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Review Article

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# Review on Post-Harvest Grain Treatments (Filter Cake, Triplex Powders and Eucalyptus Tree Powder)

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## Abstract
*Grains are harvested seed and edible dry seeds from plants cereals. They are the basis of daily diets for many populations worldwide. In addition, they are fundamental in the regular foods of many people and used for the production of different popular food. Grain losses due to insect pests in sub-Saharan Africa especially in Ethiopia are very high. Therefore, to get those daily diets and reduce loss occurred by insects, treatment of grain is very important. The objective of this review is to review studies made by various researchers and reviewers on grain treatments (filter cakes, triplex and powder eucalyptus tree leaves). Application of chemical pesticides is important to protect stored grain from insect pests. However, most of smallholder farmers challenged with many problems related to unsafe handling and use of pesticides due to improper training in safe use of pesticides, and inadequate infrastructure to regulate safe use of pesticides. Filter cake and Triplex powders applied to different grains to determine effectiveness against the grains. Filter cake is products of aluminum sulfate and Triplex is products of soap factories. Defense of stored grain from insect pests using Filter cake, Triplex powders and eucalyptus leaves tree has been practiced in Ethiopia. Filter cake and Triplex have a higher atomic percentage of silicon and oxygen in the form of silicon dioxide. Generally, grain treatment is very important through filter cake and triplex as well as by using eucalyptus tree powder, due to they have properties of toxic against insects and no health problems on humans. Therefore, Filter cake Triplex and eucalyptus leave recommended for protecting and managing grain stored by smallholder farmers in Ethiopia to discourage farmers from using dangerous chemical insecticides.*

**Keywords:** Eucalyptus Leaves, Filter Cake, Triplex, Grains

## 1. Introduction
Most of the sub-Saharan African countries store their grains in traditional structures way, which are not insect proof [1]. Post-harvest losses of grain commodities in sub- Saharan Africa are estimated to range from 20% - 40% [2]. Grain is usually stored for several months after harvest, which is much longer than other grain post-harvest steps. Grain storage losses in Ethiopia due to insect pests were estimated to be in the range of 10%-21% [3]. Grain protectants help in preserving the quality of the grain from insect damage.

Application of chemical pesticides commended to protect stored grain from insect pests. However, farmers in Ethiopia reported keeping their grains in stores infestation free was difficult because of the ineffectiveness of pesticides approved for grain treatment [4]. Despite the use of pesticides, Ethiopian smallholder farmers reported that their storages infested with weevils. In addition, Ethiopian smallholder farmers confronted with many problems related to unsafe handling and use of pesticides due to improper training in safe use of pesticides, and inadequate infrastructure to regulate safe use of pesticides [5]. Therefore, smallholder farmers to reduce hazards related to pesticides should explore safe and non-chemical alternatives for use.

Protection of stored grain from insect pests using Filter cake, Triplex powders and others practiced in Ethiopia. There is a need to explore products that are safe and effective in controlling insects in smallholder farmers' storages in Ethiopia. Two such potential products are filter cake and Triplex. Filter cake and Triplex powders applied to grains like maize and wheat to determine efficacy against to grains. Limited studies investigated different alternatives to chemical pesticides in Ethiopia [3]. Filter cake and Triplex available in Ethiopia identified as two such alternatives to chemical pesticides. Filter cake is products of aluminum sulfate and Triplex is products of soap factories. Filter cake and Triplex have a higher atomic percentage of silicon and oxygen in the form of silicon dioxide and it is possible that the mode of action will be similar to other silica-based inert dusts [6]. Powders of botanical plants (eucalyptus tree leaves powders) tested in the current study demonstrated great potential used as protectants against maize weevils in storage. Among the botanical plants powders, *A Indica* and *E Trucalli* are the highest potent botanicals and *C Aurea* revealed to be moderately toxic to the weevils. Considering the criticality of PHL reduction in enhancing the food security, it becomes very important to know the pattern and scale of these losses, especially in developing countries like Ethiopia, and identify its causes and possible solutions. Although losses occur at each stage of the supply chain from production to consumer level, storage losses considered most critical in developing countries. So far, no more work has been conducted or done on grain treatment (filter cake, triplex and powder of botanical plants) of level of eucalypts leave powder management of grain insects. This paper provides a comprehensive review and discussion on the status of storage losses of major grains, major factors that lead to these losses and possible solutions. Therefore, there is a need to acquire of information on grains treatments influences of filter cake, triplex, eucalypts leave powder in control of grains loss.

Therefore, the aim of this review paper is to review studies made by various researchers on grain treatments (filter cakes, triplex and powder botanical plants).

## 2. Literature Review

### 2.1. Grain Production

Saving the grains crop lost during postharvest operations can help in meeting the food demand and reduce the load on the economy. Ethiopia's agriculture is still dominated by the nation's many small farms, which mostly grow grains for both domestic use and export. Over three quarters of the entire land under cultivation used to grow five key cereals tiff, maize, sorghum, and barley [7]. Increases in cultivated land have been largely responsible for the growth in agriculture production over the previous ten years. The problems facing Ethiopia's agriculture sector í attaining better production rates because it UN clear how far expansion can ago. The promotion of agriculture as a source of pro-poor economic growth and the improvement of rural livelihood all depend heavily on agriculture extension,

Ethiopia's crop agriculture is complex, involving substantial variation in crops grown across the country's different regions and ecologies. Ethiopia's crop agriculture in general, and the cereals sub-sector in particular, face serious challenges. There has been substantial growth in cereals, in terms of area cultivated, yields and production since 2000, but yields are low by international standards and overall production is highly susceptible to weather shocks, particularly droughts. Thus, both raising production levels and reducing its variability are essential aspects of improving food security in Ethiopia, both to help ensure adequate food availability, as well as to increase household incomes [8,9].

### 2.2. Post-Harvest Losses of Grain

While fulfilling the food demand of an increasing population remains a major global concern, more than one-third of food is lost in postharvest operations. Reducing the postharvest losses, especially in developing countries, could be a sustainable solution to increase food availability, reduce pressure on natural resources, eliminate hunger and improve farmers' livelihoods. Most of grains are the basis of staple food in most of the developing nations, and account for the maximum postharvest losses on a calorific basis among all agricultural commodities. As much as 50% - 60% grains can be lost during, the storage stage due only to the lack of technical inefficiency and use of scientific storage methods can reduce these losses to 1% - 2% [10]. Approximately one-third of the food produced (about 1.3 billion ton), worth about US $1 trillion, is lost globally during postharvest operations every year [11]. In African countries, these losses estimated to range between 20% and 40%, which is highly significant considering the low agricultural productivity in several regions of Africa [12].

#### 2.2.1. Storage and Post-Harvest Loss of Grain during Storage

A report from the World Bank, estimated 7% - 10% of grain loss in postharvest operations at field level, and 4%–5% loss at the market and distribution stage [13]. Storage plays a vital role in the food supply chain, and several studies reported that maximum losses happen during this operation [14]. The indigenous storage structures are made of locally available materials and without any scientific design, and cannot guarantee to protect crops against pests for a long time estimated losses as high as 59.48% in maize grains after storing them for 90 days in the traditional storage structures [15].

It is important to consider both damage and losses by the insects during storage instead of just weight loss. The storage losses affected by several factors, biotic factors (insect, pest, rodents, and fungi) and abiotic factors (temperature, humidity, rain) [16]. Moisture content and temperature are the most crucial factors affecting the storage life. Most of the storage molds grow rapidly at temperatures of 20–40° C and relative humidity of more than 70% [16]. Low moisture keeps the relative humidity levels below 70% and limits the mold growth. In the traditional storage structure, temperature fluctuations due to weather changes cause moisture accumulation either at the top or bottom of the grains' bulk depending on the direction of air convection. This can be avoided by minimizing the temperature difference of inside and outside the storage structure. Grains should be dried to about 13% of the moisture content before storage to minimize the losses. Quality of grains before storage is another critical factor affecting the storage losses.

#### 2.2.2. Insect Infestation

Insect pests and toxigenic molds cause quantitative and qualitative losses to grain in storage at the farmer level. Grain losses due to insect pests in sub-Saharan Africa are very high, and the magnitude of losses varies from country to country and from region to region [17]. Among all the biotic factors, insect pests considered most important and cause huge losses in the grains (30%–40%) from field studies in Togo, Pantenius observed that insects and pests were responsible for 80%-90% of storage losses in grains [12,18]. Callosobruchus Maculatus (F.) alone, a common pulse weevil found responsible for up to 24% losses in stored pulses in Nigeria [19]. Losses due to insects in stored maize reported from 12% to 44% in the western highlands of Cameroon [19]. About 23% losses observed in maize grains stored for six months, mainly due to infestation of maize weevil and larger grain borer (LGB) in Benin [20]. The sporadic nature of LGB makes even its control difficult: it does not infest all stores of the same area, and its reoccurrence in each year is not guaranteed.

At farm, level storage, more than 30% of weight loss observed in maize due to these pests [21]. Some studies on maize losses in Ghana estimated about 5% to 10% loss in market value due to infestation by only *Sitophuilus* spp., and 15% to 45% market value loss due to damage by LGB. Overall, these losses were equivalent to about 5% of the average household income in that area [22]. Abass et al, reported that after six months of maize storage, LGB was responsible for more than half (56.7%) of the storage losses, followed by losses due to grain weevil and lesser grain borer [12]. Patel et al, observed about 25% losses by R. Dominica in wheat stored for 3 months under laboratory conditions [23].

## 2.3. Grain Treatment Methods

Food security is a major challenge for low-income sub-Saharan Africa farmers and Grain losses due to insect pests in sub-Saharan Africa are very high; and the magnitude of losses varies from country to country and from region to region [17]. Food security can be achieved by increasing food production and most importantly by reducing postharvest losses [2,24]. One of the major Factors contributing to food insecurity is low productivity due to lack of grain treatment. Grains are the basis of daily diets for many populations worldwide. They are fundamental in the regular foods of many people and used for the production of popular foods and botanically, they are the seeds of plants. They contribute macronutrients to the human diet, mainly carbohydrates, but also proteins and lipids, and micronutrients, such as vitamins and minerals. They are also an important source of dietary fiber and bioactive, particularly wholegrains, which are of interest for the production of high value food products with enhanced health benefits [25,26].

Therefore, to get those things grain treatment and management of factors are very important. Chemical pesticides, regardless of their inherent hazards, used extensively in the fast changing agricultural sector of Ethiopia [27]. Ethiopia is confronted with a number of problems related to unsafe handling of pesticide distribution and use, improper training in safe use of pesticides, and inadequate infrastructure to regulate safe use of pesticides [5]. Untrained people in the village markets sell pesticides illegally. Additionally, in Ethiopia, farmers prefer to buy small amounts of pesticides rather than the original container/package, and therefore there is no information regarding the type of pesticide and how should be diluted and applied. In countries like Ethiopia, unsafe handling of pesticides has resulted in ill health episodes, hospitalizations, and fatalities soon after a pesticide application [4].

### 2.3.1. Filter Cake and Triplex

Powdered insecticides extensively used to protect stored grain from insect pests for a long period. One group of these insecticides is silica-based powders, which have toxic effect on insects due to their ability to adsorb lipids from the insect cuticle leading to death by desiccation [28]. Filter cake and Triplex have similar properties of insecticides because of their higher atomic percentage of silicon and oxygen content [6]. The proportion of silicon and oxygen as silicon dioxide in both filter cake and Triplex was less than that found in diatomaceous earth powders, and results can't compared directly with the work done on diatomaceous earth powders by numerous researchers [29,30]. There is a need to explore products that are safe and effective in controlling insects in smallholder farmer's traditional storages in Ethiopia. Two such products are filter cake and Triplex [3,6].

A study on elemental composition of both powders using energy-dispersive X-ray spectroscopy indicated that silicon and oxygen were dominant elements. The same study showed 100% mortality when adults of the maize weevil, Sitophilus zeamais Motschulsky, were exposed to 7.5 g/m2 of filter cake and 10 g/m2 of both powders for 24 h on treated concrete arenas. According to the report of Girma et al, reported 92% mortality 3d after S [3]. Zeamais adults exposed to three genotypes of maize treated with 1, 2.5, and 5% (w/w) of filter cake. Similarly, no significant mean percentage mortality of S. zeamais (93%) was observed when adults were exposed to maize treated with 0.25% (w/w) of Triplex compared to that of a synthetic pesticide, pirimiphos-methyl (100% mortality), and 7 months after treatment [3]. These studies by Girma et al, and Tadesse and Subramanyam suggested that filter cake and Triplex could be potential alternatives to synthetic pesticides for controlling stored-product insects [3,6].

According to work of Tesfaye et al, Mortality of S. zeamais reached 100% when adults were exposed to 1000 mg/kg of filter cake for 7 or 14 days [6]. Nevertheless, 100% mortality of S. zeamais was not achieved at any Triplex concentrations and exposure times.

| Powder | $N^a$ | Mean ± SE | | $LT_{99}$ (95% CI) (h) | $\chi^2$ (df) | P-value |
|---|---|---|---|---|---|---|
| | | Intercept | Slope | | | |
| Filter cake | 240 | -2.12 ± 0.32 | 2.72 ± 0.35 | 21.92 (16.75—33.56) | 23.49 $(22)^b$ | 0.3748 |
| Triplex | 390 | -1.61 ± 0.24 | 2.00 ± 0.22 | 39.62 (29.87–60.30) | 23.28 $(37)^b$ | 0.9616 |

A N = total number of adults used to generate the probit regression estimates.
B $\chi^2$ values for goodness-of-fit were not significant (P > 0.05), indicating good fit of probit model to data.

**Table 1: Probit Regression Estimates and Times required for 99% Mortality for Sitophilus Zeamais Adults based on Mortality Assessment made 14 d after Exposure to Concrete Arenas Treated with 3 g/m2 of Filter Cake and 9 g/m2 of Triplex for Various Time Periods**

| Powder | $N^a$ | Mean ± SE | | $EC_{99}$ (95% CI) ($g/m^2$) | $\chi^2$ (df) | P-value |
|---|---|---|---|---|---|---|
| | | Intercept | Slope | | | |
| Filter cake | 120 | 1.47 ± 0.06 | 2.18 ± 0.25 | 2.48 (1.96 – 3.54) | 10.30 (10)$^b$ | 0.4147 |
| Triplex | 270 | -1.17 ± 0.28 | 2.76 ± 0.45 | 18.59 (11.91– 43.60) | 470.42 (25)$^c$ | <0.0001 |

*Source*: [31]

*aN* = total number of adults used to generate the probit regression estimates.

*b*$\chi$2 value for goodness-of-fit was not significant ($P > 0.05$), indicating good fit of probit model to data.

*c*$\chi$2 value for goodness-of-fit was significant ($P < 0.05$), indicating poor fit of probit model to data.

**Table 2: Probit Regression Estimates and Concentrations required for 99% Reduction of Sitophilus Zeamais Adult Progeny Production at 42d after Exposure to Concrete Arenas Treated with Various Concentrations of Filter Cake and Triplex for 12h**

#### 2.3.2. Maize Weevils and Eucalyptus Tree Leaves

The maize weevil (Sitophilus zeamais) is the main insect responsible for the deterioration of stored maize, sorghum, and other grain in the tropics [32]. Current research focus in stored products protection is to minimize or eliminate the use of synthetic insecticides and have economic and health benefit to applicators, consumers and the environment [33,34]. The Eucalyptus leaf powder could be use control weevil in stored maize grain.In Sub- Saharan Africa, an estimated 25% - 40% of grain is lost in stores each year due to weevil menace [15]. Eucalyptus leaves have been used as grain protectants for quite some time [35].

Eucalyptus leaf powder has a repellent effect on the olfactory and gustatory system of weevils. The effectiveness of eucalyptus leaf powder could be because as weevils feed on the maize grain, they could pick lethal doses of the plant leaf powder thereby leading to stomach poisoning. The results of the current study also revealed that the relationship between leaf powder dose and its effect on insect pests is such that an increase in the dosage would lead to an increase in the mortality of the insect pests. This means higher mortality rates could be achieved through an increase in the dosage of the leaf powder. Thus, farmers could increase the doses of the leaf powder to enhance positive results. Tanka, asserts that 1.8-cineole completely inhibits the development of eggs, larvae and pupae of *Sitophilus zeamai*s [36]. Thus, ovipositional and subsequent progeny production are inhibited. Maize Weevils are generally given the most attention because they are among the most destructive pests of stored grain. The larvae of grain weevils develop within the kernels, and when infested grain is left undisturbed for long periods can cause nearly complete destruction. Adult weevils are easily distinguished from other beetles by their elongated snouts.

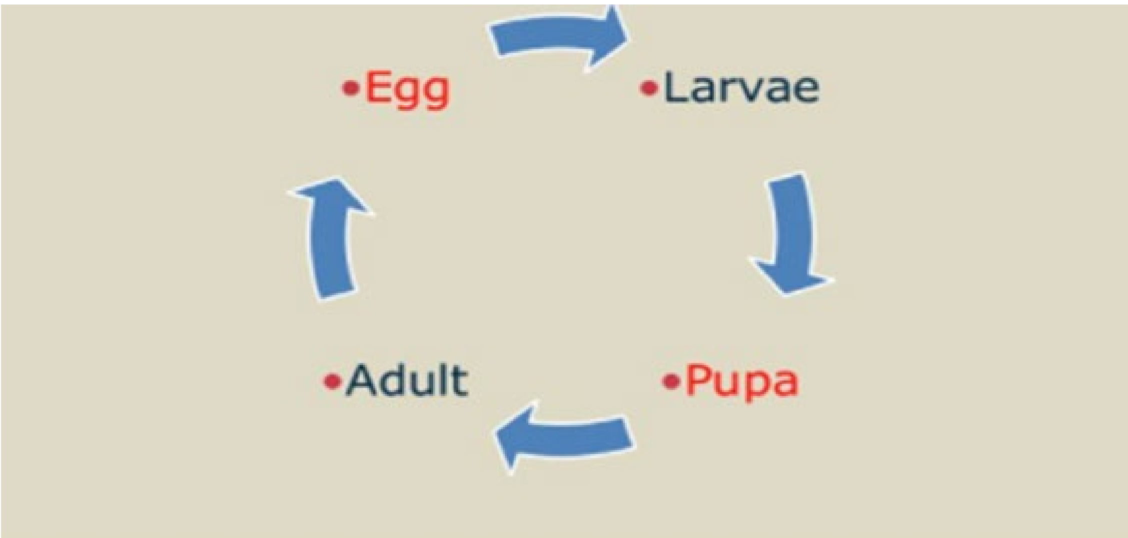


**Figure:** Life Cycles of Maize Weevils

## 3. Conclusion and Recommendation

### 3.1. Conclusion

Grains are seeds of plants and dominant in the daily diets of numerous people worldwide; for production of widespread foods. Storage losses of grains account for the maximum fraction of all postharvest losses in developing countries. According to most research show, about 23% losses were observed in maize grains stored for six months, mainly due to infestation of maize weevil and in most parts of Africa and is considered the most threatening pest, as it causes extensive damage in a very short time. Therefore, to obtain those welfares from grain treatments grains through filter cakes and triplex powder as well as by using eucalyptus tree leaves powder is very important. Therefore, including filter cake and Triplex in integrated pest management practices in farmer's traditional storage useful to protect grain from infestations. In addition, Filter cake and Triplex suggested for protecting grain stored by farmers to discourage farmers from using dangerous chemical insecticides. Generally, filter cake and Triplex include eucalyptus tree leaves powder applied to grain against insects are important for storage of grains. Filter cake and Triplex could be potential alternatives to chemical insecticides for controlling stored-product insects.

### 3.2. Recommendation

Based on the work of review the following suggestion has to recommend treating grains

➢ Give the train to all farmers

➢ Using different chemicals' are dangerous for some farmers due to lack of knowledge. therefore, rather than using chemical use filter cake and triplex as well as eucalyptus tree leaf powder are very important due local availability and their cost not high as well as safe [37].

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