Efficacy of Garlic (*Allium sativum* L.) and Red Pepper (*Capsicum annum* L.) in the Control of Bean Weevil (*Callosobruchus maculatus* L. Fabricus) in Sudan Savanna Ecological Zone of Nigeria

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Abstract
Powders prepared from two plant species Capsicum annum (Red Pepper) and Allium sativum (Garlic) were used against adult cowpea weevil (Callosobruchus maculatus L. Fabricus) on cowpea grains. The powders of Capsicum annum and Allium sativum were applied weight by weight together with cowpea seeds and mixed at different concentration of 10g, 20g, 30g and 40g respectively. The treatments were kept under ambient laboratory conditions to evaluate mortality rate, oviposition, germinability and number of holes were observed and compared at (P≤0.05) with control. All the observations recorded higher mortality and other attributes except the control which has minimum mortality of C. maculatus when compared with other treatments. The Red pepper powder applied caused highest mortality during the exposure period when compared with Allium sativum. The research work indicated that the powders of Red Pepper and Garlic can effectively control insect pest at different concentration while Capsicum annum has higher efficacy against C. maculatus than Allium Sativum. The results of the study showed that powders from those two plants at different concentrations tested can cause mortality of C. maculatus but do not have negative effect on germination as shown by proximate analysis and sensory evaluation. In conclusion, this research work suggested that the, management of C. maculatus using different concentrations of bio-insecticidal is promising and can be employed to stored cowpea weevil for a period of eight weeks.

Keywords: *A. sativum, C. annum C. maculatus, proximate analysis*

INTRODUCTION

Cowpea *(Vigna unguiculata* L.) is a pulse crop that can be grown successfully in extreme environments such as high temperature, low rainfall and poor soil with a few inputs (Diuf; 2011). Subsistence farmers in the semi-arid and sub-humid regions of Africa are the major producers and consumers of cowpea (Machacha *et. al.*, 2012). Cowpea grain is important to the income of resources poor farmers as well as to the nutritional status and diets of people in west and east Africa, Latin America and the Caribbean basin (Singh, 1987). However, post harvest losses of cowpea grain are a serious problem, and in Africa, as much as 20-50% of grain is lost because of infestation from the pest (Skerm *et al.*, 1988). Infestation results in heat generation, moisture and waste products produced by the cowpea weevil, also result in to further deterioration of the grains and moulds growth, (Singh and van Emden., 1979). This renders cowpea grain unfit for consumption and selling. Thus, farmers are forced to sell their

products. Insect pest attack cowpea at all stages of growth and can result in almost 100% loss in yield. Most times, cultivation of legumes coincides with the season during which oviposition and breeding of most insect pests of cowpea is highest. Hence, (Terao *et al.*, 1997) reported that of all these factors, insect pests and plant diseases are the major constraints to increased cowpea production. It attacks the crop at different stages of growth and often leads to significant reduction in yield especially where little or no control measure is applied (Opereake 2006). The imprudent uses of insecticides may pose a negative threat on the environment, humans and non-target organisms.

The infestation of cowpea pods by these insect begin in the field when the cowpea plant start producing pods. Damage is apparent about 2 – 3 months after harvest and virtually all of the grain may have holes by 6 months (Kebe and Sembene, 2011). At the time of harvest, approximately 0.05% of cowpea seeds contain larvae and nymphs that will continue their development in granaries thereby causing very significant post harvest crop losses (Huignord *et .al.,* 1985). An individual cowpea weevil female can reproduce herself twenty-forty (20 – 40) folds and is ready to mate and lay eggs immediately after emerging from the seed in which she metamorphosed. Egg hatching can produce reproductively active adults in as short time as 3 weeks if temperature is favorable. When a gravid female finds herself in a granary full of newly threshed seeds the storage is set for potentially disastrous losses (Murdock, *et. al.,* 2003).

The most common control method use is synthetic chemical pesticides which have been used for many years to control stored grain pest (Salem, and Abuo ela *et al.,* 2007). However, the potential hazards for mammals from synthetic insecticides caused increased concern by consumers over insecticides residue in processed food products, occurrence of insecticides – resistance insect strains, ecological consequences, increased in the cost of application of insecticides and the precaution necessary to work with chemical insecticides, call for new approaches to control stored – product insect pests using another alternatives. The use of plant materials as traditional protectants of stored products is an old practice used all over the world (Aslam, and Alikhan, 2002). The protection of stored products generally involves mixing grains with plant – base protectants (Tapondjou, *et al;* 2002). The objective of this research work is to determine the efficacy of the insecticidal properties of garlic and red-pepper in the control and or management of *C. maculatus*.

MATERIALS AND METHODS

STUDY AREA

The experiment was conducted at the Laboratory of Pest Management Technology, Federal College of Agricultural Produce Technology, Hotoro, Tarauni Local Governments area in Kano (11^0 39'N $8^0$27' E 427M above sea level) Tarauni local government area falls within Kano central as well as Sudan savanna agro-ecological zone of Nigeria.

SAMPLES AND SAMPLE SIZE

The free infested cowpea seed variety (IT99K-573-1-1) for the experiment was collected from International Institute for Tropical Agriculture (IITA) sub-station Kano where 10g, 20g, 30g, 40g and control were measured and equally weighed by weighted and introduce into Kliners jar and kept in the Entomology laboratory and the data were taken every week on mortality rate, oviposition and number of holes. Five pairs of male and female *C. maculatus* were introduced into each treatment with control. All the treatments were laid out in Complete Randomized Design {CRD} and repeated two times for accuracy and consistency of the experiment.

MATERIALS:

Garlic (*Allium sativum*), red-pepper (*Capsicum annuum*), Cowpea seeds (Fresh and free from insecticides infestation), Culturing plates (Petri dishes), Insect cage / insect rearing cage, Oven, Digital weighing balance, Muslin cloth, Filter paper, Kilners jars , Pistil and mortar, Spatula, Camel hair brush, Conical flask, 200ml plastic containers and Solvents (ethanol)

INTERPRETATION OF DATA ANALYSIS

Data collected from the experiments on the following parameters on mortality rate, number of holes, oviposition, germination, sensory and proximate analyses were subjected to the analysis of variance as described by Snedecor and Cochran (1967) using statistics 10.0 and the test among significant means were compared using Duncan's Multiple Range Test (DMRT) (Duncan, 1955).

RESULTS

Table 1:

Effect of garlic and pepper powder on mortality rate of *c. maculatus*

Treatment	Garlic	Pepper	Garlic + Red pepper
10g	1.50 (1.51)	1.50 (2.33)	1.50 (2.77)
20g	1.62 (2.38)	1.50 (2.82)	1.50 (3.85)
30g	1.50 (2.33)	1.50 (2.50)	1.50 (2.77)
40g	0.12 (0.35)	0.37 (0.74)	0.37 (0.74)

*Means in the same raw with different letters are significantly different at (P<0.05)

Table 2:

Effect of garlic and pepper powder on oviposition of *C. maculatus*

Treatment	Garlic	Pepper	Garlic +Pepper
10g	0.62 (1.061)	0.62 (0.91)	0.50 (0.75)
20g	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
30g	0.50 (0.75)	0.00 (0.00)	0.00 (0.00)
40g	1.75 (2.31)	2.62 (2.38)	1.75 (1.58)

*Means in the same raw with different letters are significantly different at (P<0.05)

Table 3:

Effect of garlic and pepper powder on numbers of holes of *C. maculatus*

Treatment	Garlic	Pepper	Garlic +Pepper
10g	0.37 (0.74)	0.37 (0.74)	0.12 (0.35)
20g	0.37 (0.57)	0.00 (0.00)	0.00 (0.00)
30g	0.12 (0.35)	0.00 (0.00)	0.00 (0.00)
40g	3.12 (2.03)	2.00 (2.20)	3.50 (2.00)

*Means in the same raw with different letters are significantly different at (P<0.05)

Table 4:
Effect of garlic and pepper powder on germination test of *C. maculatus*

Treatment	Garlic	Pepper	Garlic + Pepper	Control
10g	5.00 (1.41)	4.00 (1.41)	4.50 (2.12)	3.50 (2.12)
20g	4.50 (0.70)	5.00 (0.00)	5.00 (1.41)	4.00 (0.00)
30g	5.00 (2.82)	4.00 (0.00)	5.00 (2.82)	4.50 (2.12)
40g	4.50 (0.70)	5.00 (2.82)	5.00 (1.41)	3.50 (3.53)

*Means in the same raw with different letters are significantly different at (P<0.05)

Table 5:
Effect of garlic and pepper powder on sensory analysis test of *C. maculatus*

Treatment	Colour	Texture	Odour	Taste	Acceptability
Pepper	1.93 (0.961)	2.20 (1.01)	1.733 (0.59)	2.26 (1.10)	2.20 (0.94)
Garlic	2.33 (0.89)	2.20 (1.01)	1.80 (0.67)	1.60 (0.63)	1.86 (0.74)
Garlic + Pep.	1.93 (1.03)	1.86 (0.83)	1.86 (0.63)	2.13 (0.63)	2.00 (1.00)

*Means in the same raw with different letters are significantly different at (P<0.05)

Table 6:
Effect of Garlic and pepper powder proximate analysis on *C. maculatus*

Treatment	Garlic	Pepper	Garlic + Pepper
Ash	6.71 0.21)	4.01 (0.11)	3.81 (0.20)
Fibre	4.21 (0.08)	4.62 (0.10)	6.00 (0.110
Moisture	12.61 (0.30)	12.91 (0.42)	11.63 (0.23)
Protein	18.62 (0.33)	20.75 (0.24)	21.81 (0.31)
Fat	2.71 (0.11)	2.81 (0.080	2.72 (0.22)
Carbohydrate	56.11 (0.08)	58.18 (0.21)	60.41 (0.21)

*Means in the same raw with different letters are significantly different at (P<0.05)

DISCUSSION

The study showed that there was no significant difference in the mean mortality rate of *C. maculatus* within the whole treatment in the period during sampling of the experiment except the control sample which was highly infested by *C. maculatus,* this means that the plant extract used in controlling of cowpea weevils was affective in the storage. The present work is in conformity with the work of Raja, *et al.*,(2000) who reported that when pulses were stored in gummy bags treated with aqueous extracts of plant materials are effectively protected from insect infestation up to eight weeks.

The study showed that oviposition is slight in 10gwhich was significantly different from all the treatments; this reveals that the concentration of the treatments decreases and has an effect on oviposition with time.

The results in table 3 showed that mean effect of treatments of cowpea seeds treated with Garlic / Pepper has significant effect on number of holes/seeds. The results revealed that the control records significantly higher cowpea seeds with holes compared to other treatments at P (0.05). Garlic + Pepper was most effective as recorded on the lowest percentage cowpea with hole

Treating cowpea seeds with specified concentration does not have any significant effect on the germinability of the cowpea seeds compared with the control as shown in table 4.

The mean values of different sensory parameters are given in table 5. The mean scores were compared with the ratings used in the test which ranged from one for prepared extremely to (9) not prepared extremely. There was a significant difference at (P=0.05) this means that at different level of treatments the cowpea resulted in perceptible differences in terms of colour from the control sample the sample Garlic is significantly different and most preferred by the panelists. There was no significant difference (P=0.05) among all the samples in terms of texture and odor in all the three (3) samples used when compared with the ratings used in the test which ranged from one (1) prepared extremely to nine (9) not prepared extremely. There was no significant difference among the difference treatments applied in terms of taste, when cooked, which means the treatments were only effective on cowpea weevil but does not affect the sensory attributes of the samples which can be recommended for further use.

This finding shows that despite the effectiveness of the treatments, the samples were generally acceptable and preferred as the untreated control samples which are infested with weevils.

The study of the research conducted showed that the ash content of the treated cowpea were significantly high compared to one in literature. The result of the fibre content ranged within 4.21 (0.08) to 6.00 (0.11) which indicates its level of digestibility. The moisture content ranged between (11.68 (0.23) to 12.91 (0.42) for all the treatments which showed that the addition of the treatments cause an increase in moisture content. The experiments revealed that, the crude protein range within (18.62 (0.33) to 21.81 (0.31) which is considered slightly lower than the untreated samples. The fat contents of the treated cowpea seeds are higher than the controls.

While, the result of the Carbohydrate were taken by difference which was given as 56.11 (0.08) for Garlic, 58.18 (0.21) for Pepper 60.41 (0.21) respectively.

CONCLUSION

Research work evaluate the insecticidal effect of Red Pepper (*Capsicum annum)* and Garlic (*Allium sativum*) powder in the management of storage insect of *C. maculatus*.. Results from the experiment showed that oviposition, numbers of holes, mortality rate, during storage of cowpea seed were managed by treating the samples with plant materials. The powders revealed that both two plants were finally been effective in the management of *C. maculatus* for a period of eight weeks. Although the phytochemical parameters in the study showed that Red pepper (*Capsicuum annum)* have significant effect against *C. maculatus* when compared with Garlic (*Allium sativum*), but a synergistic effect of the two plant extract produce better result.

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