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Alternatives to Methyl Bromide in Grain Management in Kenya

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Abstract: Methyl bromide is one of the most commonly used fumigants in the Kenya for disinfesting commodities in grain silos and warehouses. The grain industry needs to act quickly to find alternatives to methyl bromide for use on grain because it will soon be banned in all developing countries due to its ozone-depleting properties. Kenya has identified carbon dioxide as an effective substitute for methyl bromide. Fumigation with carbon dioxide in well-sealed grain silos has been found to be technically feasible. A minimum carbon dioxide concentration of 35% to 40% in air for 10 days is required for complete insect mortality. Phosphine is also used as a fumigant but its use requires careful practice to avoid pest resistance. Three insecticidal sprays consisting of organophosphates and pyrethroids also proved effective for short term grain protection against stored product pests. A recent workshop in different parts of Kenya discussed the options for storage of grain. In the future, farmers may receive a premium price for grain supplied from protected, farm-based storage facilities as this action will reduce the need for methyl bromide fumigation in centralised facilities.

Introduction

Losses in storage as a result of infestation by insects can be significant. For example, maize is one of the most important food crops for the majority of Kenyans. Losses in storage on the farms have been estimated to range from 6% to 30% (De Lima 1979; Anon 1980; Mutambuki and Ngatia 2003).

To prevent such losses and to maximise the harvest, Kenya has begun to implement an integrated pest control programme for grain handling and storage. There are a range of pest control methods available including traditional, chemical and fumigation methods.

Adequate storage facilities and regular inspection of stores help to reduce the need for frequent use of chemicals, which also reduces cost and chemical residues. However, when chemical intervention becomes necessary, it must be used effectively to maximise the prospects for pest control, as well as safely and responsibly to avoid hazards to humans. Pest control must also be economic which can be achieved through proper training and the implementation of efficient management procedures.

In this paper, we report on a range of options for grain storage in Kenya that can be replacements for methyl bromide, and the actions that are underway to implement them.

Grain Protection in Kenya

Methyl Bromide

Methyl bromide is a major fumigant used to control pests in agricultural commodities. It is both effective and efficient in the control of all known storage insect pests in Kenya. It is used to disinfest commodities in stacks under sheet and in sealed silos, warehouses, rail wagons, metal containers and ships.

However, in the early 1990's, methyl bromide was identified as an ozone-depleting gas by the Parties to the Montreal Protocol. As a result, it will be removed from the list of the few remaining products capable of preventing pest damage to food and other valuable commodities. With global pressure to reduce usage of methyl bromide, the major strategies were employed by NCPB.

When methyl bromide is used, adequate distribution of methyl bromide within large silos is only possible where a forced circulatory system is incorporated in the facility. The National Cereal and Produce Board (NCPB) is responsible for storage of maize and has used methyl bromide for many years with such a system. However, methyl bromide can leak through the concrete walls, piping and manholes as sealing the storage facility is difficult.

Our initial work has been to reduce any imports of methyl bromide for grain protection by reducing the dose required for disinfestation. For example, we showed that we could re-

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duce the dose by 38% from the current recommended application rate of 16.1 g/m^3 if the treatment was carried out at 30℃, rather than a lower temperature which was the practice.

The amount of grain imported as also been significantly reduced, which has reduced the quantity of methyl bromide needed for fumigation. Before grain liberalization in 1993, NCPB was a monopoly handling all cereals and scheduled agricultural produce throughout Kenya. This led to the importation of large quantities of methyl bromide to fumigate 12 million 90kg bags of commodities annually. The quantities of commodities handled by NCPB have gradually declined to about 4 million bags annually. The reduction in imports by almost 70% has reduced the need for methyl bromide correspondingly.

Phosphine

Phosphine is also used in Kenya for the disinfestation of commodities. Application techniques for phosphine are relatively easy and this makes it a popular product.

However, unlike methyl bromide, phosphine requires not less than 5 days to be effective in our climate. The need for long exposure period to lethal concentrations means gas tightness is essential. Failure to create gas tight facilities can eventually lead to persistent survival of insects during fumigation and hence the development of resistance in certain species. This is the biggest challenge that fumigant operators are facing as effective phosphine fumigation practices have not been implemented consistently.

Phosphine is also being used to fumigate small quantities in drums which are gas tight. While fumigating bag stacks under gas proof sheets, care must be taken to avoid gas leaks. Fumigation must thus be carried out properly in terms of correct dosage to preserve this single fumigant available through reduction of insect resistance.

Carbon Dioxide

Kenya has its own natural supply of carbon dioxide which is tapped from the ground by a Kenyan company known as Carbacid Ltd. The trials carried out in concrete silos in Kenya showed that fumigation with CO_2 is technically feasible and more cost-effective than phosphine. However, the silos must be well-sealed and the study also recommended pressure testing be part of silo maintenance.

The disadvantages in CO_2 fumigation is the large quantities required and high dosages during initial fumigation since gas must be absorbed by the concrete by a process termed carbonation. For successful fumigation, gas concentrations must be maintained at a minimum of 35% for at least 10 days.

Insecticidal Sprays

We also tested the ability of insecticidal sprays such as pirimiphos methyl, fenitrothion and permethrin to control insects in silo – stored grain. These treatments proved effective for short term protection.

Training on Alternatives to Methyl Bromide

The impending ban on the use of methyl bromide in the grain sector was the subject of discussion during a two day workshop entitled "*Alternative to methyl bromide in post harvest grain management at farm level in Kenya*".

The workshops were held in Western and Eastern parts of Kenya covering most of the adjoining districts. The aim of the workshop was to raise awareness of the impending ban of methyl bromide and to explore options to replace it.

The workshop focused on the available alternatives such as phosphine and CO_2. It was emphasized that fumigation with CO_2 is technically feasible but required high doses and extended exposure period. For silo fumigation, pressure testing is a prerequisite to the use of CO_2.

The workshop further focused on appropriate treatment at farm level. If all the grain is protected, the need for immediate fumigation after reaching the central storage system would not be warranted. The result would be a reduction in the number of fumigations carried out in Kenya thereby reducing methyl bromide use in Kenya. The treated grain could attract a price premium which would be an incentive to farmers to protect stored grain.

Conclusions

The implementation of alternatives to methyl bromide such as CO_2, with procedural modifications where required and increased training of stakeholders, will reduce methyl bromide use.

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