Studies on the effect of botanical insecticides on Selepa docilis Butl, Aphis caraccivera Koch & Psara basalis Walk

Author: Vimala K John & Jini Jimmy

Abstract

Today, there are a number of bio-pesticide plant extracts being marketed as insecticides. Biopesticides usually are inherently less harmful than conventional pesticides. They generally affect only the target pest and closely related organisms, in contrast to broad-spectrum conventional pesticides that may affect organisms as different as birds, insects, and mammals. They often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. Generally, plant based compounds degrade rapidly reducing the risk of residues on food. Many of these products show wide windows of crop safety and resistance to these compounds is not developed as quickly as with synthetic pesticides due to multiple modes of action. Many plant extracts used as insecticides are fast acting, quickly inhibiting insect feeding and additional crop damage. And because they act on the insect’s gut and rapidly decompose in the environment, many plant extract insecticides are more selective to insect targets and safer to beneficial insects. The main objective of our study was to compare the effect of different botanical extracts and make better substitutes for the biopesticides, thus reducing the risk of spreading diseases after exposure to the plant extracts of same family. Here in this study, the toxicity tests were conducted to evaluate the effect of five botanical insecticides- Azadirachtin, Nicotine, Menthol, Allicin & Piperine. The modes of action of these botanicals as insecticides are somewhat different.

Keywords: Biopesticides, Azadirachtin, Nicotine, Menthol, Allicin, Piperine

1. Introduction

Phylum- Arthropoda, Class- Insecta. About two-third of the known species of animals are insects. They live in almost all types of environments. Class Insecta includes a wide variety of species. Some insects are pests. Pests are harmful species whose population size or population density goes beyond the damage threshold level. Insect pests are destructive to both animals and plants. Any method that kills, repels or interferes with the feeding, reproduction or distribution of insects can be considered as a method of insect pest control. Insect pest control does not mean the total elimination of insect pests from an area [1]. It simply means the maintenance of insect population well below the damage threshold. Different methods are used for pest control including chemical control, biological control and many other control measures.

Bio-pesticides usually are inherently less harmful than conventional pesticides. They generally affect only the target pest and closely related organisms, in contrast to broad-spectrum conventional pesticides that may affect organisms as different as birds, insects, and mammals. They often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides [2].
Many plants have developed natural, biochemical mechanisms to defend themselves from weed, insect and fungal attacks. By studying the diverse chemistries of many different plant species, scientists have discovered many useful compounds that can be used as bio-pesticides.

Plant extracts have long been used to control insects. The first botanical insecticide dates back to the 17th century, when it was shown that nicotine from tobacco leaves killed plum beetles. Today, there are a number of bio-pesticide plant extracts being marketed as insecticides.

1.1 Importance of the study
Chemical pesticides are mostly used where large scale pest control measures are required. They not only exterminate pest population at one stroke but also prevent their recurrence. But their negative impact on the environment and ecology is not fathomed fully yet.

The greatest drawback is that these poisons do not discriminate between harmful and harmless creatures that come in their way. Regular exposure can even harm the user too. Cases of physical and nervous disorders detected to be caused by over-use of insecticides now almost equal to that caused by pests itself. They also help the pests developing increased resistance to these poisons, necessitating the use of more quantities in subsequent years.

The environmental impact of pesticides is often greater than what is intended by those who use them. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, Using plant extracts as bio-pesticides offers growers many unique benefits. Generally, plant based compounds degrade rapidly reducing the risk of residues on food. Many of these products show wide windows of crop safety and resistance to these compounds is not developed as quickly as with synthetic pesticides due to multiple modes of action (Atwal & Dhaliwal, 2003)[4]. Many plant extracts used as insecticides are fast acting, quickly inhibiting insect feeding and additional crop damage. And because they act on the insect’s gut and rapidly decompose in the environment, many plant extract insecticides are more selective to insect targets and safer to beneficial insects.

1.2 Objectives of the study

- To test the toxicity of different botanical extracts against the pests of some common vegetables, after exposure for 1-3 days. For this five different botanical extracts (Azadirachta indica, Nicotiana tabacum, Allivum sativum, Mentha sativa, Piper nigrum) prepared in three different concentrations were used against Leaf caterpillar of Brinjal, Aphid of Moringa and Leaf caterpillar of Amaranthus and the percentage mortalities were found out.
- To compare the effect of different botanical extracts and make better substitutes for the biopesticides, thus reducing the risk of spreading diseases after exposure to the plant extracts of same family.

2. Materials and Methods

2.1 Pest species required

2.2 Leaf Caterpillar of Brinjal: Selepa docilis Butl
(Order : Lepidoptera_Superfamily : Noctuoidea Family : Nolidae)

2.3 Aphid of Moringa- Aphis caraccivera Koch
(Order : Hemiptera Family : Aphididae)

2.4 Leaf Webber of Amaranthus- Psara basalis Walk
(Order : Lepidoptera Family : Pyralidae)

Plate No: 1

Selepa docilis Butl ON BRINJAL

Fig 1: Brinjal plant
Fig 2: Eggs
Fig 3: Larvae
Fig 4: Pupa
Fig 5: Adult

Plate No: 2
_Aphis caracissera Koch_ ON MORINGA

Fig 6: Moringa
Fig 7: Aphids
Fig 8: Aphis nymphs & adults ants

Plate No: 3
_Psara basalis Walk_ ON AMARANTHUS

Fig 9: Amaranthus
Fig 10: Larvae
Fig 11: Pupae
Fig 12: Adult

2. Plant Extracts
2.1 _Azadirachta indica_ (Family: Meliaceae)
Azadirachtin

2.2 _Nicotiana tabacum_ (Family: Solanaceae)
Nicotine

2.3 _Mentha piperita_ (Family: Lamiaceae)
Menthone

2.4 _Allium sativum_ (Family: Liliaceae)
Piperine

Plate No: 4

Fig 13: Neem
Fig 14: Nicotine
Plant extracts of different concentrations (5%, 10% & 15%), Mortar and pestle Measuring jar, Weighing machine, Distilled water, Glass jars, Forceps, Hand sprayer, Brush, Hand lens, Scissor.

3. Preparation of Solutions
3.1 Preparation of extracts of Azadirachta indica
Fresh leaves were collected. Using weighing machine 5gm, 10gm, 15gm of the leaves were weighed separately. Then the weighed leaves were grained and made into paste using mortar and pestle. Paste was dissolved in 100ml distilled water and filtered.

3.2 Preparation of extracts of Nicotiana tabacum
Dried tobacco leaves were collected. The leaves were weighed as 5gm, 10gm and 15gm separately using weighing machine. The leaves were then boiled in equal amounts of water for 5 minutes. The solutions were made up to 100ml and then filtered.

3.3 Preparation of extracts of Mentha piperita
Fresh menthol leaves were collected. Using weighing machine 5gm, 10gm and 15gm of leaves were weighed separately. Then the weighed leaves were grained into paste using mortar and pestle. Paste was then dissolved in 100ml distilled water and filtered.

3.4 Preparation of extracts of Allium sativum
The outer peels of the garlic were removed at first. Then it was weighed into 5gm, 10gm, 15gm separately using weighing machine. Then each was grained and made into paste using mortar and pestle. Paste was dissolved in 100ml distilled water and filtered.

3.5 Preparation of extracts of Piper nigrum
Fresh leaves of pepper were collected. The leaves were weighed separately into 5gm, 10gm and 15gm using weighing machine. Then the weighed leaves were grained and made into paste using mortar and pestle. Paste was dissolved in 100ml distilled water and filtered.

4. Collection and Rearing Of Insect Pests
The collection of insect pest species used in the study was done by cutting apart the leaves containing larvae using scissors. For collecting aphids, hand lens and brush were used. Collected pest species were kept in glass jars. The mouths of the jars were wrapped with a cloth which facilitates easy air current. Sufficient amount of leaves were given. Then they were used to conduct various toxicity tests. A few of them were reared to complete the life cycle. Adult insects were used for proper identification of the species.

5. Method of application
The effect of different extracts viz. neem, tobacco, garlic, menthol and pepper were noted against the pests of some common vegetables. For each treatment 20 insects were tested at three levels of concentrations and one normal was kept unsprayed. The different concentrations of plant extracts (5%, 10% and 15%) were sprayed at the insect pests taken in the glass jars using hand sprayer. The insects dead were counted in each experiment, being discarded after each evaluation. Mortalities were recorded in certain time intervals. % mortalities of Selepa docilis & Psara basalis within 35hrs and Aphis caraccivera within 12hrs were found out. The values were tabulated. The data was analyzed statistically and graphs were plotted.
6. Observations and results
The effect of different extracts viz. neem, tobacco, garlic, menthol and pepper were tested against the three selected pest species of vegetables. Mortalities were observed after applying the extracts at three different concentrations of 5%, 10% and 15%.

On the leaf caterpillar of brinjal, Selepa docilis, 100% mortality was observed after the application of tobacco and neem extracts even within 20-35hrs. Allicin obtained from garlic extract gave 95% at concentration of 15% and 75% at concentrations of 5% and 10% Menthol extract gave 85% mortality at 15% and 75% at 5% and 10% concentrations Pepper extract at 5% gave 40% mortality while 10% and 15% gave 55% and 90% mortalities respectively. On the moringa aphid, Aphis caraccivera, 100% mortality was observed for nicotine and azadirachtin containing extracts within 12hrs after the spraying Menthone, allicin and piperine containing extracts at 15% also gave 100% mortality. Their lower concentrations gave 40%, 70% & 85% respectively.

On the leaf webber, Psara basalis, mortalities at different concentrations were observed to be similar to that of Selepa docilis caterpillar. Application of neem and tobacco extracts gave 100% mortality Garlic extract at 15% also gave 100% mortality. At lower concentrations of 5% and 10% it gave 60% and 90% respectively. On applying menthol and pepper extracts, % mortalities were observed to increase gradually with the increase in concentrations.

Graph 1: Graph showing the effect of Azadirachtin within 25hrs
**Graph 2:** Graph showing the effect of Nicotine within 25hrs

**Graph 3:** Graph showing the effect of Menthone within 25hrs

**Graph 4:** Graph showing the effect of Allicin within 25h
Graph 5: Graph showing the effect of Piperine within 25hrs

Graph 6: Graph showing the effect of Azadirachtin within 10hrs

Graph 7: Graph showing the effect of Nicotine within 10hrs
**Graph 8:** Graph showing the effect of Menthone within 10hrs

**Graph 9:** Graph showing the effect of Allicin within 10hrs

**Graph 10:** Graph showing the effect of Piperine within 10hrs
7. Discussion
From the various experimental results, it is found that the commonly used botanical insecticides along with some rare ones, gave promising results and the insecticidal activity was reached. Out of the five plant extracts used, the components, Azadirachtin and Nicotine in the neem and tobacco leaves respectively gave comparatively better mortality rates, even at low concentrations. Allicin, the component in garlic also gave better results. Menthone and Piperine components were found to be inferior to the results obtained from the others [6, 7, 8].

On the leaf caterpillar, Selepa docilis Butl, out of the five botanical extracts sprayed, Nicottiana tabacum and Allium sativum showed a toxic effect even at 5% & 10%. Azadirachta indica showed a high killing effect at high concentrations of 15%. Mentha piperita and Piper nigrum were found to be inferior to the results of other extract.

On the moringa aphid, Aphis caraccivera Koch, there was a high toxic effect for Nicotiana tabacum even at very low concentration of 5% within 4hrs. Azadirachta indica and Allium sativum also gave better toxicity. The effect of Mentha piperita and Piper nigrum showed comparatively lesser results.

On the leaf webber, Psara basalis Walk also, Nicotiana tabacum and Allium sativum had better results. Azadirachta indica showed moderate results within 35hrs. Mentha piperita and Piper nigrum had minimum results.

Out of the various toxicity levels observed, high toxicity was shown in higher concentrations. The lesser concentrations take time duration. So the increase in concentrations and time of exposure will result in a progressive increase in insect mortality.

The work was compared with other studies which was carried out by botanical extracts for control some kinds of agricultural pests [9, 10, 11]. In the study of neem leaf extract as a natural plant pesticide in the control of fire ants, GeethaV [8] observed the pesticidal and repellent effect of Azadirachta indica leaf extract at different concentrations (0% blank diet, 10, 15, 20, 50% and blank diet+50%) in the baits over a period of 40 days and the effective mortality was studied. Twenty percent concentration was found to be most effective pesticide. Fifty percent concentration was found to be the most effective repellent. All the concentrations studied killed the larvae except 5% concentration.

In another work done in [12] the neem oil was evaluated under laboratory conditions on castor semilooper, Achoea janata (Lepidoptera : Noctuidae) infesting castor plants. A significantly higher mortality rates in the treatments irrespective of doses was observed [13, 15]. A mortality rate as high as 57%, 75%, and 81% were observed in the treatments involving neem oil 2ml/L (T1), 4ml/L (T2), 6ml/L (T3) respectively. A positive dose dependent antifeedant activity of neem oil was also observed.

Garlic based oils and extract formulations have been used as insecticides against various insects on numerous crops, In the work done by Arthur et.al [13] the repellency and toxicity of 25 mint oil granules were evaluated against worker Red imported fire ants. Repellency increased with increasing milligrams per square centimeter of mint oil. Extracts from three species of plant family Piperaceae- Piper nigrum L, Piper guineese (Schum and Thonn) and Piper tuberculatum (Jacq) were tested for efficacy against insects from five orders [14, 15]. From the findings they concluded that the Piper nigrum has showed a short term repellent and feeding deterrent.

8. Conclusion
Toxicity tests are designed to evaluate the duration of exposure of a particular toxicant to produce its effects. The information regarding proper concentrations with little ill effects can be used in the insect pest management strategies. Here in this study, the toxicity tests were conducted to evaluate the effect of five botanical insecticides- Azadirachtin, Nicotine, Menthol, Allicin & Piperine. The modes of action of these botanicals as insecticides are somewhat different. The two main modes are deterancy and toxicity. Use of different extracts alternatively is an important tactic in the insect pest management. It will cause the delayed development of pesticide resistance.

Thus there are substances with insecticide effect, as the ones obtained from neem and tobacco that have originated many similar substances, which are more commercialized more than a decade ago. A class of substances that deserved a lot of attention are the substances that make part of the essential oil of some plants. The essential oils, or volatile oils can be found in aromatic plants and can present attractive, repellent, and even poisonous activity to insects and microorganisms.

Due to increased resistance of pests to synthetic pesticides, stricter environmental legislations and mounting R & D costs of chemical insecticides, interests in natural insecticides or bio-pesticides has been expanding continuously in recent years. The plant world is a very important source of natural pesticide compounds and also provides core structures from
which new and more effective pest control agents can be developed.

Recent advances in the development of transgenic crops have opened new avenues to be utilized in IPM programs. Therefore, it is evident that bulk of studies on bio-pesticides is increasing and also implies the importance, development and achievements in modern bio-pesticides and their future.

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10. References
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