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## Repellency of *Tribolium castaneum* Herbst and *Tribolium confusum* Duval (Coleoptera : Tenebrionidae) to the Rhizome and Leaf Extracts of *Zingiber cassumunar* Roxb.

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### Abstract

Repellent activity of different solvent extracts of *Zingiber cassumunar* rhizome and leaf against *Tribolium castaneum* and *T. confusum* were conducted. The results indicated that both the insect species were repelled by *Z. cassumunar* rhizome and leaf extracts. Among these, acetone extracts of rhizome showed highest repellency to *T. castaneum* than those of other extract tested. Petroleum ether extracts of *Z. cassumunar* leaf acted as repulsive to *T. castaneum* whereas other extracts exhibited weak to moderate effects to the beetles. All the extracts of leaf produced weak to moderate effects to *T. confusum* however, methanol extract of leaf showed little effect to the beetles.

**Key words:** *Zingiber cassumunar*, Seed and leaf extracts, Repellency, *Tribolium castaneum*, *T. confusum*.

### Introduction

The ecological consequences of the widespread use of pesticides result in alarming accumulation of toxic residues in the environment. This has prompted restrictions on the development and continued use of dangerous pesticides in advanced countries. Natural plant products containing biodegradable photochemical repel or inhibit insect feeding offer considerable importance for crop protection because of their repellent or

antifeedant effects, which are highly species specific.

Repellents are generally advantageous being more specific and having low mammalian toxicity (Malik and Naqvi 1984). A number of workers reported the grain protectant activity of some plant materials against insect pests due to their repellent properties (Malik and Naqvi 1984, Qureshi *et al.* 1988, Jilani *et al.* 1988, Xu *et al.* 1994, Bekele *et*

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*al.* 1996). A number of workers stated the gustatory repellent properties of the seed kernel extracts of Neem against different insects (Pradhan *et al.* 1963, Jotwani and Sircar 1965). The repellent and antifeedant properties of Neem leaves on the insect pests of both stored products and field crops have also been extensively studied (Nakanishi 1975, Radwanski 1977). Su (1985) worked on the repellent effect of *Anethum graveolens* seed on *T. confusum* and other stored product insects. Several authors also mentioned the repellent properties of some essential oils against insect attack (Yadava 1971, Schoonhoven 1978, Messina and Renwick 1983, Morallo-Rajesus *et al.* 1990). The present study was undertaken to evaluate the repellent activities of different solvent extracts of *Z. cassumunar* leaf and rhizome on *T. castaneum* and *T. confusum*.

### Materials and Methods

Extracts of leaf and rhizome were prepared by three solvents separately, *viz.* petroleum ether, acetone and methanol. Repellency test was conducted by Standard Method (Number 3) described by McDonald *et al.* (1970) with some modifications. Substrata were prepared by cutting in half whatman No. 40 filter paper disk (9 cm. diam.), then treated with the desired concentration of the extracts so that deposits of 78.60, 314.38 and 628.76  $\mu\text{g}$  of the extracts per  $\text{cm}^2$  of paper can be produced. The treated filter papers were then air-dried over night at an average of 30.5°C room temperature. Each treated

half of disk was then attached lengthwise, edge- to- edge to an untreated disk half with cellulose tape and placed in a Petri dish. The orientation of the seam was changed in each replicate to avoid the effects of any external direction stimulus affecting distribution of the test insects. Ten adults (7-14 days olds) were released in the middle of each filter paper circle and a cover was placed on the Petri dish. For each experiment, three replications were made. Individuals settled on each half of filter paper disk were counted at 24 hours intervals for 72 hours. The averages of the counts were converted to express the percentage repulsion (R) as follows:

$$R = 2(C - 50)$$

Where, C is the percentage of insects on the untreated half. Positive values expressed repellency and negative values attractancy. The averages were then assigned to different classes using the following scale:

Class	Percent repulsion
0	> 0.01 to < 0.1
I	0.1 - 20
II	20.1 - 40
III	40.1 - 60
IV	60.1 - 80
V	80.1 - 100 (McGovern <i>et al.</i> 1977)

### Results and Discussion

Different solvent extracts of *Z. cassumunar* rhizome were tested to determine their repellency against *T. castaneum* and *T. confusum*

(Table I). All the concentrations of petroleum ether extracts were found to be repellent to *T. castaneum* beetles. The highest repellent effect was observed in 628.76  $\mu\text{g}/\text{cm}^2$  (class V) while dose 78.60 and 314.38  $\mu\text{g}/\text{cm}^2$  showed the same levels of repellency (Class IV). Acetone extract exhibited strong repellent effect to the red flour beetle, *T. castaneum* at all the doses showing the repellency of Class V. The repellency of methanol extract also showed the effective result to the beetles at all the concentrations. The highest

dose strongly repelled the beetle depicting class V (average repellency 93.34%) while the mean repellent value of other two doses were 71.12 and 73.34% at 78.60 and 314.38  $\mu\text{g}/\text{cm}^2$  respectively.

*Z. cassumunar* rhizome exhibited repellency to *T. confusum* at all the concentrations although the lowest dose produced little effect to the beetles. The mean repellency of the extracts were 20.00 (Class I), 75.56 (Class IV) and 77.77% (Class IV) at the respective

**Table I. Average repellency of *Zingiber cassumunar* rhizome extracts to *T. castaneum* and *T. confusum* adults.**

Insect species	Solvent used	Concentration of extract $\mu\text{g cm}^{-2}$	*Average repellency (%) after treatment (hours)			Mean	Repellency class
			24	48	72		
<i>T. castaneum</i>	Petroleum ether	78.60	60.00	53.34	73.34	62.23	IV
		314.38	93.32	73.34	53.34	73.33	IV
		628.76	93.32	100.00	93.34	95.55	V
	Acetone	78.60	93.34	93.34	73.34	86.67	V
		314.38	93.34	93.34	73.34	86.67	V
		628.76	93.34	93.34	93.67	93.45	V
	Methanol	78.60	66.68	66.68	80.00	71.12	IV
		314.38	73.34	73.34	73.3	73.34	IV
		628.76	93.34	93.34	93.34	93.34	V
<i>T. confusum</i>	Petroleum ether	78.60	40.00	13.34	6.66	20.00	I
		314.38	93.34	73.34	60.00	75.56	IV
		628.76	86.66	86.66	60.00	77.77	IV
	Acetone	78.60	66.66	53.34	26.66	48.89	III
		314.38	73.34	73.34	20.00	55.56	III
		628.76	73.34	80.00	46.66	66.66	IV
	Methanol	78.60	46.66	13.34	33.34	31.11	II
		314.38	40.00	40.00	33.34	37.78	II
		628.76	86.66	73.34	40.00	66.67	IV

\* Values are averages of three replicates.

doses. The concentrations of acetone were effective to *T. confusum* showing the mean repellency of 48.89 (Class III), 55.56 (Class III) and 66.66% (Class IV) at 78.60, 314.38 and 628.76  $\mu\text{g}/\text{cm}^2$  respectively. Methanol extract also repelled the insect at all the concentrations at a lower rate compared to other extracts.

Repellent activity of different solvent extracts of *Z. cassumunar* leaf against *T. castaneum* and *T. confusum* are shown in Table II. All the concentrations of petroleum ether extract strongly repelled the beetle, *T. castaneum* showing the activity of Class V. Although they belonged to the same level of activity, their mean values varied with the concentrations. Acetone and methanol extracts also exhibited weak to moderate repellency effects.

**Table II.** Average repellency of *Zingiber cassumunar* leaf extracts to *T. castaneum* and *T. confusum* adults.

Insect species	Solvents used	Concentration of extract $\mu\text{g cm}^{-2}$	*Average repellency (%) after treatment (hours)			Mean	Repellency class
			24	48	72		
<i>T. castaneum</i>	Petroleum ether	78.60	93.34	93.34	73.34	86.67	V
		314.38	86.68	93.34	86.68	88.90	V
		628.76	93.34	93.34	93.34	93.34	V
	Acetone	78.60	40.00	46.68	13.34	33.34	II
		314.38	46.68	46.68	33.34	42.23	III
		628.76	53.34	53.34	53.34	53.34	III
	Methanol	78.60	20.00	26.68	46.68	31.12	II
		314.38	80.00	26.68	6.68	37.78	II
		628.76	86.68	46.68	13.34	48.90	III
<i>T. confusum</i>	Petroleum ether	78.60	40.00	13.34	-13.32	6.67	I
		314.38	46.68	66.68	46.68	53.35	III
		628.76	60.00	73.34	46.68	60.01	III
	Acetone	78.60	46.68	20.00	46.68	37.78	II
		314.38	60.00	53.34	46.68	53.34	III
		628.76	46.68	60.00	53.34	53.34	III
	Methanol	78.60	20.00	-6.68	-13.32	0.00	0.00
		314.38	20.00	-6.68	6.68	6.67	I
		628.76	13.34	26.68	26.68	22.23	II

\* Values are averages of three replicates.

In case of *T. confusum*, petroleum ether extract exhibited repellency at all the doses applied. These doses showed the repellency of class III while the lowest dose showed little effect (Class I) to the beetle. Acetone extract showed the repellency of class II in the lowest doses while in other two doses class III activity was observed. Methanol extract produced the least effect to the beetle however, the lowest dose exhibited no repellency. Highest level of repellency was recorded in all the doses of acetone extract of rhizome and petroleum ether extracts of leaf against *T. castaneum*. Our findings receive support from the result of Rahman *et al.* (1999) who reported the highest repellency in acetone extract of Neem followed by *Sapium indicum* and *Curcuma longa* at 100 mg/ml doses against *Sitophilus oryzae*. Jilani and Malik (1973) reported that water and ethanol extracts of the leaves and seeds of Neem repelled the red flour beetles, *T. castaneum*, khapra beetle, *Trogoderma granarium* and lesser grain borer, *Rhyzopertha dominica*. Qureshi *et al.* (1988) also reported that acetone extract of *Ageratum houstonianum* flowers exhibited repellency of class V at higher doses against *T. castaneum*.

Mondal and Begum (1991) reported the repellent effect of tobacco and Neem leaf powder against *T. confusum* adults. Parveen and Mondal (1992) also reported the repel-

lent effect of turmeric powder against *T. castaneum*. The result is in agreement with the result of Jilani and Su (1983) who reported that petroleum ether extract of Neem leaf acted as repellent to *T. castaneum* adults but acetone and ethanol extracts were not effective. The present result is also supported by Saim and Melon (1986) who reported that the three compounds, benzaldehyde, piperidine and geraniol of bay leaf were found to be the most effective repellents at 50 ppm under the test conditions against *T. castaneum*. Talukder and Howse (1993) reported the repellent effect of different solvent extracts of Pitraj seed on *T. castaneum* and noted that the acetone extract exhibited 88 and 93% repellency at 0.5% and 1% concentrations respectively to the beetles. Liu and Ho (1999) reported that essential oil of *Evodia rutaecarpa* strongly repelled *Sitophilus zeamais* and *T. castaneum*, but the repellent effect was more marked on *T. castaneum* than *S. zeamais*. Ho and Ma (1995) also reported that chopped garlic and garlic extracts are repellent to *T. castaneum* than *S. zeamais*.

It may be concluded that *Z. cassumunar* is a good agent to develop as a protectant for grains in stores. This plant also requires further studies so as to obtain the active ingredients with a view to determine the actual dosage needed for protecting grains in various storage conditions.

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