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TOWARDS REDUCING USE OF AGROCHEMICALS FOR THE CONTROL OF *Callosobruchus chinensis* (L.) ON STORED COWPEA SEEDS.

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ABSTRACT

This study was conducted in Sheikan locality, North Kordofan State, Sudan during season 2015/ 2016 to find out alternative method for pesticide to protect stored cowpea seeds from infestation by the beetle *Callosobruchus chinensis.*Linn (Coleoptera: Bruchidae) by using some local materials. Laboratory work was done in the Lab of Plant Protection Department, Faculty of Natural Resources and Environmental Studies, University of Kordofan. Six treatments were used: groundnut oil, wood ash, sand, neem leaf powder, rabal leaf powder and hot pepper powder. Two hundred and fifty gram of seeds were mixed with each treatment and stored under room temperature for four months to assess loss in weight of infested seeds. Also, field survey was done and 50 respondents were randomly selected from the study area, subsequently interviewed for their experience and indigenous knowledge about the methods of storage, and control of cowpea beetle. The result obtained due to infestation by *C. chinensis* showed that the mean percentage in weight loss of 100 cowpea seeds treated with the six materials used for four months was 1.6%; 49.4%; 39.5%, 41.2%, 49.6% and 47.5% respectively. Loss weight after 4 months was not significantly different between rabal leaf powder, red pepper leaf powder and wood ash ($p<0.05$) while it was different with other treatments particularly, the ground nut oil which gave significant protection. It is clear the use of some local materials can protected the seeds from infestation. The results obtained from field survey indicated that, 46% of the respondents use chemicals for the control while 54% used traditional methods to preserve the Cowpea seeds. So, we can avoid seed dressing by chemicals towards benefit of the farmers and the environment too; bearing in mind misuse of chemicals is a common problem.

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1. INTRODUCTION

Increased use of agrochemicals, however has caused considerable concern about their effect on health and natural environment as well as the agricultural products quality (Boon-long, 1990).Although the use of pesticides gives important benefit both in agriculture and in the field of public heath but it is no doubt pesticides has polluted and it is being polluted our calm and sweet atmosphere. We can't get a single gram of food stuffs without residual toxicity and the problem extend to non targeted organism like natural enemies, honey bees, livestock ,soil microorganism, and aquatic organism. In addition to this it leads to insect resurgence and create resistance to pest and diseases. More than that frequent use of pesticides increase the farmers cost of cultivation and environment pollution. It is known pests are a serious problem causing annual yield loss and during periods of storage the seeds are subjected to damage by various stored product pests and the losses due to insect pests in developing countries ranged between 25- 40 % annually (Mohammed-Ahmed, 2012). Many insects species caused damage to the stored products of these is the cowpea beetle *Callosobruchus chinensis* which is belong to the order Coleoptera, family Bruchidae, it rapidly reproduce and cause serious reduction in weight and value of stored seeds (NR1, 2003). The damage by this pest may be happened in the field which ranged from 25% to 30 % while in the store may reach 80 % within 6- 8 month in moderate areas of the world and complete losses obtained when the period of infestation prolonged(Hill, 1990). The cowpea beetle has no diapauses period. So, it causes permanent damage to the stored products. Usually farmers are depending on insecticides for pests control mostly fumigation by phostoxin tablets or treatment by organo phosphorus compounds (e.g. malathion, dizinon,) for prophylactic. Also, they used seed dressing by fungicides. The unwise use of chemicals leads to natural imbalance as well as destruction of the environment components. Under such circumstances, alternative material like use of inert dusts, edible oils and plant products that could be easily used by farmers are valuable (Isman, 2008). The modern strategy of pests control is the use of repellants, plants powders, plants oil and inert materials. Each of these materials may be used alone or mixed with other for integrated pest management towards safeguard the environment. (Adugna *et al*., 2003) mentioned in some region of Uganda , Tanzania and Eritrea many authors were reported dmixing fine sand; clay dust or wood ash with their common stored beans food and grains and Koona and Njoya, (2004) mentioned several edible and non edible oils were used for a long time for the protection of stored grains and legumes. Also, neem seed oil showed 100% control of *C. chinensis* for 5 months when applied at 10 ml/ kg.

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In the Sudan according to EL-Kmali *et.,al* (2010) two *Pulicarcia* species *P.undulata* and *P.crispa* which known locally as (Rabal) are currently being most commonly used as protectants at rural levels and Ravandeh *et al*. (2011) further, mentioned that *P. undulata* is a medical plant used as an insect repellent. The Species of the genus *Callosobruchus* and *Caryedon* are very damaging pests of stored food and forest leguminous seeds in Kordofan region (Mohamed-Ahmed, 2004 and 2012). The present study was carried out to use some botanicals; inert materials (wood Ash, Sand) and edible oil against *C. chinensis* in stored cowpea seeds. Also, comprehensive survey was launched in season 214-2015 interviewing farmers for their indigenous knowledge of the pest control. The general objective of this study is to provide alternative method for control the insect pests especially in cowpea seeds and the specific objectives is to assess the efficiency of some plant powders (red Pepper, Neem leaves, Rabal leaves); ground nut oil and inert materials (wood ash and sand) for protection cowpea seeds against the cowpea beetle *Callosobruchus chinensis*.

2. MATERIALS AND METHODS

2.1 Study location

This study was conducted in North Kordofan State (latitudes 11° 15´ and 16° 45´ N and longitudes 27° 05´ and 32° 15´ E) in seasons 2013/2014 -2014/2015. North Kordofan State is located in central Sudan in the dry semi-arid region the mean annual temperature is 27°C with extreme temperatures ranging between 10°C and 46°C. Mean relative humidity varies between 20% in December to 75% during August. The rainy season usually starts in June or early July and ends by the end of October. The main soil type is sandy -to- sandy loam.

2.2. Laboratory work

2.2.1. Rearing of insects

The investigations were executed under laboratory conditions in Department of Plant Protection, Faculty of Natural Resources and Environmental Studies, University of Kordofan, Elobeid. The work started with the collection of the cowpea beetle *C. Chinensis* (L) adults from pulse samples obtained from Elobeid market. Local cowpea variety seeds were used for rearing *C. chinensis.* The cowpea seeds were used after manual purification from inorganic and organic matters and shriveled seeds. Broken seed and other food grains were removed, then seeds were placed in an oven to dry at 60 ^{o}C for 10 minutes and stored at room temperature for seven days in cloth bags then sufficient numbers of *C. chinensis* were added. Cloth bags were periodically checked and fresh cowpea seeds were added to serve more adults when needed as stock.

2.2.2. Preparation of materials

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One kilogram of green leaves of neem tree *Azadirachta indica* were collected from the area around the University of Kordofan, they were left under shade for five days to dry. Dried leaves were ground with an electrical grinder, and then fine powder was stored in clean cloth bags. Also one kg of red pepper pods *Capsicum annuum* was put in electrical grinder and the powder was kept in cloth bag. Rabal *Pulicacia undulata* leaves were prepared by the same procedure. One litre of ground nut oil (*Arachis hypogaea* L.) was kept for the experiment beside one kg of wood ash and sand was prepared for the experiment when needed as treatments.

2.2.3. Experiment procedure

The treatments used were:

1- 250g cowpea seeds +2.5 ml Groundnut oil (G).
2-250g cowpea seeds +35g Wood ash (W).
3-250g cowpea seeds +250 g Sand (S).
4-250g cow pea seeds +35g Neem leaves powder (N)
5-250g cow pea seeds +35 g Rabal leaves powder(R).ww
6- 250g cow pea seeds +35g Pepper pods powder (P).ww
7- 250g cowpea seeds control (untreated) (C).w

The procedure described by (Mohammed-Ahmed, 2004 and 2012). Seven jars were used for the seven treatments then twenty of freshly emerged adults of *C. chinensis* were added to each jar. Each jar covered with piece of cloth and fixed with rubber band. The jars were kept in the laboratory under room conditions then left for four months (March to July 2014). Observations were carried out each month to calculate loss weight of 100 cowpea seeds .Samples were taken from each treatment and replicated three times then the mean was recorded at the end of the storage period (four months).

A bioassay was conducted under lab condition to investigate the efficacy of the above mentioned control materials on the adult of the beetle. A complete Randomized Design CRD with four replicates was used.

2.2.4. Loss assessment

Quantitative loss within four months of stored cowpea seeds was done by calculation the difference between the gross weight of 100 seeds when received and the weight after infestation then the total loss in weight was calculate in percentage.100 seeds were taken from each jar, then weighted and put back again to the same jar, this procedure was done every month during the experimental period.

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2.3. Statistical analysis

The collected data were statistically analyzed using Mstatc software. Analysis of variances for all obtained means computed. Significant differences among treatments were subjected to Duncan's multiple range test (DMRT) ($P < 0.05$ level)

3. RESULTS

3.1. Loss in weight of cowpea seeds

In the study the initial weight of 100 seeds of cowpea is 30.60 gram. The results obtained indicated that; there were highly significant differences ($P > 0.01$) in weight among the different treatments after one; two; three and four month(Table.1). In treatment of cowpea with groundnut oil, the weight of 100 seeds was 30.4, 30.3, 30.3 and 30.1g for duration of one month, two month ,three months and four month respectively. In the treatment of wood ash, sand, neem leaves powder, rabal leaves powder and treatment with pepper pods powder the mean total weight decreased by 15.5g, 12.1g, 12.6 g, 15.2 g and 14.6g respectively after four months. In the untreated seeds (control treatment) the weight decreased by 13.3 g in weight after four months.

Table (1): Weight loss of 100 cowpea seeds infested by cowpea beetle *Callosobruchus chinensis* for four months at sheikan locality in 213/2014-2014/2015.

Parameters Treatments	Initial weight	Weight of 100 seeds (g) after one month	Weightof 100 seeds (g) after two month	Weight of 100 seeds (g) after three month	Weight of 100 seeds (g) after four month
Groundnutoil	30.6	30.4ab (0.8%)	30.3 a (0.9%)	30.3 a (1.1%)	30.1a (1.6%)
Wood ash	30.6	30.1 bc (1.7%)	24.3 bd (20.5%)	20.4 de (33.4%)	15.5d (49.4)
Sand	30.6	29.9 a (2.2%)	23.1 bc (24.4%)	22.5 b (26.5%)	18.5 b (39.5%)
Neem leaves powder	30.6	30.4 ab (0.6%)	25.1 bcd (17.9%)	20.4 cd (33.4)	18 bc (41.2%)
Rabal leaves powder	30.6	29.5 ab (3.6%)	22.2 cd (27.5%)	18.2 e (40.6%)	15.4 49.6%)
Pepper pods powder	30.6	29.5 c (3.5%)	26.2 bcd (14.4%)	20. 8 de (32.1%)	16.1 d (47.5%)
Control	30.6	29.2 bc (4.6%)	27.7 ab (9.4%)	23.3 bc (24.0%)	17.3 cd (43.6%)
SE±		0.19	0.66	0.74	0.96

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CV %	3.42	10.35	6.83	8.37

Means in a column followed by the same letter are not significantly different ($p < 0.05$) according to Duncan's multiple range test (DMRT)

Percentage Weight loss

Figure,1 showed the mean percentage of weight loss in the treatment after month was 0.8, 1.7, 2.2, 0.6, 3.6, and 3.5g % in the treatments of groundnut oil, wood ash, sand, neem leaves powder, rabal leaves powder and pepper pods powder respectively. The mean percentage of weight loss in the treatment after four month was 1.6, 49.4, 39.5, 41.2, 49.6, and 47.5g % in the treatments of groundnut oil, wood ash, sand, neem leaves powder, rabal leaves powder and pepper pods powder respectively.

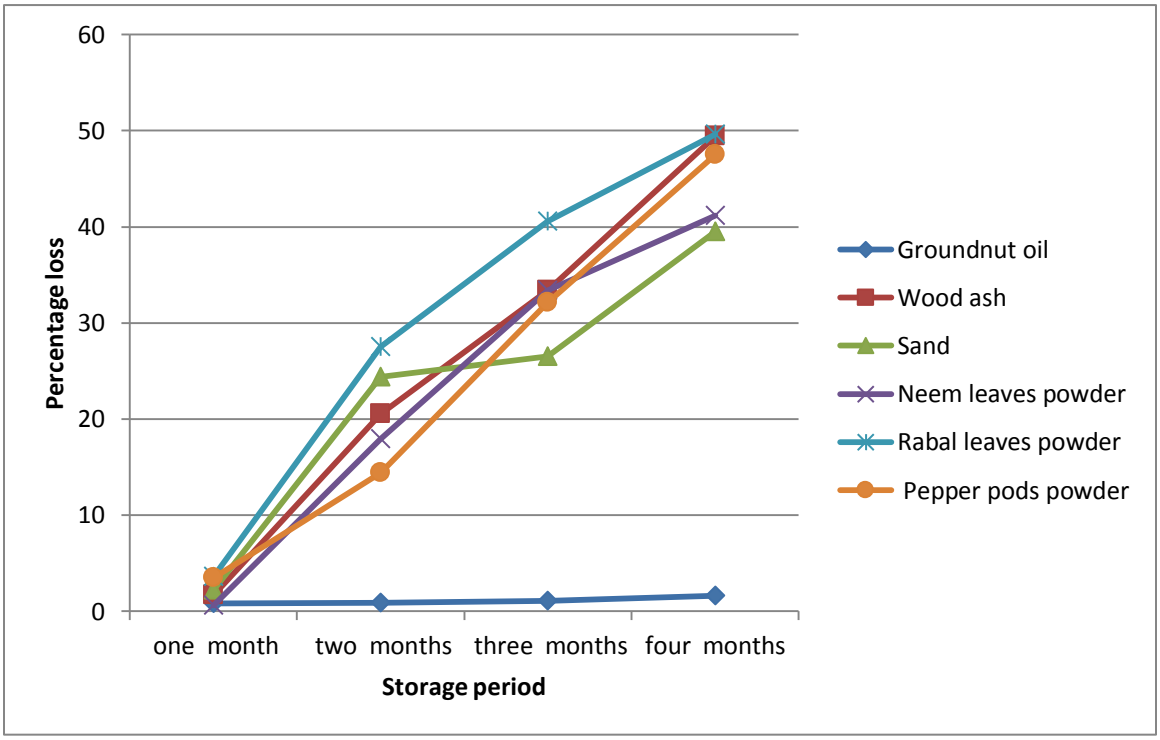

Figure (1) Percentage in weight loss of 100 cowpea seeds infestation with *Callosobruchus chinensis* for four months in 2013/2014-2014/2015.

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3.2. Field survey

The data obtained through the questionnaire in Sheikan locality revealed that 68% of respondents are males and 32% of them are females. Regarding type of stores 36 % of the males and 12% of the females used matmura as store while 24% of the males and 20%of the females stored their cowpea in house .Concerning storing the cowpea seeds in house showed that 4% of the males and 2%of the females used rakoba while 22% ; 10% of the males and females respectively used sacs for storing their cowpea seeds besides 4% of the males and 8% of the females used plastic jars . Period of storage showed that 6% and 20% of males and females stored cowpea for two months respectively and 8% of the males and 4% of the females stored cowpea for three months while 10% for each of them stored cowpea seeds for four months.

The study regarding purpose of storage showed that 56%, 24% of the males and females store cowpea for consumption and trade respectively. The data obtained through the questionnaire also revealed that 58% of the respondents mentioned beetles infestation is dominant while 22% of them mentioned weevils. About indenegous knowledge it is clear in this study 44% of the respondents use gadgad(local plant) ; 26% use pepper pod powder ; 10% use neem leaf and 6% exposed their products to the sun to control cowpea beetle. 54% of the respondents said that they used local plant and 46% of them said they used chemicals and their source of chemicals is Plant Protection Department; 38% said the source is local market; 8% said bank and 8% said organization and local trade men in the villages.

4. DISCUSSION AND CONCLUSION

Without suspicion, cowpea which is called locally Lubia, is an important crop used for consumption and as cash crop for the farmers in sheikan locality of Kordofan State,Sudan. One of the main problems of production of cowpea is the insect pests attack. According to the results obtained from previous study of Silim, *et al*., (1999) the cowpea beetle *Callosobruchus chinensis* breed almost exclusively in cowpea *vigna anguicultata* as the most preferred pulse crop it was reported to attack different leguminous seeds, it is primarily a pest of seeds of pigeon pea *Cajanus cajana*, broad bean Vicia faba, dry or garden pea *pisium sativum*, Chick pea *Cicer arietinum*, black eyed cowpea *vigna sinensis*, *mungbean vigna* radiate and azuki bean *phaseolus angularis*. Fewer investigations have been carried out on controlling this beetle with botanical material in the Sudan, but where results are available they show that they are promising.

Results obtained in this study using groundnut oil, wood ash, sand, neem leaves powder, rabal leaves powder and pepper pods powder showed that there was significant difference (P=0.05) in weight of cowpea seeds among different treatments. However, there were highly significant differences (P=0.01) in the subsequent counts, at the end of the four months. The mean

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percentage total weight loss in the control was 47.5% .The highest average total weight loss was found in the treatment with 10 pairs of *C. chinensis* (59 %).

Singh and Jambunathan (1990) stated that the *C. maculatus*, and *C. chinensis,* are the major source of losses to pigeon pea and causes greatest damage, both in pods in the field and in stored seeds. The insect multiply rapidly within a short time with heavy consequent damage once the infested seeds are stored. Infestation of pigeonpea by *C. chinensis* starts in the field and, once infested seeds are stored, there is rapid pest multiplication and destruction of seeds which may reach 100% within a very short time, the statement is agreed with our finding. This is because of continuous re-infestation of seeds, where eggs are laid on the seed surface and the emerging larvae bore inside the seeds, eat and grow and adults emerge from inside the seeds to mate and lay more eggs on the seeds to repeat the process. In this study groundnut oil efficacy is high and this agreed with khaire (1993) who concluded that oil protect seeds of legumes in good manner for long period.The result of this study showed that the cowpea weevil *C. chinensis* is an important pest on stored cowpea seeds. Qualitative and quantitative losses were high even for short storage periods and low population of this pest and it is better for farmers to gather the cowpea early in time of the harvest.

Mixing cowpea seeds with groundnut oil is an effective method to protect stored cowpea seed from damage by *C. chinensis* this result is in line with Singh *et al*. (1990) and in the sudan Hamid and Abdelbagi (2014) metioned that the volatile oil of three garlic caused significant mortality to C.maculates at concentrations of 0.1%; 1%;5% and 10% and Elkhatim and Abdebagi(2014) indicated that Hargel shoot extracts are significant as antifeedant agaist *C. maculatus*. In conclusion we should:

1- Prevent indiscriminate use of pesticides
2- Adequate information should be provided to the farmers regarding pesticides hazards
3- farmers should train to quire knowledge about all safety measures.

Finally, in this study we recommended the use of alternatives of pesticides is step to save seeds from infestation because avoidance of chemical control is highly recommended in the stores. Further studies on economic threshold level, and the impact of natural enemies on population dynamics of this pest in Kordofan were needed. Also, more research is needed to explore uses of traditional materials that have effects on insect infestation in stores.

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