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EFFECT OF POWDERED LEAVES OF *PIPER BETLE* L. ON CORCYRA *CEPHALONICA* STAINTON

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ABSTRACT

Botanicals are safer and healthier measures to control insect pests of stored grains. Studies were conducted to evaluate the insect repellency, and mortality effect of leaf powder of *Piper betle* on *Corcyra cephalonica* (Rice moth). Various concentrations (w/w) of leaf powder were treated with rice for the study. The results showed an increase in insect repellency with increase in concentration of powder treated. When fourth instar larvae were reared in leaf of *P. betle* admixtured rice significant reduction in larvae to pupal development was observed. There was significant increase in larval mortality with increase in concentration of leaf powder administration. All these results indicate that *P. betle* is a good source of bioactive principles against the stored grain pest *Corcyra cephalonica*.

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INTRODUCTION

Storage of food to satisfy the ever increasing demand of the population is a challenge to human population. One of the major problems faced during food storage is pest attack. Insects are one of the most important pests of stored grains. Insects account for about 5-10% of economic loss during post-harvest storage of food grains (Tooba *et al*., 2005, Frenemore and Prakash, 1992). To control the loss of stored food products due to insect attack chemical pesticides have been used for decades. But soon we realized the ill effects caused by these chemicals to both human and environment. There have been increased rates of congenital malformations, malignancy, infertility neurological disorders etc. along with irrecoverable damage caused to the environment by these non-degradable chemicals. Awareness about the hazards of chemical pesticides compelled us to find a safer alternative. Before the invention of chemical pesticides man traditionally depended on various natural techniques including the use of botanicals for controlling insect pests. Recently various researchers are concentrating more on identifying the ethanobotanical alternative for chemical insecticides. Numerous plants have been reported to have insecticidal, insect repellent or feeding deterrent properties.

Corcyra cephalonica, the rice moth is a major pest especially in the tropics of stored food grains (Allotey and Azalekor, 2000). It is an external feeder. *Corcyra cephalonica* is a voracious feeder of grains. Larvae are the infective stage. They feed on the grains, and starts spinning web soon after hatching from the egg. In addition to the loss and damage due to feeding, these webs, faecal matter and secondary attack by fungus makes the grain useless for consumption.

Piper betle, commonly known as betle vine belongs to the family Piperaceae. Leaves are the most commonly used part of this plant. It has been used in India for treating various ailments. It is a major component in pan and has been usedfor this recreational purpose and as mouth refresher from time immemorial. Various studies show that it is carminative, stimulant, astringent, and has anti-malarial, antibacterial, antifungal, insecticidal, antioxidant, anti-diabetic, gastro protective, antinociceptive, analgesic, and cytotoxic activities and is effective against parasitic worms(Arrawala *et al* 2014, Venketeswaralu and Devanna 2014, Shanthun-Al-Arefin, *et al* 2016). In the present study attempts have been made to analyse the biopotential of *Piper betle* as an insect control agent of stored product pest *Corcyra cephalonica*.

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MATERIALS AND METHODS

Test Insects

Corcyra cephalonica is a serious lepidoteran pest of stored cereals such as wheat, rice, sorghum, maize, millet etc.in tropical and sub tropical regions of the world. The larvae of *C. cephalonica* is the destructive stage. In addition to the damage caused by feeding, their silken threads contaminate the grain by producing dense webbing containing their faecal material and cast skins. The webbing formed is noticeably dense and tough adding to the damage caused.

Rearing of Test Insects

The eggs of *Corcyra cephalonica*, (National Accession No: NBAII-MP-PYR-01) was obtained from the National Bureau of Agriculturally Important Insects, Bengaluru, Karnataka, India were reared in the laboratory conditions. The culture was maintained on rice grains with 12 per cent moisture content, kept in plastic jars of 10kg capacity. Each 0.5 cc of eggs were reared on a newly formulated medium consisting of 2.5kg of crushed sterilized rice grain, yeast powder (1gm), crushed groundnut (100gm), streptomycin (0.5gm) sprinkled over the rice and jar was covered with black muslin cloth.

Preparation of plant material

Fresh leaves of *Piper betle* was collected locally, washed thoroughly in running water and dried in shade. This was then finely powdered using a mixer blender. The powder was then stored in air tight container for further use.

Experimental protocol

Treatment of Insects with Plant Leaf Powder

Repellencey

Powders were added separately to 5 g of crushed rice in plastic containers at dosages of 2, 4, 6, 8, 10 15 and 20 % (w/w), while the control treatment had no plant powder. A plastic container was used to study the repellency. Filter paper cut into six circles of six centimeter diameter was placed in the periphery of the plastic container and one was placed at the centre. To the papers on the periphery 5g of treated and control rice were added alternatively, then to the filter paper at the center 20 fourth instar larvae were introduced and the container was closed. After three hours number of larvae in the control and treated rice were counted. Experiment was conducted for all concentrations and all treatments were repeated six times.

Calculation of Percentage Repellency: Percentage repellency was calculated by the method described by Liu and Ho (1999).
% Repellency = 100 X (C- T)/C

The mean repellency for each treatment was assigned to a repellency class according to the standard described by McGovern *et al.* (1977)

Repellency classes: 0 = < 0.1; class I = 0.1- 20; class II = 20.1- 40; class III = 40.1- 60; class IV = 60.1- 80; class V = 80.1-100

Mortality assays

Powders were added separately to 10 g of crushed rice in plastic containers at five dosages 2, 4, 6, 8, 10, 15 and 20% (w/w), while the control treatment had no plant leaf powder. The test materials were admixed thoroughly and gently in the containers by manual agitation until the materials were evenly distributed among the grains and ensure a homogeneous admixture. The contents of the plastic containers were allowed to settle down for about 30 minutes before introducing the larvae into each jar. Ten fourth instar larvae of *Corcyra cephalonica* stainton were introduced separately into the each container. The plastic containers were securely covered with black perforated muslin cloth held in place with rubber bands to ensure adequate ventilation. The content of each of the boxes were then transferred to a dish and dead insects observations were made every day till pupation. Each experiment was carried out in six replicates.

Statistical analysis

Mortality percentage was corrected using Abbott's formula (1925). The data obtained from six replicates in all experiments were tabulated as mean ± SE. Further statistical analysis for all data were performed using one way analysis of variance (ANOVA) using SPSS software.

RESULTS

Repellency Assay

Rice treated with leaf powder of *Piper betle* showed significant repellency in all concentrations selected. Class V repellency (Table 1) was observed in the highest concentration selected (20%). *Piper betle* expressed dose dependent increase in repellency.

Table 1 Repellent effect of *Piper betle* leaf powder on IV instar larvae of *Corcyra cephalonica*

Plant	Concentration of Leaf powder	Mean repellency per cent after 3 hrs	Repellency Class
Piper betle	2%	20	I
	4%	35.71	I
	6%	43.3	II
	8%	68.57	IV
	10%	91.11	V
	15%	93.61	V
	20%	100	V

Mortality assays

There was increase in larval mortality with increase in concentration of leaf powder treated. All the treatments showed significant difference when compared to control.

Table 2 Effect of leaf powder of *Piper betle* on percentage corrected mortality of fourth instar larvae of *Corcyra cephalonica*.

Plant	Concentration (w/w)	Larval Mortality
Piper betle	Control	0.00^{f}
	2%	2 ± 4.47^{e}
	4%	4 ± 4.47^{e}
	6%	16 ± 4.47^{d}
	8%	21.67 ± 4.47^{d}
	10%	43.33 ± 5.48^{c}
	15%	65 ± 5.48^{b}
	20%	95 ± 8.94^{a}

The corrected mortality percentage was 2%, 4%, 16%, 21.6%, 43.3%, 65% and 95% at 2%. 4%, 6%, 8%, 10%, 15% and 20%

doses respectively (Table 2). Data of mortality were used for calculating lethal doses using IBM SPSS version 20. The LD_{10} L_{50} and LD_{90} doses were calculated as 4.04%, 10.6% and 27.98% respectively (Table 3).

The value is expressed as Mean ± SD same column followed by the same letters are not significantly different, ($P \leq 0.05$; Duncan's test).

Table 3 Lethal Doses and 95% confidence limit of leaf powder of *Piper betle* against fourth instar larvae of *Corcyra cephalonica*

	95% Confidence Limits for Dosage			95% Confidence Limits for log(Dosage)[b]		
Probability	Estimate	Lower Bound	Upper Bound	Estimate	Lower Bound	Upper Bound
LD_{10}	4.040	3.148	4.822	.606	.498	.683
LD_{50}	10.633	9.411	12.214	1.027	.974	1.087
LD_{90}	27.982	22.279	39.065	1.447	1.348	1.592

DISCUSSION

Powdered leaf of *Piper betle* showed significant repellent property in all test doses assayed. At the higher concentration (10%, 15% and 20%) strong repellency against fourth instar larvae of *Corcyra cephalonica* was observed. This result indicates that bioactive principles present in *Piper betle* leaf possess repellent properties against *Corcyra cephalonica* larvae. Results of earlier studies by various researchers also points towards the role of the aromatic plants as insect repellent agents. Crude powders of *Azadirachta indica, Lantana camara*, and *Tephrosia vogelii*, were reported to be effective against controlling *Prostephanus truncates* in stored grain maize (Chebet *et al* 2013). Studies show that the powders of *P. nigrum*, *Capsicum annuum* and *Cinnamomum zeylanicum* Blume had a repellent effect on *Sitophilus. zeamais (*Salvadores *et al*. 2007) *and also* against adults of *Rhyzopertha dominica* (F.), *Sitophilus granarius* (L.) and *Tribolium castaneum* (Herbst) (Sayeshteh and Ashouri , 2010). Maya *et al* (2015) reported the insect repellent property of *Hemidesmus indicus* root powder against *Corcyra cephalonica.*

Various plants have been reported to have pesticidal properties. Leaves powders of *Lantana camara*, *Clerodendrum inerme* and *Citrus limon* are reported to be larvicidal against *Corcyra cephalonica* (Morya *et al* 2010) and pesticidal effect of *L. camara* and *C. inerme* have been reported against like *Rhyzopertha dominica* (F.) (Coleoptera Bostrichidae) and *Callosobruchus chinensis* (L.) (Coleoptera Bruchidae) (Dwivedi and Garg, 2003; Singh *et al*., 1996).

Many potential bioactive agents present in *Piper betle* may be the reason for the repellent, and larvicidal property of *P. betle*. These properties of *Piper betle* could be attributed to the presence of chemical constituent like Eugenol, alpha-pinene, limonene, caryophyllene etc reported to be present in the plant.

Unfortunately the information regarding plant products which can be used as grain protectant is very few. Except for a very few registered botanical grain protectant most of the findings about botanical insecticides goes unnoticed and without any practical application. The present findings indicate the need for isolation and identification of bioactive components possessing insecticidal property from *Piper betle* and development of grain protectant formulation based on the same. These studies emphasize the importance of exploiting the insecticidal and insect repellent properties of plants to be developed as effective grain protectant.

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