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# EFFECTS OF *ARISTOLOCHIA* EXTRACTS ON THE COMMON CUTWORM, *SPODOPTERA LITURA* (F.)[1]

**Merdelyn Caasi-Lit and Belen Morallo-Rejesus[2]**

## ABSTRACT

**Crude extracts of *Aristolochia elegans* Mast. and *A. tagala* Cham,. when tested on the common cutworm, *Spodoptera litura* (Fabr.), showed pronounced deformations and malformations in the larval, pupal and adult stages and were toxic and growth inhibitory. Free choice, no choice and leaf consumption experiments also revealed that both species had repellant and antifeedant properties.**

**Key words:** *Aristolochia elegans* Mast., *Aristolochia tagala* Cham., growth inhibitors, antifeedants, repellants, common cutworm. *Spodoptera litura* (Fabr.)

## INTRODUCTION

The tropical flora is considered a great reservoir of botanical sources of pesticides. This makes the search for potential insecticidal compounds occurring naturally in plants an interesting endeavor. In response to the current interest in this line of research, Caasi-Lit and Morallo-Rejesus (1989) studied the effects of crude extracts of *Aristolochia elegans* Mast. and *A. tagala* Cham. on the Asian corn borer, *Ostrinia furnacalis* (Guenee). The extracts were found to be growth inhibitory and repellant or antifeedant to the said insect pest.

In this paper, the results of a study on the effects of the same extracts on the common cutworm, *Spodoptera litura* (Fabr.), are presented. The choice of the test insect was based on its economic importance and the relative ease of mass rearing the species. The common cutworm is polyphagous and can be collected on various crops almost throughout the year in the Philippines.

## MATERIALS AND METHODS

**Mass rearing of test insects.** Eggs and larvae of the common cutworm

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[2]Research Associate, Entomology Laboratory, Institute of Plant Breeding and Professor, Department of Entomology, respectively, College of Agriculture, U.P. at Los Baños, College, 4031 Laguna.

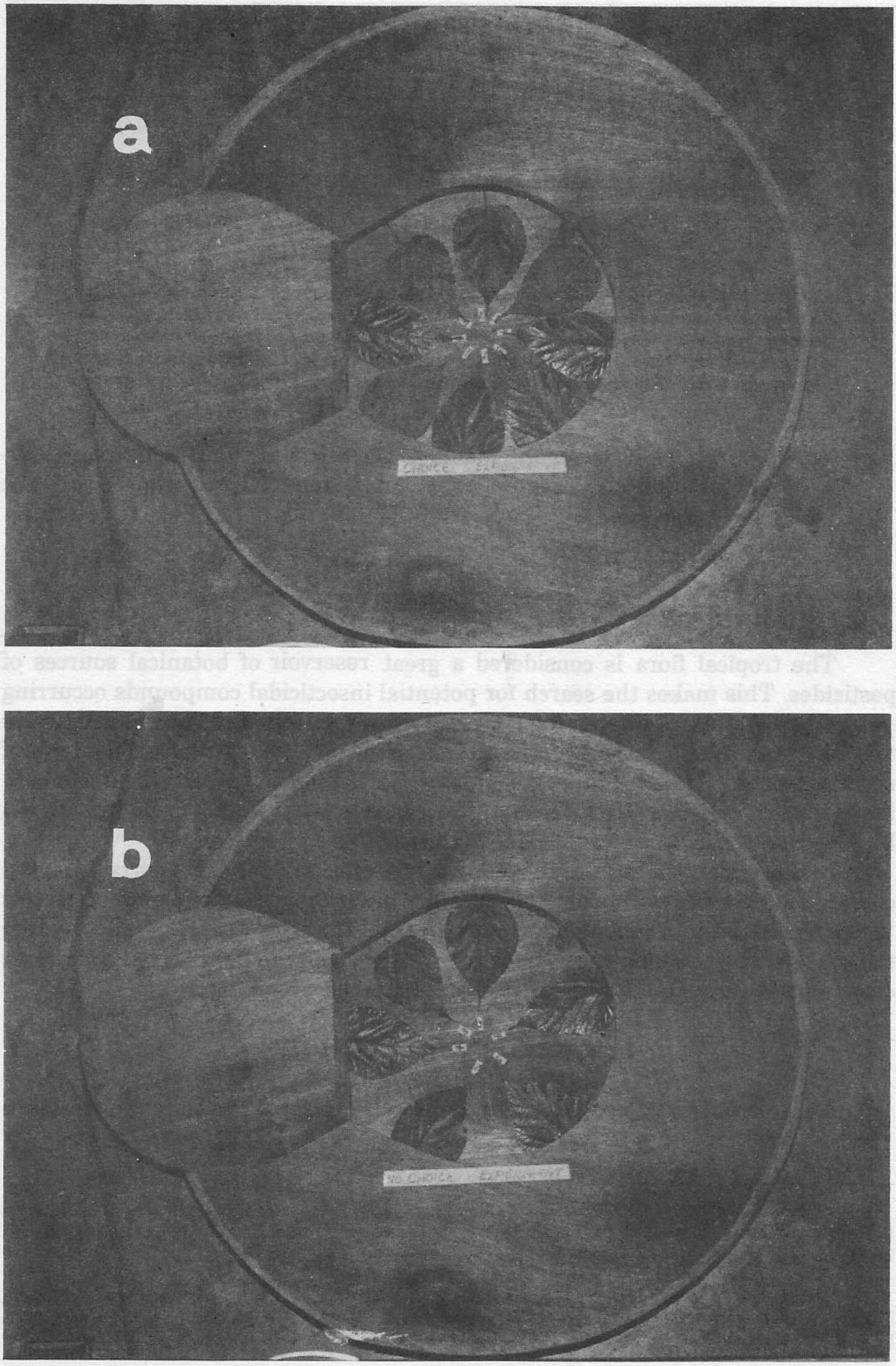


Figure 1. Set up for (a) free-choice and (b) no-choice experiments.

were collected from the UPLB Central Experiment Station on gabi (*Colocasia esculenta* (Linn.) Schott.), string beans (*Vigna sesquipedalis* Fruw.) and corn (*Zea mays* L.) and reared on leaves of mulberry (*Morus alba* L.). Pupae were sexed according to the methods of Yucheng (1971) and placed in screened cages and/or clear acrylic pans for emergence. Matured larvae were provided sand for pupation. Adults were paired and the females allowed to oviposit on fresh leaves. Eggmasses were collected daily and reared to the desired stages.

**Bioassay.** The crude extracts used in this study were part of those used in an earlier assay on corn borer. The extraction process was discussed in a previous paper by Caasi-Lit and Morallo-Rejesus (1989).

Gummy extracts were dissolved in petroleum ether at 1:1 weight by volume ratio. From this solution, concentrations of 30, 60 and 100 mg/ml were prepared by further dilution with acetone and tested for growth inhibitory and antifeedant properties.

As growth inhibitor, mulberry leaves were sprayed with five ml solution and offered to third instar *Spodoptera* larvae by placing the insects directly on the treated leaves. Larvae were supplied with freshly treated leaves until the last instar. Leaves similarly treated with pure acetone served as control. Growth inhibitory effect was based on percent pupation, pupal size, e.g. weight and length, and abnormal growth patterns. Only *A. elegans* was evaluated in this test.

Two methods were employed in the antifeedant study namely, free choice and no choice tests. Leaves similarly treated as above were placed in a circular fashion inside a cage measuring 0.9 m in diameter and 0.2 m high with a circular opening (0.3 m diameter) on top (Figure 1). In the free choice test, third instar larvae of known weight were released at the center of the cage. In the no choice test, the larvae were placed directly on the treated leaves. The free choice test was provided with acetone-treated leaves as control, while no control was included in the no choice test.

The test insects were weighed at 12, 24 and 48 hours after exposures to treated leaves. Larval behavior and the number of larvae feeding or visiting each leaf was also noted at 30 minutes, one, two, 12, 24 and 48 hours after treatment.

The test were done in a randomized complete block design, replicated three times with 10 larvae per replicate.

## RESULTS AND DISCUSSION

### Growth Inhibitory Effects of *A. elegans*

Both *Aristolochia* extracts were used in a preliminary trial. However, *A. elegans* extract gave more pronounced results, hence, only *A. elegans* extract was used.

Table 1 shows the percentage pupal and adult survival of the common cutworm reared on mulberry leaves treated with *A. elegans* extract. Percent survival for both pupae and adults generally decreased as concentration increased for normal individuals but increased for abnormal ones. A significantly higher number of normal pupae and adults was observed in the control while 56.7% and 26.7% abnormal pupae and adults, respectively, survived at 100 mg/ml. Furthermore, several larvae failed to pupate. Pupal abnormalities and larval-pupal intermediates

Table 1. Pupal and adult survival of cutworm reared on mulberry leaves treated with *A. elegans* extract.

| TREATMENT (mg/ml) | SURVIVAL (%)* | | | |
|---|---|---|---|---|
| | Pupa | | Adult | |
| | Normal | Abnormal | Normal | Abnormal |
| Control | 90.0 a | 10.0 c | 90.0 a | 0.0 b |
| 30 | 50.0 c | 46.6 b | 30.0 b | 16.7 a |
| 60 | 63.3 b | 36.6 b | 50.0 b | 16.7 a |
| 100 | 43.3 c | 56.7 a | 40.0 b | 26.7 a |

*Means with the same letter superscript are not significantly different at 5% level.

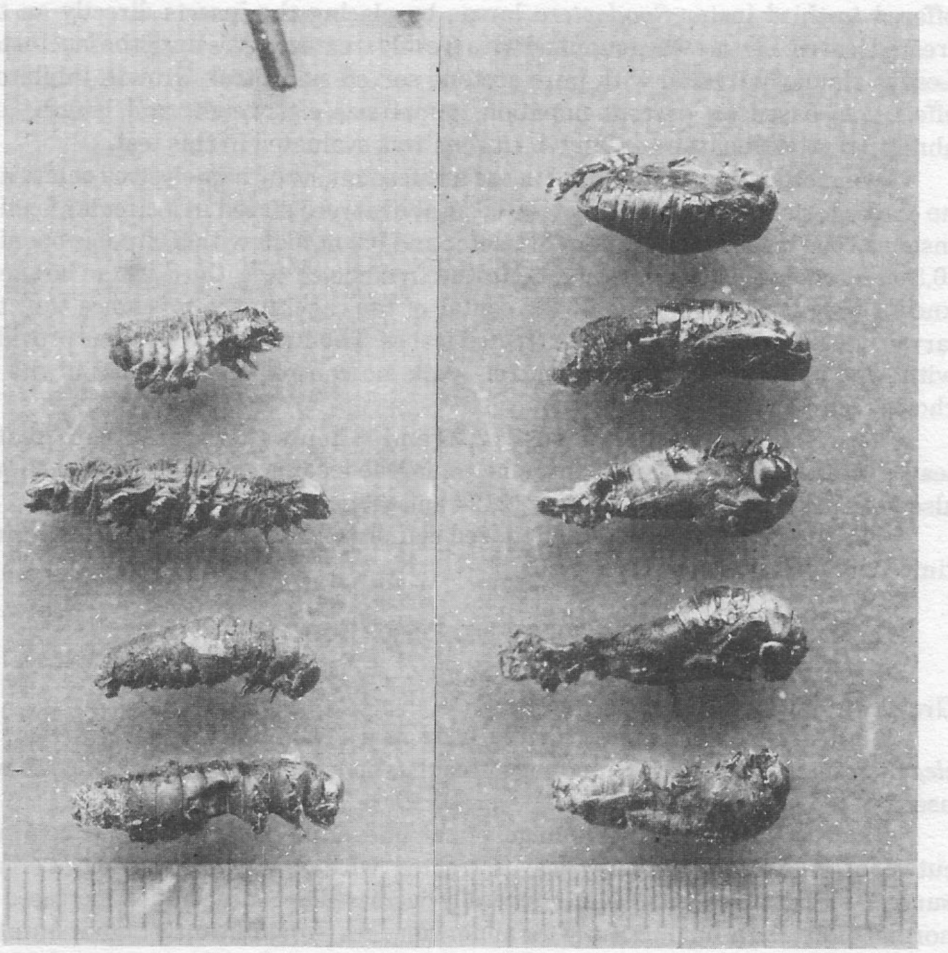

Figure 2. Larval-pupal intermediates produced by rearing the common cutworm on mulberry leaves treated with *A. elegans* extract.

were produced (Figure 2). In some cases, larval exuviae remained intact on newly formed pupal cases. Sizes of pupae varied greatly from those in the control. Normal pupae failed to emerge into adults.

The toxic and growth inhibitory effects of *A. elegans* extract were clearly demonstrated on this pest. The results were similar to those observed by Caasi-Lit and Morallo-Rejesus (1989) using the same extract on the Asian corn borer and by other workers who used the *Attacus* juvenile hormone (JH) and JH analogues on the common cutworm (Morallo-Rejesus and Martinez-Aguda, 1980; Morallo-Rejesus, 1979). Caasi-Lit and Morallo-Rejesus (1989) also inferred that the similarity in results suggests that the *Aristolochia* extracts have a JH-like mode of action.

Antifeedant effects of *A. elegans* and *A. tagala*

The antifeedant effects of *A. elegans* and *A. tagala* as measured by the number of insects visiting and/or feeding on the mulberry leaves at different time intervals for the free choice test are shown in Figure 3. As many as 20 ($\bar{X}$ = 14) larvae visited or fed on mulberry leaves treated with *A. tagala* extract at all time intervals. In contrast, at most, only 10 larvae visited or fed on those treated with *A. elegans* extract, indicating a higher degree of repellency than the *A. tagala* extract. There was no repellantaction at 30 mg/ml of *A. tagala* extract as evidenced by the increase with time of the number of insects visiting treated leaves.

The same trend was noted with *A. elegans* extract in the no choice test (Figure 4). Insect visit decreased, with the number drastically dropping after six to eight hours. However, there were approximately four to eight larvae that stayed on the leaves with 60 and 100 mg/ml concentration of *A. tagala* extract. The larvae tended to return to the leaves treated with the lower concentration as indicated by the greater number of insects that visited leaves with 30 mg/ml of extract. In the absence of food, the larvae force-fed on the treated mulberry leaves.

The antifeedant and/or feeding deterrent effects were further demonstrated by comparing consumption of treated and untreated leaves (Table 2). Leaf consumption was significantly reduced at higher concentrations of both extracts in both tests. For instance, only 2.25 cm and 9.00 cm of leaves were consumed by larvae at 100 mg/ml of *A. elegans* extract for the free choice and no choice tests, respectively. Control leaves were expectedly most preferred, with 53.75 cm for *A. elegans* and 26.75 cm for *A. tagala*. Larvae in the free choice test had the chance to select among the treatments and therefore exhibited such trend. On the other hand, the larvae in the no choice test had only a choice among higher or lower concentrations of extracts, not treated and untreated leaves.

Table 3 shows the weight gain or loss of the larvae fed with treated leaves. Comparing the two species of *Aristolochia*, *A. elegans* has stronger repellant or antifeedant properties than *A. tagala*. Weight loss was shown by the larvae at 30 mg/ml after 48 hours and at 60 and 100 mg/ml at all time intervals for *A. elegans*. On the contrary, it required 100 mg/ml for 24 hours for loss of weight to be affected by *A. tagala* extract. Finally, loss of weight by the larvae especially in *A. elegans* treated leaves and the reduced leaf consumption together suggest antifeedant properties and/or repellancy of *Aristolochia* extracts to the common cutworm.

Antifeedant effect was clearly demonstrated because insects showed initial feeding but after food recognition, started to wander and eventually died of

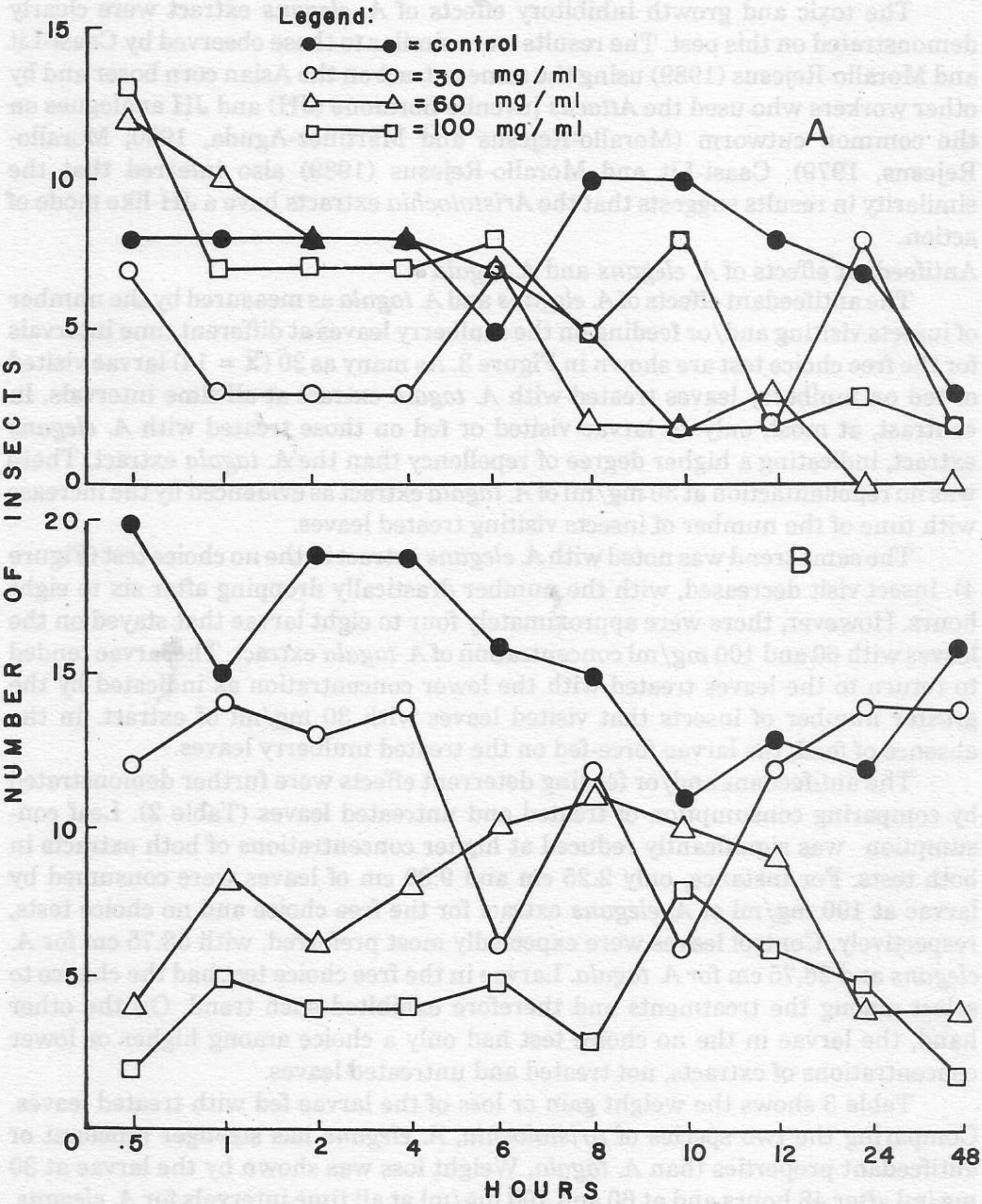


Figure 3. The number of cutworm larvae that visited mulberry leaves treated with extracts of *A. elegans* (A) and *A. tagala* (B) (Free-choice test).

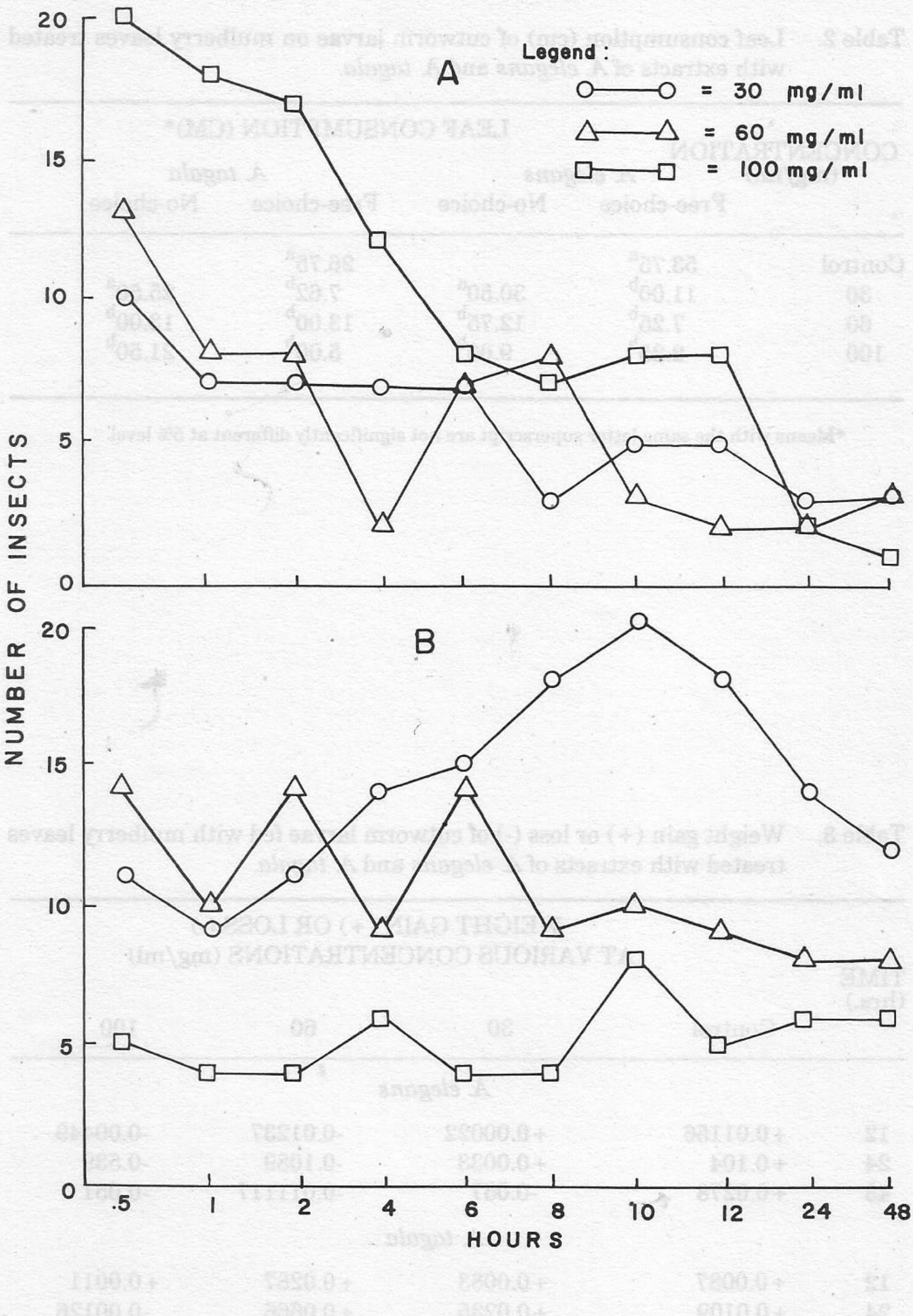


Figure 4. The number of cutworm larvae that visited mulberry leaves treated with extracts of *A. elegans* (A) and (A) *A. tagala* (B) (No-choice test).

Table 2. Leaf consumption (cm) of cutworm larvae on mulberry leaves treated with extracts of *A. elegans* and *A. tagala.*

| CONCENTRATION (mg/ml) | LEAF CONSUMPTION (CM)* | | | |
|---|---|---|---|---|
| | *A. elegans* | | *A. tagala* | |
| | Free-choice | No-choice | Free-choice | No-choice |
| Control | 53.75$^{a}$ | | 26.75$^{a}$ | |
| 30 | 11.00$^{b}$ | 30.50$^{a}$ | 7.62$^{b}$ | 25.50$^{a}$ |
| 60 | 7.25$^{b}$ | 12.75$^{b}$ | 13.00$^{b}$ | 13.00$^{b}$ |
| 100 | 2.25$^{b}$ | 9.00$^{b}$ | 5.00$^{b}$ | 21.50$^{b}$ |

*Means with the same letter superscript are not significantly different at 5% level.

Table 3. Weight gain (+) or loss (-) of cutworm larvae fed with mulberry leaves treated with extracts of *A. elegans* and *A. tagala.*

| TIME (hrs.) | WEIGHT GAIN (+) OR LOSS (-) AT VARIOUS CONCENTRATIONS (mg/ml) | | | |
|---|---|---|---|---|
| | Control | 30 | 60 | 100 |
| | | *A. elegans* | | |
| 12 | +0.01156 | +0.00022 | -0.01237 | -0.00449 |
| 24 | +0.104 | +0.0033 | -0.1089 | -0.539 |
| 48 | +0.0278 | -0.057 | -0.011117 | -0.051 |
| | | *A. tagala* | | |
| 12 | +0.0087 | +0.0083 | +0.0287 | +0.0011 |
| 24 | +0.0109 | +0.0235 | +0.0666 | -0.00126 |
| 48 | +0.0666 | +0.0155 | +0.1323 | -0.07453 |

starvation. The stronger feeding deterrent in this study was observed on the *A. elegans* extract.

The growth inhibitory, antifeedant and/or repellant action on the common cutworm can be attributed to the presence of aristolochic acid, the substance isolated and identified by Morallo-Rejesus *et al.* (1988) from leaves and seeds of *A. elegans*.

The results in this study showed that *A. elegans* and *A. tagala* are also potential sources of botanical pesticides against the common cutworm. Unlike synthetic chemicals that kill both pests and natural enemies, insect antifeedants, repellants and growth inhibitors are relatively safe to man and the environment, specific to target pests and biodegradable. Thus, antifeedants offer an alternative pest control and are particularly compatible with other integrated pest management approaches.

The *Aristolochia* extracts effectively deterred feeding and caused disorientation, reduced feeding duration and quantity of food ingested resulting to abnormal insect growth and development. However, their efficiencies remain to be tested under field conditions.

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