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Effect of the Infection of *Callosobruchus maculatus* (Fab.) on the Weight Loss of Stored Cowpea (*Vigna unguiculata (*L.) Walp)

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ABSTRACT Market survey and laboratory experiments were conducted to obtain more reliable estimates of cowpea weight loss caused by individual *Callosobruchus maculatus*. In both the market survey and laboratory experiments, a highly significant inverse linear relationship existed between *C. maculatus* feeding/emergence holes and cowpea weight loss ($P<0.001$, linear correlation coefficients (r) = -0.322,-0.959, and –0.921, for the market survey, laboratory experiments 1 and 2, respectively). Cowpea weight losses were 0.026g, 0.015g, and 0.016g per individual *C. maculatus* in the market survey, laboratory experiments 1 and 2, respectively while the highest number of *C. maculatus* feeding/emergence holes was 188, 1669, and 2028 per 200 cowpea seeds for the market survey, laboratory experiments 1 and 2, respectively. This is an important component in the establishment of an Economic Injury Level (EIL) for *C. maculatus* on *V. unguiculata*. @*JASEM*

Cowpea, *Vigna unguiculata* (L.) Walp, is one of the five most important legumes in the tropics and provides the protein for most people in the region and nitrogen to the soils (Duke, 1990). The cowpea seed beetle, *Callosobruchus maculatus* (Fab.), is the most important storage pest of cowpea throughout the tropics (NRI, 1996). The quantity of cowpea lost annually through *C. maculatus* is substantial, although no accurate figures are available; cowpea damage estimates have always been expressed in percentages. For instance, Caswell (1976) indicated 50% loss at Ibadan and minimally above 30% at Zaria. Caswell (1980) also reported that *C. maculatus* damage level to cowpea reached 10% by January and rose to 50% by July. Throughout tropical Africa, *C. maculatus* consumed 50-90% of cowpea in storage annually (IITA, 1989). Frequently, farm storage for six months was accompanied by 70% seed infestation and about 30% weight loss and virtually unfit for consumption (Singh and Jackai, 1985). These percentage losses are mere estimates. The quantification of cowpea losses through *C. maculatus* is very desirable. This study was undertaken to determine the cowpea weight loss caused by the development of individual *C. maculatus* in a cowpea seed

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MATERIALS AND METHODS

Market Surve:y Seeds (white) of a local cowpea cultivar, 'Potiscum', were purchased monthly for a 12-month period from four major markets (Town, Creek Road, Mile One, and Mile Three) in Port Harcourt, Nigeria to assess the weight loss caused by individual *C. maculatus* throughout its life history. Monthly, five 250g-cowpea samples were purchased from each market. Each 250g-sample within a market was purchased from different randomly- selected market stall, by picking every fifth stall. Each sample was placed separately after purchase and subsequently taken to the laboratory. In the laboratory, each sample was emptied into a tray and 200 seeds were selected at random, by picking every third seed; each seed inspected for *C. maculatus* emergence holes. The number of holes per 200 seeds was recorded. The 200 seeds were then oven-dried in perforated 228 x 101 mm-brown envelopes at 135 ± 4^0F for 21 hours. Drying of preliminary samples beyond 21 hours resulted in a very negligible loss in weight. The drying was to eliminate the variation that might result from the moisture content of the seeds. Each 200 seed-sample was weighed after drying and the weight recorded.

Laboratory Experiment: Two separate but similar experiments were conducted. In each experiment, 10 x 200 cowpea seeds without any *C. maculatus* feeding/emergence holes from the market survey were selected, placed in perforated 228 x 101 mm-brown envelopes and oven-dried at 135 ± 4^0F for 21 hours. The weight of each 200 seed-sample was then recorded. Each of the dried 200 seed-sample was placed in one-litre, transparent, plastic container. One hundred unsexed *C. maculatus* adults, obtained by sieving infested cowpea in a local market, were introduced into each of the 10 plastic containers per experiment. The mouths of the containers were then covered with muslin mesh, held in place with rubber

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bands. The containers were kept under fluctuating laboratory conditions (26.3 – 28.5 ^{0}C and 73.5 – 83.0% r.h.) and *C. maculatus* allowed to go through two generations with a total duration of 50 days based on a developmental period of 24.3 days reported by Pessu and Umeozor (2003) under similar laboratory conditions. The containers were left undisturbed at the end of first generation. During the emergence of the second generation, the containers were inspected daily to remove emerged adults. Inspection of the containers was continued until no adult emergence was observed for three consecutive days. The seeds in each container were examined to remove *C. maculatus* eggs adhering to the surface of the seeds. The number of *C. maculatus* feeding/emergence holes on the 200 seeds per container was counted and the seeds weighed; all the data were recorded. Since each larva develops within a single cowpea seed and emerges as adult through an emergence hole (Tun, 1979; Caswell, 1980), the number of feeding/emergence holes was indicative of the number of emerged adults and, consequently, the number of *C. maculatus* that caused the damage. The data for the market survey and the laboratory experiments were subjected to Simple Linear Regression Analyses. Weight of cowpea per 200 seeds was treated as a dependent variable; *C. maculatus* feeding/emergence holes per 200 seeds were the independent variable.

RESULTS AND DISCUSSION

In both the market survey and laboratory experiments, a highly significant inverse relationship (P<0.001) existed between the weight of cowpea and *C. maculatus* feeding/emergence holes (Table 1, Figs 1 and 2).

Table 1. Relationship between *Callosobruchus maculatus* feeding/emergence holes and the weight of cowpea.

Experiment	W	X	Y	Z	Intercept	*r*	Prob[b]
Market survey	0-188	240	37.2-53.6	-0.026	47.76	-0.322	0.001
Laboratory							
1	0-1669	20[a]	24.7-52.3	-0.015	49.15	-0.959	0.001
2	0-2028	20[a]	18.4-49.1	-0.016	44.89	-0921	0.001

[a]Weight of each 200 seeds recorded at the beginning and end of laboratory experiment W = Range of feeding/emergence holes per 200 seeds; X = Number of 200 seeds, Y = Range of wt per 200 seeds (g); Z = Slope (β) (g/hole), [b]Highly significant (P<0.001; Linear regression analysis; weight of cowpea = α - βfeeding/emergence hole).

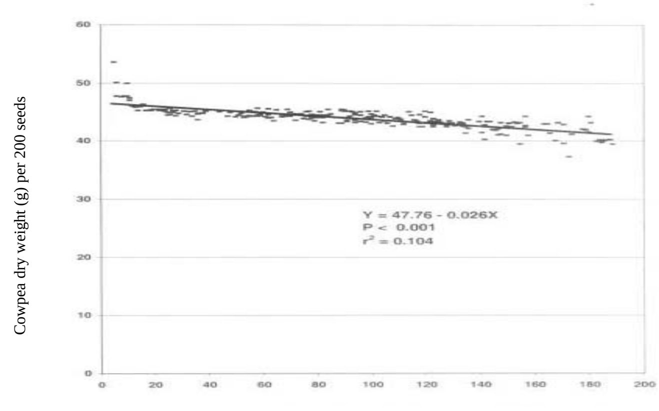

Fig 1. The estimated linear regression between weight of cowpea (Y) and *Callosobruchus maculatus* feeding/emergence hole (X) in the market survey.

In the laboratory experiments, the linear correlation coefficients (*r*) were –0.959 and –0.921 for experiments 1 and 2, respectively (Table 1) indicating that the relationship between the weight of cowpea and *C. maculatus* feeding/emergence holes was linear. On the basis of the slopes (β), the loss in weight of cowpea caused by *C. maculatus* feeding/emergence holes was 0.026g per hole within a range of 0-188 feeding/emergence holes per 200 seeds for the market survey (Table 1). In the laboratory experiments, the loss due to individual *C. maculatus* was 0.015g per hole based on the maximum of 1669 feeding/emergence holes per 200 seeds and 0.016g per hole based on the maximum of 2028 feeding/emergence holes per 200 seeds for experiments, 1 and 2, respectively (Table 1). The loss in weight of cowpea attributed to individual *C. maculatus* was greater in the market survey than in any of the laboratory experiments but the number of feeding/emergence holes in the market survey was lower than that in each laboratory experiment. This indicated that as the number of feeding/emergence holes per the same number of cowpea seeds increased the weight loss of cowpea due to individual *C. maculatus* decreased.

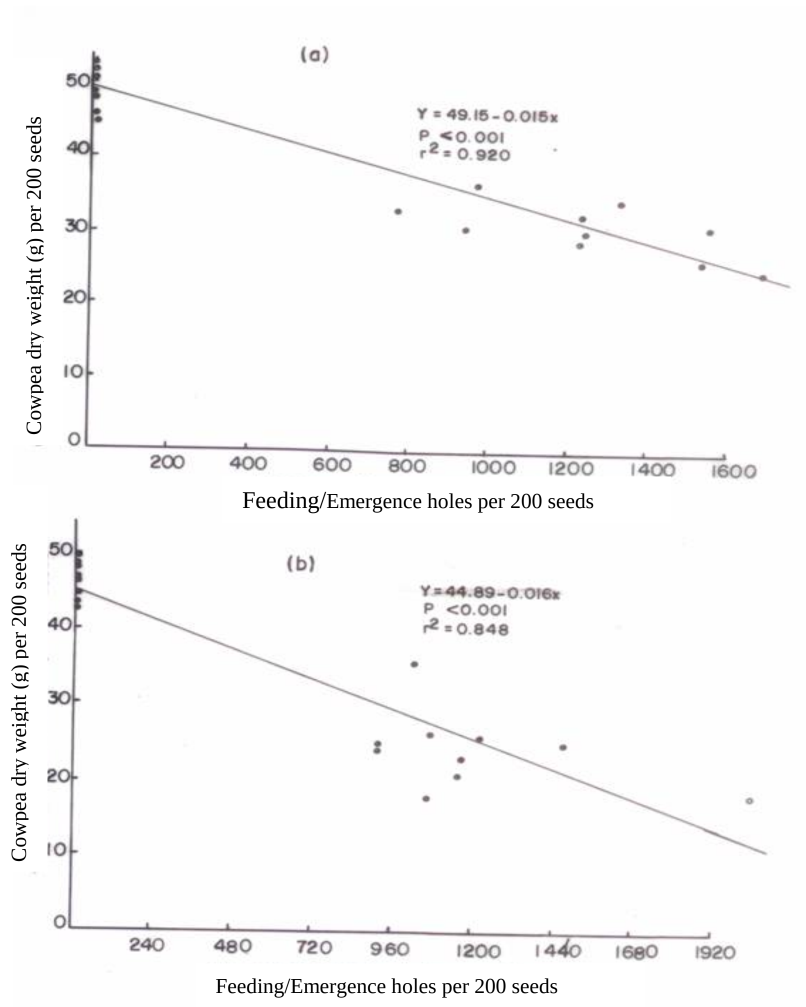

Fig 2. The estimated linear regression between weight of cowpea (Y) and *Callosobruchus maculatus* feeding/emergence hole (X); (a) and (b) are laboratory experiments 1 and 2, respectively.

Similar observation was made by Caswell (1980) who observed that when more than one larva were present in a seed, the percentage loss per emerging adult was less. Increase in larval density resulted in larval competition which affected food availability, larval mortality, developmental time, and adult size (Mitchell, 1990). Thus, larval competition probably accounted for the reduced weight loss of cowpea per individual *C. maculatus* as the number of feeding/emergence holes increased. Unlike previous cowpea loss estimates, the results of this study have reliable estimates of cowpea weight loss caused by individual *C. maculatus.* This is an important component for the establishment of Economic Injury Level (EIL) of *C. maculatus* on cowpea.

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