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Repellent Effect of Some Indigenous Plant Extracts Against *Trogoderma granarium* (Everts)

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Abstract : Six aboriginal plant species were screened to observe possible repellent action against khapra beetle. Repellent property has been confirmed in all the plant species using olfactometer. Acetone extract of *Emblica officinalis* exhibited maximum repellency whereas minimum repellency was recorded in *Ziziphus jujuba* pet ether extract.

Key words : Repellents, indigenous plants, *T. granarium.*

Introduction :

Today pest control is a serious problem of developing countries. *Trogoderma granarium* commonly known as khapra beetle is a serious pest of stored grains particularly of wheat grains (Durrant, 1921).

Trogoderma granarium Everts [**Synonyms:** *Trogoderma afrum* Priesner, *Trogoderma khapra* Arrow, *Trogoderma quinquefasciata* Leesberg, **Common names:** escarabajo khapra (Spanish), khapra beetle (English), khaprakäfer (German), trogoderma (dermeste) du grain (French)] has been nominated as among 100 of the "World's Worst" invaders. The Khapra beetle is one of the most important stored product pest worldwide which maintains its presence in stores in very low numbers and is able to survive long period of time in inactive state. *T. granarium* is a member of the Coleoptera family Dermestidae. The adult males are 1.4-2.3 mm long, 0.75-1.1 mm wide; adult females are 2.1 - 3.4 mm long, 1.7 - 1.9 mm wide, ovate and densely hairy beetles. Colour of the khapra beetle is as follows: head and pronotum dark reddish-brown, elytra reddish-brown, usually with indistinct lighter reddish-brown fasciae; venter of thorax and abdomen reddish-brown; legs yellowish-brown. The setae on the dorsal surface are of two types: evenly distributed, coarse, semi-erect, yellowish-brown ones; and , few scattered, dark reddish brown setae, colour of setae follows the colour of cuticles.The pronotum medially and laterally has indistinct patches of yellowish-white, ensiform setae, and elytra with two or three indistinct band of yellowish-white, ensiform (flattened) setae. The median ocellus on

the front is always distinct. Antennae are yellowish-brown, 9, 10 or 11 segmented, with 3-5 segmented club.

The khapra beetle is synanthropic (associated with man or with human dwellings). Occurs in grain stores, food stores, malthouses, seed processing plants fodder production plants, dried milk factories, merchant stores, stores of packing materials (used sacks, bags, crates). The beetle occurs in hot, dry conditions, predictably in areas which, for at least 4 months of the year, have a mean temperature greater than 20°C and an RH below 50% (CABI CPC).The khapra beetle has no direct effects on the environment. The indirect effects however, are loss of stored grain and the effect of fumigation agents on the environment. If the beetle is left undisturbed in stored grain it can cause significant weight loss and in case of seeds it may lead to significant reduction in seed viability. Weight loss can be between 5-30% in sometimes in extreme cases 70%.

The control of insects includes every thing that makes life hard for insects and tend to kill them. The chemical control is a very quick, effective and popular method of pest control, but these create acute and chronic poisoning in man and other non-target animals. Repellents are the substances which as stimulants elicit avoiding reactions and are non-poisonous. Repellent substances cause insects to orient their movement away from the food source. Repellents are usually volatile chemicals and express their activity in volatile phase. A strong repellent will be sensed by insects from a few centimeter distance causing them to fly or crawl away.

Plant extracts are considered to be non-pollutant, less toxic and easily bio-degradable. Although certain plants have already been reported to possess repellent action against stored grain pests (Gundu Rao & Majumdar, 1962; Ahmed & Eapen, 1986; Nawrot *et. al*., 1982; Behal 1998), however, very little information is available on the efficacy of indigenous flora. on *T. granariun*.

In India, the use of deoiled neem (*Azadirachta indica*) seed powder mixed into wheat seemed to be an effective and cheap method to control the pest in stored wheat. Heat treatment has proved to be very effective. The treatement involves a 30-minute exposure at 60°C (140°F) which has given a 100% kill of all stages of the khapra beetle. Diapausing larvae are more resistant to high temperatures than non-diapausing larvae. It has been

reported that some natural mortality of larvae occur in stores due to warming caused by activities of khapra beetle itself. In storage facilities trapping proved to be a useful surveillance tool using pheromone and larval traps. Treatment with fast electrons, using a linear accelerator, could provide an efficient method of controlling khapra beetle in store grain (ISSG, 2004).

For storage protection neem is usually used as a powder from crushed seeds which is mixed with the grain at various concentrations. This gives protection of many insect pests including weevils, *Sitophilus* spp., khapra beetles, *Trogoderma granarium* and lesser grain borer, *Rhizopertha dominica* (Golob and Webley, 1980; Saxena et al., 1989) however, contradictory results are also obtained. The neem product gives a bitter smell and taste which can reduce its attractiveness as a protectant in food grain in particular in areas where there is shortage of water for washing the treated produce. The risk for aflatoxin contamination in the grain owing to neem fruits which have not been dried properly should also be considered.

In recent past some indigenous plants have been reported to possess repellent property against khapra beetle. Abrol and Chopra (1963) had evaluated several indigenous plants for repellent action against *T. granarium*. Dwivedi and Bajaj (2000) assessed *Cassia* leaf extract for its repellent activity on khapra beetle. Later Dwivedi and Sharma (2002) investigated repellency of 5 plant extracts against khapra beetle.

Keeping in view, the ample scope of processing newer plant species, the present work has been taken up on the repellent action of leaf extracts of 6 plant species *viz. A. lebbek* (Mimosaceae), *T. orientalis* (Cupressaceae), *Z. jujuba* (Rhamnaceae), *D. alba* (Solanaceae), *E. officinalis* (Euphorbiaceae) and *M charantia* (Cucurbitaceae) .

Material & Method :

The culture of khapra beetle *T. granarium* was reared at 35 ± 2º C & 60% ± 10 RH. 30 gms. of powdered leaf material was extracted in Soxhlet apparatus for 8 hours in 300 ml of solvent (Deshmukh and Borle 1975). Acetone and pet ether were used as solvent. The extract was filtered and kept in refrigerator as stock solution (100% conc.)

The repellency was tested by following Read *et al* (1970) using an 'Y' shaped olfactometer, having 3 arms *viz*. base, control and experimental arm. A piece of sponge soaked in 1 ml. of plant extract (100% conc.) was

placed in experimental arm, whereas control arm contained soaked sponge piece in the same amount of solvent only. 20 freshly emerged beetles were introduced in the non-reacting base arm of the olfactometer. After 30 minutes, the number of individuals in each arm were counted. The repellency percentage was calculated using Granett *et al*. (1949) formula.

Results & Discussion :

Both the acetone and pet ether extracts repellency results have been tabulated in Table-1. Acetone extract of *Emblica officinalis* exhibited maximum percent repellency (88.66%) while lowest percent repellency (66.22%) was recorded in pet ether extract of *Ziziphus jujuba*. *Datura alba* acetone extract showed 77.58% repellency which is at par with *Ziziphus jujuba* acetone extract (77.55%).

Momordica charantia acetone showed 74.87% repellency while pet ether extract exhibited 74.47% repellency. Similar results with *Momordica charantia* were also registered by Mohiuddin *et al*., (1987) who obsevered 75% repellency of *Momordica charantia* against *T. castaneum*.

Datura alba pet ether extract (71.13%), *Thuja orientalis* pet ether extract (68.63%), *Albizia lebbek* acetone extract (67.96%), *Thuja orientalis* acetone extract (67.51%), *Albizia lebbek* pet ether extract (66.81%), *Ziziphus jujuba* pet ether extract (66.22%) have been obsevered. Similar repellent action of plant extracts were also obsevered by Qadri (1973), Jilani and Malik (1973) Garcia (1990), Partho and Sethi (1997), Dwivedi and Mathur (1997) against stored product pests.

Table 1 : Percentage repellency of leaf extracts (in Acetone and Pet ether) of plant species against *T. granarium*

S. No.	Plant name	Family of Plant	Mean % Repellency in (Acetone)	Mean % Repellency in (pet ether)
1.	*Emblica officinalis*	Euphorbiaceae	88.66	70.01
2.	*Datura alba*	Solanaceae	77.58	71.13
3.	*Ziziphus jujuba*	Rhamnaceae	77.55	66.22
4.	*Momordica charantia*	Cucurbitaceae	74.87	74.47
5.	*Albizia lebbek*	Mimosaceae	67.96	66.81
6.	*Thuja orientalis*	Cupressaceae	67.51	68.63

Thus the percentage repellency of different plant extracts in decreasing order can be summarized as follows :-

E. officinalis (Acetone) > *D.alba* (Acetone) > *Z. jujuba* (Acetone) > *M. charantia* (Acetone) > *M. charantia* (P.E.) > *D. alba* (P.E.) > *E. officinalis* (P.E.) > *T. orientalis* (P.E.) > *Z. jujuba* (P.E.).

From the observations recorded, it is concluded that in most of the plants, acetone extract exhibited more effective repellent action than pet ether extract but in *T. orientalis* pet ether or extract gave more promising results. Both acetone and pet ether extract of *M. charantia* exhibited equal effects as repellent.

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