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STUDY OF ALP TOXICITY ON LARVAL STAGES OF *Ephestia calidella* (GUEN.) A PEST OF STORED DRY FRUITS

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AUTHOR'S CONTRIBUTION
The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

In regard to the control by fumigation of Aluminium Phosphide (AlP) was tried to suitable control measures against the *Ephestia calidella* (Guen.) a pest of stored dry fruits. Aluminium Phosphide was tested at different level of dosages such as Low (1 gm/ m^3), Medium (2 gm/ m^3) and high (3 gm/ m^3) as well as different time exposures as 24, 48, and 72 hours in laboratory conditions. Aluminium Phosphide was most effective in 72 hours exposure at all dosages against all the larval stages of the pest. Toxic effects of AlP fumigation on field and godowns workers have been founded. Biological control of the pest by *Bracon hebetor* Say was also studied.

Keywords: Fumigation; toxicity; aluminium phosphide; stored dry fruits; biological control.

1. INTRODUCTION

The easy handling and relatively cheaper chemical controls measure are very common and most widely used in India. Amongst the chemical, the use of fumigants is a most commonly adopted measures as described by Opit et al. [1] in 2012 and Sekhon et al. [2] in 2010. In present investigation Aluminium Phosphide (AlP) was tried to suitable control measures against the larvae of *Ephestia calidella* (Guen.) a pest of stored dry fruits.

In view of the immense emerging population of India the food problem is of prime importance as reported by Nagaraja and Benni [3] in 2017. We have to escalate the production and productivity of food and on the other hand protecting them from the insect pests in the harvest and storage. As regard the richness of the food contents, the fruits and dry fruits is on first priority.

The essential condition to store dry fruits for a long time results in a great loss by different pests. Out of them the *Ephestia calidella* (Guen.) is a serious storage pest of dry fruits, cereals, oil seeds and pulses as described by Gupta S. [4].

In regard of biological control the use of *Bracon hebetor* Say and *Trichogramma minutum* R. were attempted on *Ephestia calidella* (Guen.) but the *Bracon hebetor* Say was successfully reared on the mature larvae of this pest as natural enemy as investigated by Gupta S and Sharma H B.[5,6].

2. MATERIALS AND METHODS

The conditions and methods of storage with incidence and intensity together with the damage caused by it were recorded. The moths of the test insect, *E. calidella* were collected from Indian Grain Storage Institute, Hapur (U.P.).

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For the convenience of study four districts viz. Agra, Mathura, Hathras and Morena were selected. Samples from traders were brought to laboratory for the analysis of quantitative and qualitative losses. The population of larvae and pupae were recorded. Sampling was done from the jute bags, debris on the floor, crack and crevices of the godowns and retailers stores.

In order to evolve suitable measures of control for *Ephestia calidella* (Guen) by fumigation of Aluminium Phosphide was tested.

The above experiment was employed on larval stages of test insect under the laboratory conditions, in jars the larvae of test insects were treated at different level of dosages such as Low (1 gm/ m^3), Medium (2 gm/ m^3) and high (3 gm/ m^3) as well as different time exposures as 24, 48, and 72 hours. All experiments were done in four replications and after 24, 48 and 72 hours the mean mortality was counted Adjustment for mortality occurrence in control insect was made by using Abbot's formula [7] and for statistical analysis Finney [8].

3. OBSERVATIONS

Aluminium Phosphide (AlP) is in tablet or pellet with solid compact, dry and highly potent fumigant value. It has ammonium carbonate and stabilizing materials with active and inert ingredients respectively. It releases Phosphine while coming into contact with atmosphere moisture. This Phosphine is non inflammable non responsive and stable. It does not affect the properties or leave any toxic residue after fumigation of any product It is deadly toxic to all the pests. It is effective against all stages of development from egg to adults. It is kept in Aluminum tubes with transparent air tight plastic stoppers.

All the larval stages of test insects were released in jars. The observations were recorded. The effectiveness of AlP fumigation was calculated by the median valve of the observations. The calculations of percent control to assess the effectiveness of different dosages of AlP fumigation against larval stages of test insects have been shown in Tables 1 and 2.

4. RESULTS AND DISCUSSION

Aluminium Phosphide proved most effective against in 72 hours at all dosages - (Low, Medium and high) 1, 2. & 3 gms/ cubic meter on larvae of test insects. The effectiveness was maximum in 72 hours which runs as follows respectively - 94.1%, 96.3% and 97.4% for larvae (Fig. 1).

The Aluminium Phosphide was tested as suitable control measures against the pest. This was done with different levels of doses and exposure duration. The Aluminium Phosphide was most effective in 72 hours against all developmental stages. Coyne [9], Cherian and George [10], Pradhan and Bhatia [11], Pingale and Swaminathan [12], Muthu & Pingale [13], Bhambhani [14], Narayanan & Bhambhani [15] and Bhambhani & Rout [16] are some of the important scientists who have worked on the use of fumigants against the stored grain pests. But the toxicity of the fumigants has been also denoted by Page & Lubatti [17], Jacobs [18], Brown & Heuser [19], Clegg & Levis [20], Hayward [21], Bridges [22], Lindgren et al. [23], Berk [24], Richardson & Balock [25], Bond and Monro [26], Bruce et al. [27], Cotton [28], Alumot et al. [29], Torkelson et al. [30], and Lynn [31]. Who have described the use of various particular fumigants which runs in accordance with present investigation.

Cosenza et al. [32] on the stored garlic and Leesch et al. [33] on the dates, described the sterility of the insect by the various chemicals. In 2016 Rajendran S. [34] described Status of Fumigation of different fumigants of various Stored Grains to protect them from their pests and regulatory laws for using fumigants in India.

Toxic effects of AlP fumigation on field and godowns workers has been founded as described by Chaudhary SK et al. [35] in 2013, Mehropour O et al. [36] in 2012

Table 1. Effect of different dosages of AlP fumigation on 100 larvae of test pest during various exposure times

Dosages in gm/ cube meter	Mean of all four replications No. of larvae dead		
	24 hrs	48 hrs	72 hrs
1	13.0	31.0	94.5
2	13.75	40.5	96.5
3	19.5	43.5	97.6

Table 2. Percentage effectiveness at different dosages of AlP fumigation on larvae of test pest during various exposure times according to Abbot's formula

Dosages in gm/ cube meter	Percentage effectiveness at various exposure time		
	24 hrs	48 hrs	72 hrs
1	9.5	27.6	94.1
2	11.3	37.3	96.3
3	16.3	40.7	97.4

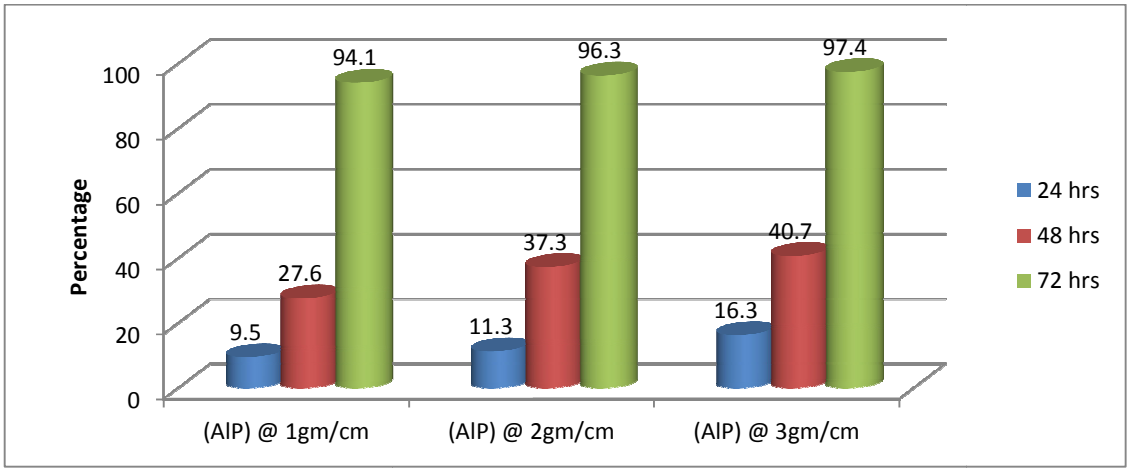

Fig. 1. Different dosages of AlP fumigant on larvae of test pest during various exposure times
(Y axis showing Percentage effectiveness)

and Sudakin DL, [37]. Biological control of *E. calidella* by its natural enemy *B. hebetor* was also studied and it appeared that *B. hebetor* can be successfully used for biological control of *E. calidella.*

5. CONCLUSION

Fumigation of AlP or Phosphine can be successfully used to control the larvae of *Ephestia calidella* (Guen.) a pest of stored dry fruits. *E. calidella* can also be successfully controlled by its natural enemy *B. hebetor*. To minimize the toxic effect of AlP on workers both aspects can be used in integrated manner.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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