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# *Chromolaena odorata* (Siam Weed) as Bio-pesticide Against Beans Weevils

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## Abstract

The increased use of pesticides in the control of vector pests has raised some concern over the adverse effect of these chemicals on humans, domestic animals and their environment. This research was undertaken to harness the beneficial use of dried *Chromolaena odorata* (Siam weed) leaves and stems to control beans weevil (*Acanthoscelides obtectus*) in storage system. Experimental research method was done with two groups, groups A and B. Group A was treated with dried grinded *Chromolaena odorata* leaves and stem in the ratio 1:1 and group B was treated with dried chopped *Chromolaena odorata* leaves and stem in the ratio 1:1. Result of the study revealed higher mortality of bean weevils after seven (7) days in group A with the highest mortality rate obtained from Treatment four (4) with ten (10) grams of dried ground *Chromolaena odorata* leaves and stem. Based on this study, beans farmers and traders could use *Chromolaena odorata* to control beans weevils in their storage area.

## Keywords

*Chromolaena odorata*, Bean Weevil, Bio-pesticide, Mortality Rate, Nitrate, Actellic Dust

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## 1. Introduction

The increased use of pesticide in the control of vector pest and filthy insects has prompted some concern over the adverse effect of these chemical substances on living organisms and their environment [1]. The harmful nature of these synthetic chemical pesticides leads to the inhibition of actions of enzymes and blocking of essential processes in organisms. There is increasing use of harmful organophosphates such as Actellic dust and Sniper (2, 2 dichlorovinyl-dimethylphosphate) in the preservation of beans. Ideally a pesticide must be lethal to the target species, but not to non-target species, including man, unfortunately, this is not the case, therefore the controversy of use and abuse of pesticides has surfaced [2]. The rampant use of these chemicals, under the adage, "If a little is good, a lot more will be better" has played havoc with human and other life forms [2].

The bean weevils or seed beetles are a subfamily (*Bruchinae)* of beetles, now placed in the family *Chrysomelidae*, though they have historically been treated as a separate family. They are Granivores, and typically infest various kinds of seeds or beans, living for most of their lives inside a single seed. The family includes about 1,350 species found worldwide. Bean weevils are generally compact and oval in shape, with small heads somewhat bent under. Sizes range from 1 to 22mm for some tropical species. Colors are usually black or brown, often with mottled patterns. Although their mandibles may be

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elongated, they do not have the long snouts characteristic of true weevils. Adults deposit eggs on seeds, then the larvae chew their way into the seed. When ready to pupate, the larvae typically cut an exit hole, and then return to their feeding chamber. Adult weevils have a habit of feigning death and dropping from a plant when disturbed.

*Chromolaena odorata* is a perennial shrub forming dense tangled bushes 1.5-2.0 m in height, occasionally reaching 6m as a scrambler up trees. *Chromolaena odorata* originated in subtropical and tropical America, and had a wide native distribution, from the Southern United States to Northern Argentina, and exhibits considerable variation throughout its distribution. It was argued that the source of the original introduction is likely to have been Jamaica in the West Indies. In the Neotropics, *Chromolaena odorata* is always found in competition or association with a complex of closely related species not present in Asia or Africa. In the new world, *Chromolaena odorata* is common in most habitats except undisturbed rainforest. It is typically a plant of secondary succession, rapidly invading clearings and persisting until shaded out by the overgrowth of forest trees. The plant can be poisonous to livestock as it has exceptionally high level of nitrate (5 to 6 times above the toxic level) in the leaves and young shoots; the cattle feeding on these die of tissue anoxia [3].

It is generally regarded as poisonous to animals and thus not recommended as a livestock feed. However, some studies show its benefits in low concentrations, such as up to 5% for egg-laying chickens which also improved yolk colour [4]. In Malaysia, where *Chromolaena odorata* is an invasive exotic, plant parts are used by traditional practitioners for treatment of burns, wound healing, skin infections, post-natal wounds, and as an anti-malarial [5]. It has also been reported to possess anti-inflammatory, astringent, diuretic and hepatotropic activities [6, 7].

Since the use of chemicals to control bean weevil and other grain pests have been abused causing possible chaos to humans, this study became important for the need of alternative biological pesticide using dried grinded and chopped *Chromolaena odorata* leaves and stems.

# 2. Materials and Methods

## 2.1. Collection and Identification of *Chromolaena Odorata*

The *Chromolaena odorata* stems and leaves used for the study were collected in the locality of Nnamdi Azikiwe University Awka, Nigeria. The *Chromolaena odorata* was authenticated by the taxonomist, Mrs Aziagba V. A, of the Department of Botany, Nnamdi Azikiwe University, Awka. The voucher specimen was deposited in the Hebarium of the Department.

## 2.2. Preparation of *Chromolaena Odorata*

The *Chromolaena odorata* stems and leaves were washed with distilled water and then dried for 30 days under room temperature. After 30 days, a portion of the stems was chopped and a portion was ground with a blender. Likewise, a portion of the leaves was chopped while a portion was ground with a blender. 50g of chopped *Chromolaena odorata* leaves were mixed with 50g of chopped *Chromolaena odorata* stems while 50g of ground *Chromolaena odorata* leaves were mixed with 50g of ground *Chromolaena odorata* stems.

## 2.3. Sources of Weevils and Beans

The weevils used for the study were sourced from beans storage facilities in Eke Ukwu, Owerri, Imo State, Nigeria, while the beans used were obtained from Eke Awka Market, Awka, Anambra State, Nigeria. The beans used were free of weevils.

## 2.4. Grouping

Negative control: 0g dried *Chromolaena odorata* leaves and stems was used, 10g of beans grain was weighed and placed in small bags in a cage to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Positive control: 2.5g Actellic Dust (Powder) was weighed and put into the cage that simulates a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

### 2.4.1. Treatments with Ground *Chromolaena Odorata* Mixture

Treatment 1:2.5g of a mix of dried ground *Chromolaena odorata* mixture, was weighed and put into the cage that simulates a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Treatment 2:5g of a mix of dried ground *chromolaena odorata* mixture, was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Treatment 3:7.5g of a mix of dried ground *chromolaena odorata* stem and leaves, was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Treatment 4:10g of a mix of ground *chromolaena odorata* stem and leaves, was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

#### 2.4.2. Treatments with Chopped *Chromolaena Odorata* Mixture

Treatment 5: 2.5g of a mix of chopped *Chromolaena odorata* leaves and stem and was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Treatment 6: 5g of a mix of chopped *Chromolaena odorata* leaves and stem was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Treatment 7: 7.5g of a mix of chopped *Chromolaena odorata* leaves and stem and was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

Treatment 8: 10g of a mix of chopped *Chromolaena odorata* leaves and stem and was weighed and put into the cage to simulate a warehouse, and was covered with a net to allow sufficient air get in, 10g of beans grain was weighed and placed in small bags to simulate bags of beans in the warehouse, then 10 live weevils were introduced on the floor of the cage.

### 2.5. Nitrate Determination

Nitrate content was determined using the method of [8].

## 3. Result

### 3.1. Treatment with Ground *Chromolaena Odorata*

Table 1 shows the result of the experiments carried out with ground *Chromolaena odorata* leaves and stem (in the ratio 1:1) after a period of seven (7) days. Positive control (2.5g Actellic dust) showed the highest mortality rate with no live weevil both on the floor and inside the bag of beans after 7 days. Negative control (0g of sample) showed the lowest mortality rate with all the weevils surviving after 7 days. Treatment 1 ($T_1$) showed mortality of 5 weevils on the floor and inside the bag of beans with 2.5g of sample, Treatment 2 ($T_2$) showed mortality rate of 7 weevils with 5g of sample, Treatment 3 ($T_3$) showed a mortality rate of 8 weevils with 7.5g of sample and Treatment 4 ($T_4$) showed the highest mortality rate of 9 weevils with treatment of 10g of *Chromolaena odorata* sample mix.

**Table 1.** Mortality Rate with Ground Sample.

| Treatments | *Chromolaena odorata* (g) | Quantity of beans (g) | Number of live weevils | Number of dead weevils after 7 days | Number of live weevils after 7 days |
|---|---|---|---|---|---|
| Positive control (Actellic Dust) | 2.5 | 10 | 10 | 10 | 0 |
| Negative control | 0 | 10 | 10 | 0 | 10 |
| $T_1$ | 2.5 | 10 | 10 | 5 | 5 |
| $T_2$ | 5.0 | 10 | 10 | 7 | 3 |
| $T_3$ | 7.5 | 10 | 10 | 8 | 2 |
| $T_4$ | 10.0 | 10 | 10 | 9 | 1 |

### 3.2. Treatment with Chopped *Chromolaena Odorata*

The table 2 shows the result of the experiments carried out with a mix of chopped *Chromolaena odorata* leaves and stem (in the ratio 1:1) after a period of seven (7) days. Positive control (2.5g actellic dust) showed the highest mortality rate with no live weevil after 7 days. Negative control (0g of sample) showed the lowest mortality rate with all weevils alive. Treatment 1 ($T_1$) showed mortality rate of 6 weevils with 2.5g of sample, Treatment 2 ($T_2$) showed mortality rate of 5 weevils with 5g of sample, Treatment 3 ($T_3$) showed a mortality rate of 7 weevils with 7.5g of sample and Treatment 4 ($T_4$) showed the mortality rate of 7 weevils with 10g of sample.

**Table 2.** Mortality Rate with the Chopped Sample.

| Treatments | *Chromolaena odorata* (g) | Quantity of beans (g) | Number of live weevils | Number of dead weevils after 7 days | Number of live weevils after 7 days |
|---|---|---|---|---|---|
| Positive control (Actellic Dust) | 2.5 | 10 | 10 | 10 | 0 |
| Negative control | 0 | 10 | 10 | 0 | 10 |

| Treatments | *Chromolaena odorata* (g) | Quantity of beans (g) | Number of live weevils | Number of dead weevils after 7 days | Number of live weevils after 7 days |
|---|---|---|---|---|---|
| $T_5$ | 2.5 | 10 | 10 | 6 | 4 |
| $T_6$ | 5.0 | 10 | 10 | 5 | 5 |
| $T_7$ | 7.5 | 10 | 10 | 7 | 3 |
| $T_8$ | 10.0 | 10 | 10 | 7 | 3 |

### 3.3. Result of the Nitrate Analysis

The nitrate content per 1g of *Chromolaena odorata* mixture (leaves and stems, 1:1 ratio) was 79.99mg/g.

## 4. Discussion

The pesticidal effect of both the ground and chopped formulations of *Chromolaena odorata* were evident in this study as shown in the tables 1 and 2. The positive control killed 100% of the weevils at the end of the study while the highest treatment in the ground sample category killed 90% of the weevils. The highest treatment in the chopped sample category killed 70% of the weevils. Therefore, the pesticidal effect of *Chromolaena odorata* leaf and stem formulation was concentration dependent. The results of this study is in agreement with the study by [9] where cowpea grains treated with the leaf powder of *Chromolaena odorata* exhibited significant repellent activity against the adults of *Callosobruchus maculatus* (F.).

Other studies also confirmed the pesticidal and insecticidal properties of leaves of *Chromolaena odorata. Chromolaena odorata* leaf was reported to have insecticidal properties against rice weevil [10]. The insecticidal properties of leaves of *Chromolaena odorata* against adult stage of *Periplaneta americana* (Cockroach) was also reported [11]. The roots of *Chromolaena odorata* have also been found to exhibit effective pesticidal and insecticidal properties. A study confirmed the repelling and insecticidal effect of *Chromolaena odorata* with the highest concentration (10% w/v) of the root extract causing 100% mortality against *Macrotermes* species, following a 36 h exposure period [12]. Also a similar study reported that the root powder of *Chromolaena odorata* caused significant mortality (100%) against *C. maculatus* following a 72 h exposure period [13].

The increase in mortality rate of bean weevil as observed in this study may be as a result of the phytochemical composition of *Chromolaena odorata* plant. The leaf extract of *Chromolaena odorata* has been reported to contain flavonoid, tannin, saponin and alkaloid [14, 11]. Saponin of *Cestrum parqui* has been used to treat larval stage of mosquito indicating its insecticidal property [15]. Many studies have also shown that saponin can generate adverse physiological response in animal and pests [16]. Flavonoids were implicated to have effect on biochemical reactions involving mitochondrial enzymes [17]. Therefore flavonoid effects on the mitochondrial enzyme components could be used in the control of insect/pest population.

The result of the study also showed that the nitrate level of the sample was high at 79.99mg/g. The plant can be poisonous to livestock as it has exceptionally high level of nitrate (5 to 6 times above the toxic level) in the leaves and young shoots; the cattle feeding on these die of toxic anoxia [3]. It is possible that the high nitrate level of the sample contributed to the killing of the weevils through inhalation and oral routes.

## 5. Conclusion

The result of the study showed that a mix of *Chromolaena odorata* stem and leaf can be used as an organic pesticide to control pests (Beans weevil) in food and food storage facilities. The use of this potential organic pesticide especially in grinded form will preclude the use of synthetic pesticides that pose a great threat to human lives. It is worthy of note that the sample (organic pesticide) used for this study did not come in contact with the beans yet it was effective in controlling beans weevils. It is therefore recommended that the Departments of Agriculture and Health in many countries where *Chromolaena odorata* is largely found, champions the use of the plant (biological/organic pesticide) nationally and locally as alternative to synthetic pesticides considering its effectiveness and also due to the fact that it is health and environment friendly.

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