# Controlling of palmyra fruit infectious *carpophilus. spp* beetle by using selected medicinal plants

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**Keywords:** Botanical pesticides, palmyra palm, pesticides.

## Introduction

Ripened palmyra fruit is a delicious food source with excellent nutritious values and medicinal properties which can be developed into many value-added products. Palmyra palm, scientifically known as Borassus flabellifer is a tropical wild edible fruit tree that is globally grown in south Asian countries such as Sri Lanka, India, Bangladesh, Malaysia, Indonesia, Philippines, and East African countries [1]. In the Sri Lankan context, it is commonly grown in the dry zone including Northern and Eastern provinces. Ripen Palmyra fruits act as a part of the mission of reducing hunger in rural communities through direct consumption as well as developed products such as drinks, dumplings, candy, jams, etc. Rapid decomposition of ripened fruits due to the pest attack, renders them un-consumable, creating food waste and the mission harder.

Generally, fruit pest attacks are prevented by treating with pesticides including Pyrethroids, Carbamates, Organochlorines, and Organophosphates [2]. But with time, pesticides are identified as a major cause of environmental pollution as well as a critical health hazard to humans and animals. Bioaccumulation, changes in biological cycles, concentrating in soil and water sources are some of the environmental consequences of pesticides and they cause chronic health issues such as cancers, immunological disorders, genetic mutations, neurological disorders, birth defects, and fetal death [2, 3]. Therefore, scientists have paid attention towards botanical pesticides in order to minimize the detrimental impacts of pesticides and fulfill the pest control aspect. This study was aimed to identify the infective pest to the Palmyra fruits and analyze the insecticidal activity of leaves of Azadirachta indica (Neem), Justicia adhatoda (Malabar nut), Citrus × aurantiifolia (Lime), Tabernaemontana divaricata (Crape jasmine), Lantana camara (Shrub verbena), and flowers of Tagetes erecta (Marigold) which were considered as medicinal plants. Identification of potential botanical insecticide for control of Palmyra fruit pest will be a valuable attempt to increase the utilization of Palmyra fruit up to its maximum values.

## Methodology

**Identification of pest.** Pests were collected from the Batticaloa district and identified using morphology. Identification was confirmed by Prof. (Mrs) R. Gnaneswaran, University of Jaffna.

**Preparation of plant extracts.** Samples were collected from Buttala and Sammanthurai areas and authenticated by Mr. EMJM. Rizvi, Senior Lecturer, SEUSL. Samples were cleaned, shade dried for six weeks, ground, sieved using a 212 mic laboratory sieve, and stored at 4º C. From fine powder, 20 g was soaked in 200 ml of 100% methanol and mechanically shacked at 300 rpm for 24 hours. Extracts were evaporated using a shaking water bath at 40º C, 60 SPM speed. Resulted crude was dissolved in 95% acetone to made 1 g/ml, 0.1 g/ml and 0.01 g/ml solutions.

**Bioassay.** Bioassay was done by the Petri dish method using three replicates for each concentration and a control test using acetone. 1 cm2 fruit part was dipped in a particular solution 20 minutes, air-dried 1 hour under room temperature, pests were introduced to

treated fruits, and mortality was observed after 12, 24, 48, 72 hours [4].

**Statistical analysis.** Mortality was calculated as mean± standard error. Graphs were plotted using Microsoft Excel and the General Linear Model of ANOVA in Minitab17. Statistically significant was considered at $p$=0.05.

## Results and Discussion

The study identifies the infective pest to the ripen Palmyra fruits and analyzes the pesticide potential of selected medicinal plants against the pest. The pest was observed under a light microscope and dissection microscope. The body consisted of head, thorax, and abdomen, therefore, the pest was identified as an insect. The adult was dark brown to black with 4 to 5mm length, 2 to 3mm width, three pairs of legs, hard forewings, and flying hind wings. The body consisted of 5 abdominal segments, 2 covered with short, thick, hairy elytra and 3 segments exposed. The Head consists of pair of 11 segmented and clubbed-shaped antennas. Fruits were infected with the pest after it ripens and fell to the ground. By following morphology and infective procedure, the pest was identified as a species of sap beetle that belongs to the class Insecta, order Coleoptera, family Nitidulidae, and genus *Carpophilus*.

For the mortality testing, the dried plant materials were extracted using 100% methanol as the menstruum. Methanol is an organic solvent that can extract active insecticidal metabolites that are in maximum yields because many insecticides are organic compounds. Dried samples maximize the active compounds in the extract by allowing maximum penetration of solvent compounds to the cells. Shade drying protects the active secondary metabolites from light by preventing light-induced chemical reactions [5]. Stock solutions are prepared using acetone as solvent.

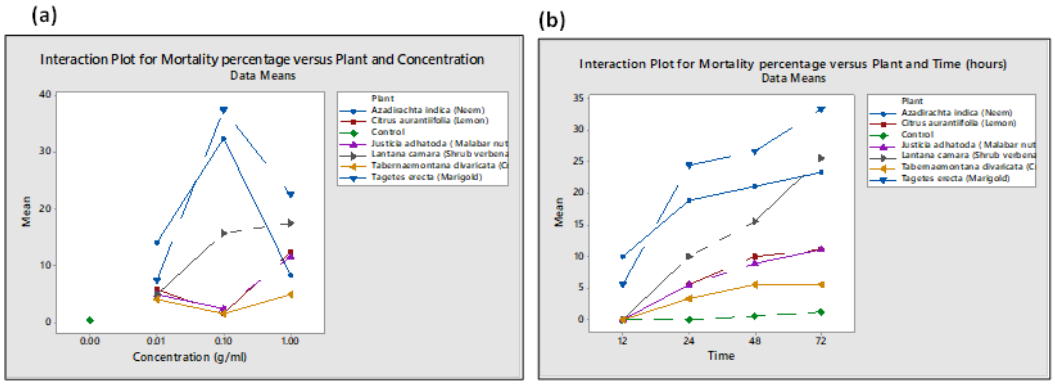


**Figure 1.** (a) Interaction plot for Mortality percentage versus Plant and Concentration, (b) Interaction plot for Mortality percentage versus Plant and Time.

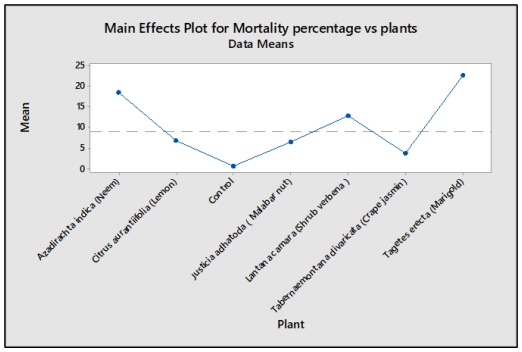


**Figure 2.** Main effect plot for Mortality percentage versus plant.

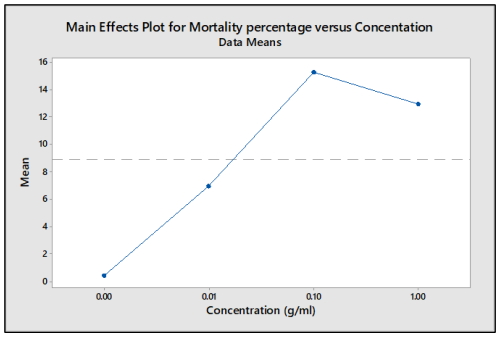


**Figure 3.** Main effect plot for Mortality percentage versus concentration.

Quantitative analysis of mortality of different plant samples showed that all plants have insecticidal properties against the target pest in different amounts, and different concentrations of plants have different mortality with the time. For all plants, the mortality was increased with time.

From all plants, Tagetes erecta flower extract, Azadirachta indica leaf extract, and Lantana camara leaf extract were showed the ability to control the Palmyra fruit beetle.

From all concentrations, 0.1g/ml solutions were showed maximum mortality, and 0.01g/ml solutions not given any effective mortality. Highest concentration (1g/ml) was given low mortality than 0.1g/ml solution. The reason will be a high concentration of metabolic compounds may keep away insects from the sample due to the strong aroma and flavor in it.

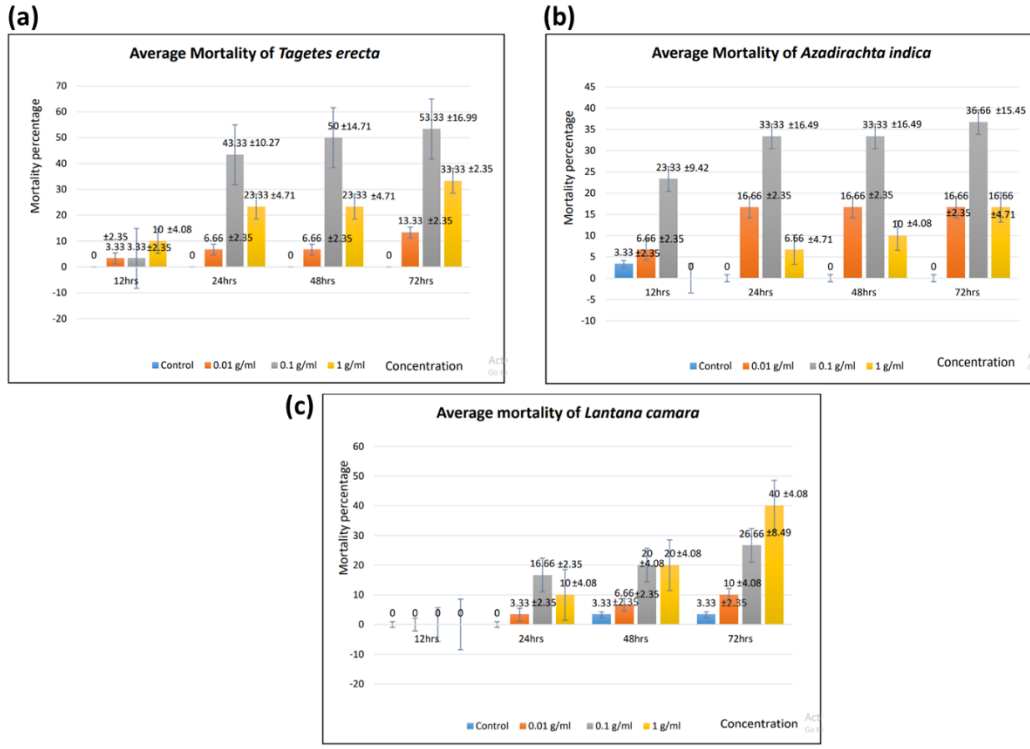


**Figure 4.** (a) Average Mortality of Tagetes erecta, (b) Average Mortality of Azadirachta indica, (c) Average Mortality of Lantana camara.

For Tagetes erecta and Azadirachta indica extracts, efficient concentration was 0.1 g/ml and for Lantana camara extract, efficient concentration was 1 g/ml.

Tagetes erecta flower extract showed 53.33 ± 16.99 maximum percent mortality by 0.1 g/ml concentrated solution during the 72nd hour of observation. Lantana camara leaf extract showed the second-highest mortality of 40 ± 4.08 percent by 1 g/ml solution at the 72nd hour of observation. Azadirachta indica leaf extract showed maximum mortality as 36.66±15.45 percent from 0.1 g/ml concentrated solution in the 72nd hour of observation. But, up to the 48th hour of observation, Tagetes erecta showed the highest mortality (50±14.71) followed by Azadirachta indica (33.33±16.49), and Lantana camara (20±4.08). Therefore, when considering the time of response and magnitude of the response, the efficiency of the plant extracts can be arranged as Tagetes erecta > Azadirachta indica > Lantana camara. All tested plants have previously been recorded for their insecticidal properties through scientific experiments and there are many more plants with insecticidal potential which can be developed into efficient botanical insecticides to the target pest.

**Conclusion**

The present study identified that the tested pest belongs to the genus Carpophilus and revealed three potential insecticidal plants from tested plants. Tagetes erecta flower extract showed maximum mortality followed by Azadirachta indica leaf extract, and Lantana camara leaf extract respectively. Maximum mortality was given by 0.1 g/ml concentration of all plants and with time, mortality was increased. Considering plant type, concentration, and time, Tagetes erecta was the efficient botanical insecticide to the Palmyra fruit beetle. Testing more botanicals will encourage the development of strong botanical insecticide to control the Palmyra fruit beetle and it will ensure food security.

**Acknowledgment**

I would like to express my profound gratitude to my supervisor Dr.V. Sujarajini for giving this invaluable opportunity to complete my research under her supervision and for her guidance, immense knowledge, and encouragement throughout this work.

I would like to express my sincere gratitude to Prof. (Mrs) R. Gnaneswaran, Department of Zoology, University of Jaffna for her support to complete this work.

I would like to express my sincere gratitude to Mr. EMJM. Rizvi, Senior Lecturer in Biology. Dept. of Biological Sciences, South Eastern University of Sri Lanka, for his guidance to complete this research work.

I also would like to express my sincere gratitude to Dr. AM. Razmy, Senior Lecturer in Statistics, Dept. of Mathematical Sciences, South Eastern University of Sri Lanka for his guidance to complete my research work.

I am extremely thankful to all other lectures of the Department of Biological Sciences, South Eastern University of Sri Lanka for their continuous support for the completion of my research work.

I would like to acknowledge with much appreciation the support of the biology laboratory technical officer, chemistry laboratory technical officer, and other laboratory staff for their continuous support throughout the time.

I would like to give my big thank to Ms. MMRSS. Manthilake for her support.

I would like to give my special thanks to my family members and my friends Malshani Thennakoon and Sanjana Fernando for always standing behind me and encouraging me.

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