Efficacy of Multiple Cellophane Bagging in the Control of Cowpea Bruchids *(Callosobruchus Maculatus)*

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Abstract: **- An experiment was conducted to study the efficacy of multiple cellophane bagging in the control of cowpea bruchid *(Callosobruchusmaculatus)*. The treatments consisted of single, double, triple, 4- layer and 5-layer low density cellophane bagging along with a control. The experiment was laid out in a laboratory using a completely randomized design in five replications. Each batch of seed stored weighed 2 kg and was stored under the same environmental conditions in the laboratory. Data collected after four months of storage included bruchidoviposition, population, number of holes/seed and weight loss. Minitab statistical software was used to carry out the analysis of variance for all the data collected and the treatment means were compared using 95% confidence interval test. Results indicated that bruchidoviposition, population and number of holes/seed decreased significantly (P<0.05) with increasing cellophane layers. Multiple cellophane bagging therefore presented a high potential for use in the control of cowpea bruchids.**

Keywords: Cowpea, Bruchids, Cellophane bagging, Population

I. INTRODUCTION

Cowpea *(Vignaunguiculata L.)* is an important grain legume which serves as a vital source of protein in the diets of the peoples of the developing tropical countries where consumption of animal protein is rather low because of social and economic reasons. More than 70% of the world's cowpea production is concentrated in three countries, namely: Nigeria, Brazil and Niger with Nigeria being the World's leading producer (Singh *et al*., 1989).

Preservation and storage of cowpea poses a great challenge to cowpea producers in West and Central Africa because of losses arising from bruchid infestation. Many farmers sell cowpea grain at low harvest-time prices rather than risk losses by bruchids during storage. Losses are both quantitative and qualitative where in heavy infestation, loss of grain weight, viability, nutritional value, market value and taste occur.A conservative estimate of cowpea storage loss is put at 25% (Mousa, 2006). Cowpea bruchids are seed beetles that develop and reproduce rapidly in stores of cowpeas. A female bruchid which has just emerged from the seed and newly mated can produce 60 – 120 eggs (Fox, 1993) most of which hatch into larvae and survive to adult-hood. The short life cycle of five weeks and the large number of eggs laid at a time by a female bruchid ensure rapid population build up within a short period of time.

The need to develop alternative safe, cheap and chemical-free cowpea storage techniques is apparent owing to the fact that the use of synthetic pesticides has presented quite a number of problems to producers, consumers and the environment. Apart from increased cost of pesticides and the handling hazards, there are concerns about threat to human health and the environment. In 2009 alone, food poisoning arising from improper chemical storage of cowpea resulted in 10 deaths and 20 more hospitalised after eating contaminated cowpea in the Northern Nigerian State of Kano (IPS, 2009). Public awareness of these risks has increased interest in finding safer chemical-free alternatives.

Purdue University in the USA initiated the Purdue Improved Cowpea Storage (PICS) which is a triple layer bagging (hermetic storage) technology involving the use of triple – layer High Density Polyethylene (HDPE) bags with thickness of about 80 microns cowpea storage in the West and Central Africa (Baribusta*et al.*, 2010),

This study was carried out with the objective of evaluating the efficacy of low density multiple cellophane bagging in the control of cowpea bruchids.

II. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at the Federal Polytechnic, Bauchi, Nigeria in the Post Harvest Processing Laboratory of the Department of Agricultural and Bio-Environmental Engineering Technology.

2.2 Sources of Experimental Materials

Local variety of cowpea known to be highly susceptible to bruchid attack, were purchased from MudaLawal market in Bauchi Local Government Area of the State at harvest season. The seeds were picked for the experiment. Low density transparent cellophane bags were also purchased from the same Market.

2.3 Treatments and the Experimental Design

The treatments consisted of single, double, triple, 4-layer and 5-layer cellophane bagging and a control. The control was a woven nylon or polypropylene bag. The experiment was laid out in the laboratory using a completely randomized experimental design in five replications. Each batch of seed stored in the laboratory weighed 2 kg and were all stored for a period of 4 months before opening.

2.4 Data Collection and Analysis

At the end of 4 months of storage, data on bruchidoviposition/seed, bruchid population/kg of seeds, mean number of holes created per seed, and the weight loss were recorded. One way analysis of variance was carried out on the data collected to test for the significance of the treatment effects using Minitab software. The treatment means were compared using individual 95% confidence interval generated by the Minitab software.

III. RESULTS AND DISCUSSION

The results of the effect of treatment on the mean number of bruchid eggs laid/seed after 4 months are presented in Table 1. The results indicated that the treatment effect was significant at both 5% and 1% levels of significance.

The highest mean oviposition of 19.86 which is approximately 20 bruchid eggs/seed was recorded with the control. The values of oviposition decreased steadily with increasing number of cellophane layers up to 5-layer bagging where almost zero oviposition was recorded. In the same vein, bruchid population decreased significantly ($P<0.05$) from 896 live bruchids/kg of seeds in the control to just about 18 in 5-layer cellophane bagging (Table 2). The above pattern of observation could be explained from the fact that in hermetic storage, insects respire aerobically and thus utilize the oxygen in the airtight container while also raising the CO_2 level. According to Margam (2009), once the oxygen level falls sufficiently low, the beetles cease feeding and become inactive. The state of inactivity itself causes growth and development to cease and in turn reproduction stops. This must have accounted for the decrease in bruchid population as the cellophane layers increased. When oxygen becomes deficient and the state of inactivity sets in, the beetles begin dying, the early instar larvae and pupae appear to be particularly vulnerable.

The results of the effect of treatment son the mean number of holes/seed are presented in Table 3. The results showed that the mean number of holes created by bruchids/seed was highest with the control and lowest with 5-layer cellophane. Approximately, 4 holes/seed were recorded with the control which decreased significantly ($P<0.05$) to almost zero in the 4-layer and 5-layer cellophane bagging respectively. This therefore indicated an evidence of a strong cowpea grain protection against the bruchid attack in the multiple cellophane bagging.

IV. CONCLUSION

The study assessed the efficacy of multiple cellophane bagging in the control of cowpea bruchids. The multiple bagging techniques based on the principle of hermetic storage which is chemical-free and therefore poses no health hazards to consumers. Besides, it is also cheapand readily available.

Single, double, triple, 4-layer and 5-layer low density cellophane bagging and a control were assessed. In all the characters assessed, it was observed that bruchid infestation and damage decreased significantly with increasing cellophane layers.Multiple cellophane bagging therefore presents a high potential for use in the control of cowpea bruchids.

Appendix 1

Table 1: One-Way ANOVA, treatment means and the 95% confidence interval test for number of eggs laid/seed after 4 months of storage.

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Analysis of Variance
Source      DF       SS        MS        F        P
Treatment    5   1160.7     232.1    21.61**   0.000
Error       24    257.8      10.7
Total       29   1418.5
                                    Individual 95% CIs For Mean
                                    Based on Pooled StDev
Level        N     Mean     StDev   -----+---------+---------+---------+-
Control      5   19.860     5.981                             (---*----)
1-Layer5    12.120     3.798                     (---*----)
2-Layer      5   10.940     3.614                   (----*---)
3-Layer      5    9.060     0.802                    (---*---)
4-Layer      5    4.260     0.744         (---*---)
5-Layer      5    0.104     0.027    (---*---)
                                    -----+---------+---------+---------+-
Pooled StDev =    3.277                0.0       7.0      14.0      21.0
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Appendix 2

Table 2: One-Way ANOVA, treatment means and the 95% confidence interval test for bruchid population after 4 months of storage.

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Analysis of Variance
Source     DF        SS        MS         F        P
Treatment   5   2890752    578150   238.46**   0.000
Error      24     58189      2425
Total      29   2948941
                                   Individual 95% CIs For Mean
                                   Based on Pooled StDev
Level       N      Mean     StDev  -+---------+---------+---------+-----
Control     5    896.00     73.10                              (-*)
1-Layer     5    766.40     57.52                          (-*)
2-Layer     5    572.80     43.30                    (*-)
3-Layer     5    443.20     51.41               (-*)
4-Layer     5    164.80     36.49      (*-)
5-Layer     5     17.60      6.69  (-*)
                                   -+---------+---------+---------+-----
Pooled StDev =    49.24             0       300       600       900
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Appendix 3

Table 3: One-Way ANOVA, treatment means and the 95% confidence interval test for number ofholes/seed after 4 months of storage

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Analysis of Variance
Source     DF        SS        MS         F        P
Treatment   5    42.751     8.550    83.26**    0.000
Error      24     2.465     0.103
Total      29    45.216
                                   Individual 95% CIs For Mean
                                   Based on Pooled StDev
Level       N      Mean     StDev  --+---------+---------+---------+----
Control     5    3.6480    0.3213                              (-*--)
1-Layer     5    2.7080    0.3890                        (--*-)
2-Layer     5    2.4120    0.4510                      (-*--)
3-Layer     5    1.8740    0.1299                 (--*-)
4-Layer     5    0.7300    0.3733        (-*--)
5-Layer     5    0.1080    0.0449  (--*-)
                                   --+---------+---------+---------+----
Pooled StDev =   0.3205            0.0       1.2       2.4       3.6
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