A preliminary study of pre-harvest insect infestation and storability of four Ghanaian maize varieties

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SUMMARY

The extent of field infestation of one local maize variety and three introduced high yielding varieties by *Sitophilus* spp. and the stability of these varieties in storage were determined. Differences in the levels of field infestation of the four varieties by *Sitophilus* spp. were not significant at the 5 per cent level. However, the local maize variety suffered a significantly lower weight loss in storage than the high yielding varieties.

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RÉSUMÉ

OFOSU, A.: *Une étude préliminaire de l'infestation d'insecte ténébrant avant la récolte et la mise en stockage de quatre variétés du maïs ghanéen.* L'étendue de l'infestation par *Sitophilus* spp. dans le champ d'une variété locale du maïs et trois variétés améliorées et la stabilité de ces variétés en stockage a été determinés. Les différences dans les niveaux de l'infestation par *Sitophilus* spp. de ces quatre variétés n'etaient pas significatif au niveau de 5%. Cependant, la variété locale a eu une perte du poids moins significatif en stockage que les variétés améliorées.

Introduction

The storability of maize depends to a large extent on the susceptibility of the cobs to infestation by insects in the field and the inherent susceptibility of the maize grains to infestation by insects in store (Wheatley, 1971).

Eden (1952) and Giles & Ashman (1971) among others have shown that cobs of different maize varieties differ in susceptibility to pre-harvest insect infestation. Differences in the susceptibility of maize varieties to post-harvest insect infestation have also been found (Wheatley, 1971; Dobie, 1974). In Ghana, available information shows that grains of most high yielding varieties are less susceptible to post-harvest insect infestation than some local maize varieties (Ofosu, 1976, 1977). Information on the susceptibility of these maize varieties to pre-harvest insect infestation is, however, lacking.

The present study determined the susceptibility of three released high yielding maize varieties and one local variety to pre-harvest infestation by *Sitophilus* spp., *S. oryzae* and *S. zeamais* occur in Ghana and are very important field-to-store insect pests of maize. Subjective assessments by extension staff of the Ghana Ministry of Agriculture indicate that local maize varieties are damaged to a lesser extent in storage than high yielding varieties. The study therefore ascertained if the local maize variety stores better than high yielding varieties.

Materials and methods

Susceptibility to pre-harvest infestation

Three high yielding maize varieties, La Posta, Composite 4 and Composite W were obtained from Crops Research Institute, Kwadaso, Ghana. A local variety, Mprumem local, was obtained from Gomoa Mprumem in the Central Region of Ghana. All four varieties are white grained. The four maize varieties were planted in a randomized complete block design with four replications. Each

plot consisted of eight rows each 20 m long. Spacing was 0.9 m between rows and 0.4 m between hills. Two grains were planted per hill. The maize was planted on 6 May and harvested on 5 Oct 1982. Recommended cultural practices were followed (Twumasi-Afriyie & Edmeades, 1982). No insecticide was applied to the growing crop.

At the time of harvest, 10 hills were selected at random from each of the six middle rows of each plot. The number of cob-bearing plants on selected hills were recorded. Cobs on each hill were harvested into paper bags and taken to the laboratory where they were desheathed, shelled and sieved.

Sitophilus spp. sieved from the maize were counted. The shelled maize was put back in the paper bag and stored in the laboratory at a temperature between 25 and 28 °C for six weeks. Relative humidity at 09.00 h GMT ranged between 75 and 85 per cent and between 56 and 73 per cent at 15.00 h. Emerging *Sitophilus* spp. were sieved from the stored maize daily during the first week of storage and thereafter at weekly intervals.

Storability of maize

The rest of the cobs from each plot were harvested. Cobs of the same variety from different plots were bulked and divided into four sub-groups. Each sub-group was weighed accurately. Three sub-groups of each variety were stored for 14 weeks in three round cribs. The remaining sub-group of each variety was desheathed. Grains classified as completely damaged and therefore unfit for human consumption were removed from cobs with a sharp pointed stick. Such grains were either germinated, mouldy, mouldy and germinated or extensively damaged by larvae of *Mussidia nigivenella, Ephestia cautella* and *Corcyra cephalonica.*

Undamaged grains on the cobs were shelled by hand, sieved, and their weight as well as moisture content determined. The weight was then adjusted to 12 per cent moisture content. From this result, the weight of undamaged grains obtained from a known weight of cobs was calculated at the selected moisture content. These figures were then used to calculate the weight of undamaged shelled grain initially stored in each crib.

At the end of the storage period, cobs were removed from cribs, desheathed and shelled as before. The weight of undamaged grains (adjusted to 12 per cent moisture content) obtained from cobs stored in each crib was determined. The difference between the calculated initial weight and actual final weight of undamaged grains represented the weight loss suffered by the maize during 14 weeks' storage. A low weight loss indicated good storability.

Results

Susceptibility to pre-harvest infestation

The number of adult *Sitophilus* spp. found infesting cobs at harvest and the number of *Sitophilus* spp. sieved from incubated grains were added together (Table 1). To allow for selected hills without plants or cob-bearing plants, 60 hills were originally selected at random but the results shown in Table 1 are based on the first 50 hills with cob-bearing plants sampled on each plot.

TABLE 1
Pre-harvest Infestation of Four Ghanaian Maize Varieties by Sitophilus *spp.*

Variety	*Mean number of* Sitophilus *spp./cob*		*Mean*
	One-cob hills	*Two-cob hills*	
Mprumem local	27.8	25.9	26.9
Composite 4	32.9	33.2	33.1
La Posta	46.5	42.3	44.4
Composite W	46.9	43.6	45.3
Cob/hill mean	38.5	36.3	

CV (a) = 13.1 per cent; CV (b) = 5.3 per cent. Differences between means are not significant at the 5 per cent level.

To test whether the level of insect infestation was affected by the number of cobs on a hill and

whether the differences in the number of *Sitophilus* spp. infesting cobs of the four maize varieties were significant, an analysis of variance based on a split-plot design was conducted. Variety was a main plot and number of cobs per hill was a sub-plot. The analysis was conducted using transformed (log X) data. Significance of differences between means was tested with Duncan's multiple range test (Gomez & Gomez, 1976).

Differences in the number of *Sitophilus* spp. per cob between one-cob and two-cob hills were not significant. Differences in the number of *Sitophilus* spp. infesting the four maize varieties were also not significant. Interaction between maize variety and number of cobs per hill was not significant. Results show that the level of pre-harvest infestation by *Sitophilus* spp. of a local maize variety harvested 152 days after planting was not significantly lower than the level of infestation of the high-yielding varieties.

Storability of maize

Weight losses suffered by the four maize varieties during a 14-week storage period are shown in Table 2. Each crib was regarded as a 'plot' in a randomized complete block design experiment. Significance of the differences between mean weight loss suffered by the four varieties was tested with Duncan's multiple range test (Gomez & Gomez, 1976). Mprumem local suffered a significantly lower percentage weight loss than all the high yielding varieties. Composite W, with the lowest storage potential, suffered a percentage weight loss almost twice that suffered by Mprumem local.

TABLE 2
Percentage Weight Loss in Four Varieties of Maize Stored 14 Weeks in Round Cribs

Variety	*Percentage weight loss*			*Mean*
	Crib 1	*Crib 2*	*Crib 3*	
Mprumem local	6.6	6.6	6.8	6.7 a
Composite 4	9.3	9.8	7.1	8.7 b
La Posta	11.0	9.7	10.8	10.5 b
Composite W	12.7	12.2	13.4	12.8 c

CV = 30.9 per cent. Any two means with a common letter are not significant at the 5 per cent level.

Discussion

Eden (1952) and Giles & Ashman (1971) found that the higher the level of pre-harvest infestation suffered by maize ears, the faster the deterioration of the ears in storage. In the present study, no significant differences in the level of pre-harvest infestation by *Sitophilus* spp. were found between the four maize varieties, even though the levels of infestation in the high-yielding varieties were higher than the level in Mprumem local. Significant differences were, however, found in the weight losses suffered by the maize varieties in storage. The effect of field infestation on the storability of maize is obvious, since the ranking of the varieties with respect to field infestation was the same as their ranking with respect to weight losses in storage (Tables 1 & 2).

The study also confirmed the observation of extension staff of the Ministry of Agriculture and farmers that introduced high-yielding varieties do not store as well as local varieties. The need to include advice on post-harvest handling methods in the recommended procedures for cultivating introduced high-yielding varieties is indicated as well. If this is not done, high yields obtained in the field may all be lost to insects in storage.

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