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Incidence of *Sitophilus oryzae* and Other Stored-product Pests on Cowpea in Local Markets in Accra: Management Strategies Employed by Retailers

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Abstract: In recent times, the unusual presence of *Sitophilus* on cowpea has become an issue in Ghana as it constitutes a threat to food sufficiency and food security; this, by extension, necessitated the execution of this survey to establish the specific identity of the insect and its incidence, on stored cowpea in Ghana and consequently assess the level of awareness of traders and the management strategies employed. Using internal morphological identification techniques, the insect was identified as *Sitophilus oryzae* with an incidence rate of 12, 22 and 20% as against 50, 41 and 42% incidence rate of *Callosobruchus maculatus* after 30, 60 and 90 days respectively, of undisturbed storage of cowpea within the marketing systems in Accra, Ghana. Relatively low number of retailers (35.44%, N = 79) was aware of this occurrence, with 91.14% of this employing the energy-demanding and time-consuming sieving techniques as their main control strategies. This paper draws attention to the possible worsening of food insecurity already eminent in Africa for insects are no respecters of international or geo-political boundaries as they can spread to other countries, should this observation be left unchecked.

Key words: Weevils, *Vigna unguiculata*, storage, market, pest, management, food security

INTRODUCTION

Cowpea, *Vigna unguiculata* (L.) Walper, also known as black-eyed peas, is a crop of worldwide importance cultivated in the tropics and subtropics (Asante and Mensah, 2007); and is source of food for humans and feeds for animals along with some industrial values (Mbata, 1992). It has provided more than half of the plant-derived protein consumed by resource poor people (Asante and Mensah, 2007). However, the crop is subject to insect infestation both in the field and in the storage, thereby causing severe loss of which such storage loss could be very enormous.

The most abundant pest of stored cowpeas is *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae) (Wolfson *et al.*, 1991), with the ability to infest cowpea in the late pre-harvest stage, a means through which it gets into stores or even through the entire marketing system to retail stores where most raw grains and processed commodities spend some time (Hagstrum and Subramanyam, 2006) before being sold and it is even worse off when the poor hygiene within storage facilities constitutes a major source of infestation (Mbata, 1992) in that insects adapt to diverse habitats by exploiting

essential resources and feeding on different food types, a strategy which encourages rapid population build-up (Hagstrum and Subramanyam, 2006).

Callosobruchus maculatus has been the major stored product pest of cowpea. On the contrary, *Sitophilus* species (Coleoptera:Curculionidae), a major storage insect pest of cereals, was found in recent times infesting cowpea sold in one of the markets in Accra; it was later identified as *Sitophilus oryzae* (Linnaeus) (Egbon, 2009; Egbon and Ayertey, 2009). *Sitophilus* species being the most injurious cereal pest, *S. oryzae* may well be the most dangerous owing to its ability to develop on different food materials such as cowpea (Egbon *et al.*, 2012). These observations necessitated the execution of this survey to ascertain its relative incidence on cowpea within the marketing systems; and to establish retailers' perceptions and their integrated management strategies.

MATERIALS AND METHODS

The incidence and abundance of the stored product insects associated with cowpea within the market system were assessed across three selected markets in Accra metropolis viz Kaneshie, Madina and Makola Markets. In each market, 3 stores were used except in Madina market

where 2 stores were used for lack of third volunteer. This survey was done in phases over the time range of 30 to 90 days. The 1st phase was initially carried out on the day when samples of cowpea were purchased from retailers, whilst the 2nd and 3rd were executed 30 and 60 days later respectively. The cowpea samples were purchase irrespective of their varieties and grain sizes, though they were all white-coated cowpeas.

At each retailer's store standard measures of cowpea samples of about 800 g were introduced into 9 glass containers, covered with a mesh to prevent rodents from entering and/or feeding on it, but wide enough for insects to enter. At each phase, 3 of these containers per retailer's store were emptied into plastic bags and taken to the laboratory for subsequent examinations. Though all cowpea samples were purchased on the same day in each market surveyed, those of the second and third lots (phases) were left in the retailers' stores to ascertain the range of insects that would infest the samples after 30 and 60 days of undisturbed storage within the marketing system, so as to establish the fate of cowpea should it be infested by *Sitophilus*, if stored for these lengths of time.

In the laboratory, the retrieved insects were sorted, counted and identified. Recovered *Sitophilus* were identified using the insects' genitalia. Prior to this, an additional thirty-day of incubation was observed in the laboratory for all cowpea retrieve from the market to allow sufficient time for any insect within any given sample to emerge. After this period, the recovery of adult insects was discontinued to avoid the introduction and counting of second Filial (F₂) adults, with the assumption that, after the specified period of incubation, all recovered insects were those on the samples as at when it was purchased and/or retrieved from the market stores as the case may be. Data were transformed using log transformation.

Questionnaires were administered to cowpea retailers at the markets mentioned above to evaluate their knowledge about the infestation of cowpea by *Sitophilus oryzae* and their management measures. As a guide to making an informed decision, the pictures and specimens of *Sitophilus* and *Callosobruchus* species were presented to them before they provided the needed information on the questionnaires.

RESULTS

Incidence and abundance of recovered insects: The findings of this survey have shown that within thirty days of undisturbed storage in the marketing systems one-half the total number of insect pests recovered from cowpea was *Callosobruchus maculatus* with *Sitophilus oryzae* trailing behind at 12%, though rose to 22 and 20% after 60 and 90 days, respectively (Table 1).

Table 1: Incidence and abundance ($\bar{x}\pm SE$; replicates per market = 9) of the different stored product insects recovered from cowpea grains after different periods of undisturbed storage within the different markets (\log_{10} transformed data)

Phase/ Duration	Markets	<i>C. maculatus</i>	<i>S. oryzae</i>	Parasitoids ¹	Others
Phase 1 (30 days)	Kaneshie	1.711±0.22	0.411±0.15	1.220±0.25	0.053±0.05
	Makola	1.051±0.33	0.034±0.03	0.881±0.39	0.000
	Madina	0.360±0.11	0.180±0.08	0.426±0.19	0.080±0.08
	Incidence ³	50	12	36	2
Phase 2 (60 days)	Kaneshie	1.997±0.27	1.075±0.17	1.496±0.42	0.296±0.15
	Makola	1.072±0.29	0.635±0.27	0.790±0.29	0.350±0.19
	Madina	0.982±0.32	1.570±0.50	0.000	0.220±0.15
	Incidence ³	41	22	31	6
Phase 3 (90 days)	Kaneshie	2.038±0.12	0.985±0.33	1.683±0.24	0.187±0.09
	Makola	1.618±0.19	1.051±0.35	0.338±0.19	0.550±0.21
	Madina	0.776±0.35	2.091±0.08	0.366±0.24	0.050±0.05
	Incidence ³	42	20	34	4

¹*Bracon* species and *Anisopteromalus calandrae*; ²*Tribolium* species, *Gnathocerus* species and heteropteran bug, ³Percentage incidence of insects in each phase



Plate 1(a-d): (a) Ventral view and (b) Side view of *Gnathocerus* species, (c) Ventral view and (d) Dorsal view of the heteropteran bug

Anisopteromalus calandrae (Howard) (and *Bracon* species) recovered from cowpea had a relatively high incidence rate all through the storage periods. Other insects recovered were summed up as one group, 'others', *videlicet*: *Tribolium* species, *Gnathocerus* species and heteropteran bug (Plate 1), which were quite few in numbers.

Figure 1 shows the relative incidence of each group of insects over the duration of the survey which reveals the seemingly close rate of 31, 33 and 36% *C. maculatus* whereas *S. oryzae* had a sharp increase from about 8% through 40 to 52%. The parasitoids had a fairly stable proportion all through these periods.

Demography of retailers and their knowledge about the presence of *Sitophilus oryzae* on cowpea: The demography shows that, the age-group 41-50 years made up the majority of retailers (50%, N = 79); followed by

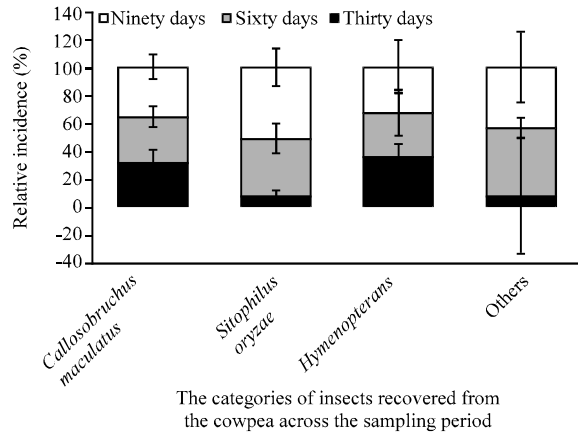


Fig. 1: Relative incidence of each insect group over the three sampling phases

age-group 31-40 years (32%), 10% were less than 30 years while 8%, above 50 years and they were mostly females (99%) with varied educational stance, of which 53% had basic education and 29% had no formal education. Of all respondents, 29, 47, 4% and 1% stores cowpea for less than a month, about 2 months, about 3 months and above 3 months respectively while 19% was uncertain about the duration of cowpea. Storage was mostly done using jute sacs (92%). It was also established that two-third of the respondents had never seen *Sitophilus* on cowpea but on the contrary, 35% had seen it; among the 35, 89% had seen it on more than two occasions, 4 and 7% had observed it twice and once, respectively.

Management strategies employed by cowpea retailers:

Different management measures have been employed by retailers against insect pests of cowpea (including *Sitophilus oryzae*). Ninety one percent (91.14%) of these retailers sieved their cowpea every morning while 28% used other measures like chemical treatment (23%), heating (1%), a few discarded infested grains when infestation was severe 1 and 3% employed such other measures as sun drying. Some retailers integrated these different measures. All traders sold their cowpea products on a ‘first in, first out’ basis, with 56% of them removing grain spillage daily while 44% did not engage in such cleaning activity. The sanitary conditions of the stores which were surveyed were fairly clean, with 58.2 and 29.1% of good and fair sanitary conditions, respectively while 11.9% was ‘poor’.

Cowpea sold in the market ranges from those with big seeds (sold by 97.5% of the respondents), small seeds (sold by 98.7% of the respondents), white seeds (sold by 98.7% of the respondents), brown and red beans (sold by

20.3 and 11.4% of the respondents, respectively) and 78% of the retailers purchased these cowpeas from Ghana [Bawku, Tamale, Techiman, among others], 47% from Togo; Nigeria (15%), Niger (13%) and Burkina Faso (6%). Eighty four percent of these traders have been trading on cowpea for more than 2 years while 15% had just been in the business for 1-2 years.

DISCUSSION

The major insect pest of stored cowpea is *Callosobruchus maculatus* (Fabricius) (Haines, 1991), which was still the case in this study. However, other than the reports on the utilization of dried cassava by *Sitophilus oryzae* (Haines, 1991); and yellow split-peas (*Pisum sativum*), chicken peas (*Cicer arietinum*) and lentils (Cotton, 1920; Combs *et al.*, 1977; Holloway, 1986; Dent *et al.*, 2003), its presence on cowpea, within the marketing system and/or in storage, has never been this obvious nor documented.

Though Gould (1979) made a proposition having carried out studies on phytophagous mites, that the diet of phytophagous insects could expand to include other unrelated species or those which are chemically dissimilar (Courtney *et al.*, 1989; Dobler *et al.*, 1996). This survey has corroborated these predictions with the recent incidence of *S. oryzae* on cowpea and the susceptibility of some cowpea varieties to this stored product pest of cereal (Egbon *et al.*, 2012).

The liberal trade system in West Africa could become a means through which this strain of *S. oryzae* spread. In order to combat this pest, there is need for concerted efforts amongst member nations in West African bloc to screen out susceptible varieties of cowpea. Although Egbon *et al.* (2012) has initiated this by screen some cowpea varieties, more varieties still need to be screened.

The alternative host of this strain of *Sitophilus oryzae* need to be ascertained so that the inaction one nation does not jeopardize the effort of others, as insect pests are no respecters of international or trans-national boundaries. Hence the need for all eyes to be on black-eyed peas in Ghana and the suggestion that, breeders should concentrate on developing cowpea varieties with multiple resistances as a means to minimize the time-consuming and energy-demanding rituals carried out by retailers who constantly sieve grains to separate insects-like *Callosobruchus maculatus* and *Sitophilus oryzae*-from their products.

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