(KEJAANS)

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES

January, 2025 Vol. 1, issue 1

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ISSN: 1595-5776

KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)

JANUARY, 2025: Volume 1, Issue 1

OFFICIAL JOURNAL OF THE

FACULTY OF AGRICULTURE

KEBBI STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY, ALIERO

ISSN: 1595-5776

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The first page of the manuscript should contain the title of the article, which should be concise and explicit, typed with upper-case, bold, 14 font size, TNR and not more than 21 words. The surname and forenames (in full) of authors, affiliation of each author should be provided. Phone number and email address of the corresponding author (identified by an asterisk) should be provided. Superscripts should be used to relate authors to their affiliations.

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KEBBI JOURNAL OF AGRICULTURE AND NATURAL SCIENCES (KEJAANS)
JANUARY, 2025: Volume 1, Issue 1:37-41
p-ISSN: 1595-5776

INSECTICIDAL EFFECT OF BITTERLEAF (*VERNONIA AMYGDELINA*) AND FIRE WOOD ASH POWDERS ON COWPEA WEEVIL (*CALLOSOBRUCHUS MACULATUS*)

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ABSTRACT

An experiment was conducted in the Crop Science Laboratory of the Kebbi State University of Science and Technology, Aliero, to investigate the effect of Bitter Leaf Powder and Fire Wood Ash on cowpea weevil. Treatments consisted of Bitter leaf powder at 5%, 10%, synthetic insecticide (Permithrin at 5g/100g) and the untreated control laid out in a Completely Randomized Design (CRD), in three replicates. The powders were tested along with a synthetic insecticide as a check and the control using grains of a local cowpea variety. Data were collected on the weevil mortality count, weevil population count and number of seed damage. Results showed significant reduction of infestation on the stored cowpea seeds among the treatments and wood ash proved more potent than the other organic treatments in reducing weevil infestation in stored cowpea seeds. The study demonstrated that the two organic insecticides used were effective in controlling Cowpea weevil with ash been significantly better in the protection of cowpea grains from weevil damage during storage.

Keywords: Organic insecticide, bitter leaf, wood ash, cowpea weevil, Storage.

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is a major source of dietary protein that nutritionally complements staple low-protein cereals and tuber crops. It is very popular and unique in that it produces food for man and fodder for livestock. It has high potential to increase income for both farmers and traders (Owolade *et al*., 2004). Cowpea is a warm weather crop that is well adapted to drier regions of the tropics like Nigeria where other food legumes do not thrive well (Abate *et al*., 2011). It is one of the most economically and nutritionally important indigenous African grain legumes produced throughout the tropical and subtropical areas of the world.

Adult beetles, are very short lived, usually not more than 12 days under optimum condition, during this time the female (*Callosobruchus maculatus*) lays eggs up to 115, although oviposition may be reduce in the presence of previously infested seeds (Abate *et al*., 1998). Some adult females may have the ability to distinguish their own oviposition and appear to

ignore the oviposition deposited by other females (Wijeratne and Smith, 1998). The optimum temperature for oviposition is high in *C. maculatus*, about 30-35 ^{0}C. As the eggs are laid, they are firmly glued to the surface of the host seed, smooth-seeded varieties being more suitable for oviposition than rough seeded varieties (Parr *et al*., 1996).

Large amount of legumes and some other crops suffer insect pest damage which result in loss of nutritional, weight and seed viability. Nigeria witnessed rampart cases of food poisoning from cowpea stored with highly toxic insecticides resulting in death. Despite constraints, such as diseases and the limited use of fertilizers and irrigation inputs (Brisibe *et al*., 2011), one of the major problem is storage pest of cowpea such as *C. maculatus*. The higher the infestation levels before harvest, the greater the damage to the seeds in storage.

Synthetic insecticides are widely used, and misused in the of control storage insects, as evident in the Nigeria press reports on poison cases, sudden death, blindness, and skin irritation are among the problems attributed to use of inappropriate storage of synthetic chemicals in Nigeria. Application of insecticides in protecting cowpea seeds against insect pests is inevitable because the crop is an important legume which provide cheap source of protein to man and livestock, in addition to increasing the storage life of grains and reduce human poisoning.

Materials and Method

The experiment was conducted in the Crop Science Laboratory, Department of Crop Science, Kebbi State University of Science and Technology, Aliero under ambient conditions. Kebbi State is located in the dry Savannah agro-ecological zone (Latitude 3^0 1.0 North and Longitude 5^0 15 East) 350. The rainy season starts in late April to middle of October. The hottest months are March, April and May, while the coldest months are November to February which are characterized by dry Harmattan (a dry, dusty, cold, low humidity condition). The relative humidity range from dry and wet seasons is about 49% with an annual evaporation rate of 2,034 mm. The temperature varies from 15 ^{0}C to 20 ^{0}C during the Harmattan, and from 32 ^{0}C to 40 ^{0}C during the hot season (March to May), with mean annual temperature of 27.8 ^{0}C (Ojanuga, 2006).

Insect culture

Adult *C. maculatus* used for the study were obtained from naturally infested cowpea seeds collected from Birnin Kebbi Central Market, Kebbi State. Adult's weevils were reared on clean uninfected white variety of cowpea seeds in Kliner Jars. The insect culture was raised in ten (10) Kliner Jars containing 100g of cowpea seed, five pairs of freshly emerged adults were introduced into each treatment.

Preparation of Plant Material and Wood Ash

Bitter leaf powder

Fresh bitter leaves were washed with clean water, air dried for five days and later grounded into powder using mortar and pestle and the powder was sieved using a 0.5 mm sieve.

Fire Wood Ash

The wood ash was obtained from the fire woods burnt during cooking, and was sieved using a 0.005 mm sieve in order to separate it from the dirt.

Synthetic chemical

The synthetic chemical Insecticide was permethrin (5g/100grains), that belonged to the pyrethroid class of chemicals.

Treatments and Experimental Design

The experiment consist of six treatments replicated four times. The treatments are; 5g Bitter Leaf Powder (BLP)/100g cowpea seeds, 10g Bitter Leaf Powder/100g cowpea seeds, 5g Fire Wood Ash (FWP)/100g cowpea seeds, 10g Fire Wood Ash/100g cowpea seeds, a

recommended synthetic insecticide powder (Pirimophos-methyl: Acetylic dust 2%, applied at 0.5g/100g cowpea, Okunade *et al*., 2002) and the Untreated Control (UC). The Kliner jars were arranged in a Completely Randomized Design (CRD) on the laboratory benches.

Data Collection

The following data were collected;

1. Weevil mortality count was achieved by sieving the cowpea seeds in each Kliner Jar to count the number of dead weevils and recorded per treatment.
2. Number of seed damaged by counting the number of seeds infested by the weevils in each Kline Jar.
3. Number of damaged seeds was done by counting the number of seeds that have feeding holes as a result of damage by weevils.

Data Analysis

Data collected were subjected to Analysis of Variance and means found to be significantly different were separated using the Least Significant Difference (LSD) at 5% level of significance.

Results and Discussion

Results

Weevil mortality count

According to the results obtained in this trial all levels of bitter leaf powder and wood ash conferred different levels of protection on cowpea grains in storage against weevil as compared to the Synthetic Insecticide (S.I.) that produced a significant level of protection as shown in Table 1. Firewood ash at 10% (8.83) gave better protection than S.I which in turn is better all the levels of bitter leaf powder and wood ash. The least effected was the untreated control (6.38), that produced significantly ($p>0.05$) lower level of control. This result is supported by the work conducted by Giga (1995), who reported that, the use of wood ash and other plant materials have insecticidal properties in conferring protection to the plants and plant products.

Table 1: Weevil mortality as affected by bitter leaf powder and firewood ash on cowpea grains storage

Treatment	Weevil mortality
Control	6.38^{e}
BLP 5%	7.83^{d}
BLP 10%	8.16^{C}
FWA 5%	8.33^{b}
FWA 10%	8.83^{a}
S.I	0.66^{f}
$LSD_{0.05}$	0.52

Means with the same letter (s) are not significantly different at 5% level of Significance.

Weevil population count

Weevil population was significantly reduced by the application of the different levels of both Bitter Leaf Powder and Fire wood ash. The SI produced better protection (4.33), than all the other treatments, the least protection was from the untreated control (46.00). The different concentrations of BLP 5% (19.33), BLP 10% (12.00), FWA 5% (8.66) and SI (7.33) gave significantly different levels of control on weevil mortality count (Table 2.0). The finding agreed with Gwinner (1996), that organic pesticides from plant origins such as the firewood ash is known to be effective in

controlling storage pests, mainly Coleopterans such as (*C. maculatus*) on stored cowpea seeds.

Table 2: Weevil population count as affected by bitter leaf powder and firewood ash on cowpea seed storage

Treatment	Weevil population
Control	46.00[a]
BLP 5%	19.33[b]
BLP 10%	12.00[c]
FWA 5%	8.66[d]
FWA 10%	7.00[d]
SI	4.33[f]
LSD $_{0.05}$	2.19

Means with the same letter (s) are not significantly different at 5% level of Significance.

Number of seed damage

Results indicated cowpea grains that were not treated with any insecticide were the most affected by weevils suffered significantly higher seed damages by weevils in storage than all other levels of both powders applied. All the treatments containing bitter leaf and wood ash produced similar protection except Firewood ash at 5% and 10% that conferred similar protection against weevil damage and significantly lower than that produced by the synthetic insecticide which is significantly the highest as shown in Table 3. This result tallied with that obtained by Ukeh *et al*. (2010), who stated that the old age practice of traditional tropical farmers is to mix a local plant with their grains prior to storage may be an alternative to synthetic insecticides due to their low toxicities, cost and easy availability.

Table 3: Number of seed damage as affected by bitter leaf and firewood ash on cowpea seeds storage

Treatment	No. of seed damage(g)
Control	79.33[a]
BLP 5%	76.00[b]
BLP 10%	70.66[c]
FWA 5%	18.33[d]
FWA 10%	17. 66[d]
S.I	15.00[f]
LSD $_{0.05}$	2.23

Means with the same letter (s) are not significantly different at 5% level of significance.

Conclusion

Result of the experiment showed that firewood ash at 10% proved more potent and effective in the control of cowpea weevil (*Callosobruchus maculatus*) infestation in stored cowpea seeds.

Recommendation

Firewood ash 10% having recorded the highest numbers of weevil mortality, also in terms of weight it shows the highest seed weight is therefore, recommended. The use of these Botanicals will go a long way in reducing the

harmful effects of synthetic insecticides to man and his environment at the same time. Also higher rate of both Bitter leaf and wood ash is recommended in subsequent researches in reducing infestation of insect pest on stored crops.

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