

Hermetic Control Treatment of *P. truncatus* (Horn) (Coleoptera: Bostrichidae) Infestation on Stored Dried Cassava Chips in Polythen Bags

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Abstract: The focus of this research study was on the hermetic control treatment against *Prostephanus truncatus* Horn, 1878 infestation on dried cassava chips, over an infestation period of 10 weeks in the store. The experimental set-up was done in three hermetic treatments, this include, single bag, double bags and triple bags treatment. Each treatment was replicated 15 times. The used bags were made up of polythene material, with 0.056 mm thickness and 360 mm x 600 mm in dimension. The bags were made air tight by fasten the opening with twine. Each set - up contained 20 kg of dried cassava chips and 30 adults *P. truncatus*. These were stored in the laboratory. At the end of the storage period, *P. truncatus* rate of emergence and weight loss in dried cassava chips decreased with increase in the treatment bag layers. Furthermore, mortality rate in *P. truncatus* decreased with increased treatment bags layers. The use of polythen bag hermetic treatment technique converse protection on stored dried cassava chips. However, triple bags layers treatment was the most effective for *P. truncatus* control.

Keywords: Hermetic, infestation, *P. truncatus*, polythene and mortality

INTRODUCTION

The large grain borer *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) is a devastating storage pest of dried cassava. Weight loss of 36.92 and 63.20%, in dried cassava chips variety TME 30572 and TME 1 were recorded respectively within a storage period of 112 days in the laboratory, Hassan and Popoola (2001). This magnitude of weight loss qualify the pest *P. truncatus* to be classify as serious pest and not an occasional pest as submitted by Schulten (1988). In Togo 11% weight loss was recorded before the introduction of *P. truncatus* to maize. This loss was increased to 35% when the pest was introduced, (Pantenius, 1987). An enormous damage of 40% and 70% weight loss had been reported in maize and cassava respectively in Kenya (Anon, 1974).

These cassava are use as food, raw material in starch and alcohol production, also, they are use as animal feed among other uses. Cassava tuber *Esculenta manihot* enjoy an enormous domestic and export market opportunities. In a study conducted to determine the feature market opportunities for cassava. 64 countries with at least 7,000 metric tones production per year were analyzed. This study shows possibilities of domestic and export business opportunities. Furthermore, the study shows that large quantities of the cassava are needed for domestic use by these countries. A case study of Nigeria, where the government policy favours the use of 10% cassava flour in bread production, this policy could save the country US\$14.8 million per year in foreign exchange (FAO, 2004).

Consequently, the degree of damage inflicted on dried cassava chips by *P. truncatus* in storage calls for adequate control measures. Several chemical control measures in use are expensive, with high, residual effects and technical know- how. Therefore, this study considered the effectiveness and plausible introduction of hermetic (air - tight) method to control level of infestation of *P. truncatus* on dried cassava chips in storage.

MATERIALS AND METHODS

Weighed 20 kg of processed dried cassava chips was introduced into three different treatment bags. 15 replicates were used for each treatment. The treatments bags include one polythene bag layer, two (double) polythene bags layers and three (triple) polythene bags layers. The polythene used measured 0.056 mm in thickness, with 360 mm × 600 mm in dimension. The thickness was measured using Electronic Digital Micrometer (Starrett No734). Where more than 1 bag was used for the treatment they were tucked into one another. Infestation was done with 30 adults' *P. truncatus* per bag, for single, double and triple bags set-up. The set-ups were tide with twine to prevent contamination and escape of the pest. This also ensured that the set - up were kept air-tight. Theses set - up were stored away in a Conviron at room temperature in the Entomology Laboratory, Department of Zoology, University of Ibadan, Nigeria, for periods of ten weeks. This research study was conducted in the year 2010.

Table1: Mean values of *Prostephanus truncatus* Emergence rate under hermetic control* treatment for duration of Ten weeks at room temperature

Hermetic control treatment bag layer	<i>P. Truncatus</i> Mean (\pm SE) emergence rate	
	Instars	Adults
Single (One) bag layer	46.10 \pm 10.60 ^a	265.00 \pm 54.20 ^a
Double (Two) bag layers	17.00 \pm 31.50 ^b	9.60 \pm 1.40 ^b
Triple (Three) bag layers	3.60 \pm 0.60 ^b	5.90 \pm 0.87 ^b

*: Hermetic control at room temperature; Each mean value is replicated 15 times; p<0.05 Using Duncan's Multiple Range Test; Mean values followed with same letter in a row is not significantly different

At expiration of the experimental period the following were determined: Breeding / Emergence rate and Mortality rate of *P.truncatus*, also weight loss in infected dried cassava chips was determined using different standard methods of investigations.

Precautions: For effective use of hermetic storage treatment in *P.truncatus* control; the bags must be a high density polythene to avoid been perforated due to handling. The dried cassava chips must be broken down to little chips and trapped intergranular air within the chips must be expelled.

RESULTS

***P. Truncatus* Emergence under Hermetic Storage**

Condition: The result of infestation of dried cassava chips by *P. truncatus* for ten weeks under hermetic storage condition in the laboratory is shown in Table 1. The results revealed that hermetic storage treatment of *P. truncatus* reduced drastically the pest rate of emergence. The triple bags treatment was the most effective, with significant difference compared to the single bag treatment at p<0.05 using Duncan's Multiple Range Test.

Mortality in *P. truncatus* under hermetic storage

condition: Table 2 shows that the emerged *P. truncatus* suffered high mortality in the setup. Consequently significant mortality was recorded between one layer bag and double bags treatment. Same significant difference was recorded between single bag treatment and triple bags treatment. Using Duncan's Multiple Rang Test at p<0.05 (Table 2).

Weight loss in dried cassava chips under hermetic condition: Weight loss due to *P. truncatus* activities in the dried cassava chips was inversely proportional to the

number of bags used for the treatment. Weight loss recorded in single layer bag treatment was significantly different at p<0.05 using Duncan's Multiple Range Test compared to double layers bags and triple layers bags treatments (Table 2).

DISCUSSION

Prostephanus truncatus ferocious feeding habit has been implicated in the high weight loss in stored products. Also,their wide geographical distribution world wide as pest of roots and tubers products earn them the status of serious pests, consequently, adequate control measures to reduce *P. truncatus* population is needed. As a result of the poor financial status of farmers and low income of traders that cultivate and trade in this crop an effective and cheap control method is required. Several control measures of good qualities have been applied with little or no success. Air - tight (Hermetic) their wide geographical distribution world wide as pest of roots and tubers products earn them the status of serious pests, consequently, adequate control measures to reduce *P. truncatus* population is needed. As a result of the poor financial status of farmers and low income of traders that cultivate and trade in this crop an effective and cheap control method is required. Several control measures of good qualities have been applied with little or no success. Air - tight (Hermetic) their wide geographical distribution world wide as pest of roots and tubers products earn them the status of serious pests, consequently, adequate control measures to reduce *P. truncatus* population is needed. As a result of the poor financial status of farmers and low income of traders that cultivate and trade in this crop an effective and cheap control method is required. Several control measures of good qualities have been applied with little or no success. Air - tight (Hermetic)emergences were recorded as the polythene bags layer increases. Increased bag layers reduced the possibility of damage to the bags, thereby keeping air out of the set-up. *P. truncatus* was able to puncture the bags with their strong and powerful mandible but the more the bags layer the less the hole punctured on the polythene bag. Howard (1983) and Ramirez-Martinez and Silver (1983) also recorded this behaviour in *P. truncatus* in their studies where hole were bored in perpep and polythene. In two and three layers bags treatments, where bored hole were reduced or not available, air was completely short out

Table 2: Mean values of *P. truncatus* Mortality and weight loss in dried cassava chips under hermetic control* treatment for storage period of ten weeks at room temperature

Hermetic control bag layer treatment	Mean \pm SE of <i>P. truncatus</i> mortality rate	Mean \pm SE weight loss in dried cassava chips (g)
Single (One) bag layer	82.60 \pm 16.70 ^a	7.58 \pm 0.83 ^a
Double (Two) bag layers	19.20 \pm 2.19 ^b	0.64 \pm 0.54 ^b
Triple (Three) bag layers	22.70 \pm 1.66 ^b	0.04 \pm 0.03 ^b

*: Hermetic control at room temperature; Each mean value is replicated 15 times; p<0.05 Using Duncan's Multiple Range Test; Mean value followed with same letter is not significantly different

out of the set - up and less significant progeny were recorded with high mortality rate. This was in line with previous study by Bailey (1965), where five different insects were studied under hermetic storage conditions. He was able to arrive at the point that oxygen concentration depletion caused retarded development of the pests' population. Furthermore, he was of the opinion that the accumulated carbon dioxide does not necessarily lead to death in some pest such as *Tribolium* species. *Trogoderma* species larval may under go diapause at low carbon dioxide with little mortality, Burges (1959).

High mortality rate was recorded in this study, although this may not be directly connected to oxygen concentration depletion, but it might be due to over crowding. Increased population without dispersal with time may increase the population beyond carrying capacity of the store. When this happens, competition for space, food and opposite sex sets in. Howard (1983) and Chittenden (1911), agrees that tubers and roots are good breeding site for *P. truncatus* and adequate food size is needed for better frass production for the offspring. In hermetic storage conditions the facilities required for survival may become inadequate and this may lead to mortality of the pests.

Emergence and mortality rate are major factors that determine weight loss in stored products due to pest activities. It was not surprising to record decreased weight loss of dried cassava chips as polythene bags layers increases. Single bag was easier to puncture than double and triple bags, when they puncture the bag this allows for air to enter the set up thereby increasing the oxygen concentration. This improves the conditions of the pests and assists population build up. Increase in adult population increase the boring and feeding activities of *P. truncatus* which results in weight loss in the dried cassava chips. Howard (1983), noted that, the amount of frass produced by *P. truncatus* was equivalent to the numbers of eggs laid, which suggest that the frass produced is for the offspring.

Hermetic control technique in storage is not only user friendly. It is highly economical; it protects dried cassava chips from *P. truncatus* infestation, which in turn protect the crop quality for high marketability and availability as food and raw material for factories and all users.

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REFERENCES

- Anon, 1974. Recommended methods for the detection and measurement of resistance of agricultural pests to pesticides. Tentative method for adults of some major beetle pests of stored cereals with malathion or Indiana. FAO method No. 15, Pl. Prot. Bull., 22: 127-137.
- Bailey, S.W., 1965. The position of khapra beetle in Australia. FAO. Plant Protect. Bull., 6: 1-2.
- Burges, H.D., 1959. Studies on the dermestid beetle, *Trogoderma granarium*. III. Ecology in malt stores. Ann. Appl. Biolog., 47: 445-462.
- Chittenden, F.H., 1911 Papers on insects affecting stored products. The lesser grain borer. The larger rain borer. Bull. Bur. Ent. U.S. Dept. Agric., 96: 929-952.
- FAO/IFAD, 2004. A Review of Cassava in Africa with Country Case Studies on Nigeria, Ghana, the United Republic of Tanzania, Uganda and Benin. Proceedings of the Validation on the Global Cassava Development Strategy. Reterived from: <http://www.fao.org/docrep/007/y5287e/y5287e04.htm#bm04.1>
- Hassan, A.T., K.O.K. Popoola, 2001. *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) ability to breed and damage potential on cassava dried chips. Bioscience. Res. Comms., 3(6): 519-583.
- Howard, D.C., 1983. The population biology of the greater grain borer *P. truncatus* (Horn) Ph.D. Thesis, University of Readings, UK.
- Pantenius, C.H., 1987. Verlustanalyse in kleinbäuerlichen Maislagerungssystemen der Tropen, dargestellt am Beispiel von Togo. Dissertation, Christian-Albrechts Universität, Kiel, pp: xiii +249
- Ramirez-Martinez, M. and B.J. Silver, 1983. Deterioration and Damage Produced in Corn Grains In: Oxley, T.A., S. Barry, (Eds.), Mexico by *Prostephanus truncatus* (Horn) Coleoptera: Bostrichidae). Biodeterioration, John Wiley, N.Y., 5: 252-591
- Schulten, G.G.M., 1988. FAO's experiences with crop loss-assessment. Insect Sci. Appl., 9: 763-767.