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# Repellency and toxicity of *Couroupita guianensis* leaf extract against Silverleaf Whitefly (*Bemisia tabaci*)

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***Abstract-*** Whitefly (*Bemisia tabaci* Genn.) is a widely distributed and highly harmful plant pest species. The management of *B. tabaci* has been typically carried out by chemical pesticides. In the last decade however, there has been an increasing interest in natural products, particularly those of plant origin, to control this pest species. In the present work, aqueous extract of *Couroupita guianensis* plant was evaluated for insecticidal activity against eggs, nymphs and adults of *Bemisia tabaci*, on tomato plant grown in the greenhouse condition. In a separate experiment, *C. guianensis* extract treatment was tested for repellency. The aqueous extract showed low insecticidal effects on *B. tabaci* eggs. However, nymphs and adults were more sensitive towards *C. guianensis* treatment. The *C. guianensis* extract reduced the survival rate of *B. tabaci* by 19.2%, 29.2% and 35.34% after treatment of eggs, nymphs and adults, respectively. Overall, results suggest that the aqueous extracts of *C. guianensis* leaves show high insecticidal effects on nymphs and adult flies whereas low effect on the eggs of *B. tabaci* as compared to control. The results revealed that the tested material exhibited reasonable insecticidal activity against all the stages of whiteflies. Hence, the extracts from *C. guianensis* plant could be used as an effective and environmentally sustainable bio-insecticide for the control of whiteflies, *Bemisia tabaci*.

***Index Terms-*** *Couroupita guianensis*, insecticidal activity, Whitefly.

## I. INTRODUCTION

India is an agricultural country and more than 80% of the population depends on agriculture. Pathogenic organisms and insect pests cause tremendous crop loss worldwide and reduce the yield by 20–40%. In India, approximately 18% of food grains are lost due to pathogens and insect pests. Different chemical pesticides are used to control the pests and reduce the loss. Application of chemical pesticides is polluting the environment, causing ill effects on nontarget organisms, developing resistance, and causing resurgence of pests. These call for an alternative to chemical pesticides through natural means of pest control, including vigorous search for new sources of botanical insecticides. Plant-based pesticides are highly suitable since they have low toxicity, are easily biodegradable, and have multimode of action; they are suitable for organic agriculture.

Higher plants are a rich source of novel natural substances that can be used to develop environmental safe methods for insect control. Insecticidal activity of many plants against several insect pests has been demonstrated. The deleterious effects of plant extracts or pure compounds on insects can be manifested in several manners including toxicity, mortality, anti-feedant growth inhibitor, suppression of reproductive behavior and reduction of fecundity and fertility[1]. Plant-derived substances have multimode of actions against different agricultural pests and act as antifeedant[2] and larvicidal[3] agents; they reduce adult emergence and increase adult abnormalities[4, 5]; they inhibit larval growth[6] and cause ovicidal and oviposition deterrent activities[7]; and they bring about cytological changes[8]. Plants may provide potential alternatives to currently used insect-control agents because they constitute a rich source of bioactive chemicals. Much effort has been focused on plant-derived materials for potentially useful products as commercial insect-control agents[9]. *Bemisia tabaci* is a polyphagous insect that attacks more than 700 plant species all over the world. This species is known for its genetic diversity that includes a complex of biotypes or, as recently suggested, a complex of 11 well defined groups with 24 distinct species. Plant damage is caused by transmission of plant viruses, direct feeding, plant physiological disorders, honeydew production and fungal growth. At present, chemical application is necessary to control this pest, which often results in overuse of these chemicals. Therefore, Silverleaf Whitefly has developed resistance to many conventional insecticides throughout the world, especially organophosphates and pyrethroids[10].

*Couroupita guianensis* leaves extract showed antifeedant, larvicidal, and ovicidal activities against *Helicoverpa armigera*[11, 12] and antifeedant activity against *Spodoptera litura*. In the present study, the toxicity and repellency of aqueous extract of *C. guianensis* (known to have medicinal activity) was investigated against the Silverleaf whitefly, *B. tabaci*.

## II. MATERIALS AND METHODS

### a. Plant Sample

Fresh plant leaves of *Couroupita guianensis* were collected from the Botanical garden, Institute of Science in December 2013 (Photoplate 1C).

### b. Preparation of the Plant Extract

The healthy leaves of the selected plant were collected and thoroughly washed in running tap water and air dried for 7-10 days. The dried material was mechanically powdered, sieved using meshes and stored in an airtight container. A 10 % wt/v aqueous extract was prepared by boiling the air-dried powdered plant material in sterile distilled water for 20 min and then cooled to room temperature. The aqueous extracts were filtered using Whatman No.1 filter paper to remove particulate matter. The final volume of each filtrate was completed to 100 ml with distilled water. The aqueous extracts were prepared shortly before application. Negative control was represented by distilled water.

**c. Insect culture**

The colony of *B. tabaci* was maintained on tomato plants. To obtain immature whiteflies, 4-week-old greenhouse grown tomato plants (whitefly-free greenhouse) were trimmed to three fully expanded leaves and were transferred to the whitefly colony for 48 hr. Adults were then aspirated from the plants, and the plants were placed in a separate cage. The synchronously developing, uniformly-aged whitefly populations were then held until they developed to the appropriate stage.

**d. Egg mortality**

Immediately after the adult whiteflies were aspirated from the plants, the plants were sprayed with the extract. Water served as the negative control. For testing, the number of eggs per plant was fixed to 50. There were five replicates (plants) for each treatment. Eight days after treatment, the unhatched eggs and newly emerged nymphs were counted and the percent hatch calculated.

**e. Pupal mortality**

Fourteen days after infestation, when most of the nymphs were in the red-eye stage (Photoplate 1B), the plants were sprayed as before. For testing, the number of nymphs per plant was taken to be 50. There were five replicates (plants). Seven days after treatment, when most of the pupae had emerged from control plants, the number of empty pupal cases and pupae that failed to emerge was counted and the percent of emergence was calculated.

**f. Adult mortality**

A fully expanded leaf was placed in wet moss inside a petri plate. The leaf was dipped into the solution of the required treatment and left as it is overnight. About 30 adult flies (Photoplate 1A) were then introduced inside each petri plate. Distilled water was used as negative treatment. The number of dead whitefly adults was recorded after 48 hr. A whitefly adult was considered dead if it did not move after probing with a paint brush. Five replicates were made for each treatment.

**g. Repellency test**

Two fully expanded leaves of tomato were placed individually in petri plates. One leaf was dipped in the tested plant extract and the other one was dipped in distilled water. The petri plates were placed in a plastic box covered with fine netting material. About 50 immobilized adults were placed between the two petri plates. Numbers of adults attracted to each leaf was recorded after 24hr. Five replicates were made for each treatment.

## III. RESULTS AND DISCUSSION

The toxicity effect of *C. guianensis* extract was studied on different stages of whitefly and the results obtained are tabulated in Table-1. The aqueous extract of *C. guianensis* showed low insecticidal effect on *B. tabaci* eggs. However, nymphs and adults were more sensitive towards *C. guianensis* treatment (Fig. 2). The *C. guianensis* extract reduced the survival rate of *B. tabaci* by 19.2%, 29.2% and 35.34% after treatment of eggs, nymphs and adults, respectively. The toxic effect of *C. guianensis* extract on eggs, nymphs and adult whiteflies was 2.4%, 21.6% and 24.67% (Fig. 1), respectively and it was higher compared to the negative control (D/W).

The extract of *C. guianensis* showed high repellency effect to adults of whitefly. Around 70% adult flies were attracted to the negative control (water) and 30% were attracted to the plant extract, thus showing that the plant extract has around 70% repellency activity (Table-2).

| Sr. no. | Life stages | Treatment | Mortality Mean ±SD | % Mortality |
|---|---|---|---|---|
| 1. | Eggs | Treated | 9.6 ±2.07 | 19.2 |
| | | Control | 8.4 ±1.52 | 16.8 |
| 2. | Pupae | Treated | 14.6 ±2.88 | 29.2 |
| | | Control | 3.8 ±0.83 | 7.6 |
| 3. | Adults | Treated | 10.6 ±2.07 | 35.34 |
| | | Control | 3.2 ±0.84 | 10.66 |

**Table 1: Toxicity test in Whitefly- Effect of *Couroupita guianensis* leaf extract.**

Treated= Treatment with *C. guianensis* leaf extract; Control= Treatment with D/W

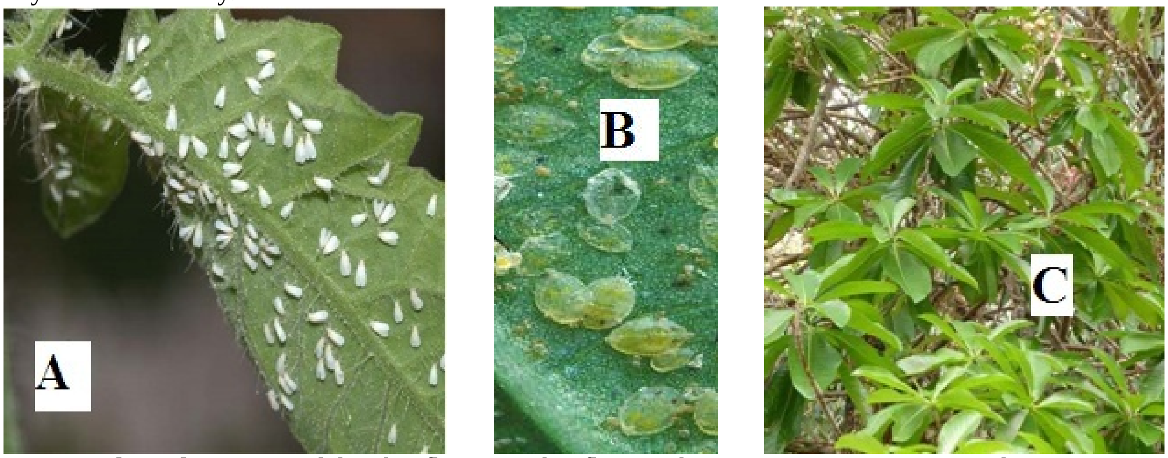
**Table 2: Repellency test in Whitefly- Effect of *Couroupita guianensis* leaf extract.**

| Sr. No. | Parameters | No. of adult flies attracted towards: (out of 50) | |
|---|---|---|---|
| | | *C. guianensis* leaf extract | Control- Distilled Water |
| 1. | Mean ±SD | 14.8 ±1.30 | 35.2 ±1.30 |
| 2. | Percentage | 29.6% | 70.4% |

Whitefly management has traditionally depended on the use of synthetic insecticides. However, the increasing resistance of *Bemisia* species to insecticides provides an impetus to use integrated pest control measures, including biopesticides and biological control to combat this pest. Biopesticides are based on natural products and synthetic analogs of naturally occurring biochemicals and are more acceptable than conventional pesticides because of their reputation for being less hazardous to humans and other non-target organisms[13]. Among the biopesticides, the chemical phytoconstituents derived are from a variety of plant families. The biological activity of plant extracts against bacteria, fungi, viruses and insects has been effectively reported[14, 15, 16].

*Couroupita guianensis* is a tree belonging to the family Lecythidaceae. Various parts of this tree have been reported to contain oils, keto steroids, glycosides, couroupitine, indirubin, isatin and phenolic substances. *C. guianensis* has showed a broad spectrum of antibacterial and antifungal activities. It is known that one of the active constituents of the medicinal plant *C. guianensis*, namely isatin, is known to exert cytotoxic activity against certain cancer cell lines, and a potential source of new chemotherapeutic agents[17].

Repellent activity of the test plant could be attributed to the complex mixture of compounds that are detected by the susceptible insect[18]. *C. guianensis* is among the ancient aromatic plants and this aromatic property could be responsible for the repellent activity towards whitefly.




**Photoplate 1**: A- Adult Whiteflies; B- Whitefly nymphs; C- *Couroupita guianensis* leaves

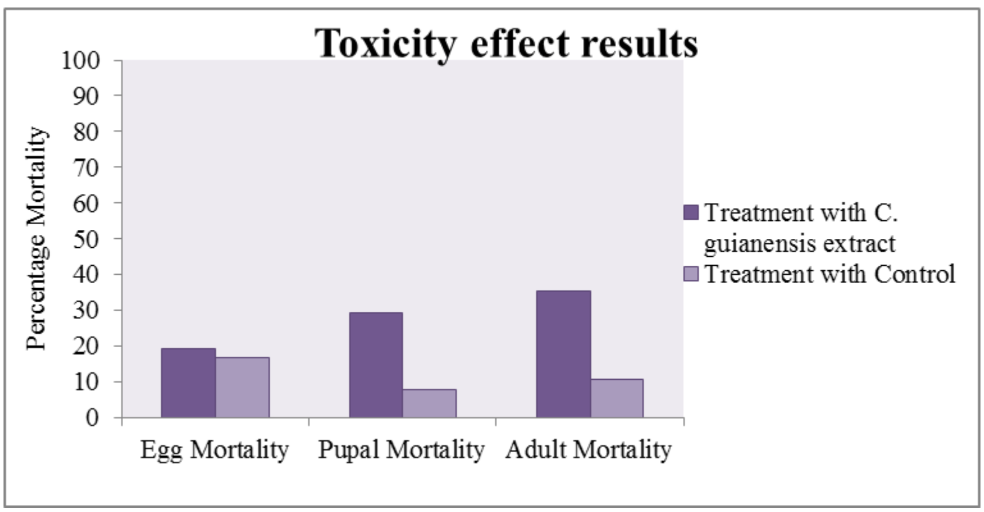



**Figure 1. Toxic effect of *C. guianensis* aqueous leaf extract on % egg, pupal and adult mortality.**

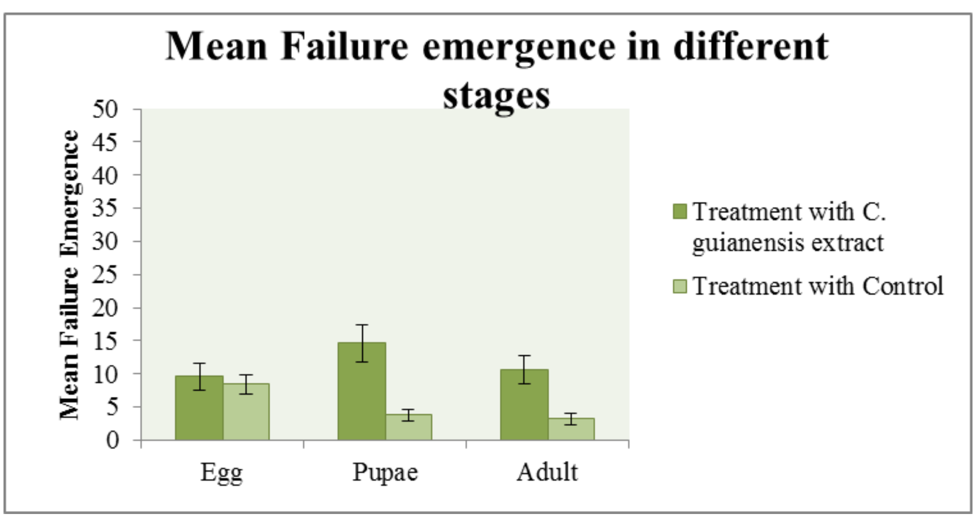



**Figure 2. Mean failure of emergence in the different stag es of whiteflies after treatment with *C. guianensis* extract.**

## IV. CONCLUSION

The current study showed that the aqueous extract of *C. guianensis* has moderate insecticidal activity against *B. tabaci*. The results of this study offer some scientific credence to the traditional use of medicinal plants for the management of Silverleaf whitefly. There are many opportunities for the use of plant phytoconstituents as an alternative to synthetic insecticide; one is their insecticidal potency and environmental sound nature, easy accessibility by the rural community. Another important opportunity is their easy application as a spray insecticide treatment. There is, however, a need for further investigation on their safety and efficacy (*in vivo* and under natural conditions) as well as cost-effectiveness of the products that exhibited strong insecticidal activity with a view of substituting the conventional drugs. Furthermore, the extraction method is simple and cost-effective and the application techniques could be easily designed for on-farm use. Since *B. tabaci* transmits tomato leaf curl virus, developing new methods of control is obviously important.

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