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The Effect of Time of Harvest on the Damage Caused to Cowpea by the Storage Bettle, *Callosobruchus Maculatus* (FAB.) (Coleoptera: Bruchidae)

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The effect of time of harvest on the level of damage caused by *Callosobruchus maculatus* on cowpea was studied. Cowpea (*Vigna unguiculata*) (variety Asontem) was planted on 9 raised beds each measuring 2.4m x 2.4 m, 3 each for early, mid and late harvests i.e. 60,70 and 80 days respectively. Each plot had 20 plant stands. The plants were sprayed with PAWA (Lambda cyahalothrin) at 5 weeks after germination and with Cymethoate at flower bud and pod formation stages. Harvesting was done by hand-picking pods from the inner rows of plants. The harvested pods were sun-dried and the seeds were removed and stored in sealed transparent bottles. The number of adult weevils emerging were collected and counted weekly for 8 weeks. Weight loss, percent damaged seeds and the number of holes were noted for each harvest time. Mean number of emerged adults ranged from 1.7 at 60 days of harvest to136.7for 80 days of harvest. Significantly larger number of holes and higher % damage were recorded for the 80 days harvest than the 60 and 70 days harvest (p= 0.0001). Prompt harvest of matured cowpea pods would reduce the destruction of stored cowpea by *C. maculatus.*

Keywords: Cowpea, Storage Bettle, *Callosobruchus Maculatus,* Coleoptera: Bruchidae.

INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walp. is one of the most widely cultivated, versatile and nutritious grain legumes (Ethlers and Halla,1997). It has been consumed by humans since the earliest practice of agriculture in the developing countries of Asia, Latin America and Africa, where it is a valuable source of proteins, vitamins and mineral salts (Singh *et al.,* 2003). Cowpea is now a broadly and highly adapted crop which is cultivated around the world as a vegetable, shelled dried pea and as a cover crop. The mature legume contains 23-25% protein, 50-67% carbohydrates, 1.9% fat, 6.35% fibre as well as some of the B-vitamins (Bressani, 1985). Cowpea seed is therefore valued as nutritional supplement to cereals in many parts of the developing world.

Yields of cowpea are, however, low (Ogbuinya, 1997) due to limited availability of improved varieties, which are high yielding, and damage caused by field and storage insect pests (Ndoye, 1978; Rusoke and Fatunla, 1987; Monti *et al*., 1997).

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Some of the major field insect pests are aphid (*Aphis craccivora*) that attacks the crop from the seedling to podding stage, flower thrips (*Megalurothrips sjostedti*) at the flowering stage, the pod borer *Maruca vitrata* at the flowering and podding stages and pod sucking bugs such as *Riptortus dentipes*, *Clavigralla* spp.and *Anocplocnemes curvipes* at the podding (FSREU, 1999; IPMCSRP, 2000), and the storage bettle, *Callosobruchus maculatus*. The field pests can cause reduction in yield as high as 95% depending upon location, year and variety (Gudrups *et al*., 1997).

Infestation by the storage pest is very low at the time of harvest and may sometimes be undetectable (Huignard, *et al*., 1985). The bettle multiplies very fast in storage, giving rise to a new generation every month (Ouedraogo *et al*., 1996). Infestations on stored grains may reach 50% within 3-4 months of storage (Pascual-Villalobus and Ballesta-Acosta, 2003). If not managed, the storage pest, on the other hand, can cause as much as 100% damage to the stored produce reducing the quantity, quality and consequently, the market value (Mbata, 1993., Shade *et al*., 1996). If not managed, the pest can damage 100% of stored grain causing weight losses up to 60% (Kaita *et al*., 2000).

In Ghana, many of the resource-poor farmers do not treat their harvested grains with insecticides before storing them. It is therefore necessary to reduce losses by knowing the best time to harvest the crop so that fewer weevils would be carried into storage. The study was therefore carried to determine the most appropriate time to harvest cowpea to reduce the level of *C. maculatus* infestation before storage.

MATERIALS AND METHODS

The study was carried out on an experimental farm near the Department of Theoretical and Applied Biology, Kwame Nkrumah University of Science and Technology, Kumasi during the minor rainy season of 2008. Cowpea seeds (variety Asontem) were obtained from the Legume Breeding Division of the Crops Research Institute (CRI) of the Council for Scietific and Industrial Research (CSIR), Kumasi, Ghana. Nine plots were prepared, each measuring 2.5 m (breadth) by 5.0 m (length) and 1 m between plots representing three harvesting times with 3 replicates in a randomised complete block design (RCBD). There were six rows of 5 m long per plot and 0.50 m between rows and two seeds per hill of 0.20 m apart within row. Refilling of gaps was done two days after germination and the seedlings were thinned to two per hill where necessary. Four seeds per hole were planted. Filling of gaps created by ingeminated seeds was done 2 days after germination. The seedlings were allowed to grow till day 14 before thinning out to 2 seedlings per hole. Clearing of Weeding was done two and six weeks after germination and thereafter when necessary. The cowpea plants were sprayed with PAWA 2.5 EC (Lambda cyhalothrin, 2.5g a.i/litre) at thirty days after planting (DAP) i.e. at the flower bud formation and 40 DAP (flower formation) and with Cymethoate Super EC (combination of 36 g Cypermethrin and 400 g Dimethoate per litre) 50 DAP (pod formation).

Two meters at each end of the two middle rows were cut off and the one metre in the middle was used as the harvest area. . Early harvesting was done at 60? DAP, mid-harvesting at 70? DAP and late harvesting at 80 DAP. At each harvest, 100 pods were randomly selected from the harvest area of each plot. The pods were sun-dried for 5 days, threshed and the seeds , weighed and stored in 500 ml capacity kilner jars sealed with a nylon mesh (gauge?) fastened with a rubber band..

Data collection

The number of 0-1 day-old adult weevils emerging from each treatment was sieved out daily, counted and discarded until emergence ceased. At the end of adult emergence the seeds of each treatment were weighed and the loss in weight calculated. At the 8th week, the cowpeas for each harvest were weighed and the weight loss was calculated. The number of damaged seeds and holes on them were counted from 100 seeds sampled at random from the bulk. Percent damaged seeds were calculated using the formula:

$$\text{Percent damaged seeds} = \frac{\text{Number of damaged seeds}}{\text{Total Number of seeds sampled}} \times 100\%$$

Data analysis

The general linear model (GLM) procedure of SAS (SAS institute 2008) was used to analyze the data. Where significant difference ($P< 0.05$) was observed, mean separation was done using Student Newman Kuel's (SNK) test.

RESULTS

Number of weevils emerging

Weevil infestation was observed in all the treatments. There was an increase in the number of emerged weevils from the early to the late harvest (Figure. 1). The difference among the means of the three times of harvest was significantly different ($P< 0.05$) (Table 1). In the early harvest, emerged adults were observed after 28 days in storage. On the other hand, emergence from the mid and late harvested crops started only 7 days after storage.

Table 1. Effect of time of harvesting on mean weevil emergence, damaged seeds and number of holes per damaged seeds.

Time of harvest	No. of weevils emerging	weight loss(g)	No. of holes	% damage
Early	1.7a	4.91a	1.0a	1.0a
Mid	81.3b	13.77b	10.1b	10.7b
Late	136.7c	29.46 c	21.2 c	23.3 c

Means with different letters in the same column are significantly different (P< 0.05)

Weight loss (g)

Early harvested cowpea recorded the least weight loss of 4.91g, whilst the late harvested crop recorded the largest weight loss of 29.46g (Table 1). The difference among the treatments was significant (P< 0.05) (Table 1).

Percent damaged seeds and number of holes

Early harvested cowpea recorded the least percent damage whilst the late harvest had the greatestt percent damage (Table 1). A high significance difference was recorded for percent damage in the three times of harvesting (P< 0.05) Similarly, early harvested seeds had the least number of holes (1.0) whilst the late harvested recorded the greatest number of holes (21.2). The differences among the mean numbers of holes was highly significant P< 0.05.

DISCUSSION

The cowpea storage beetle, *C. maculatus* infests cowpea seeds from the field to store where the entire stored material could be completely damaged within a very short time. This insect infests the cowpea plants before harvest. They lay eggs on both green and dry mature pods (Messina, 1987). These eggs are then carried from the field into storage. Thus, the population of *C. maculatus* in storage depends on the initial level of infestation and length of time cowpea is stored. The longer matured cowpea stays on the field before harvest the larger would be the initial infestation and consequently the greater the damage.

It was observed that the longer cowpea stayed in the field before harvest the greater the number of adults emerging in store (Figure. 1). The early harvested cowpea recorded very low numbers of emerged adults, an indication that at the time of harvest, infestation was very low (Huignard *et al*., 1985). The fact that the early harvested crop recorded the least adult emergence was also due to the fact that harvesting was done 1 week after application of the insecticide, which drastically reduced the numbers of *C. maculatus*. There was a progressive increase in adult emergence from the early to late harvest (Figure.1). The effects of the insecticides reduced with time, thus allowing the pest to increase in numbers during subsequent harvests.

Weight loss in cowpea seeds was as a result of the larvae eating up the endosperm. The larvae made use of the dry matter from the seeds thereby reducing the weight. Early harvested crop recorded the least weight loss because it was least infested than the mid and late harvests. The late harvested crop recorded larger weight loss than the mid harvested crop because it had the largest infestation and subsequently the larvae ate comparatively more of the stored food and thus had the largest adult emergence. In the early harvested crop, weight loss was mainly due to loss of water from the seeds rather than due to infestation since cowpea from this harvest recorded very low adult emergence compared to the other harvests times. Golob, (1993), observed that in Northern Ghana, levels of cowpea damage varied from 15 to 94%. Golob, *et al*. (1996) however concluded that even though *C. maculatus* attacked cowpea, weight loss was rarely in excess of 9% even after six months of storage.

There was obviously some damage to the seeds when adult weevils emerge it. The larger the number of adults that emerged the larger the number of seeds that were

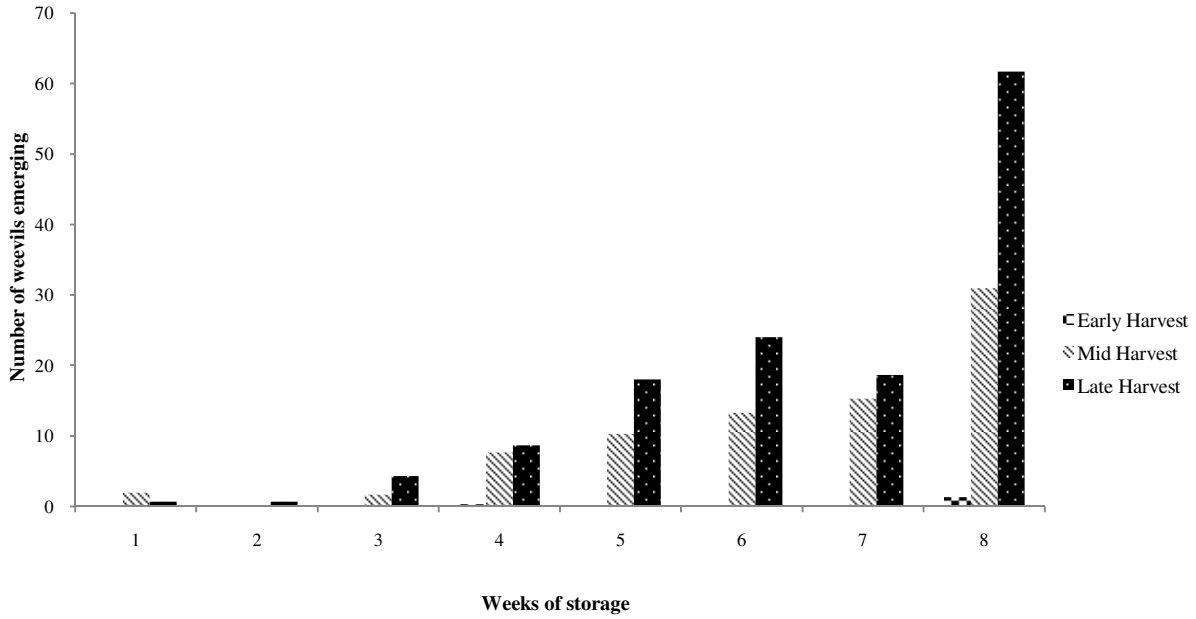

Figure 1: Effect of time of harvest on adult weevil emergence

damaged and hence the larger the number of holes. The late harvested crop which recorded significantly larger number of emerge adult weevils also had significantly larger number of holes and percent damage. On the other hand, early cowpea which had the least number of emerged adults also recorded the least number of holes and consequently the least percent damage. Even though early harvesting led to lower infestation, some of the pods did not contain matured seeds. It is therefore best to harvest cowpea at 70 days after germination, at a time when seeds would be fully formed and infestation is relatively low.

CONCLUSION

Callosobruchus maculatus is a major storage pest of cowpea which infects cowpea before harvest. The higher the infestation levels before harvest the greater the damage to the seeds in storage. This will result in higher weevil emergence causing a greater weight loss, larger number of holes and consequently loss of economic value. It is therefore important that cowpea is harvested at a time when *C. maculatus* numbers are low because it takes 3-4 months for *C. maculatus* population to reach damaging levels in unprotected seeds. Harvesting cowpea at 70 days will result in fewer *C. maculatus* being carried into storage. If cowpea seeds are to be stored for longer periods, then it is advisable to treat the seeds with recommended insecticides.

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