Available online at www.sciencedirect.com
ScienceDirect
Journal of Stored Products Research 44 (2008) 173–178
Journal of STORED PRODUCTS RESEARCH
www.elsevier.com/locate/jspr

Cooking oils and "Triplex" in the control of *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae) in farm-stored maize

Girma Demissie[a,*], Addis Teshome[a], Demissew Abakemal[a], Abraham Tadesse[b]

[a]*Bako National Maize Research Project, P.O. Box 3, Bako, Ethiopia*
[b]*Ethiopian Institute of Agricultural Research, P.O. Box 2003, Addis Ababa, Ethiopia*

Accepted 24 October 2007

Abstract

The uses of some cooking oils viz., noug oil, soybean oil, sunflower oil, corn oil and olive oil, and the reputedly non-toxic botanical "Triplex", were evaluated against maize weevil, *Sitophilus zeamais*, in stored maize grain under local Ethiopian storage conditions in 2003. For comparison, an untreated sample and the synthetic insecticides, malathion 5% dust and Actellic 2% dust, at the recommended rates of 0.05% (w/w) were included. All the cooking oils tested had a significant toxic effect on the weevils in stored grains. The oil treatments showed significantly higher mortality of adult weevils at each sampling period compared with the untreated grains. The cooking oil treatments also significantly reduced weight loss and grain damage as compared with the untreated control. The Triplex treatment was of comparable effectiveness to the synthetic insecticides, causing high mortality of adult weevils, low-percentage grain damage and low-percentage weight losses. These promising oils and Triplex could be recommended for use as part of an integrated pest management program in stored maize, particularly at low levels of pest infestation and, in the case of cooking oils, for grain intended for home consumption.

Keywords: Cooking oils; Botanicals; Triplex; Maize weevil; Stored maize

1. Introduction

Insect damage to stored grains and cereal products has been of great concern to man throughout the ages. The losses from crops in storage have resulted in waste of labor and shortages in food supply. The primary aims of storing food commodities are to effect a uniform supply of food throughout the year, to make available reserves for contingencies and to speculate on higher prices whether it is for local or export markets. For one or more of the above reasons, maize grain is often stored in Ethiopia for more than 6 months (Emana, 1999), but the lack of quality storage structures for grain storage and the absence of storage management technologies force many maize growers to sell their produce immediately after harvest. Consequently, farmers receive low market prices for the surplus grain they produce (Beyene et al., 1996).

On a worldwide basis, as much as 10% of the stored cereal grain is estimated to be lost through insect infestation (Larry, 2000). In Ethiopia, losses ranging from 20% to 30% are common in stores due to insect pests (Abraham, 1991; Emana, 1999). These losses impact both the market value and intrinsic value of the grain to end-users (Mvumi, 1995). Post-harvest losses by storage insect pests such as the maize weevil, *Sitophilus zeamais* Motschulsky continue to pose a major problem in Africa (Markham et al., 1994). Storage problems have increased as traditional varieties have been replaced by improved, high-yielding varieties which are generally more susceptible to insect damage than those of local origin, thus increasing the need for insecticides (Dobie, 1974). In Ethiopia in general and around the Bako region in particular, *S. zeamais* is the dominant storage pest of maize. Studies in the Bako areas of Ethiopia have shown that grain damage levels up to 100% have been found in some grain samples

*Corresponding author. Tel.: +251 911 679700/+251 576 650465; fax: +251 576 650267.
E-mail address: gdemissie2002@yahoo.com (G. Demissie).

0022-474X/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.jspr.2007.10.002

from farm stores after 6–8 months of storage (Abraham, 1991). The high cost of pesticides, the danger of resistance building up, and the potential hazards of pesticides in the hands of farmers with little knowledge make alternative control measures highly important for stored-product insect pests (Giga et al., 1999).

In recent years, many workers have given greater attention to the control of stored grain pests using vegetable (cooking), essential and mineral oils. Edible/cooking oils can be more cost effective than synthetic insecticides and are environmental friendly. Maize grain admixed with groundnut, rapeseed and sunflower oils was demonstrated by Tembo and Murfitt (1995) to be effective in the control of maize weevil. In an experiment conducted to assess the toxic effects of indigenous plant oil extracts, applications of 1 ml oil/50 gm of maize from *Lippia adoensis* Hochst. and *Monodora tenuifolia* Benth. resulted in maximum weevil mortalities of 52% and 57% after 21 days and 2 months, respectively (Odeyemi, 1993). Pereira (1983) successfully evaluated six vegetable oils as protectants for cowpeas and bambara nuts. Reijntjes et al. (1992) studied the insecticidal activity of various botanical products including hot pepper chillies, castor oil and papaya leaves on *S. zeamais*. Eight vegetable oils—mustard, soybean, coconut, neem, groundnut, cotton, sesame and castor oil—were tested by Dey and Sarup (1993) against adults of *Sitophilus oryzae* (L.) on three varieties of stored maize. Shukla et al. (1992) treated wheat with various edible oils to note their effect on adults of *S. oryzae*. The order of toxicity of the oils for *S. oryzae* was in ascending order—dalda (20%), coconut (69%), palm, mustard, soybean, sesame, rape and groundnut which all produced 90% mortality. However, almost all the above-mentioned trials were laboratory-based and were of short duration, and therefore they did not take into account the responses which would have been observed under real farm conditions.

The present study was carried out to evaluate the insecticidal activity and efficacy of noug oil, soybean oil, sunflower oil, corn oil, olive oil and a botanical product called "Triplex" against weevils on stored maize under real farm conditions. Triplex is a by-product of the MIDROC soap factory in Ethiopia which produces liquid soap by utilizing the local plant known as "endod" (*Phytolacca dodecandra* L.). This plant has been shown to have insecticidal properties (Adane and Abraham, 1995). Triplex is produced in different formulations but the one used in this study is a powder although the commercially available product is a liquid used for the control of ticks. However, Triplex has not been experimentally evaluated on maize and this study was undertaken to evaluate and report on its effect as a control agent for maize weevil.

2. Materials and methods

2.1. Description of the study site

The experiment was conducted in Ethiopia at Bako, West Shoa Zone of the Oromiya National Regional State in Ethiopia. At 9°N latitude and 37°E longitude, 260 km west of Addis Ababa on the road to Nekemt, Bako represents a mid-altitude sub-humid zone with high potential for maize production. The National Maize Research Coordination Center is located here. The altitude of the area is about 1650 m above sea level and the average annual rainfall is 1237 mm. The warm humid climate is ideal for storage insect pests like the maize weevil. Meteorological data during the experimental season indicated that the mean daily minimum, maximum and average air temperatures of the site were 13.5, 29.7 and 21.4 °C, respectively.

2.2. Experimental materials

The experiment was started in 2003 during the dry season and was run for 1 year. Five different types of cooking oils (noug oil, soybean oil, sunflower oil, corn oil and olive oil) and the botanical Triplex were used for the experiment. To assess their cost-effectiveness, the prices of these cooking oils in the local market at the onset of this experiment are indicated in Table 1. With the possible exception of olive oil, all are a far-cheaper option than purchasing insecticides. Triplex powder was obtained from the MIDROC soap factory in Ethiopia which has stated its intention of distributing this by-product free of any cost to resource-poor farmers if it is effective. The product is reported by the producers to be non-toxic to humans (MIDROC Soap Factory, personal communication).

The maize grain used in the experiment was obtained from local farmers in the Bako region of Ethiopia. Farmers buy F_1 maize seed from seed suppliers for sowing and the F_2 grain is harvested and stored for food and not for seed. Since F_1 seed of any hybrid maize cannot be produced and stored by farmers, it was this F_2 maize grain that was used for the experiment. The maize grains were bulks of hybrid varieties BH-660 and BH-540. The different cooking oils at the rate of 5 ml/kg and Triplex powder at 0.25% (w/w) were admixed with 50 kg of maize grains separately. An untreated sample and synthetic insecticide treatments, malathion 5% dust and Actellic 2% dust at the recommended rates of 0.05% (w/w), were used as comparative controls for the oils and Triplex treatments. Nine hessian sacks each containing 50 kg of grain treated with one of the

Table 1
The prices of cooking oils in the local market at the beginning of the experiment

Oils	Price/liter (Ethiopian Birr)[a]
Noug oil	11.00
Soybean oil	12.75
Sunflower oil	14.85
Corn oil	16.80
Olive oil	25.00

[a]One Ethiopian Birr ≈ US$0.112 ≈ £0.056 ≈ €0.082.