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Evaluation of A Few Botanical Insecticides against the Insect Pest *Henosepilachna vigintioctopunctata* (Fab.) On *Solanum melongena* Plant

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Abstract: *A field study was conducted on infested brinjal plants to control the major insect pest Henosepilachna vigintioctopunctata. Brinjal or eggplant (Solanum melongena L.) is an important solanaceous crop of subtropics and tropics. The methanol and hexane extracts of Eucalyptus globulus and Anacardium occidentale were taken as sample and considered as botanical insecticides. By direct spraying method, the mortality rate was examined and the variation on percentage of death rate of grubs were analysed for 24 hrs, 48hrs, 72hrs and 96hrs. This study revealed that the extracts from E. globulus showed best results among the other insecticides (80% & 60%) respectively.*
Keywords: *Anacardium occidentale, Botanical insecticide, Brinjal, Eucalyptus globulus, Solanum melongena.*

I. Introduction

Insects are economically important organisms. Some of them are beneficial and some are harmful. Beneficial insects are used as food, for production of silk, medicine and other products useful to human beings. Some of them play an important role in pollination. Insects which are called pests transmit disease in society and cause damage to the crops, timber forests etc. An animal whose population increases to such an extent as to cause economic loss to crops or a nuisance and health hazard to human being and his live stock is called a pest.

Henosepilachna vigintioctopunctata is an insect pest belonging to Order Coleoptera, the largest order not only of insects but also of entire animal kingdom. Economically, beetles are important in two basic ways. On the debit side, plant feeding, when abundant, are pests of agriculture crops and forest trees. On the credit side, predatory species contribute significantly to man's attempt to control plant feeding pest.

Henosepilachna vigintioctopunctata is a serious pest of Solanaceous crops such as egg plant and potato over a wide range from Japan to South Asia and Australia [1-3]. In Pakistan, *H. vigintioctopunctata* can be found with varying degree of population densities in all the areas where the host plants are grown [4].Many cucurbitaceous plants are grown together with Solanaceae as host plants of *H.vigintioctopunctata*[5]. Moreover, it is a recorded pest of cucurbitaceous crops in India [6]. Similarly its larvae and adults have been found feeding on nightshades, trumpet flower weed (*Datura stramonium*), cucumber, melon and cotton [7].

Two species of epilachna beetle viz., *Epilachna dodecastigma* (Wied.) and *Epilachna vigintioctopunctata* Fab are serious pests of vegetables in Bangladesh. *Epilachna dodecastigma* is fairly common and causes damage to the solanaceous and cucurbitaceous crops [8]. The peak period of infestation varies with regions. Generally the peak is found in July and August. *Epilachna dodecastigma* Wied is a very important insect pest of vegetables. It is widely distributed in South and East Asia, Australia, America and the East Indies. Sometimes it is called a leaf scraping coccinellid beetle [9].

The third and fourth instar grubs are more destructive and voracious. *Epilachna* beetle may damage up to 80% of plants depending on place and season for variations of prevailing environmental conditions [10]. *Epilachna* beetle feeds actively in the morning and evening hours and feeding declines rapidly in the middle of the day and after midnight. The daily fluctuation in the rate of feeding depends mainly on the temperature which determined the level of metabolism [11].

This ladybird is larger than other ladybird species. Carefully counted, there were 13 black spots on each wing cover, two spots on thorax, i.e. 28-spotted in total. There were the dense short hairs on its body. Most other ladybird beetles are predators on soft body insects. This ladybird species, both larvae and adults, feed on plants. Usually the adults feed on the upper surface of leaves, while the larvae feed on the lower surface. These ladybirds are slow moving, when disturbed, they escape by dropping onto the ground.

The adult *Epilachna* beetles as well as its grubs cause serious damage to cucurbit, brinjal and potato throughout India and other South-East Asian countries. The *Epilachna* beetles are polyphagous mostly feeding on vegetable plants such as bitter gourd, brinjal, potato, tomato, etc. *E. dodecastigma* prefers cucurbit vegetables while *E. vigintioctopunctata* mostly feeds on solanaceous vegetables. Both grubs and adult beetles feed by scraping chlorophyll from epidermal layers of leaves in a semicircular pattern in rows. The infested leaves turn brown which gradually dry away and fall off resulting into complete defoliation of the plant [12].

The adult beetles are 8mm long and 5-6 mm wide and are spherical, pale brown with black spots. *H.vigintioctopunctata* bears 28 spots.

The Epilachna beetles are active throughout May to August in hilly areas and May to September in plains. They hibernate in winter in the heaps of dry plants, cracks and crevices or in the soil. The female lays about 450 eggs in clusters; each cluster contains 15-50 eggs, on the under surface of the leaves. The eggs are cigar-shaped, bright yellowish in colour. The egg hatches within 2-7 days (2-3 days in summer, 4-7 days in winter). The young larvae are small, flat and yellow in colour with yellow spines or hairs on the dorsum. The yellowish coloured grubs and adults feed voraciously on the leaves and tender parts of the plant and often cause serious damage when they appear in numbers. As a result, the leaves are completely skeletonised leaving only a network of veins.

After passing through four moults during 7-21 days, it becomes full-grown. The full-grown grub is about 8mm in length and 4mm in width. Pupation takes place on the underside of the leaves. The pupa is yellow orange in colour having brown white margins in the dorsum. Its anterior portion is smooth while posterior region is spinous. Pupal period lasts after a few days in summer and 1-2 weeks in winter, after which adult beetle emerges out. The life cycle is completed within 15-54 days. The adult survives for 4 weeks to 6 months. There are 7-8 generations of the epilachna beetles in plains and 1-2 generations in hills. Thirty five to seventy five percent leaves can be severely damaged by grubs and adults [13].

The insect pest management is the application of technology, in the context of biological knowledge, to achieve a satisfactory reduction of insect pest numbers or effects and to maintain the pest population below levels that cause economic damage. For convenience of study, the insect pest management may be grouped into physical, mechanical, cultural, biological, chemical, hormonal, genetical and legal practices. Few tactics are preventive such as physical and mechanical measures, cultural practices and legal control that prevent the insect to attain a pest status while others are curative such as biological, biopesticidal and chemical control that reduce the number of insects infesting the crop or human belongings.

In several parts of the world particularly in Europe and China, various substances such as sulphur, hellebore (a poisonous herb), and arsenic were used as pesticides before the recorded history. Prior to the 1940s the insecticidal value of a number of inorganic chemicals (e.g. arsenic, mercuric chloride, carbon disulphide) and organic chemicals of botanical origin (e.g. pyrethrum, nicotine) was known and put to extensive use. The discovery of DDT by Paul Muller in Europe in 1939 revolutionised insect control and marked the beginning of the development and application of synthetic organic insecticides. Since that time hundreds of compounds of varying insecticidal value have been discovered, and thousands of new potential toxicants are being evaluated each year by a detailed screening process. More than 90% of currently used pesticides are of the synthetic organic variety.

During the early periods of development of modern synthetic insecticides the only aim was to evolve more effective insecticides. i.e., the consideration was unidirectional. However, in recent years due to awareness of environmental risks of and rapid development of resistance of insects to insecticides, development of newer insecticides becomes more difficult. At present it is rather impossible to have an ideal insecticide that fulfils all the desired qualities such as: (i) it should be safe to non-target organisms but be highly efficient to kill the target insects, (ii) it should not be phytotoxic nor should it impairs the germination of seeds, and cause damage to flowers and fruits, (iii) it should not impart off-flavour of food materials, (iv) it should kill the target insects very quickly, (v) it should be persistence in toxicity, i.e., it should maintain lethal action for a longer period, (vi) it should be quickly degradable if persistence is not required, (vii) it should be stable during longer storage, (viii) it should be cheaper and within the reach of poor farmer, etc. However, these attributes differ in different situations [14].

The insecticides seem to be indispensable in maintaining high levels of health, nutrition and quality surroundings. In agriculture, these are regular component as their application has played an important role in the development of modern agriculture. They are effective when applied against large pest population, and are also readily available for the users whenever needed.

However, the world has seen the environmental risks posed by these chemicals. Its application can be very hazardous, and direct contact with a highly toxic insecticide can cause severe illness and even death. Because of this, careful reading of the instructions on the labels on insecticide containers and constant concerns with safety during their application (avoidance of spillage on clothing or skin, or inhalation of sprays or dusts; not smoking or eating when working with toxicants) are so important. Major concern is also the presence of residues in food products, plant and animal, that has been treated with insecticides at some point in their production and the natural hazards by disrupting the intricate balance of ecosystems [15].

Environmental pollution with insecticides has become a matter of great concern. Highly residual insecticides can pass well beyond their intended targets and may reduce populations of beneficial insects and wildlife. DDT in particular has been banned in this regard. Another major problem associated with the use of insecticides is the development of insecticide resistance in strains of several pest species. There are more than

500 species of insects that have developed resistance to insecticides. In addition, unfortunately, natural enemies of insect pests are more susceptible to insecticides than the insect pests and are easily eliminated from the agro ecosystem. Evidences of pesticide threats to human health and economic effects have been documented in several studies [16, 17].

II. Materials And Methods

The present study was carried out during 2014-2015, in MCC Farm, Madras Christian College, Tambaram, Chennai.

2.1 Collection of Plants

In this experiment, the fresh leaves of *Eucalyptus globulus* and *Anacardium occidentale* were collected from the forest areas near Chengalpattu, Chennai. They were washed with distilled water and shade dried for 6 days. The dried leaves were uniformly ground by using mechanical grinder. The bioactive components were extracted using the methods with slight modification [18].

2.2 Extraction of Plant Material

5 gm of the dried powder was poured into a cellulose thimble. This was kept in the soxhlet apparatus. The extraction was done by adding 200 ml of solvent (Methanol, Hexane) to the sample. The sample was then placed in the extractor at 70^0C for 10 hrs. When the extraction time was complete, the thimble was removed and the content was carefully transferred to a sterilised glass container and allowed to air dry. Then the container was kept in the refrigerator for the study purpose.

2.3 Test Insects

For experiment purpose, newly hatched first and second instars of *H.vigintioctopunctata* were collected in mass amount from the brinjal field in the Madras Christian College farm, Chennai.

2.4 In vivo analysis

Prior to this study in vitro experiment was carried out earlier [19]. For in vivo analysis, 20 *Solanum melongena* plants were grown in black coloured polythene bags (25.4cm x 9.8cm) provided with proper water, nutrition and sunlight for a month. When the plants matured, the healthy second instar grubs of H. *vigintioctopunctata* were introduced carefully. 3 grubs were introduced in each plant to infest the plant for 12 hrs. Then the already prepared solvent extractions of plant material were diluted individually with the distilled water in the ratio of 4:1. Then it was poured into separate spray bottles for spraying. After this, 8-10 sprays were sprayed to each infested plants on the first day. Thus, each experiment was held for 5 trials.

Everyday the number of dead grubs and live grubs on the plant were noted /recorded. The number of grubs that escaped was also recorded. The mortality rate was analysed and the number of days required achieving lethality or total mortality after 96 hrs were noted. The control plant was sprayed with water to rule out the possibility that spraying (or poor care) contributed to death. Percentage of grub mortality was calculated and corrected by Abbott's formula.

$$\text{Corrected Mortality (\%)} = \frac{\%MT - \%MC}{100 - \%MC} \times 100$$

Where

%MT = % Grub mortality in treatment

%MC = % Grub mortality in control

III. Results

3.1 Efficiency of Herbal Extracts in an In vivo condition

Results on the mortality of second instar larvae of *H. vigintioctopunctata* by using the direct contact spraying method at Day 1(Table 1). Similar to in vitro analysis, after spraying the extract no mortality was observed on the first day or 24 hrs. But on second and third day, all the extracts showed significant grub mortality.

The data obtained from in vivo analysis is 80%, 60%, 60% and 40% for methanol extract of *E. globulus* and hexane extract of *E. globulus*, methanol extract of *A. occidentale* and hexane extract of *A. occidentale* respectively. However, the percentage of mortality in the control experiment was low when compared to the other treatments.

Among these, methanol extract of both the plant species showed highest significant mortality than hexane extract. Likewise, when compared with *A. occidentale*, *E. globulus* herbal preparation showed greater potential effect on the grub mortality.

IV. Figures And Tables

Table 1: Residual efficiency of different herbal products on control of *H.vigintioctopunctata* (In vivo analysis)

Plant species	Solvent used	Duration of Grubs mortality (%)				Total mortality (%)
		24hrs	48hrs	72hrs	96hrs	
Eucalyptus globulus	Hexane	0%	10%	50%	0%	60%
	Methanol	0%	40%	20%	20%	80%
Anacardium occidentale	Hexane	0%	30%	10%	0%	40%
	Methanol	0%	10%	40%	10%	60%
Control		0%	0%	0%	0%	0%

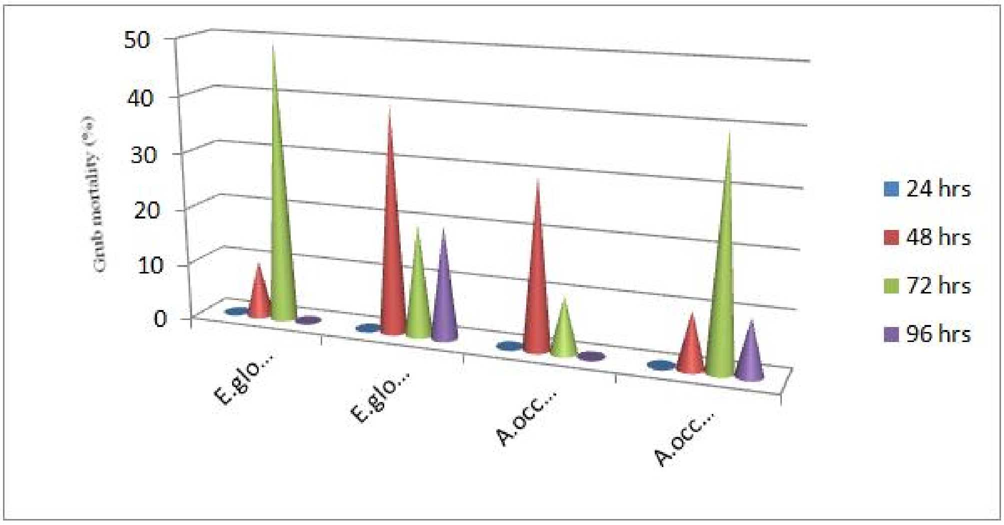

Fig.1: Diagrammatic representation of different herbal products on control of *H. vigintioctopunctata*.

V. Conclusion

The use of botanical pesticides is now emerging as one of the prime means to protect crops and their products and the environment from pesticides. Botanicals degrade more rapidly than most chemical pesticides and therefore are considered to be eco friendly and less likely to kill beneficial pests than synthetic pesticides with longer environment retention. By this study, *E. globulus* plant species was found to have good result in eradication of *H. vigintioctopunctata*. These make a way for production of alternative botanical insecticides for agriculturists in future.

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