DEVELOPMENT OF PHOSPHINE FUMIGATION TECHNIQUE FOR BAG CUM BULK WHEAT STORED IN HOUSE TYPE GODOWNS

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In house type godowns, bag cum bulk storage of wheat is common in Pakistan Agricultural Storage and Services Corporation (PASSCD). For protection of stored wheat in these godowns, phosphine fumigation is always done by using aluminium phosphide (AlP) tablets. In this practice total number of tablets are scattered around and on the surface of the stack. This method was tested and proved to be ineffective because of insufficient penetration and retention of phosphine gas in deeper zones of the stack. To improve upon phosphine fumigation two other methods (multiple and dosing pipe application methods) were tested. In multiple application method a higher dose rate was used in two successive applications while in dosing pipe method, perforated PVC pipes were used in the bulk wheat to apply the AlP tablets. Out of these three methods, dosing pipe method proved to be the most effective and resulted in better retention and distribution of phosphine gas in different zones of the bulk wheat.

INTRODUCTION

House type godowns constitute a major proportion of the wheat storage facility with Pakistan food handling agencies. Basically these godowns are meant for bag storage but Pakistan Agricultural Storage and Services Corporation (PASSCD) is using them for bag cum bulk storage to enhance their storage capacity from 1100 to 1600 mt/ godown (Qureshi, 1989). In this practice, bulk wheat is contained in an area enclosed by pad walls made of wheat filled gunny bags. PASSCD is trying to modify these structures for complete bulk storage of wheat for efficient handling (Acasio and Javed, 1992). The present total capacity of bag cum bulk wheat storage by PASSCD is about 450,000 mt.

Many of the PASSCD's house type godowns are in good shape and are fumigable for the whole godown fumigation (Halliday et al. 1990) The present practice for insect pest management in these godowns include (a) surface spraying of empty godown's interior with primiphos methyl (actellic) (b) Whole-godown phosphine fumigation by using aluminium phosphide tablets at the rate of one tablet per cubic meter of the space.

The studies carried out by Alam and Ahmad (1989) and Alam et al. (1991) indicated disparate levels of resistance in stored grain insect pests in Pakistan against the toxic action of phosphine gas. Under-dosing, particularly due to inadequate exposure periods over the years is the main reason for the development of high resistance to major stored grain insect pests in Pakistan.
For the control of phosphine resistant insects Winks (1986) and Mahmood et al. (1991) have proposed an increase in the exposure period of phosphine gas in a well sealed enclosure rather than increase of AlP tablets to be a preferred strategy. The method of application of AlP tablets also plays a significant role in this context. Besides, uniform distribution of phosphine gas in all parts of the enclosure, it is also highly desirable for complete control of insect pests.

The present study was an effort to improve the AlP tablets application techniques for the control of stored grain insect pests in bag cum bulk storage. The present fumigation procedure being practiced by PAsseo was compared for its effectiveness with different methods tested here in order to maintain lethal concentration of phosphine gas in all parts of the grain bulk for sufficient long period of time.

MATERIALS AND METHODS

The experiments were conducted in house type godowns located at PASseO complex at Manga Mandi near Lahore. Each godown was 30.58 m long, 18.93 m wide and 5.5 m high. Bulk wheat was loaded manually in each godown in the form of a single stack in the center. Wheat was supported by two bags wide pad wall on the four sides. Thus, the actual size of the bulk cum bag stack was 28.78 m in length, 17.10 m wide and 3.4 m high. A gangway of about 0.75 m was left all around the stack for inspection and fumigation purposes. The top of the wheat bulk was levelled manually. Before loading, the floor, walls and roof of each godown were sprayed with 1% Acteclic 50 E.e by using a power sprayer.

Three different methods of AlP tablet application were tested and compared for phosphine fumigation. Retention of phosphine gas in free space and different representative zones of the grain mass was monitored for comparison. These methods were:

1. Single application Method. This is a routine fumigation method being used by PAsseo in bag cum bulk storage and was used to serve as a reference for comparison. In this method, AlP tablets were applied in a scaled godown at the rate of one tablet per cubic meter of spate and all the 3184 tablets were applied in single application. The 60% of the total tablets (1910) were spread around the stack in the gangways while the rest (1247) were placed on the top surface of the grain bulk.

2. Multiple Application Method. In this method, all AlP tablets were used but applied in two parts. Of the total number of 7160 tablets used (at the rate of 2.5 tablets per cubic meter), the first application of 4776 tablets (at the rate of 1.5 tablets per cubic metre) was followed by a second application of 3184 tablets (at the rate of 1.0 tablet per cubic metre) after an interval of 48 hours. The first application was done as described in single application method. In the second application, the AlP tablets were thrown inside the sealed godown through an opening made by removing a glass from one of the ventilators. This glass was fixed again as quick as possible to keep the conditions sealed.

3. Dosing Pipe Method. In this method four PVC pipes were fixed with each of the central pillars of the godown before loading of wheat. The bottom end of each pipe was about half meter above floor level. Each pipe was 13 cm in diameter and 4 m in length, having rings of
perforations. Each ring was separated by a 50 cm blank portion (Figure). Three fourth portion of each pipe was immersed in the wheat bulk. The total number of AIP tablets used in this method was same as used in the single application method i.e. 3184 (at the rate of one tablet per cubic metre of space). Thirty percent of the total number of tablets (956) were mixed with grain and poured into the four pipes (each pipe containing 239 tablets) in such a way that two bands of such mixture separated by normal grains were formed (Figure). The remaining 2228 tablets were scattered around the grain stack and on the surface of wheat bulk.

RESULTS AND DISCUSSION

Results on the average values of phosphine gas concentration monitored in various zones of wheat bulk and the free space in godown are presented in Table 1, which indicated that:

a) When AIP tablets were applied according to the currently used method i.e. single application at the rate of one tablet per cubic metre of space, peak concentrations of 620 and 515 ppm of phosphine gas were reached after one day in the free godown space and the top peripheral zone of wheat bulk respectively. During this time however, very little gas had reached the bottom central parts of wheat bulk (only 40 ppm). Peak concentrations of 440 and 245 ppm of phosphine were reached respectively in the middle semi-peripheral and bottom central parts of wheat bulk on the second and fourth day respectively after AIP application. Phosphine gas concentration above 200 ppm could be maintained only for three to four days in the different parts of wheat bulk (Table) at different times.

b) In the case of multiple application method involving a 2.5 times increase in the quantity of AIP, peak concentration of 890 and 730 ppm phosphine gas were reached in the free godown space and top peripheral zone of wheat bulk respectively on the fourth day. Peak concentrations of 400 and 250 ppm phosphine were however, reached in the middle semi-peripheral and bottom central zones of wheat bulk on sixth and eighth day respectively after AIP application. Phosphine concentrations of 200 ppm
much higher than 200 ppm were recorded throughout the period of observation i.e. up to nine days after the application of AlP tablets (Table).

Ahmad et al., (1987) had recommended that in view of the development of resistance in storage pests, a minimum concentration of 200 ppm of phosphine gas may be maintained in all parts of the space for a minimum period of seven days for effective fumigation. Through their simulated laboratory studies, Mahmood et al., (1991) have shown that, for complete mortality of mixed pest populations (resistant and susceptible strains), a phosphine concentration of above 240 ppm was required with an exposure time of at least 14 days although above 90% mortality was achieved in an exposure time of seven to eight days. In the view of these observations and studies, the dosing pipe method tested here would seem to be the most appropriate method which will control insect pests in bag cum bulk wheat stored in house type godowns by PASSCD.

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REFERENCES


