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POTENTIALS OF TUMERIC PLANT (*Curcuma longa* L.) POWDER FOR THE CONTROL OF BRUCHID BEETLES ON COWPEA SEEDS (*Vigna unguiculata* L) DURING STORAGE

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ABSTRACT

There has been growing interest in the use of natural plant products for protection of agricultural commodities due to their low mammalian toxicity and low persistence in the environment. It is against this background that this study was conducted to evaluate the potentials of Tumeric (*Curcuma longa* L.) plant powders for the control of bruchid beetles on cowpea (*Vigna unguiculata*) seeds. A synthetic insecticide, Cypermethrin and three *Curcuma longa* plant products (leaf, root and flower powders) were tested on cowpea seeds infested with ten teneral adults of male and female bruchid beetles in a Completely Randomized Design (CRD). The products were tested at 2.5g/50 g of cowpea seeds, while Cypermethrin was applied according to manufacturer's recommendation to serve as the standard check.. Each treatment was replicated four times with the control and left for five days before data collection commenced. Data were collected on mean egg laid, hatched, mean number of adults that emerged from each replicate, mortality of insects, mean number of holes and weevil perforation index (WPI) as well as the total developmental period of the insects treated with different plant products of *C. longa*. The results obtained

revealed significant differences ($P \leq 0.05$) in the mean egg laid of 11.6 ± 1.8 when the root powder was applied, when compared with the value of 84.6 ±3.9 obtained at the control experiment. Similarly, the lowest mean mortality was obtained at the control experiment (1.4±0.2) and was significantly different from the highest value of 10.0 obtained when Cypermethrin was applied. The results of this experiment also revealed lowest seed perforation (4.1 %) and Weevil Perforation Index of 1.2 when the powder of root was applied indicating that the root powder showed good potential as bio-insecticide for the control of bruchid beetles on cowpea seeds during storage.

Keywords: Cowpea, Oviposition, Tumeric, Eclosion, Cypermeth rin, *Curcuma longa*

INTRODUCTION

Cowpea (*Vigna unguiculata* L.)Walp is a major source of dietary protein in tropical and subtropical regions of the world, especially where availability and consumption of annual protein is low (Ofuya, 1986; Opareke *et al.*, 1998). Cowpea is high in protein content. It is generally a natural complement to the staple diet and in Tropical Africa, cowpea is a choice legume (Romain, 2001). The protein content of cowpea ranges from 23 – 30 % depending on the genotype and environmental factors, the lysine content is relatively high and thus improves the protein quality of cereals (Romain, 2001). Smartt (1990) reported that raw ripe seeds of cowpea contain an average per 100 g of edible matter; 10.0 g water, 22.0 g protein, 1.4 g fat, 59.1 g carbohydrate, 3.7 g fibre, 3.7 g ash, 104 mg Ca and other elements in negligible quantities. In Tropical Africa, cowpea is consumed mostly in form of dry grain or young pods. Cooking cowpea inactivates anti-metabolic

factors, lowers the concentration of lysine without modifying the nutritive value of cowpea to any great extent (Duke, 1981).

Cowpea bruchid (*Calloso bruchus maculatus* (F.)) causes extensive damage to stored grains, infesting as much as 60 % of the seeds (Singh and Rachie, 1985). Post-harvest losses of cowpea due to the bruchids constitute a major setback in the storage of this crop (Singh *et al.*, 1990). A substantial (30 – 80 %) of the total annual production of cowpea valued at over 30 million US dollars is lost annually in the United States alone as a result of this pest (Ohiagu, 1985). Infestation by *C. maculatus* damaged seeds during its developmental period resulting in holes bored into the seeds. Bruchid beetle is a phytophagous and holometabolous insect, which causes direct, weight loss and reduction in quality of cowpea seeds (Adenekan and Sosanya, 2006). The adult female of *C. maculates* lays its eggs on seed testa and the emerging larvae bore into the seeds where they feed, complete their development and cause extensive damage (Credlant and Wright, 1985). Some workers have reported that the number of eggs laid on cowpea seeds by female *C. maculatus* varied between 58 and 91 at ambient temperature (Mitchell, 1990; Adenekan 2002).

Synthetic chemical insecticides have been used with great success, but problems associated with their use and procurement has necessitated the exploration of a more sustainable alternative (Echezona, 2006). A number of plant materials had been tried and found to be effective. Some include fresh and deodorized palm oil (Ajayi*et al.*, 1987), powders from Pawpaw, Moringa and *Piper guineense* Schum

(Adenekan*et al.*, 2013; Ivbijaro and Agbaje, 1986), and root back of *Anona senegalensis* L. (Aku *et al.*, 1998).

Tumeric (*Curcuma longa* L.) is a herbaceous plant that has a wide range of culinary and medicinal values. It is a flowering perennial that belongs to the Zingiberacea and native to South Asia. It is a leafy stemless plant with oblong lily-like greenish leaves (Ammon *et al.*, 1991). It typically attains a height of three feet and is characterized by its yellow root as well as pale clustered flowers in which active ingredients are common. It is widely used as a colouring agent for curies and other dishes. It is also used in the cosmetic industry for its brilliant yellow colour and characterized perfume and as a dye for colouring fabrics in India and Pakistan (Obasi*et al.*, 2013). Tumeric plant has many medicinal properties. Modern in vitro studies have revealed that Tumric contains potent anti-oxidant, ant-inflammatory and anti-cancer agents (Ticalk *et al.*, 2004). Despite these numerous and important uses of Tumeric, its insecticidal properties has not been investigated; hence, this paper examined the potentials of Tumeric plant part powders for the control of Bruchid Beetles on cowpea seeds during storage.

MATERIALS AND METHODS

The experiment was conducted at the Entomology Laboratory of the Federal College of Agriculture (FCA), Ibadan. Ife Brown variety of cowpea seeds used in this study was obtained from the Institute of Agricultural Research and Training (IAR&T), Ibadan. After sorting and cleaning, seeds of similar sizes were selected and kept in the refrigerator at a temperature of 10^0C in order to prevent bruchid infestation until they were needed for the experiment.

A laboratory culture of *C. maculatus* was established from already infested cowpea seeds obtained from the International Institute for Tropical Agriculture (IITA), Ibadan. The culture was maintained in a kilner jar in the laboratory under ambient temperature of 30 ± 2 ^{0}C and 85 % relative humidity.

The plant products evaluated for insecticidal activities were collected from the Horticultural Research Institute of Nigeria, Ibadan, three months before the commencement of the study. The leaves, roots and flowers of the plant were separately collected. They were rinsed and dried in the Pest Management Laboratory of FCA, Ibadan at 27 – 29°C. The plant parts were ground separately to fine powder using electric blender and kept in dry bottles in the laboratory until needed for the investigation. The culture of *C. maculatus* used in this study was laboratory cultures established and maintained in 2016 as described by Adenekan *et al.,* (2018). *The* untreated cowpea seeds kept in the refrigerator were taken out and allowed to acclimatize for 48 hours under ambient laboratory condition before being used. Forty grammes (40 g) of seeds were placed in each kilner jar arranged in four groups. There were five treatments replicated four times. The treatments were leaf, root and flower powder of Tumeric plant (*Curcuma longa*), Cypermethrin and untreated cowpea seeds which served as the control experiment. The plant product powders were applied at the rate of 50 g kg^{-1} of cowpea seeds. Cypermethrin was applied according to the manufacturer's recommendation (5.0 g kg^{-1}) to serve as standard check. Ten (10) teneral adults (5 males and 5 females) of *C. maculatus* were infested and confined in each kilner jar for five days.

The kilner jars were arranged in Completely Randomized Design (CRD). Each group contained five treatments with the control experiment set aside in the laboratory for five days before data collection commenced. The beetles were left to mate and oviposit on the seeds. Total number of eggs laid, hatched and number of adult that emerged from each treatment was recorded and analyzed using Analysis of Variance (ANOVA). The weevil perforation index (WPI) was calculated using the formula proposed by Fatope *et al*. (1995):

$$WPI = \frac{\%\ \text{treated grains perforated}}{\%\ \text{control grains perforated}} \times 100$$

Treatment means were separated with the aid of the Least Significant Difference (LSD) at $P \leq 0.05$ level of significance. The Percentage Seed Perforation and the total developmental period as well as mortality of weevils under each treatment were observed, recorded and analysed.

RESULTS AND DISCUSSION

Application of Tumeric plant (*Curcuma longa*) powders have significant effects on the oviposition, eclosion, mortality and mean percentage of emerged adults of bruchid beetles on cowpea seeds ($P \leq 0.05$) (Table 1). The cowpea weevils treated with leaf powder recorded a mean number of egg laid of 52.3 ± 6.3 and was significantly different from 11.6 ± 1.8 obtained when the root powder was applied. All the plant parts powders applied significantly reduced the number of eggs laid by the beetles on cowpea seeds. The lowest mean number of eggs laid (11.6 ± 1.8) was recorded when the root powder of turmeric plant was applied, which was significantly different when compared to the highest number of eggs laid (84.6 ± 3.9) at

the control experiment where no plant powder was applied (Table 1).

All the bruchid beetles treated with Cypermethrin died within 24 hours of the introduction of insects (Table 1). The mean eggs hatched of 40.5 ± 3.6 was recorded when leaf powder of Tumeric plant was applied and was significantly different from the mean values of 2.4 ± 1.1, 26.9 ± 3.6 and 80.8 ± 7.5 for root powder, flower powder and the control experiment, respectively (Table 1). However, there was no oviposition on seeds treated with Cypermethrin while the root powder of Tumeric plant was able to significantly reduce oviposition and eclosion of the beetles in comparison with the control. The mean numbers of dead weevils (mortality) when Tumeric plant powders were applied are presented in Table 1. The highest mean mortality of 8.7 ± 0.4 was recorded when the root powder of the plant was applied while the lowest (1.4 ± 0.2) was obtained at the control experiment. This clearly indicate that tumeric plant, which contains cucumin as active ingredients has the potentials for reducing damages caused by bruchid beetles on cowpea seeds at storage.

The mean percentage of emerged adults obtained when the root powder of Tumeric plant was applied was 20.7 %, which significantly increased to 95.5 % in the control experiment where no plant powder was applied (Table 2). This revealed that the root powder of the plant had tremendous reduction effect on the adult bruchid beetle emergence. This translated to reduced number of seed damaged in treated grains (Table 2). The results presented in Table 2 revealed that percentage seed perforation and mean number of holes per seed were significant at 0.05 level of significance. The

lowest value of 4.1 % seed perforation was obtained when the root powder of Tumeric plant was applied, which was significantly different when compared with 12.2, 10.4 and 45.3 % obtained when the leaf, flower powders and the control experiments are respectively considered (Table 2). Similarly, the lowest Weevil Perforation Index (WPI) of 1.2 obtained at the application of root powder, which has the tendency to reduce damages caused by the insect when compared with the value of 3.5 obtained at the control experiment where no plant part powder was applied. Total developmental period of 18 days was recorded at the treatment where root powder was applied and was significantly different from 24 and 23 days obtained when the flower powder and control experiment were respectively considered. However, no significant difference was observed in the developmental period when the leaf and the flower powders were applied, but significantly reduced at the control experiment.

The use of plant products for the control of stored products is an ancient practice that has been largely neglected by farmers with the advent of synthetic pesticides (Qi and Burkerholder, 1981; Golob and Webley, 1980). The use of local products and other materials to protect stored crop grains have been reported by several researchers (Golob, 1999; Adesina, 2012; Adenekan *et al.*, 2013). The 100 % mortality of bruchid beetles observed when synthetic insecticide (Cypermethrin) was applied indicated that no plant product marched its efficacy, but the higher adult insect mortality observed when the root powders of the tested plant was applied shows that the root powder of the plant has toxic effect on survival and development of the insects on cowpea

seeds during storage. This result is consistent with Adenekan and Shosanya, (2006) with the use of dry flower powder of *Plumeri arubra* for the control of *Calloso bronchus maculatus*. The lower weevil perforation index (WPI) obtained when the dry root powder was applied is a clear indication that the plant's active ingredients (cucumin) could be used as bio-insecticide in the control of insect pests of cowpea during storage. The present investigation has demonstrated the insecticidal activity of *Cucuma longa* in the control of bruchid beetles on cowpea seeds at storage. It is hereby recommended that farmers could adopt the use of dry root powder of Tumeric plant for the control of bruchid beetles. The use of this plant as bio-insecticide merit further scientific investigations.

Table 1: **Effect of Tumeric Plant (*Curcuma longa* L.) powders for the control of Bruchid beetles seeds at storage**

Treatment	Mean no. of eggs laid (oviposition) (±SE)	Mean no. of eggs hatched (eclosion) (±SE)	Mean no. of dead weevils (mortality) (±SE)	Mean percentage emerged adults (%)
Leaf powder	52.3 ± 6.3	40.5 ± 3.6	2.8 ± 1.2	77.4
Root powder	11.6 ± 1.8	2.4 ± 1.1	8.7 ± 0.4	20.7
Flower	31.6 ± 1.4	26.9 ± 3.6	6.2 ± 1.9	82.3
powder	0.0	0.0	10.0	0.0
Cypermethrin	84.6 ± 3.9	80.8 ± 7.5	1.4 ± 0.2	95.5
Control	11.8	10.5	2.3	15.6
LSD (0.05)				

Standard Check…… Cypermetrin;
LSD ……Least Significant Difference;
S.E……Standard Error
Rate……50g/Kg:
n……10 beetles.

Table 2: **Potentials of tumeric (*Curcuna longa* L.) powders on seed perforation index** (WPI) **and developmental periods of bruchid beetles on cowpea**

Treatment	Seed perforation (%)	WPI	Mean no. of holes/seed	Total developmental period (days)
Leaf powder	12.2	15.3	0.9	24
Root powder	4.1	1.2	0.1	18
Flower	10.4	8.6	1.2	24
powder	0.0	0.0	0.0	-
Cypermethrin	45.3	-	3.5	23
Control	10.2	2.4	0.3	3.6
LSD (0.05)				

Standard Check…… Cypermetrin
LSD ……Least Significant Difference
S.E……Standard Error
Rate……50g/Kg
n……10 Beetles
WPI……Weevil Perforation Index

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