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Control of Cowpea Weevil (*Callosobruchus Maculastus*) using Indigenous Storage Methods

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ABSTRACT

Cowpea (*Vigna unguiculata*) and its subspecies from the genus *Vigna* and family *Fabaceae* is one of the most important food legume crops in the semi-arid tropics covering Asia, Africa, Southern Europe, and Central and South America. Cowpea is known for its nutritional composition especially protein content and is often recommended as foodstuff to help balance the nutritional status of consumers. Weevil infestation however, has been one of the odds associated with the storage of cowpea in an attempt to ensure prolong shelf-life and crop quality. The study was conducted between December and May on "beng pella", a cultivar of cowpea commonly grown in Nyankpala in the Tolon District of Northern Region. The objective of the study was to assess the effectiveness of some indigenous storage methods on the control of cowpea weevils. Two indigenous treatment methods commonly used in Northern Ghana for the storage of cowpeas and the triple bagging method were adopted. The treatment methods were wood ash from mahogany (Khaya senegalensis), dried powdered orange peels, and polyethylene liners and nylon sacks for triple bagging. Samples were analyzed based on physical characterization using number of hole count, germination test and live and dead weevils count. From the results, wood ash and orange peel treatments were more effective in controlling Callosobruchus maculatus, followed by triple bagging. The controls were in a state not acceptable economically and agronomically.

Key Words: Cowpea, *Callosobruchus maculastus*, Triple bagging, Orange peels, Wood ash

INTRODUCTION

Cowpeas (*Vigna unguiculata*) and its subspecies from the genus *Vigna* and family *Fabaceae* are one of the most important food legume crops in the semi-arid tropics

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covering Asia, Africa, Southern Europe, and Central and South America. The main cowpea-producing countries in Africa include Nigeria, Niger, Burkina Faso, Ghana, Kenya, Uganda, Malawi and Senegal (Raemaekers, 2001). Cowpea is drought-tolerant and warm-weather crop, well-adapted to drier regions of the tropics, where other food legumes do not perform well. It also has useful ability to fix atmospheric nitrogen through its root nodules and grows well in poor soils which have high percentage of sand (more than 85% sand) and soils with low organic matter content (0.2% organic matter) (Singh, 2003). According to Singh (2003), the estimated worldwide area under cowpea production is about fourteen (14) million hectares of which West Africa alone accounts for about 9.3 million hectares with annual production of about 2.9 metric tonnes. Ghana's cowpea production is estimated at about 900,000 hectares annually (GARE, 2002).

The cultivation of cowpea in Ghana is carried out mostly in the transitional zone, Guinea Savanna zone of Northern, Brong Ahafo, Upper East and Upper West regions. The most common variety cultivated by farmers in Nyankpala is the creeping and erect ("beng pella"). Other cultivars of cowpea such as "*ayiyi"*, *"asontem"* and "*ormondoh"* are also cultivated in small quantities and harvested often between September and October. Cowpea production in Nyankpala is affected by insects infestations specifically weevils (*Callosobruchus maculatus*) during storage although there has been some cases of weevil infestation before harvest. According to Biswa *et al.* (2002), cowpea is one of the grains that suffer post harvest losses most as a warm season, annual, herbaceous legume. It suffers heavily from insects, both on field and during storage.

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Although some pesticides are widely available for the control of weevils, these pesticides are expensive, polluting, and potentially dangerous to users and the final consumer. Consequently many cowpea growers in Nyankpala do not use pesticides due to cost and restore to the use of indigenous, inexpensive and non-synthetic methods to prevent and control weevils.

The three most common methods used in Northern Ghana are wood ash, bagging and orange peels storage. Wood ash from the remains of some specific fuel woods are often collected, sieved and used in the storage of cowpeas from medium to long term storage. Bagging of cowpeas either with polypropylene or jute bags is the commonest and easiest method of storage that is often hampered by weevil infestations and deterioration of cowpeas. In recent times however, there has been the introduction of the triple bag. Triple bagging is a technology developed by Purdue University in collaboration with African researchers, known as Purdue Improved Cowpea Storage (PICS) is literally 'bagging' the problem of cowpea bugs by using non-chemical, hermetic storage. A PICS bag is composed of three layers: two inner layers of high density polyethylene and an outer layer of ordinary woven polypropylene. PICS works by sealing cowpeas in an airtight container, which kills all the adult insects and most of the larvae within days. At the same time the triple bags keep the remaining larvae dormant and unable to damage the seeds.

Orange peels are also collected when in season from markets, dried and pounded to obtain fine granules which are mixed with the cowpeas for storage. Stored cowpeas are often meant to be used as planting material for the next planting season.

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The objective of the study was to assess the effectiveness of these three storage methods in controlling cowpea weevils to ensure quality and viability.

MATERIALS AND METHODS

Study Sample and Treatment Methods

Cowpea variety "Beng Pella" was obtained during the harvest season at a moisture content of 12%. The cowpea was screened and weighed for the treatments. Treatments were; [1]cowpea with wood ash from mahogany; two 7 kg plastic containers, were filled with a mixture of 5 kg of cowpea and 2 kg wood ash and containers closed tightly, [2]cowpea with dried orange peels; two 25 kg sacks were filled with 5 kg of cowpea and mixed thoroughly with 1.0 kg of dried powered orange peels, and [3]triple bagging; two 25 kg high density polyethylene liners placed in one woven polyethylene bag was filled with 5 kg of cowpea and tied. The treatments are as indicated in figure 1 below. Controls of each of the methods were created without the treatments and stored at mean temperature range of 20 ^{o}C – 39 ^{o}C for five months. All treatments were in duplicate.

Treatment Descriptions

Triple Bagging

Two separate high density polyethylene bags and one ordinary woven polypropylene sack were used by placing the two high density polyethylene bags into each other after ensuring the bags were leak free. Both bags of high density polyethylene were placed into the woven polypropylene bag. With all three bags in place the two outer bags (one high density polyethylene and the woven sack) were folded down leaving clearly one high density polyethylene bag to be filled. After

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filling the inner- most bag with dried cowpea, the bag was firmly squeezed to press out air while eliminating air spaces and the bag tied with a rope. The remaining part above the tie was twisted and folded back on itself and tied. The same process was repeated for the remaining two bags and is as indicated in Figure 1.1.

Figure 1: Wood ash, Orange peels and Triple bagging treatments respectively

Powdered Orange peels

Peels of orange(s) were collected and dried to moisture contents that permit pounding by use of mortar and pestle to acquire a fine grind. Fine ground orange peels were mixed with dried cowpea at a moisture content of 12% in 25 kg polypropylene bag for storage.

Wood Ash

Cooled mahogany wood ash was collected from a food joint in Nyankpala and sieved for use in storing the cowpea at 12% moisture content in a plastic bucket.

Data Collection and Analyses

Hundred (100) cowpea grains were taken monthly from each sample for the determination of holes count, germination test and live and dead weevil count as indicated below;

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Hole count

100 grains from each treatment taken and the number of holes manually counted in each grain, after sorting them out according to the number of holes on each grain. Sorting was based on zero, one, two and three or more hole counts. The procedure is repeated three times and the average count determined.

Germination percentage

100 grains were planted and nurtured. Germination was observed, counted and recorded at 5 and 14 days after sowing. The seedlings were classified into normal seedlings, and abnormal seedlings. Percent germination was calculated as;

$$\%\ Germination\ = \frac{Number\ of\ normal\ seedlings}{Total\ number\ of\ sown\ seeds} \times 100$$

Weevil count

1kg of cowpea was taken from each treatment and sieved to separate weevils. Live and dead weevils were counted manually and means recorded

Data was analyzed for significance using paired t-test.

RESULTS AND DISCUSSION

There were changes in the physical appearance of samples after storage using the parameters below;

Number of Hole Count

Number of holes for each treatment increased slightly while holes for controls increased sharply resulting in almost all grains with holes at the end of the research. Means of the hole counts are as shown in Table 1. There were however no significant difference ($p \leq 0.05$) within and between samples of wood ash, orange

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peels and triple bagging except between wood ash, orange peels, triple bagging and the controls.

Table 1: Average Holes Count

Holes	Treatment	Before Storage	January	February	March	April	May
0	Ash	92	92	91	91	90	90
0	Orange peels	92	91	90	86	74	60
0	Triple bagging	92	88	82	70	61	30
0	Control Ash	92	76	55	21	1	0
0	Control OP	92	74	50	20	0	0
0	Control TB	92	74	50	20	0	0
1	Ash	6	6	6	7	8	8
1	Orange peels	6	7	6	9	15	24
1	Triple bagging	6	8	11	20	25	34
1	Control Ash	6	15	24	43	3	1
1	Control OP	6	16	26	30	1	0
1	Control TB	6	16	26	30	1	0
2	Ash	2	2	2	2	2	3
2	Orange peels	2	2	3	4	8	11
2	Triple bagging	2	3	5	7	9	22
2	Control Ash	2	5	14	28	32	13
2	Control OP	2	6	14	25	33	12
2	Control TB	2	6	14	25	33	12
3	Ash	0	0	0	0	0	1
3	Orange peels	0	0	1	1	3	5
3	Triple bagging	0	1	2	3	5	14
3	Control Ash	0	4	7	8	64	86
3	Control OP	0	4	8	15	66	88
3	Control TB	0	4	8	15	66	88

* OP (Orange peels), TB (Triple bagging)

Bio-deterioration activities due to non treatment of grains in the controls created a favourable environment for weevil development, causing heavy infestations and fast deterioration of the grains. Below in Figures 2, 3, 4, and 5 are illustrations of cowpea grains before and after storage under each method.

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Figure 2: Cowpea grains before and after storage (wood ash treatment)

Figure 3: Cowpea grains before and after storage (orange peel treatment)

Figure 4: Cowpea grains before and after storage (triple bagging)

Figure 5: Cowpea grains before and after storage (control)

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Germination Percentage

The germination percentage per treatment changed per month but was not significantly different ($p \leq 0.05$) except for the controls which lost complete viability from the fourth month. The germination percentage for triple bagging decreased sharply from the second month of storage as indicated in Table 2 and this can be attributed to the hermetic environment created led to reduction in seed viability.

Table 2: Average Germination Percentage

Treatment	Before Storage	January	February	March	April	May
Ash	96	96	96	95	95	94
Orange peels	96	96	95	94	94	93
Triple bagging	96	95	90	89	86	74
Controls Ash	96	75	53	18	0	0
Control OP	96	72	50	20	0	0
Control TB	96	72	50	20	0	0

* OP (Orange peels), TB (Triple bagging)

Weevil count

Weevil count increased progressively for all treatments except for ash and this can be attributed to non-treatment in controls and a temperature build-up in the triple bagging and is as indicated in Table 3. Triple bagging works effectively at locations with low temperature ranges and adequate aeration. Ash treatments indicated suppression from the treatment resulting in the death of weevils. Live weevil counts increased for orange peels the third month which can be attributed to the reduction in fragrance of flavonoids, limonoids and essential oil in the orange peel powder.

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Table 3: Weevils Count

	Treatments	Before Storage	January	February	March	April	May
Live	Ash	3	0	2	4	5	6
	Orange peels	3	0	15	80	120	181
	Triple bagging	3	160	225	350	500	610
	Controls Ash	3	175	463	470	801	1192
	Control OP	3	180	463	500	800	1200
	Control TB	3	180	463	501	800	1209
Dead	Ash	2	10	20	40	50	60
	Orange peels	2	5	15	40	50	160
	Triple bagging	2	150	215	400	600	700
	Controls Ash	2	180	350	550	900	1392
	Control OP	2	185	350	555	900	1401
	Control TB	2	185	350	555	900	1400

* OP (orange peels) TB (triple bagging)

CONCLUSION

All treatments provided sufficient protection against cowpea weevils with wood ash and orange peels methods been effective in controlling *Callosobruchus maculates* followed by triple bagging. The triple bagging however, after storage does not require additional economical or human resource to separate the produce from the treatment before use or sale to consumers compared with treatments of wood ash and orange peels. Ash treatment was more effective in maintaining cowpea viability and quality followed by orange peels and triple bagging. The control method of storing cowpea proofed ineffective and unreliable stored for a period of 5 month and more. It is however recommended that wood ash and orange peels treatment be used by farmers and processors storing small quantities of cowpea for use as plant input and for house hold use due to the quantity of wood ash and peels needed for effective storage and removal before sale. Triple bagging however can be used for storage of cowpeas in large quantities meant for food processing. The use of effective indigenous non-toxic methods such as ash and orange peels will help reduce the problems associated with contamination and recontamination of agro produce with the use of synthetic pesticides.

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REFERENCES

Biswa, K., Bandyopadhyay, U., Banerjee, R.K. and Chattopadhyay, I. (2002). Biological Activities and Medical Properties of neem (Azandiracta indica)'' Current Science, Vol. 82 No. 11 pp. 1336-1345. Available at: www.hindawi.com/journals/ija/2010/2352801. Accessed: 6- 12- 2011.

GARE (Ghana Annual Review of Entomology) (2002). Insect pests of cowpeas, vol.31, pp 95-119. Available at: http:// www.annualreviews.org/doi/pdf/10.1146. Accessed: 07-02- 2012

Gomez, C. (2004). Cowpea Post-Harvest Operations - Edited by AGST/FAO. Available at: http:/www.fao.org/inpho. Accessed: 02-01-2012

Raemaeker, K. (2001). Crop Production in Tropical Africa. Ibadan, Nigeria pp 372.

Singh, B. (2003). "Improving the Production and Utilization of Cowpea as Food and Fodder" Field Crops Research 84. Pp 150-169. Available at: http:// www.wikimediafoundation.org. Accessed: 01-12-2011.

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