

# STUDIES ON PENETRATION OF PACKAGES BY CIGARETTE BEETLE, *LASIODERMA SERRICORNE*(F.), RED FLOUR BEETLE, *TRIBOLIUM CASTANEUM*(HERBST) AND RUSTY GRAIN BEETLE, *CRYPTOLESTES FERRUGINEUS* (STEPHENS) TO AVOID CROSS INFESTATION

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## ABSTRACT

The experiments were conducted at the Post Graduate Research Laboratory, Department of Entomology, TNAU, Coimbatore during 2016. The results of penetrating ability of three storage insect pests namely *L. serricorne*, *T. castaneum* and *C. ferrugineus* on packages of varying thickness are reported. The maximum penetration was observed in 20 micron  $\mu$  thickness plastic package followed by 30 $\mu$  thickness plastic package by *L. serricorne* larvae with mean number of penetrated larvae 19.33 and 15.83 respectively, whereas adults of *L. serricorne*, larvae and adults of *T. castaneum* were able to penetrate only 20 $\mu$  thickness with mean number of penetrated insects 18.67, 18.00 and 19.00 respectively at 96 hours after release. Larvae and adult stages of *C. ferrugineus* failed to penetrate any of the packages. The use of package material well above 40 $\mu$  and above were found to prevent entry and cross infestation by storage pests.

## INTRODUCTION

Among all storage pests, insects cause loss up to 6.58 per cent (Latha and Naganagoud, 2015). Infestation by insects in high valued products makes unfit for consumption (Mishra and Nigam, 2011) and for packaging of these products polythene packages are widely used (Abhishek *et al.*, 2014; Mullen and Mowery, 2000; Mohan *et al.*, 2007). The use of fragile packaging materials for storage causes cross infestation and loss by storage insect pests (Mullen and Mowery, 2000). The damage also depends on stage of storage insect pest to penetrate packaging materials (Gerhardt and Lindgren, 1954; Mohan *et al.*, 2007). The objective of the paper was to check the vulnerability of locally available packaging materials for penetrating ability of larval and adult stages of three storage insect pests, Cigarette beetle, Red flour beetle and Rusty grain beetle which were found to be the pests of dried chillies during survey.

## MATERIALS AND METHODS

The penetration study of different packages by stored product insect pests of dried chilli to avoid cross infestation, was conducted in PG Laboratory, Department of Entomology, TNAU, Coimbatore. This study was conducted based on 'cup

test' apparatus described by Gerhardt and Lindgren (1954) and similar method used by Mohan *et al.*, 2007.

### Description of cup test apparatus

It involves use of two plastic cups and a packaging material was held between the two cups was tightly covered by using cellophane tape. In the bottom cup 2g of crushed chilli was placed and 20 test insects were released in the top cup (Fig. 1)

### Packaging materials used for penetration study

Five plastic material of different micron  $\mu$  thickness along with silver foil and muslin cloth were selected for penetration study. T1 - 20 $\mu$  plastic material, T2 - 30 $\mu$  plastic material, T3 - 40 $\mu$  plastic material, T4 - 50 $\mu$  plastic material, T5 - 60 $\mu$  plastic material T6 - Silver foil and T7 - Muslin cloth (Fig. 2)

### Test insects

Penetration study was conducted for both larva and adult stages of cigarette beetle, *Lasioderma serricorne*, red flour beetle, *Tribolium castaneum* and rusty grain beetle *Cryptolestes ferrugineus*. The cultures of all insects were maintained in laboratory and freshly emerged adults were used for the experiment. Mass culturing of all test insects done in plastic jars containing medium of 5% dried ground brewer's yeast and 95% wheat flour as method mentioned by Mahroof and Phillip (2008). Twenty test insects were released per

experimental unit. A separate experimental setup prepared for adult and larva of each species.

### Record of observations

The number of insects penetrated the packages were recorded at 24 hours interval after release of test insects, up to 96 hours for all the insect species. The images of penetrated packages were taken using image analyser microscope (Leica M205A).

### Data analysis

The data recorded in different treatments were subjected to analysis of variance (ANOVA) using AGRSS.

## RESULTS AND DISCUSSION

### Penetration by *Lasioderma serricornne* larva and adults

**Table 1: Penetration of package material by *Lasioderma serricornne* larvae**

Treatments	Mean number of adults penetrated			
	24 HAR	48 HAR	72 HAR	96 HAR
T1(20 $\mu$ plastic material)	1.00(1.17) <sup>b</sup>	5.33(2.40) <sup>b</sup>	10.33(3.29) <sup>b</sup>	19.33(4.45) <sup>c</sup>
T2(30 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	13.17(3.62) <sup>c</sup>	15.83(3.97) <sup>b</sup>
T3(40 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T4(50 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T5(60 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T6(Silver foil)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T7(Muslin cloth)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
SEd	0.14	0.10	0.11	0.13
CD(0.05)	0.30	0.21	0.24	0.27

Values are mean of three replications; HAR = Hour(s) After Release; Figures in parentheses are transformed square root values; In a column means followed by same letter(s) are not significantly different ( $p=0.05$ ) by LSD

**Table 2: Penetration of package material by *Lasioderma serricornne* adult**

Treatments	Mean number of adults penetrated			
	24 HAR	48 HAR	72 HAR	96 HAR
T1(20 $\mu$ plastic material)	2.33(1.54) <sup>b</sup>	13.67(3.72) <sup>b</sup>	17.67(4.26) <sup>b</sup>	18.67(4.38) <sup>b</sup>
T2(30 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T3(40 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T4(50 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T5(60 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T6(Silver foil)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T7(Muslin cloth)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
SEd	0.25	0.22	0.06	0.05
CD(0.05)	0.54	0.48	0.12	0.15

Values are mean of three replications; HAR = Hour(s) After Release; Figures in parentheses are transformed square root values; In a column means followed by same letter(s) are not significantly different ( $p=0.05$ ) by LSD

**Table 3: Penetration of package material by *Tribolium castaneum* larvae**

Treatments	Mean number of adults penetrated			
	24HAR	48HAR	72HAR	96HAR
T1(20 $\mu$ plastic material)	0.67(1.68) <sup>b</sup>	7.33(2.78) <sup>b</sup>	17.00(4.17) <sup>b</sup>	18.00(4.30) <sup>b</sup>
T2(30 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T3(40 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T4(50 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T5(60 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T6(Silver foil)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T7(Muslin cloth)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
SEd	0.055	0.12	0.07	0.07
CD(0.05)	0.11	0.26	0.16	0.15

Values are mean of three replications; HAR = Hour(s) After Release; Figures in parentheses are transformed square root values; In a column means followed by same letter(s) are not significantly different ( $p=0.05$ ) by LSD

The larva of *L. serricornne* penetrated the 20 $\mu$  thickness plastic package after 24 Hours After Release (HAR) (Fig. 3a) followed by 30 $\mu$  (Fig. 3b) thickness plastic package after 72 hours (Table 1). There was no penetration observed in other packages. Adults of *L. serricornne* penetrated 20 $\mu$  thickness plastic package after 24 HAR (Fig.3c), whereas there was no penetration observed in other packages (Table 2).

### Penetration by *T. castaneum* larva and adults

The larva of *T. castaneum* penetrated 20 $\mu$  thickness plastic package (Fig. d) after 24 HAR. Adults of *T. castaneum* penetrated 20 $\mu$  thickness plastic package after 24 HAR (Fig.3e) (Table 3 and 4), whereas there was no penetration observed in other packages.

### Penetration by *Cryptolestes ferrugineus* larva and adults

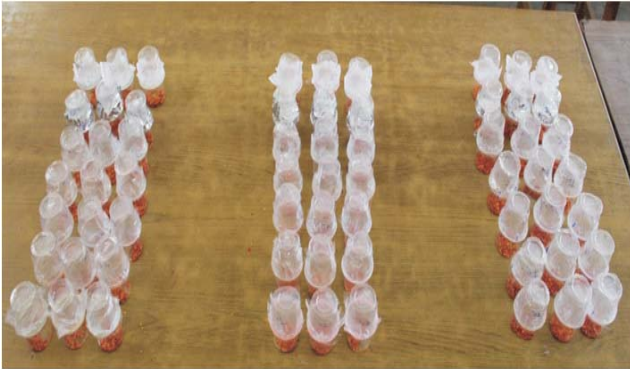


Figure 1: Experimental set up for penetration study

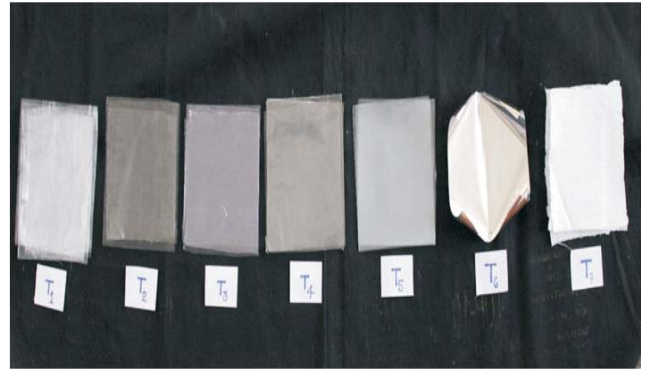


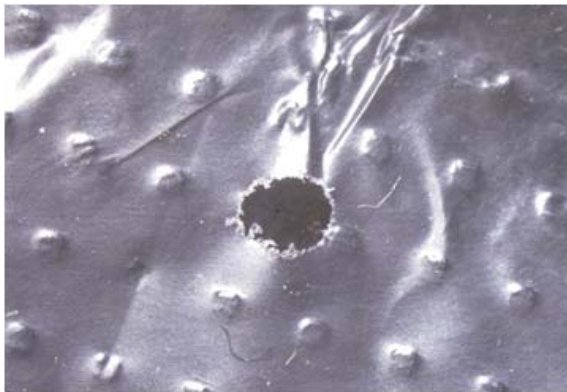
Figure 2: Package materials used for penetration study



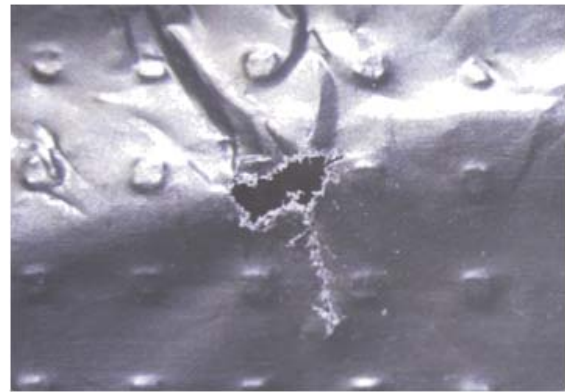
3A



3B



3C



3D



3E

Penetration of packaging material by insect pests of crushed chilli. Figure 3a. Penetration of *L. serricornae* larvae in 20µ plastic package material. Figure 3b. Penetration of *L. serricornae* larvae in 30µ plastic package material. Figure 3c. Penetration of *L. serricornae* adults in 20µ plastic package material. Figure 3d. Penetration of *T. castaneum* larvae in 20µ plastic package material. Figure 3e. Penetration of *T. castaneum* adults in 20µ plastic package material.

**Table 4: Penetration of package material by *Tribolium castaneum* adults**

Treatments	Mean number of adults penetrated			
	24 HAR	48 HAR	72 HAR	96 HAR
T1(20 $\mu$ plastic material)	1.33(1.34) <sup>b</sup>	12.66(3.62) <sup>b</sup>	18.67(4.38) <sup>b</sup>	19.00(4.41) <sup>b</sup>
T2(30 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T3(40 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T4(50 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T5(60 $\mu$ plastic material)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T6(Silver foil)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
T7(Muslin cloth)	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>	0.00(0.71) <sup>a</sup>
SEd	0.06	0.09	0.05	0.04
CD(0.05)	0.14	0.19	0.12	0.08

Values are mean of three replications ; HAR = Hour(s) After Release; Figures in parentheses are transformed square root values ; In a column means followed by same letter(s) are not significantly different ( $p = 0.05$ ) by LSD

The larva and adult stages of *C. ferrugineus* was not penetrated into any of the packaging material. Results revealed that 20 $\mu$  and 30 $\mu$  thickness plastic package materials was penetrated by *L. serricornis* larvae, while adults of *L. serricornis* penetrated only 20 $\mu$  thickness plastic package. Lu and Ma (2015) classified *L. serricornis* as the effective penetrator group of stored product insect pest.

Larvae and adults of *T. castaneum* able to penetrate only 20 $\mu$  thickness plastic package materials. The observations of Alanko *et al.* (2000) confirmed that *T. castaneum* is a secondary feeder and its mouthparts are modified for chewing.

The above tested insects failed to penetrate, above 30 $\mu$  thickness packages. However use of low thickness packaging materials for storage of valuable products may lead to damage by storage insects and results in cross infestation of products. Hence use of packaging material above 40 $\mu$  thickness is ideal for better storage and to avoid cross infestation.

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