of Vegetable Oils against Mustard aphid, *Lipaphis erysimi* Kalt., under Field Condition

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Abstract: Four vegetable seed oils viz., Bitter gourd (*Momordica charantia*), Small bitter gourd (*Momordica dioica*), Bottle gourd (*Lagenaria siceraria*), Ridge gourd (*Luffa acutangula*) seed, solvent extracted oils were evaluated against mustard aphid, *Lipaphis erysimi* Kalt., in the farm of mustard crop. All the natural insecticides (Vegetable oils) were found very effective and caused 100% mortality (indicated by non-motility of the insects) at 6% conc. in 24 hrs. Seed oil of Small bitter gourd and Bottle gourd were found to be satisfactory natural insecticide giving 100% mortality at 4% conc. in 24 hrs. Lower concentrations up to 2% was also found effective but require longer time (up to 32 hrs.) to give 100% mortality in case of Small bitter gourd and Bottle gourd. No further spray was given to crop and also no further infestation of aphid found in the vegetable oil treated crop.

Key words: mustard aphid, natural insecticide, vegetable oil, bitter gourd, small bitter gourd, ridge gourd, bottle gourd

1 Introduction

India is an agricultural country, about 2/3 of its total population are dependent on agriculture. The food requirements of total population are mostly fulfilled through agricultural crops. According to food habit, oil/fat is one of the most important components of Indian human diet. The sources of oils are mostly of plant/vegetable origin i.e. seed oils. Plant protection plays an important role in addition to good seed, proper soil, water and fertilizer management. Inspite of development of various modern synthetic insecticide and pesticides, loss of crops and stored grains due to attacks of pests and diseases is still considerable due to vector versatility and increasing tolerance of pests to these chemicals. In recent years the use of pesticides, particularly of insecticides has become very common. Excessive and indiscriminate use of these toxicants has unlimited hazards for human being and cattle.

The vegetable crops and other edible parts of plants are directly exposed to the applied pesticides/insecticides and are usually consumed before the plant system is able to get rid of the pesticidal/insecticidal residue or the latter is diluted to the non-toxic level. Likewise, in the case of oil bearing seeds, many such chemicals being oil soluble are not removed from the plant system.

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under natural conditions and the slow poisoning by the chemicals contained in food may continue. Fumigation, spraying and dusting of pesticides liberate a fair volume of harmful vapours in the atmosphere and consequently create a certain degree of atmospheric pollution. The mustard aphid, *Lipaphis erysimi* Kalt., is a key pest of mustard (1-3) causes serious damage to oil seed crop (*Brassica* sp.) which is major oilseed crop of India. These problems have now attracted the attention of scientific community for the development/use of bio-base, natural, eco-friendly pesticide/insecticide.

Pesticides/insecticide of plant origin may be indigenously available but are considered comparatively safe. It has been reported that over 2000 plant species belonging to about 170 natural families are known to have insecticidal properties (4). Oils of vegetable origin have also been found to possess insecticidal properties and because of their easy availability in rural areas these could be widely used for plant protection purposes, both as such and after saponification (5). Oils have different effects on insects/pests. The most important is that they block the air holes (spiracles) through which insects breathe, causing them to die from asphyxiation and suffocation. Smearing of oil on the cuticle/outer surface of insect acts as a barrier leads to dehydration and death of insect/pest. In some cases, oils also may act as poisons, interacting with the fatty acids of the insect and interfering with normal metabolism. Oils also may disrupt how an insect feeds, a feature that is particularly important in the transmission of some plant viruses by aphids (6, 7).

The toxicity of vegetable oil is minimum and at least compared to alternative pesticides. It is quickly dissipated by the natural process of evaporation leaving negligible residue. It is easy to mix with other pesticide to increase its performance and use. Many vegetable oils have drying or semi-drying properties and these oils could well be utilized as insecticides. It has been reported that the phytoesterrols present in these oils are ideal emulsifying agents (8) and the emulsions are the important form to be used for the purpose of spray as insecticide. Non oil products present in the oil or other portions of the plants such as alkaloids, glycosides, coumarins, flavones, saponins, essential oils, etc., are also potential components to be exploited for pest control (9).

In the present study the seed oil of Small bitter gourd (*Momordica dioica*) is taken for investigation of its insecticidal properties. However, comparative study is being done with Bitter gourd (*Momordica charantia*), Bottle gourd (*Lagenaria siceraria*) and Ridge gourd (*Luffa acutangula*) of same family (*Cucurbitaceae*). Cucurbits form an important group of vegetable crops. Biochemically the cucurbits are characterized by bitter principles, called cucurbitacins (10). A systematic search for these substances in the family indicates that great majority of species contain bitter principles in some portions of the plant e.g. seeds, leaves, flowers etc., at some stages of development. Chemically cucurbitacins are tetracyclic triterpenes having extensive oxidation level. They occur in nature, free as glycosides or in complicated mixtures.

## 2 Experimental

Four vegetable seed oils of *cucurbitaceae* family, viz. Bitter gourd (*Momordica charantia*), Small bitter gourd (*Momordica dioica*) Bottle gourd (*Lagenaria siceraria*), Ridge gourd (*Luffa acutangula*) were taken for experimental work. Seed of Bitter gourd, Bottle gourd and Ridge gourd were collected from the field of Kannauj district, Uttar Pradesh, INDIA and Small bitter gourd seeds from Jalaun district of Bundelkhand region, Uttar Pradesh, INDIA.

The seeds of Bitter gourd, Bottle gourd, Ridge gourd and Small bitter gourd were pre-dried separately in a Yorco hot air oven at 40 ± 2°C as it makes the sample easier to grind for better extraction, breaks fat water emulsions to make fat dissolve easily in the organic solvents and helps free fat from the tissues of foods (11). After drying seeds were grinded thoroughly in an electric grinder. The ground seeds were extracted serially in glass soxhlet extractor with petroleum ether (60-80°C) as a solvent. The extracted oils were separated out after evaporation of the solvent.

Teepol (Sodium salt of alkyl benzene sulphonate) emulsifier was taken from M/s. Daga Finmark India Limited, Ahmedabad, Gujrat, INDIA for preparation of oil emulsions with distilled water. The oil emulsions of required concentration 2, 4, 6 and 8% were prepared by mixing equal volume of solvent extracted experimental seed oil and Teepol (each) with the help of distilled water. Thus prepared emulsion of various concentrations were sprayed on mustard crop at vegetable farm, Department of Vegetable Science, Chandra Shekhar Azad University of Agriculture and Technology, Kan-
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pur, INDIA during the peak season of pest population (Dec to Jan 2005) (Fig. 1a, 1b, 1c, 1d, 1e).

The testing plants were randomly selected from the field, aphid population was counted and tags were applied on different parts of mustard crop. Different concentration of oil-water emulsion (o/w) was sprayed on pre-tagged (counted no of insect) plant 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 four replications for each treatment were performed. The percentage reduction of pest population (mortality) with respect to control was calculated by the

Abbott’s formula (12,13) which is as follows:

\[
P = 100 \left[1 - \left( \frac{T_a \times C_b}{T_b \times C_a} \right) \right]
\]

Where, 
\[
P = \text{Percentage reduction over control}
\]
\[
T_a = \text{Population in treatment after spray}
\]
\[
T_b = \text{Population in treatment before spray}
\]
\[
C_a = \text{Population in control after spray}
\]
\[
C_b = \text{Population in control before spray}
\]

3 Results and Discussion

The effect of time and solvent extracted Ridge gourd (Luffa acutangula) seed oil concentration on mortality

![Fig. 1a Field of Mustard aphid Infested Crop.](image)

![Fig. 1b Spray of Ridge Gourd Seed Oil on the Mustard aphid Population.](image)

![Fig. 1c Spray of Bitter Gourd Seed Oil on the Mustard aphid Population.](image)

![Fig. 1d Spray of Bottle Gourd Seed Oil on the Mustard aphid Population.](image)

![Fig. 1e Spray of Small Bitter Gourd Seed Oil on the Mustard aphid Population.](image)
of mustard aphid are given in Table 1. It is apparent that application of seed oil for 4 to 8 hrs. are not sufficient for 100% mortality. However 50%, 80% and 100% mortality of mustard aphid was observed in 24 hrs. by using 2%, 4%, 6% and 8% of oil concentration respectively.

Likewise, the effect of time and Bitter gourd seed oil concentration on mortality of mustard aphid are given in Table 2. It is clear from Table 2 that the application of Bitter gourd (Momordica charantia) seed oil produces 66.7%, 77.7% and 100% mortality of mustard aphid in 24 hrs at 2%, 4% and 6-8% conc. respectively. Similarly the application of Bottle gourd (Lagenaria siceraria) and Small bitter gourd (Momordica dioica) seed oil provided 100% mortality in 24 hrs. at 4% concentration for each. The effects of time and Bottle gourd and Small bitter gourd seed oil concentrations on mortality of mustard aphid are given in Table 3 and 4.

The effects of different seed oil concentration on the time required for 50% mortality (LT\textsubscript{50}) are shown in Fig. 2. It is apparent from the figure that time required for 50% mortality decreases with increase in concentration of all the experimental seed oil in spray. Time required for 50% mortality (LT\textsubscript{50}) is 5 hrs. in case of Bottle gourd seed oil while it is 7 hrs. in case of Small bitter gourd seed oil but colour of the treated plant darkens in case of bottle gourd seed oil but no change in colour observed in case of Small bitter gourd seed oil. Thus over all results of Small bitter gourd seed oil are better than other oils.

4 Conclusion

From the present study it is concluded that insecticidal activity by the application of Ridge gourd and Bitter gourd seed oils at 6% concentration for 24 hrs results in 100% mortality of mustard aphid with no adverse effect on the experimental plants. Bottle gourd and Small bitter gourd resulted in 100% mortality at slightly lower concentration i.e. 4% level in same time, however the darkening of plant was observed on the experimental plant to which 4% and higher concentration of Bottle

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**Table 1** Effect of Ridge Gourd Seed Oil Concentration on Mortality of Mustard aphid.

<table>
<thead>
<tr>
<th>Conc. (%)</th>
<th>(%) Mortality after 4 hrs.</th>
<th>(%) Mortality after 8 hrs.</th>
<th>(%) Mortality after 24 hrs.</th>
<th>(%) Mortality after 32 hrs.</th>
<th>LT\textsubscript{50} (hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>18.7</td>
<td>37.5</td>
<td>50</td>
<td>98.0</td>
<td>24.0</td>
</tr>
<tr>
<td>4%</td>
<td>25</td>
<td>40.0</td>
<td>80</td>
<td>100</td>
<td>11.4</td>
</tr>
<tr>
<td>6%</td>
<td>29.0</td>
<td>58.3</td>
<td>100</td>
<td>100</td>
<td>7.0</td>
</tr>
<tr>
<td>8%</td>
<td>44.4</td>
<td>88.9</td>
<td>100</td>
<td>100</td>
<td>4.6</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
</tbody>
</table>

*LT\textsubscript{50} Time required to give 50% mortality

**Table 2** Effect of Bitter Gourd Seed Oil Concentration on Mortality of Mustard aphid.

<table>
<thead>
<tr>
<th>Conc. (%)</th>
<th>(%) Mortality after 4 hrs.</th>
<th>(%) Mortality after 8 hrs.</th>
<th>(%) Mortality after 24 hrs.</th>
<th>(%) Mortality after 32 hrs.</th>
<th>LT\textsubscript{50} (hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>18.2</td>
<td>54.5</td>
<td>66.7</td>
<td>90.9</td>
<td>7.6</td>
</tr>
<tr>
<td>4%</td>
<td>22.2</td>
<td>55.5</td>
<td>77.7</td>
<td>94.4</td>
<td>7.2</td>
</tr>
<tr>
<td>6%</td>
<td>25.0</td>
<td>69.2</td>
<td>100</td>
<td>100</td>
<td>5.4</td>
</tr>
<tr>
<td>8%</td>
<td>31.2</td>
<td>87.5</td>
<td>100</td>
<td>100</td>
<td>5.1</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
</tbody>
</table>

*LT\textsubscript{50} Time required to give 50% mortality

**Table 3** Effect of Bottle Gourd Seed Oil Concentration on Mortality of Mustard aphid.

<table>
<thead>
<tr>
<th>Conc. (%)</th>
<th>(%) Mortality after 4 hrs.</th>
<th>(%) Mortality after 8 hrs.</th>
<th>(%) Mortality after 24 hrs.</th>
<th>(%) Mortality after 32 hrs.</th>
<th>LT\textsubscript{50} (hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>20</td>
<td>55.5</td>
<td>86.6</td>
<td>100</td>
<td>7.4</td>
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<tr>
<td>4%</td>
<td>33.3</td>
<td>66.6</td>
<td>100</td>
<td>100</td>
<td>5.0</td>
</tr>
<tr>
<td>6%</td>
<td>57.1</td>
<td>71.4</td>
<td>100</td>
<td>100</td>
<td>3.6</td>
</tr>
<tr>
<td>8%</td>
<td>61.5</td>
<td>84.6</td>
<td>100</td>
<td>100</td>
<td>3.1</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
</tbody>
</table>

*LT\textsubscript{50} Time required to give 50% mortality

**Table 4** Effect of Small Bitter Gourd Seed Oil Concentration on Mortality of Mustard aphid.

<table>
<thead>
<tr>
<th>Conc. (%)</th>
<th>(%) Mortality after 4 hrs.</th>
<th>(%) Mortality after 8 hrs.</th>
<th>(%) Mortality after 24 hrs.</th>
<th>(%) Mortality after 32 hrs.</th>
<th>LT\textsubscript{50} (hrs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>25</td>
<td>50</td>
<td>85.0</td>
<td>100</td>
<td>8.0</td>
</tr>
<tr>
<td>4%</td>
<td>28.5</td>
<td>57.1</td>
<td>100</td>
<td>100</td>
<td>7.0</td>
</tr>
<tr>
<td>6%</td>
<td>33.3</td>
<td>66.6</td>
<td>100</td>
<td>100</td>
<td>5.0</td>
</tr>
<tr>
<td>8%</td>
<td>55.5</td>
<td>88.8</td>
<td>100</td>
<td>100</td>
<td>3.8</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>—</td>
</tr>
</tbody>
</table>

*LT\textsubscript{50} Time required to give 50% mortality
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gourd seed oil were used but no adverse effect was observed in the case of Small bitter gourd seed oil. Hence from this experimental study it is clear that solvent extracted seed oil of Small bitter gourd (*Momordica dioica*) at 4% concentration level may be used safely for controlling mustard aphid population in the field crop. The insecticidal activity in Small bitter gourd seed oil was higher in comparison to other oils of *Cucurbitaceae* family, may be due to presence of alkaloid momordicin in the oil (14).

Although the objective set out for this research have been fulfilled, the scale up studies are required to understand the mechanism(s) of solvent extracted seed oil of *Cucurbitaceae* family on different food crops for other insects. The research is also required to observe the effect of application of seed oil on food grain storage, which shall be useful in replacing use of harmful chemicals to environment friendly insecticide.

References