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RESEARCH ARTICLE

# Studies on the comparative efficiency of different traps in attracting various storage pests in paddy seed processing units

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## ABSTRACT

Experiments were conducted to compare the efficiency of four different kinds of traps namely TNAU insect probe trap, TNAU pit fall trap, Indicator device and Stack probe trap and then indicator device against normal sampling method to collect insects present in processed and stored paddy seeds at a particular time interval. The direct comparison of efficiency of traps in collecting rice weevil, *Sitophilus oryzae*, red flour beetle *Tribolium castaneum* Herbst, angoumois grain moth, *Sitotroga cerealella* Oliver and lesser grain borer, *Rhizopertha dominica* Fabricious which are of economic importance on 30, 60, 90, 120 and 150 days after well processed and sampled seed lots. It was found that maximum number of pests was collected in stack probe trap followed by TNAU insect probe trap before and after fumigation. Among the pests lesser grain borer was collected more followed by angoumois grain moth.

**Keywords:** *trap, storage pests, pest dispersion*

## INTRODUCTION

Rice is damaged by several insects in storage, of which rice weevil *Sitophilus oryzae*, rice moth Corcyra cephalonica (Stainton), red flour beetle Tribolium castaneum Herbst, angoumois grain moth, *Sitotroga cerealella* Oliver, lesser grain borer, *Rhizopertha dominica* Fabricious and khapra beetle *Trogoderma granarium* Everts are of economic importance (Vaidya and Ramesh Lal, 2001). It is very important to prevent the losses in stored products due to insect pests. There has been extensive and intensive use of various insecticides including Malathion in storage premises for the control of insect pests. The continuous use of the insecticides has resulted in the development of resistance in major stored grain insects to several insecticides including Malathion at various locations in the world (Champ and Dyte, 1976). Use of traps is a relatively better method of detecting wandering insects in bulk stored grain. The traps such as pit fall trap at grain surface (Watters and Cox, 1957) and probe trap under grain surface (Loschiavo and Atkinson, 1973) offer numerous advantages over standard sampling procedures. Detection of insects using food baited trap (Strong, 1970), sticky traps (Burkholder, 1974), pheromone-baited traps (Burkholder, 1974) and electric light trap (Pursley, 1987) were also used as effective tools.

As the majority of the adult insects attacking stored grain have wandering behaviour, insect traps have been proved effective as a sensitive tool for detection of stored grain insects (Hagstrum *et al*, 1990).

Traps exploit insect behaviour to detect insect population with less effort than absolute sampling methods (Mohan *et al,* 1993). Keeping this in view, studies were carried out on the comparative efficiency of different traps in attracting various storage pests like Rice weevil, Lesser grain borer, Red flour beetle and Angoumois grain moth.

## MATERIAL AND METHODS

The experiment was carried out in private processing units (Krishna seeds, Dharapuram, and Adithya seeds Madatukulam). Well processed paddy seeds of variety ADT(R) 45, four months after harvest were taken for experiments. Seeds were kept in 30 kg packing. Four kinds of traps were used to monitor the infestation of pests and observation was made on collection of pests *viz.*, Rice weevil, Lesser grain borer, Red flour beetle and Angoumois grain moth, at the interval of 30 days after the date of processing till 150 days. About 5 kgs of processed paddy seed were sampled and collected in a container by the random sampling method. In such containers, probe traps were installed @ 1 number each for 5 stacks.

The other three traps such as pit fall trap, indicator device and stack probe trap were installed in between stacked bags @1 per stack in paddy seed processing unit (Six bags were stacked one over the other). For control there were no such traps

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used. About 5 kgs of seed samples were collected through the normal sampling method and kept in five containers without any trap. The experiment was carried out with five treatments and five replications in FCRD design.

Observation on a collection of pests without fumigation was taken based on the number of pests collected in each category at an interval of 30 days after the date of processing till 150 days and compared the strategy of pest distribution so as to manage them by scheduling control measures in time.

The same kind of observations was taken on collection of pests after fumigation. Well processed paddy seeds of variety ADT(R) 45, were taken for observation. It was 4 months after harvest. Four kinds of traps were used to monitor the infestation of pests and observation was made on collection of pests at an interval of 7 days after the date of fumigation till 35 days. Traps were installed as such in paddy seed processing unit. Seeds were stored in 30 kgs packing.

## RESULTS AND DISCUSSION

As majority of the adult insects attacking stored grain have wandering behaviour, insect traps proved effective as a sensitive tool for detection of stored grain insects (Hagstrum et al, 1990). In such connection, study on dispersion of storage pests in paddy seed lots without fumigation indicated that the maximum mean number (61.8) of rice weevils were collected in stack probe trap, next to which was TNAU insect probe trap (28.7) followed by TNAU pit fall trap (16.5) and then indicator device in which 12.9 weevils were collected on 150 DAT. Use of traps is a relatively better method of detecting wandering insects in bulk stored grain. The traps such as pit fall trap at grain surface and probe trap under grain surface (Loschiavo and Atkinson, 1973) which is in support of our study. Observation was taken every month from 30 to 150 days i.e. up to 5 months. Since in normal sampling method no trap was used, the number of weevils collected was zero. Maximum of 128.8 weevils were collected in Stack probe trap on 150 DAT (Table 1).

**Table 1. Use of traps – dispersion of rice weevil in stored paddy seeds without fumigation**

| Treatments | Details of the treatment | No of traps used | No of rice weevils collected | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 30 Days | 60 Days | 90 days | 120 Days | 150 Days | Mean |
| | TNAU insect probe trap | 5 | 15.8 (4.0)[a] | 23.0 (4.9)[a] | 23.4 (4.9)[b] | 32.0 (5.7)[b] | 49.4 (7.0)b | 28.7 (5.3)b |
| | TNAU Pitfall trap | 5 | 4.8(2.3)[c] | 9.0 (3.1)[b] | 16.6 (4.1)[c] | 23.8 (4.9)[c] | 28.4 (5.4)c | 16.5 (3.9)c |
| | Indicator Device | 5 | 3.8 (2.0)[d] | 7.4 (2.8)[c] | 11.0 (3.4)[d] | 14.0 (3.8)[d] | 28.4 (5.4)c | 12.9 (3.5)d |
| | Stack probe trap | 5 | 8.8 (3.0)[b] | 25.2 (5.1)[a] | 63.8 (8.0)[a] | 82.6 (9.1)[a] | 128.8 (11.3)a | 61.8 (7.3)a |
| | Normal sample | - | 0.0 (0.7)[e] | 0.0 (0.7)[d] | 0.0 (0.7)[e] | 0.0 (0.7)[e] | 0.0 (0.7)d | 0.0 (0.7)e |
| Mean | | | 6.6 (2.4)[E] | 12.9 (3.3)[D] | 23.0 (4.2)[C] | 30.5 (4.8)[B] | 47.0 (6.0)[A] | |
| CD @ 5% | Treatment (T) | 0.2 | | | | | | |
| | Days (D) | 0.2 | | | | | | |
| | T vs D | 0.5 | | | | | | |

Figures in parenthesis are square root ( √x+0.5) transformed value
In a column, figures followed by a common lower case letter are not significantly different at p=0.05.
In a row, figures followed by a common upper case letter are not significantly different at p=0.05

**Table 2. Use of traps – dispersion of lesser grain borer in stored paddy seeds without fumigation**

| Treatments | Details of the treatment | No of traps used | No of lesser grain borer collected | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 30 Days | 60 Days | 90 days | 120 Days | 150 Days | Mean |
| | TNAU insect probe trap. | 5 | 6.6 (2.7)[b] | 13.2 (3.7)[a] | 19.8 (4.5)[b] | 23.6 (4.9)[c] | 34.0 (5.9)[c] | 19.4 (4.3)[b] |
| | TNAU Pitfall trap | 5 | 3.8 (2.1)[c] | 11.8 (3.5)[ab] | 23.0 (4.8)[a] | 22.8 (4.8)[c] | 28.4 (5.4)[d] | 18.0 (4.1)[b] |
| | Indicator Device | 5 | 2.2 (1.6)[d] | 10.2 (3.2)[c] | 24.6 (5.0)[a] | 31.6 (5.7)[b] | 44.2 (6.8)[b] | 22.6 (4.4)[b] |
| | Stack probe trap | 5 | 11.2 (3.4)[a] | 14.0 (3.8)[a] | 22.4 (4.8)[a] | 69.4 (8.4)[a] | 122.4 (11.1)[a] | 47.9 (6.3)[a] |
| | Normal sample | - | 0.0 (0.7)[e] | 0.0 (0.7)[d] | 0.0 (0.7)[c] | 0.0 (0.7)[d] | 0.0 (0.7)[e] | 0.0 (0.7)[c] |
| Mean | | | 4.8 (2.1)[E] | 9.8 (3.0)[D] | 18.0 (4.0)[C] | 29.5 (4.9)[B] | 45.8 (6.0)[A] | |
| | Treatment (T) | 0.2 | | | | | | |
| CD @ 5% | Days (D) | 0.2 | | | | | | |
| | T vs D | 0.4 | | | | | | |

Figures in parenthesis are square root ( √x+0.5) transformed value
In a column, figures followed by a common lower case letter are not significantly different at p=0.05.
In a row, figures followed by a common upper case letter are not significantly different at p=0.05

Over all observation showed that that maximum numbers (122.4) of lesser grain borer was collected in Stack probe trap on the 150th day of installation. This shows that the catch of lesser grain borer is higher in the stack probe trap than others (Table 2). The catches obtained from different traps after 150 days indicates that as usual stack probe trap ranks first (16.2 nos) in mean red flour beetle collection (Table 3). Indicator device, TNAU pit fall trap and TNAU insect probe traps were on par with each other

**Table 3. Use of traps – dispersion of red flour beetle in stored paddy seeds without fumigation**

| Details of the treatment | No of traps used | No of red flour beetle collected | | | | | |
|---|---|---|---|---|---|---|---|
| | | 30 Days | 60 Days | 90 days | 120 Days | 150 Days | Mean |
| TNAU insect probe trap | 5 | 0.6 (1.0)$^{a}$ | 3.4 (1.8)$^{b}$ | 6.2 (2.6)$^{b}$ | 8.6 (3.0)$^{b}$ | 11.4 (3.4)$^{c}$ | 6.0 (2.4)$^{c}$ |
| TNAU Pitfall trap | 5 | 0.0 (0.7)$^{b}$ | 4.6 (2.1)$^{a}$ | 8.2 (2.9)$^{ab}$ | 11.2 (3.4)$^{ab}$ | 17.8 (4.3)$^{b}$ | 8.4 (2.7)$^{b}$ |
| Indicator Device | 5 | 0.0 (0.7)$^{b}$ | 4.8 (2.3)$^{a}$ | 10.4 (3.3)$^{a}$ | 14.4 (3.9)$^{a}$ | 20.0 (4.5)$^{b}$ | 9.9 (2.9)$^{b}$ |
| Stack probe trap | 5 | 1.2 (1.3)$^{a}$ | 5.8 (2.5)$^{a}$ | 13.8 (3.8)$^{a}$ | 19.6 (4.4)$^{a}$ | 40.4 (6.4)$^{a}$ | 16.2 (3.7)$^{a}$ |
| Normal sample | - | 0.0 (0.7)$^{b}$ | 0.0 (0.7)$^{c}$ | 0.0 (0.7)$^{c}$ | 0.0 (0.7)$^{c}$ | 0.0 (0.7)$^{d}$ | 0.0 (0.7)$^{d}$ |
| | | 0.4 (0.9)$^{E}$ | 3.7 (1.9)$^{D}$ | 7.7 (2.7)$^{C}$ | 10.8 (3.1)$^{B}$ | 17.9 (3.9)$^{A}$ | |
| Treatment (T) | **0.2** | | | | | | |
| Days (D) | **0.2** | | | | | | |
| T vs D | **0.5** | | | | | | |

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showing 9.9, 8.4 and 6.0 mean numbers of red flour beetles collected after 150 days. In a general the number of red flour beetle collected was less in all the traps and all the periods than other pests.

Mohan, 1993 found that the trap is ideal for use in seed processing and especially in long term storage units. In our study also the trap attracted all stored paddy pests like lesser grain borer, Rhyzopertha dominica, red flour beetle, Tribolium castaneum, rice weevil, Sitophilus oryzae and angumois grain moth, Sitotroga cerealella in large numbers which corroborates prior findings.

**Table 4. Use of traps – dispersion of rice weevil in stored paddy seeds after fumigation**

| Details of the treatment | No of traps used | No of rice weevil collected | | | | | |
|---|---|---|---|---|---|---|---|
| | | 7 Days | 14 Days | 21 days | 28 Days | 35 Days | Mean |
| TNAU insect probe trap. | 5 | 0.8 (1.1)$^{a}$ | 3.4 (2.0)$^{a}$ | 8.2 (2.9)$^{b}$ | 15.6 (4.0)$^{b}$ | 20.0 (4.5)$^{b}$ | 9.6 (2.9)$^{a}$ |
| TNAU Pitfall trap | 5 | 1.0 (1.2)$^{a}$ | 1.8 (1.5)$^{a}$ | 4.2 (2.2)$^{c}$ | 4.8 (2.3)$^{c}$ | 6.8 (2.7)$^{c}$ | 3.7 (2.0)$^{b}$ |
| Indicator Device | 5 | 1.0 (1.2)$^{a}$ | 2.6 (1.7)$^{a}$ | 2.8 (1.7)$^{c}$ | 4.4 (2.2)$^{c}$ | 7.4 (2.8)$^{c}$ | 3.6 (1.9)$^{b}$ |
| Stack probe trap | 5 | 1.2 (1.3)$^{a}$ | 2.4 (1.7)$^{a}$ | 15.6 (3.9)$^{a}$ | 32.4 (5.7)$^{a}$ | 48.6 (7.0)$^{a}$ | 20.0 (3.9)$^{a}$ |
| Normal sample without any trap | - | 0.0 (0.7)$^{a}$ | 0.0 (0.7)$^{b}$ | 0.0 (0.7)$^{d}$ | 0.0 (0.7)$^{d}$ | 0.0 (0.7)$^{d}$ | 0.0 (0.7)$^{c}$ |
| | | 0.8 (1.1)$^{E}$ | 2.0 (1.5)$^{D}$ | 6.2 (2.3)$^{C}$ | 11.4 (3.0)$^{B}$ | 16.6 (3.6)$^{A}$ | |
| Treatment (T) | **0.2** | | | | | | |
| Days (D) | **0.2** | | | | | | |
| T vs D | **0.6** | | | | | | |

Figures in parenthesis are square root ( √x+0.5) transformed value

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In a row, figures followed by a common upper case letter are not significantly different at p=0.05

**Table 5. Use of traps – dispersion of lesser grain borer in stored paddy seeds after fumigation**

| | Details of the treatment | No of traps used | No of lesser grain borer collected | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 7 Days | 14 Days | 21 days | 28 Days | 35 Days | Mean |
| | TNAU insect probe trap. | 5 | 4.0 (2.1)$^{a}$ | 12.2 (3.5)$^{a}$ | 23.0 (4.8)$^{a}$ | 21.6 (4.7)$^{b}$ | 30.8 (5.6)$^{b}$ | 18.3 (4.2)$^{b}$ |
| | TNAU Pitfall trap | 5 | 0.8 (1.1)$^{b}$ | 2.2 (1.6)$^{c}$ | 3.8 (2.1)$^{d}$ | 10.2 (3.3)$^{c}$ | 12.8 (3.6)$^{d}$ | 6.0 (2.3)$^{d}$ |
| | Indicator Device | 5 | 2.2 (1.7)$^{a}$ | 3.4 (2.0)$^{c}$ | 13.2 (3.7)$^{c}$ | 13.0 (3.6)$^{c}$ | 17.8 (4.3)$^{c}$ | 9.9 (3.0)$^{c}$ |
| | Stack probe trap | 5 | 2.8 (1.8)$^{a}$ | 7.2 (2.8)$^{b}$ | 18.4 (4.3)$^{b}$ | 35.2 (5.9)$^{a}$ | 62.6 (7.9)$^{a}$ | 25.2 (4.6)$^{a}$ |
| | Normal sample without any trap | - | 0.0 (0.7)$^{c}$ | 0.0 (0.7)$^{d}$ | 0.0 (0.7)$^{e}$ | 0.0 (0.7)$^{d}$ | 0.0 (0.7)$^{e}$ | 0.0 (0.7)$^{e}$ |
| Mean | | | 2.0 (1.5)$^{E}$ | 5.0 (2.1)$^{D}$ | 11.7 (3.1)$^{C}$ | 16.0 (3.6)$^{B}$ | 24.8 (4.4)$^{A}$ | |
| | Treatment (T) | 0.2 | | | | | | |
| **CD @ 5%** | Days (D) | 0.2 | | | | | | |
| | T vs D | 0.4 | | | | | | |

Figures in parenthesis are square root ( √x+0.5) transformed value

In a column, figures followed by a common lower case letter are not significantly different at p=0.05.

In a row, figures followed by a common upper case letter are not significantly different at p=0.05

After fumigation, pest collection was recorded on 7th, 14th, 21st, 28th and 35th day i.e. at weekly intervals (Table 5). Mean number of insects collected was maximum in stack probe trap (20.0) after 35 days followed by TNAU insect probe trap (9.6). TNAU pit fall trap and Indicator device were on par with each other which collected 3.7 and 3.6 mean numbers of rice weevil in 35 days after

**Table 6. Use of traps – dispersion of red flour beetle in stored paddy seeds after fumigation**

| | Details of the treatment | No of traps used | No of red flour beetle collected | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 7 Days | 14 Days | 21 days | 28 Days | 35 Days | Mean |
| | TNAU insect probe trap. | 5 | 1.0 (1.2)[b] | 4.8 (2.3)[a] | 7.8 (2.9)[a] | 11.8 (3.5)[b] | 14.0 (3.8)[b] | 7.9 (2.7)[b] |
| | TNAU Pitfall trap | 5 | 1.0 (1.1)[b] | 2.4 (1.7)[b] | 5.6 (2.5)[b] | 7.2 (2.7)[c] | 8.4 (3.0)[bc] | 4.9 (2.2)[c] |
| | Indicator Device | 5 | 0.8 (1.1)[b] | 2.8 (1.8)[b] | 7.6 (2.8)[a] | 10.4 (3.3)[b] | 10.8 (3.4)[b] | 6.5 (2.5)[b] |
| | Stack probe trap | 5 | 2.8 (1.8)[a] | 5.8 (2.5)[a] | 9.8 (3.2)[a] | 16.0 (4.0)[a] | 22.6 (4.8)[a] | 11.4 (3.3)[a] |
| | Normal sample without any trap | - | 0.0 (0.7)[bc] | 0.0 (0.7)[c] | 0.0 (0.7)[c] | 0.0 (0.7)[d] | 0.0 (0.7)[c] | 0.0 (0.7)[d] |
| Mean | | | 1.1 (1.2)[D] | 3.2 (1.8)[C] | 6.2 (2.4)[B] | 9.1 (2.9)[A] | 11.2 (3.1)[A] | |
| CD @ 5% | Treatment (T) | 0.2 | | | | | | |
| | Days (D) | 0.2 | | | | | | |
| | T vs D | 0.4 | | | | | | |

Figures in parenthesis are square root ( $\sqrt{x+0.5}$) transformed value
In a column, figures followed by a common lower case letter are not significantly different at p=0.05.
In a row, figures followed by a common upper case letter are not significantly different at p=0.05

fumigation. There was significant difference between the use of traps and normal sampling method. Stack probe trap recorded maximum rice weevil collection (48.6 nos) on the 35th day after fumigation. The maximum mean number of lesser grain borer collected on 35 days after fumigation in stack probe trap was 25.2 which ranks first followed by TNAU insect probe trap (18.3). Indicator device stands next with the collection of 9.9 numbers on the same day (Table 5). Like in all other experiments, the mean number of red flour beetle adults collected was maximum in stack probe trap at 35 days after fumigation as shown in Table 6. The mean number of insects caught in insect probe trap was 7.9 which was on par with the Indicator device (6.5) and was followed by TNAU pit fall trap (4.9). Detection of insects using food baited trap (Strong, 1970), sticky traps (Burkholder, 1974), pheromone-baited traps and electric light trap (Pursley, 1987) were also used as effective tools which also supported our study.

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