DIETARY EFFECT OF TRITERPENES (ECDYSTEROID MIMICS) FROM *NEPHROLEPIS* SP. FOR THE MANAGEMENT OF *MODUZA PROCRIS* CRAMER

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Abstract

The present study has been undertaken to assess the insecticidal value of the pteridophyte, Nephrolepis *sp*. In this work, the effects of terpenoids (ecdysteroid mimics) from *Nephrolepis sp*. on the development of *Moduza Procris (a pest of the ornamental plant Mussaenda frondosa)* was studied. This is the first report of the insecticidal property of the hot-aqueous frond extracts of this pteridophyte. Nephrolepis extracts were taken as leaf decoction. Four different concentrations (1, 0.75, 0.5 and 0.25 %) of the extract was taken for the experiment. 3 replicates were maintained for each concentration. The leaves of the host plant, *Mussaenda frondosa* were dipped in the extract and given as feed for the larvae. From the observation it was noted that the larvae died due to the ingestion of ecdysteroids. From dose – response chart it was concluded that higher the concentration of the extract, higher is the rate of mortality. Lc 50 value was calculated using Regression equation intercept and was found to be 0.54%. Regression coefficient is 0.9314 which is close to 1, which indicates that the mortality rate (Y) is positively correlated to concentration.The current study clearly show the susceptibility of *M. Procris* to phytoecdysteroid ingestion. The toxicity of phytoecdysteroids is associated with an increase in mortality together with disruption of development. Together, these results and the literature data indicate that phytoecdysteroids play a role as defensive substances against phytophagous insects.

Index terms - Phytoecdysteroid, Nephrolepis, Terpenoids, ***Moduza Procris***

I. **Introduction**

The study of insect-plant interactions is currently one of the most actively investigated areas in chemical ecology, partly owing to its interesting perspectives for the development of new bio pesticides with plant origins. These interactions involve numerous secondary plant metabolites that may interfere with behaviour, growth and/or development of insects. Phytoecdysteroids are secondary metabolites produced by many plants. They represent analogues of insect steroid hormones (ecdysteroids) that control insect growth, development, and reproduction. Many plants contain a variety of chemicals with moulting hormone activity in insects. This phytoecdysteroid occur relatively in large concentration in many plants (0.001 to 0.1 %). Over 100 ecdysteroid have been identified from wide range of plant species (Lafont and Horn, 1989). These ecdysteroid have a broad hormonal activity in insects. Phytoecdysteroids are plant derived ecdysteroids. They are a class of chemicals that plants synthesize for defence against phytophagous insects. These compounds are mimics of hormones used by arthropods in the moulting process known as ecdysis. Lacking the properties of classic plant hormones, phytoecdysteroids may be involved in plant growth and defense. When insects eat the plants with these chemicals they may prematurely moult, lose weight, or suffer other metabolic damage and die. Chemically phytoecdysteroids are classed as triterpenoids, the group of compounds that include triterpene, saponins and phytosterols. Plants synthesize phytoecdysteroids from mevalonic acid in the mevalonate pathway of the plant cell using acetyl CoA as a precursor. Over 250 ecdysteroid analogues have been identified so far in plants. Literally, thousands of secondary substance has been catalogued from angiosperms. The discovery of plant steroids with moulting hormone activity stimulated a wide spread search for similar hormone mimics. According to Camps, out of 111 plant families, 27families of pteridophytes, 10 families of gymnosperms and 74 families of angiosperms have been shown to contain 69 phyto ecdysteriods with moulting hormone activity.

There is hardly any cultivated plant that is not attacked by at least one lepidopteran pest. Most caterpillars are defoliators or miners of succulent plant tissues. *Moduza procris*, commonly known as The Commander, is a medium-sized, strikingly coloured brush- footed butterfly found in South Asia and South- East Asia. The caterpillar is one among the major pest of ornamental plants belonging to Rubiaceae family. This study was undertaken to evaluate the ecdysteroid activity of Nephrolepis sp. (pteridophyte) against *Moduza procris.*

II. **Methodology**

INSECT REARING

Moduza procris was collected as larvae from the locally available host plant- *M. frondosa.* The larvae at different stages of development were kept in separate plastic containers and reared, maintaining optimum temperature and humidity. Larvae were provided with fresh leaves of Mussaenda daily. The feeding, growth and moulting of each larvae were noted accurately and recorded.

PHYTOECDYSTEROID EXTRACTION

The young fronds of Nephrolepis sp. was collected from moist areas. The fronds were dried in shade. It was then powdered finely. For extraction, a leaf decotion was prepared with distilled water. The starting ratio of crude powder to water ratio is fixed, i.e.1:4. The volume is the brought down to one-fourth its original volume by boiling during the extraction procedure. Then, the concentrated extract is filtered, mixed well and kept aside overnight. The next morning the liquid extract was obtained from the upper portion of the mixture.Preliminary screening of terpenoids in the decoction was done using Salkowski's test.

TREATMENT

Different concentrations were prepared from the concentrated extract. Concentrations tested were 0.25%, 0.5%, 0.75% and 1%. Treatment consisted of 4 concentrations and control. Test leaves (Mussaenda) were dipped in solutions of each concentration for 10 minutes. Control leaves were prepared by dipping in water. Freshly moulted larvae of second instar, attained from the laboratory culture were introduced into plastic containers with treated and control leaves. To have uniformly aged insects in the experiment, freshly moulted larvae were used. Observations on the larvae were made daily. There were three replications for each concentration and untreated control.

Statistical analysis:

All experiments were performed in triplicate. Mortality in the control was corrected using Abbott's Formula (Abbott, 1925). The MS Excel 2007 was used to find regression equation (Y=mortality; X=concentrations), the LC50 was derived from the best-fit line (intercept) obtained.

III. **Result and Discussion**

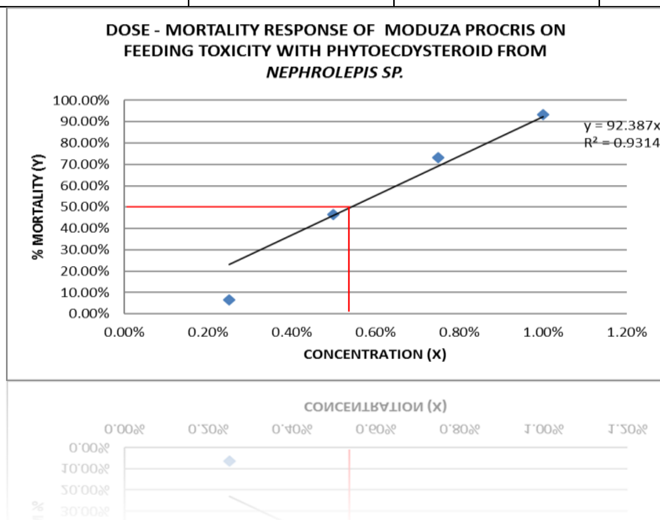
The results of regression analysis indicated that the larval mortality rate (Y) is positively correlated with the ecdysteroid concentration (X), having a regression coefficient (R) close to 1. The lethal concentration value (L C 50) is found to be 0.54%.

A number of studies have investigated insect susceptibility to dietary phytoecdysteroids. Most of the species examined have been lepidoptera, due to the pre-eminence of this order among phytophagous pests. Some species are very tolerant, such as *H. virescens* (Kubo et al. 1987), *H. armigera* (Robinson *et al.* 1987), and *S. littoralis* (Blackford *et al.* 1996). Other species, *Cynthia cardui* and T*yria jacobaeae*, for example, are semi tolerant (Blackford and Dinan 1997a), while others are highly susceptible, such as *S. frugiperda, Pectinophora gossypiella* (Kubo *et al.* 1981, 1983), *Acrolepiopsis assectella* (Arnault and Sláma 1986), *A. urticae* (Blackford and Dinan 1997

The data presented in this report clearly show the susceptibility of *M. Procris* to phytoecdysteroid ingestion. The toxicity of phytoecdysteroids is associated with an increase in mortality, together with disruption of development. These larval mortality and developmental defects could result from the cytotoxicity of phytoecdysteroids on the larvae's midgut. Tanaka and Yukuhiro (1999) also found that, in B. mori larvae fed 20E (a phytoecdysteroid), the morphology of midgut epithelial cells was disrupted. Together, these results and the literature data indicate that phytoecdysteroids play a role as defensive substances against phytophagous insects. But, is it feasible to use phytoecdysteroids for crop protection against insect pests? To answer this question, much work is necessary in the laboratory and also in the field. For the moment, certain strategies could be foreseen. First, the use of such compounds by treating with the extracts of plants rich in phytoecdysteroids is difficult to conceive, except in confined spaces, like the conservation of stored-products in stock. Second, it is possible to imagine cultivated plants protecting themselves against insect pests by stimulating them to produce phytoecdysteroids. Indeed, the taxonomical distribution of plants producing ecdysteroids suggests that the genes necessary for their production are widespread in the plant kingdom (Dinan 2001).The use of phytoecdysteroids to fight against insect pests is not an alternative for the methods used currently, but they represent interesting molecules that could have an important part in integrated pest management strategies.

Table 1: Percentage of individual mortality

Concentration of extract	1 %	0.75 %	0.50 %	0.25 %	Control
% of individual mortality	100	60	40	0	0
	80	100	60	20	0
	100	60	40	0	0
Average	93.3± 11.54701	73.3 ± 23.09401	46.6 ± 11.54701	6.6 ± 11.54701	0



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