STUDY OF THE EFFECTIVENESS OF BIO-PESTICIDE ON MEALYBUG

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Abstract:
The use of botanicals in pest management is not only useful for suppression of pest population but also helps to maintain the sound ecological balance. Tulsi (*Ocimum sanctum)* is an aromatic plant in the Lamiaceae family. It has been used for thousands of years in Ayurveda due to its diverse healing properties. In conclusion it can be stated that it was effective significantly at different concentrations. The botanicals used in this study such as *Ocimum sanctum* were showed different levels of insecticidal activities. These findings of the present study suggest that *Ocimum sanctum* extract can be used as a botanical spray to get better and safe control of mealybug P.solenopsis.
The present work deals with selection of suitable herbs with a maximum mortality rate of scale insects. This could go a long way in controlling adult females to prevent further production of eggs in consecutive generations. Since phytochemicals are safe, easily available round the year and cost effective, these stimulate local efforts to enhance the magnitude of pest control. Such an effective formulation can be used for large scale field study by agriculturists to decimate scale insect menace during flowering and fruition. The research has shown that insecticides made from natural botanical source such as tulsi leaves for mealybug eradication are less toxic as compared to those from the synthetic origin hence it is safer to use insecticides prepared from natural raw materials since they have little or no adverse effects on human health.

Keywords: Biopesticides, Mealybug, efficiency, botanicals extract.

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Introduction:

Tulsi is an aromatic plant in the Lamiaceae family. Tulsi has been used for thousands of years in Ayurveda due to its diverse healing properties. Tulsi's extracts are used in ayurvedic remedies for common colds, headaches, stomach disorders, inflammation, heart disease, various forms of poisoning, and malaria. Traditionally, tulsi is taken in many forms: as herbal tea, dried powder, fresh leaf, or mixed with ghee. Essential oil extracted from Karpoora Tulsi is mostly used for medicinal purposes and in herbal cosmetics, and is widely used in skin preparations due to its anti-bacterial activity. For centuries, the dried leaves of Tulsi have been mixed with stored grains to repel insects. These plants in harmonious integration with other safe methods of pest control like biological control can provide eco-friendly and economically viable solutions for pest problems in near future. [Aheer GM, Shah Z, Saeed M (2009), Asogwa EU, Ndubuaku TCN, Ugwu JA (2010)]

Malvaceae, Solanaceae and Leguminaceae. The host range of the mealybugs includes Grape, Date Palm, Apple, Avocado, Banana, Citrus, Okra, Tomato, Brinjal Cotton and a few Ornamentals. *Hibiscus rosa-sinensis* is a typical host which is frequently attacked by Maconellicoccus hirsutus. Host records of M. hirsutus extend to 76 families and over 200 genera, including Beans, Chrysanthemum, Citrus, Coconut, Coffee, Cotton, Corn, Croton, Cucumber, Grape, Guava, Hibiscus, Peanuts, Pumpkin, Rose, And Mulberry. [Karar et al. (2010), Mealybugs are white to pink in colour and measure 3–4 mm in length. In case of M. hirsutus, eggs as well as crawlers are pink in colour. The crawlers measure 0.3 mm in length. Immature females and newly matured females are greyish-pink which are dusted with mealy white wax. Adult females are 2.5– 4.0 mm long, soft-bodied, elongate oval and slightly flattened. Females are provided with 9-segmented antennae, anal lobe bars, numerous dorsal oral rim ducts on all parts of the body except the limbs and long, flagellate dorsal setae. Males have one pair of very simple wings, long antennae and white wax filaments projecting posteriorly with no mouthparts. [Singh et. al. (2000) and Prishanthini et. al. (2014)]

Non-infected plants can be infected from infected plants as juvenile mealybugs can crawl from an infected plant to another plant. Small ‘crawlers’ are readily transported by wind, rain, birds, ants, clothing and vehicle and may settle in cracks and crevices, usually on new plants. The wax, which sticks to each egg, also facilitates passive transport by equipments, animals or people. The female mealybug is not active and unable to fly. In fact, humans are great friends helping in transport of mealybugs. As the infested plant back the colonies of mealybugs migrate from shoot tips to twigs, branches and finally down the trunk. Long- distance movement is most probable through carrying infested planting material and fresh fruit and vegetables across the country or even from one end of a farm to the other. Ants, attracted by the honeydew, have been seen carrying mealybugs from plant to plant. [Tanwar R.K, Jeyakumar P, Monga D. (2007)]

Materials and Method:

In the formulation of natural insecticide the following steps were used

- Collection of plant and insects
- Screening of plant extracts.
- Evaluation of efficacy of different genera and species agaist *P. solenopsis.*
- Statistical analysis.

The study was conducted under labouratory conditions of Department of Zoology, Sevadal Mahila Mahavidyalaya, Nagpur during the period of Jan 2018 to April 2018.

Culture Of Mealybugs

The laboratory culture of *P.solenopsis* was established from individuals collected from Hibiscus flower plants in college gardens, home garden those do not have any previous exposure to pesticides.

Mealybug culture on Hibiscus plant

Collection of botanicals:

The botanicals used in this experiment were *Ocimum sanctum* (Tulsi) leaves were obtained from the college garden of Sevadal Mahavidyalaya .The leaves collected than washed with sterile distilled water until the dirt was completely removed. Then the fresh leaves were finely ground using motor and pestle until the paste form was obtained.

Preparation of extracts

1) ***Extract of Tulsi:***

The paste of fresh Tulsi leaves were transferred in a beaker containing 200 ml distilled water. And the mixture was boiled for 1 hour and kept for 24 hour at room temperature. Then it was filtered through normal filter paper by using funnel.

Table 1: Experimental design for 24 hours and 48 hours

Number of Insect	**Treatment**	**Dose in ml of concentration in 25ml DW and Duration**		**Duration in hours**
20(control)	Observation under laboratory conditions.			
20 (Experimental)	Tulsi	5 ml	10 ml	24 hours
20 (Experimental)	Tulsi	5 ml	10 ml	48 hours

Evaluation of Efficacy Of Botanicals Agaist P. Solenopsis Was Done.

Formula for Efficiency Rate and % Efficiency:

$$\text{Efficiency Rate} = \frac{\text{total number of bites received before application}}{\text{Total number of bites received after application}}$$

$$\%\text{Efficiency} = \frac{\text{Efficiency rate}}{\text{Total number of bites received before application}} \times 100$$

Statistical Analysis

For all the data obtained the differences among the percent efficiency of botanicals on mealybugs at all treatments were subjected to analysis of variance (one way ANOVA) and differences among means were considered significant at a probability level of five percent ($p \leq 0.05$).

Results and Discussion:

Efficacy of botanicals under laboratory conditions:

The efficacy of few selected botanical pesticides at different concentrations was evaluated against mealybug. The results revealed that the treatments are significantly differing among themselves in causing mortality of *P.solenopsis*. ($p<0.05$) After an exposure of 24 hours the maximum mortality (100%) was observed in tulsi extract .The mortality caused by each treatment increased gradually with an increase in the exposure interval.

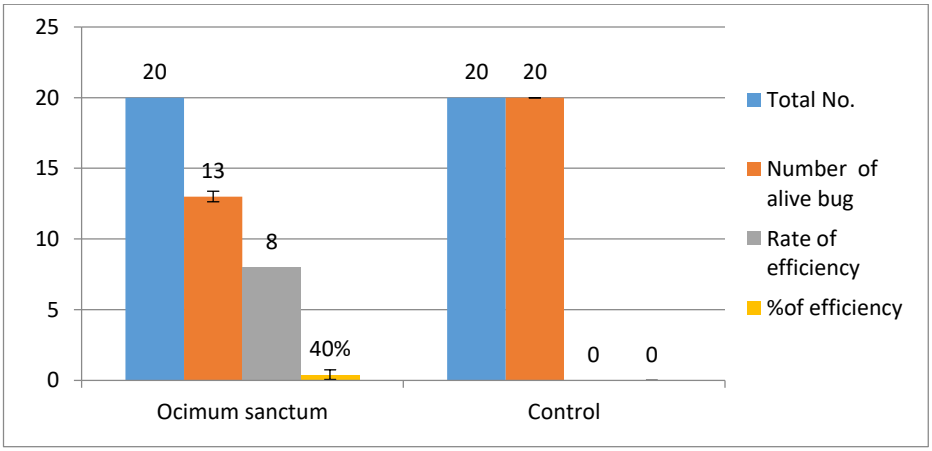
Figure 1 and 2 shows the comparison of percentage mean mortalities to different botanicals at different concentrations at 24 hrs. and 48 hrs. after initial applications. Mortality rates increased with increasing concentrations for all botanicals.

Table 2: Mean percentage mortalities of *Phenacoccus solenopsis* to different botanical solutions at 5 ml concentration for 24 hours after initial application. Values express (Mean S.E)Treatment.

Treatment	Doses	Duration	Total No.	Number of alive bug	Rate of efficiency	%of efficiency
Ocimum sanctum	5 ml	24 hrs	20	13±0.37	8±0.34	40%
Control	00	24 hrs	20	20	00	00

Values are mean ± SEM, n=5 in each group, *Significant at P< 0.05,** Highly Significant at P< 0.001.

The Percent efficiency of botanical solutions at 5 ml on mealybyg after 24 hours and 48 hours treatment are shown in **graph 1 and 2.**

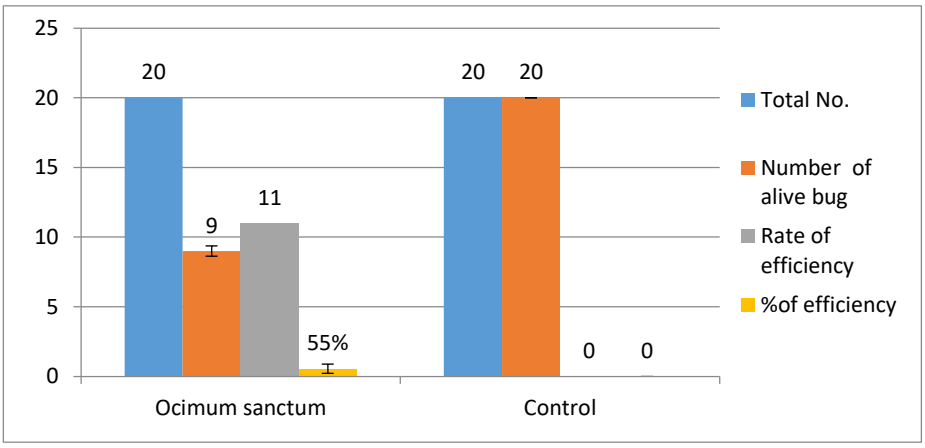


Graph 1: Percent efficiency of botanical on mealybyg after 24 hours treatment

Table 3: Mean percentage mortalities of *Phenacoccus solenopsis* to different botanical solutions at 5ml concentrations for 48hours. Values express (Mean S.E) treatment.

Treatment	Doses	Duration	Total No.	Number of alive bug	Rate of efficiency	%of efficiency
Ocimum sanctum	5 ml	48 hrs	20	9±0.37	11±0.32	55%
Control	00	48 hrs	20	20	00	00

Values are mean ± SEM, n=5 in each group, *Significant at P< 0.05,** Highly Significant at P< 0.001.



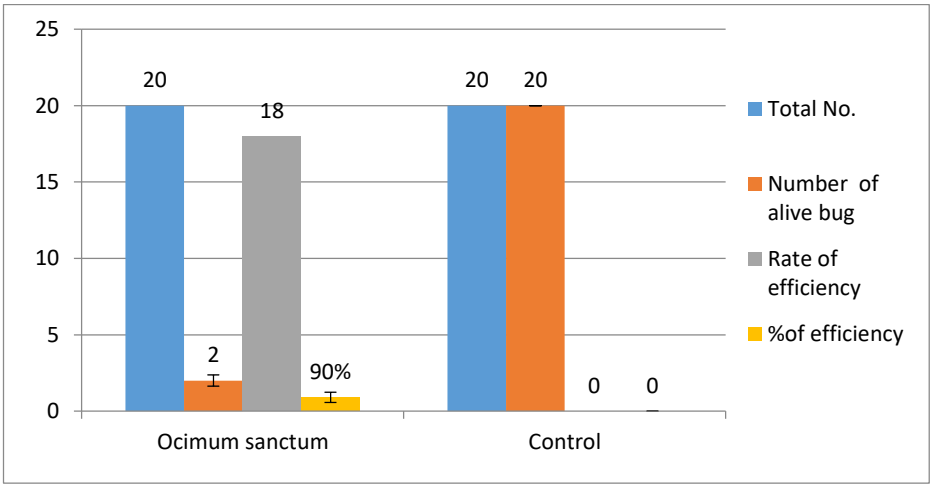
Graph 2: Percent efficiency of botanical on mealybyg after 48 hours treatment

The Percent efficiency of botanical solutions at 10 ml on mealybyg after 24 hours and 48 hours treatment are shown in **graph 3 and 4.**

Table 4: Mean percentage mortalities of *Phenacoccus solenopsis* to different botanical solutions at 10 ml concentrations for 24 hours. Values express (Mean S.E) treatment.

Treatment	Doses	Duration	Total No.	Number of alive bug	Rate of efficiency	%of efficiency
Ocimum sanctum	10 ml	24 hrs	20	2±0.24	18±0.51	90%
Control	00	24 hrs	20	20	00	00

Values are mean ± SEM, n=5 in each group, *Significant at P< 0.05,** Highly Significant at P< 0.001.

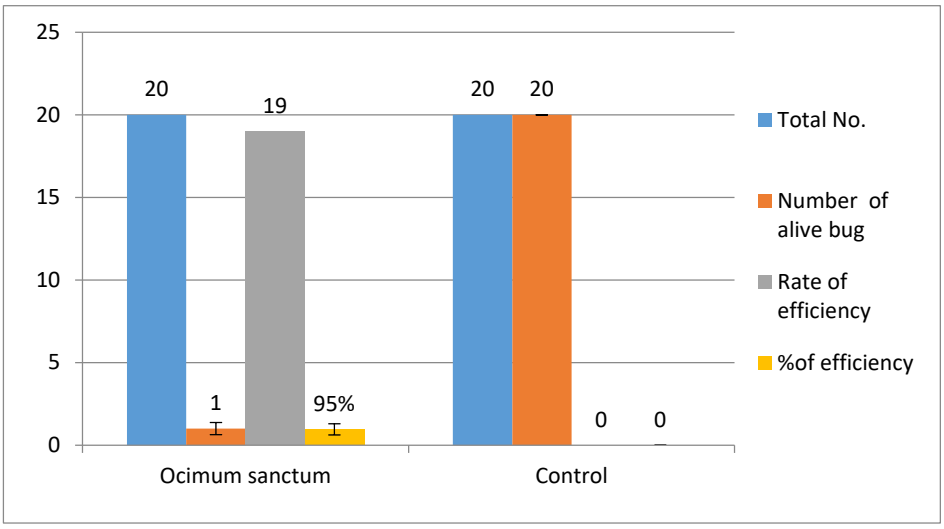


Graph 3: Percent efficiency of botanical on mealybyg after 24 hours treatment

Table 5: Mean percentage mortalities of *Phenacoccus solenopsis*to different botanical solutions at 10 ml concentrations for 48hours. Values express (Mean S.E) treatment.

Treatment	Doses	Duration	Total No.	Number of alive bug	Rate of efficiency	%of efficiency
Ocimum sanctum	10 ml	48 hrs	20	1±0.24	19±0.24	95%
Control	00	24 hrs	20	20	00	00

Values are mean ± SEM, n=5 in each group, *Significant at P< 0.05,** Highly Significant at P< 0.001.



Graph 4: Percent efficiency of botanical on mealybyg after 48 hours treatment

The above results indicated that mortality of mealy bug *P.solenopsis* on shoe flower treated with different botanical at different concentrations increased with an increased concentration and with increased exposure.The result indicated **(Table 5)** that the highest efficacy of botanicals are treated with 10 ml concentration for 48 hours on mealybug *P.solenopsis.* The result indicated that the lowest efficacy of botanicals are treated with 5 ml concentration for 24 hours on mealybug *P. solenopsis.* The tulsi extract was most effective on mealybug, treated with 10 ml concentration for 48 hours, as compared to the result of Prishanthini M and Vinobaba M (2014) they examined that, laboratory studies were carried out to evaluate the efficacy of some locally available botanicals against cotton mealy bug *Phenacoccus solenopsis* on shoe flower plants *Hibiscus rosa - sinensis*. Plants extracts obtained from *Azadirachta indica, Ocium sanctum, Calotropis gigantea, Nicotina tabacum and Alium sativum* using standard methods. Among all these botanicals, extracts were prepared and dilutions were obtained at 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.5, 2.0 percentage concentrations with the addition of soap solution. Among the treated botanicals, *O.sanctum* was effective significantly ($p<0.05$) at lower concentrations and has the 0.6% concentration as LC_{50}.

(a) Tulsi extract for 24 hrs **(b) Tulsi extract for 48hrs**

Fig 1: Mortality of mealybug for 5 ml concentration

(a)Tulsi extract for 24 hrs **(b)Tulsi extract for 48hrs**

Fig 2 : Mortality of mealybug for 10 ml concentration .

Based on these results development of new formulations with the combinations of these botanicals which can be produced and applied using simple methods applicable to local public will be very useful. Moreover, analyzing new botanicals from different plant origins and least toxic chemicals for their efficacy against the mealybugs are also necessary to reduce use of the toxic chemical insecticides. More research on the active ingredients, pesticide preparations, application rates and environmental impact of botanical pesticides are a prerequisite for sustainable agriculture. [Asogwa EU et. al. (2010) and Arif MI et. al. (2009)]

In general no adverse effects were reported from the use of the prepared sample. The prepared insecticide effectively as required and are non-toxic and non-allergic to humans. Environmentally, the production process is over 90% pollution free and does not involve any known chemical reactions. The raw materials for the production are entirely natural products. [Karar HM. et. al. (2010) and Singh et. al. (2004)]

Summary and Conclusion:

- In developing countries, the losses of crops due to pest, plant disease and competition from weeds is great. In households, pest and insects such as mosquitoes, cockroaches, mice etc pose risks such as the destruction of furniture, clothing and to the causation of various diseases, most seriously; malaria. Pesticides / insecticides produced to kill these pests in order to prevent these damages, also tend to have adverse effects on humans in various ways, most especially those produced from synthetic materials.
- The use of botanicals in pest management is not only useful for suppression of pest population but also helps to maintain the sound ecological balance.
- Tulsi is an aromatic plant in the Lamiaceae family. Tulsi has been used for thousands of years in Ayurveda due to its diverse healing properties
- In conclusion it can be stated that *Ocimum sanctum* was effective significantly at different concentrations. The botanicals used in this study such as *Ocimum sanctum* were showed different levels of insecticidal activities. These findings of the present study suggest that *Ocimum sanctum* extract can be used as a botanical spray to get better and safe control of mealybug P.solenopsis.
- The major tool in biological control operation is the application of synthetic insecticides, such as organophosphate compounds. This has not been very successful due to operational, economic and ecological factors. Due to lack of cost effective pesticide with environmental sustainability and harmful effect to plants, anovel pesticide to control scale insect is formulated. The present work deals with selection of suitable herbs with a maximum mortality rate of scale insects.
- This could go a long way in controlling adult females to prevent further production of eggs in consecutive generations. Since phytochemicals are safe, easily available round the year and cost effective, these stimulate local efforts to enhance the magnitude of pest control. Such an effective formulation can be used for large scale field study by agriculturists to decimate scale insect menace during flowering and fruition.
- The research has shown that insecticides made from natural botanical source such as tulsi leaves for mealybug eradication are less toxic as compared to those from the synthetic origin hence it is safer to use insecticides prepared from natural raw materials since they have little or no adverse effects on human health.

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