

ORIGINAL RESEARCH ARTICLE

**Study on Fumigant and Contact Toxicity of *Catharanthus roseus* Against *Sitophilus oryzae***

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**ABSTRACT**

**Background & objectives:** In view of the recently increased interest in developing plant origin insecticides as an alternative to chemical insecticide, this study was undertaken to assess the fumigant and contact toxicity of crude aqueous extract of *Catharanthus roeus* leaf (Apocynaceae) against larvae and adult *Sitophilus oryzae*.

**Methods:** Leaves were collected and dried crude aqueous extract of *Catharanthus roeus* leaf was done with Soxhlet's extractor in distilled water for 8 hrs. Extracts were concentrated using rotary evaporator (BUCHI B-850) under reduced pressure at 60°C. Bioefficacy of crude aqueous extract of *Catharanthus roeus* leaf was evaluated under laboratory conditions using 10, 14 and 18<sup>th</sup> day larvae and adult Rice weevil.

**Results:** The fumigant and contact toxicity of crude aqueous extract of *Catharanthus roeus* leaf exhibited higher toxicity against rice weevil. After 24 hours of exposure period fumigant and contact toxicity LD<sub>50</sub> values were 0.027 mg cm<sup>-2</sup> and 0.083 mg cm<sup>-2</sup> respectively.

**Interpretation & conclusion:** From the results it can be concluded that the larvae and adult rice weevil were susceptible to crude aqueous extract of *Catharanthus roeus* leaf. Such findings would be useful in promoting research aiming at the development of new bio-insecticides for rice weevil control based on bioactive chemical compounds from *Catharanthus roeus* leaf an alternative to chemical insecticides.

**Kew Words:** *Sitophilus oryzae*, *Catharanthus roeus*, contact toxicity, fumigant actions, aqueous extract.

**INTRODUCTION**

Rice weevil (*Sitophilus oryzae* L.) has been reported as one of the severe pests of cereal grains and their products [1]. The pest prefers soft varieties of wheat grains [2]. Attempts have been made to get complete control of the stored grain insects by insecticidal application but in vain. Moreover, fumigation is the most widely adopted method and has been in practice. None of these methods and products can be declared as safe to the precious lives of human beings, birds, beneficial insects and animals and to the environment [3]. Similarly they are recommended for use in residential premises with special precautions and care. In contrast, the products obtained from certain medicinal plants can be used without risk to non target organisms. Additionally, consumption of extracts from some of the medicinal plants is even beneficial for human beings [4].

The botanical insecticides are considered to have potentials in killing insects. It is unlikely to induce fast resistance problems and very friendly to many animals and in Thailand. Many studies have reported efficacy of botanical against various pests. For instance, *Cymbopogon winterinus* (Jewitt) for the control of *Culex pipien quinquefasciatus* [5], *Capsicum frutescans* for *Sitophilus zeamais* (Motschulsky) [6], *Cleome viscosa* extract as the oviposition inhibitor for *Sitophilus oryzae* L. [7].

The focus over the last few years has been on the determination of the insecticidal activity of isolated chemical compounds from plant extracts in order to find out the most biologically active chemical components [8, 9, 10, 11, 12, 13, & 14].

*Catharanthus roseus* (L.) is an important medicinal plant of the family Apocynaceae that is

used to treat many fatal diseases. In addition, *C. roseus* has a good antioxidant potential. There are two common cultivars of *C. roseus* named on the basis of the observed flower colour, the pink flowered 'Rosea' and the white flowered 'Alba' [15]. *C. roseus* is extensively commercially cultivated in northern India to meet the ever increasing demand for this medicinal plant in the indigenous systems of medicine, as well as for the pharmaceutical industry.

Very little information is available on the use of plant extracts on the insect pests of stored grains, especially on the *S. oryzae*. Therefore the present study was initiated to find and recommend possibly the most effective plant extracts against *S. oryzae* in the stored wheat grains.

## MATERIALS AND METHODS

*Catharanthus roseus* leaves were collected from C. Abdul Hakeem College campus, Melvisharam and identified in the botany Department. *C. roseus* leaves were dried and extracted using a modified method of [16]. The extraction was done with Soxhlet's extractor in distilled water for 8 hrs. Extracts were concentrated using rotary evaporator (BUCHI B-850) under reduced pressure at 60 °C. The extracts were stored at 4°C until preparation of a stock solution. Stock solution was prepared by weighing a certain amount of the extracts and diluting in distilled water to give a series of concentrations.

*Sitophilus oryzae* were reared in the laboratory on whole wheat grains for several generations. Colonies were maintained in the dark in a climatic chamber set at 25±2 °C and 60±5% r.h. Adult beetles, 2–4 weeks old, were used for the experiments.

Series of dilutions of aqueous extract of *C. roseus* leaves were prepared using distilled water. Aliquots of 1 ml of the dilutions were applied into 6 cm dia. petridishes for surface-film bioassay [17]. The solution was allowed to evaporate for 1 hour and the treated insects were transferred to petridishes. Controls were treated with distilled water alone. Fifteen adults or larvae were used for each concentration and 20 adults or larvae were used for control. The petridishes were kept in the incubator and mortality was observed after 24 h.

Series of dilutions of aqueous extract of *C. roseus* leaves were prepared using distilled water. Glass vials (6 cm long, 1.8 cm dia.) capped with polypropylene stoppers were used for the bioassays. Adult insects were transferred to the vials in groups of ten individuals and the vials were covered with fine nylon cloth secured with adhesive tape. Aliquots of 50 µl of the dilution were placed into similar vials. After evaporating the solution, the vials containing the insects were turned upside down over the vials containing the plant extract so that the plant vapours saturated the atmosphere of the vials containing the beetles. Four replications of each treatment were set up. Controls were maintained in the similar way with the distilled water only. The vials were kept in the incubator and mortality was observed after 24 h post-exposure.

Mortality data were corrected using Abbott's formula [18]. The observed data were subjected to probit analysis according to [19] [17] using a software developed at the Department of Agricultural and Environmental Science, University of Newcastle Upon Tyne, U.K.

## RESULTS AND DISCUSSION

In surface-film bioassay aqueous extract of *C. roseus* leaves offered the highest toxicity to adults and 10-day old larvae, whereas *C. roseus* leaves provided the maximum toxicity to 14- and 18-day old larvae. *C. roseus* leaf extract vapour (by fumigation) caused the highest mortality of various life stages of *Sitophilus oryzae* at LD<sub>50</sub> level (Table 1). The adults were more susceptible than larvae to contact and fumigant actions. As the larvae grew older, they became less susceptible. In contrast to contact toxicity, adults were susceptible to the fumigant toxicity of aqueous extract of *C. roseus* leaves, and they were more susceptible than larvae.

Aqueous extract of *Catharanthus roseus* leaves generally a more effective contact poison and fumigant against the adults of *Sitophilus oryzae*. These findings are similar to those of nutmeg oil [20]. The essential oil of garlic was more toxic to *T. castaneum* than to *S. zeamais* by contact [21], Oil of clove was toxic to *S. oryzae* and *Rhyzopertha dominica* [22].

Recently, Rajendran and Sriranjini<sup>23]</sup> mentioned that essential oils of plants (mainly belonging to Apiaceae, Lamiaceae, Lauraceae and Myrtaceae) and their components (monoterpenoids and others) were tested for fumigant toxicity where many of them indicated positive results against stored insect pests including *S. oryzae* and *T. castaneum*. *M. cajuputi* is in the family Myrtaceae. Many researchers have demonstrated the insecticidal activities of numerous plant species from the Myrtaceae family on several stored product insects. For example, Lee *et al.* 2004<sup>[24]</sup> studied 42 essential oils extracted from several species of the Myrtaceae family found in Australia and reported that 2 *Melaleuca* species namely *Melaleuca armillaris* (So. Ex. Gaetn.) Sm. and *M. fulgens* K. Rule showed the fumigant toxicity to *T. castaneum* with the LD<sub>50</sub> equalling 30.6 and 28.6  $\mu\text{L L}^{-1}$ , respectively. In our experiment the LD<sub>50</sub> for contact toxicity is 0.083

mg cm<sup>-2</sup> and fumigant toxicity with an LD<sub>50</sub> of 0.027 mg cm<sup>-2</sup> of aqueous extract of *Catharanthus roseus* leave against adult *S. oryzae*.

In summary, *Catharanthus roseus* leaf extract had fumigant and contact toxicity against *S. oryzae*. These findings demonstrated the potential of aqueous extract of *Catharanthus roseus* leaf for further development into a biopesticide in the control of stored-product insects. The advantages of using *Catharanthus roseus* as a grain protectants are because it can be easily extracted by steam distillation, it have very low toxicity to mammals since the popular medicinal plant consumed by people in various parts of the world and the are volatile and this can be potentially used fumigants. Crude extracts of *Catharanthus* made using 50% and 100% methanol had significant anticancer activity against numerous cell types in vitro (at <15 mcg/ml)<sup>[25]</sup>.

**Table 1. Contact and fumigant toxicity of aqueous extract of *Catharanthus roseus* leaf against *Sitophilus oryzae* larvae and adults.**

Bioassay	Life stage	Dose LD <sub>50</sub> (mg cm <sup>-2</sup> )	95% confidence limits		Regression equation	$\chi^2$ (2df)
			Lower (mg cm <sup>-2</sup> )	Upper (mg cm <sup>-2</sup> )		
	Adult	0.083	0.061	0.109	Y=3.938027 + 1.22351X	0.598
Surface-film bioassay	Larval age	0.201	0.153	0.239	Y=3.571133+1.102561X	0.163
	10 day	0.218	0.175	0.267	Y=3.9024 15+ 1.06257X	0.279
	14 day	0.235	0.133	0.317	Y=3.819133+ 0.82974X	0.618
	18 day					
	Adult	0.027	0.017	0.039	Y=4.452773+1.204901X	0.823
Fumigation bioassay	Larval age					
	10 day	0.048	0.034	0.064	Y=4.345173+0.960671X	0.086
	14 day	0.061	0.041	0.110	Y=4.299612+0.781603X	0.066
	18 day	0.090	0.063	0.133	Y=3.847487+1.213423X	0.520

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