

## Phosphine Fumigation for Post-Harvest Pest Control

Sankarganesh E\* and Lavanya Sravani B

Research Scholar, Department of Agricultural Entomology, BCKV, Mohanpur- 741252,  
West Bengal, India

Corresponding Author\*: [e.sankar333@gmail.com](mailto:e.sankar333@gmail.com)

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### SUMMARY

With the increased pressure on global population and changing climatic scenario, there is need to safeguard and store country's food grains, which are an important part of our food security. Among the various biotic and abiotic factors, insect pest incidence is being considered as paramount importance. The loss caused by the insects during the crop growth stage and extent of qualitative and quantitative damage due to stored grain pests in stored commodities is enormous. Apart from losses, it also adversely affects the import and export trade. Mostly, post-harvest pests are inter-related and associated with food commodities in storage, particularly in the developing countries where poor sanitation practices are followed. Fumigation is the process of releasing the toxic chemical in gaseous state in gas tight enclosure for sufficient period in sufficient concentration which is considered to be lethal to target pest.

### INTRODUCTION

About 40 million tonnes of food grains are stored as a buffer stock in several warehouses and godowns to manage any unforeseen eventuality in our country. Stored grain pests like rice weevil and pulse beetle are widespread and destructive internal feeders of cereals and pulses with the estimated post-harvest loss ranged from 50% and 30-40% respectively. In general, the dry matter loss of food grains was reported to be 17% in cereals and up to 50% in pulses. In order to maintain the quality and long term storage of the produce, control of stored product pest is of foremost concern. Control is prerequisite to prevent contamination/adulteration of human foods. Several measures like monitoring, sanitation, controlled temperature, irradiation, diatomaceous earth and biological control strategies are being followed. In addition, use of broad-spectrum pesticides is also increased to control the stored pests. However, fumigation is the age old practice which is effective, economical and most promising technique has been continued to the present date. It is followed around the world to reduce the pest incidence during the storage of commodity, irrespective to the stage and pest category.

### Significance of phosphine fumigation:

In India, the grains which are meant for consumption are stored in various godowns and warehouses where fumigation is done on regular intervals to protect from pest infestation and supply of insect free products to the consumers. Methyl bromide (Mbr) and Phosphine (PH<sub>3</sub>) are the two fumigants widely used for the pest control throughout the country. These phytosanitary measures are of extreme importance to facilitate the safe import and export of commodities between the nations. At present for the import of commodities, methyl bromide fumigation is being undertaken all over the country which is banned or restricted in developed countries because of ozone depletion potential and high toxicity toward the environment. Due to lack of other alternative fumigant, Mbr is still continued in India which may be banned soon across the country. In search of other alternative, Phosphine (Aluminium phosphide) emerged as one of the significant fumigant used worldwide and registered in India for disinfestations of

durable commodities and is in use mainly for cereals, pulses, spices and other agricultural commodities with many desirable characteristics like less residual effects, ease in handling and low cost. Phosphine gas evolved from the tablets or granules effectively controls the various stored product pests in storage. Its action against pests is generally slower than Mbr, but works effectively with longer exposure period. Phosphine penetrates well into commodities and can be rapidly removed by aeration after treatment. However, the phosphine fumigation needs certain favorable conditions to fumigate the commodities which are generally ineffective below 15°C and below 50% relative humidity.

**Table 1. General properties of phosphine**

Odour	Carbide or garlic-like odour may be due to impurities
Chemical formula	PH <sub>3</sub>
Boiling point	-87.4°C
Freezing point	-133.5°C
Molecular weight	34.04
Specific gravity gas (air = 1)	1.214°
Liquid (water at 4°C = 1)	0.746(-90)
Latent heat of vaporization	102.6 cal/g
Lowest explosion point	1.79% by volume in air
Solubility in water	26 cc/100 ml at 17°C (very slightly soluble)
Method of evolution as fumigant	From preparations of aluminium and magnesium phosphide
Pertinent chemical properties	Reacts with copper and precious metals

Source: FAO, 1984

### Formulation and dosage:

Commercial formulations are commonly available in the form of aluminium phosphide or less commonly, magnesium phosphide formulated with ammonium carbamate or urea to lessen the risk of flammability. Generally, ALP tablets (56% formulation) used for the fumigation whereas magnesium formulation were used for the tobacco fumigation. General dose rate of 3 tablets/MT on weight basis or 2.25g/m<sup>3</sup> on volume basis is recommended. Phosphine has been found promising for effective control of many stored grain insect pests. In commercial facilities infestations must be fumigated to gain control over the pests (Table 2). Heavy infestations and characteristic odor which usually necessitates the food should be destroyed.

**Table 2. List of few stored grain insects and some biological aspects**

Grain pests	Time required for complete life cycle	Remarks
Rice weevil	4 weeks	Universal feeder in whole grains
Granary weevil	26 days	Universal feeder in whole grains
Coffee bean weevil	4 weeks	Lays eggs in corn in field infestations, may continue for 3 months after storage
Lesser grain moth	4 weeks	Universal feeder in whole grains
Angoumois grain moth	5 weeks	Mostly infest stored corn
Rice moth	6 weeks	General feeder
Indian meal moth	6-8 weeks	Prefers coarse grade of processed grain
Mediterranean flour moth	6-9 weeks	Prefers grain
Saw toothed grain beetle	4 weeks	Prefers grain products
Confused flour beetle	6 weeks	Attacks grains and grain products
Red flour beetle	5 weeks	Attacks grains and grain products

Source: Mason, 2004

## CONCLUSION

Recently generators and cylindered phosphine and sachets have also become available, allowing controlled release of the phosphine gas and avoiding some problems such as residue disposal associated with tablet formulations. Phosphine fumigation in formulation with aluminium phosphide (ALP) is widely used for the grain consumption and distribution in India. It is also being used during the trade as a phytosanitary treatment against several insect pests generally in grains trade.

## REFERENCES

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