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The use of wood ash for the protection of stored cowpea seed (*Vigna unguiculata* (L.) Walp.) against Bruchidae (Coleoptera)

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Dry wood-ash has been reported to provide effective, cheap and safe control of several pests of stored seeds by providing mechanical protection, especially if it is thoroughly mixed with the seed. Mixtures of seed and either clays, ash, talc, or sand are among the earliest recommendations for controlling bruchids in beans (Metcalf 1917; Headlee 1924; Subramanian 1935; Deay & Amos 1936; Lever 1941). Such use of ash has been reported on subsistence farms in Uganda (Davies 1970). However, little is known of the actual ratios of ash and beans needed for effective protection, or of the mechanism of protection. These issues motivated this investigation.

Ash was obtained by burning the dried post-harvest remains of *Phaseolus* leaves and stems, and sieving out large particles. The test crop chosen

was cowpea seed of a local Kenyan variety similar to Kakamega I. The pest chosen was *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae). Specimens were obtained from a stock culture maintained at the University of Nairobi, and had emerged from seed during the previous 24 hours.

Twenty grams of clean, sterilized cowpea seed were placed in plastic tubes 3.5 × 7.5 cm. Ash was added at a rate of 5, 10, 15, 20 and 30 % by weight (w:w) of seed. An ash-free control sample was also prepared. Five beetles of each sex were placed in each experimental mixture. The tubes were covered with finely perforated lids, and placed in an incubator at 30 °C and 70 % relative humidity. Each treatment was replicated four times. The activity of the beetles was observed intermittently, and the total number of progeny and percentage of seed damaged (holed) for each tube were determined after one breeding cycle.

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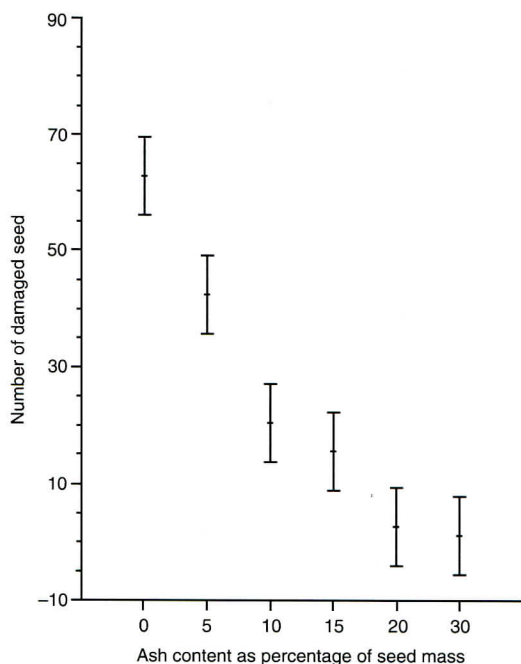


Fig. 1. Means and 95 % confidence intervals of the numbers of seeds damaged by the progeny of five pairs of bruchids in 20 g of dry cowpeas mixed with various ratios of ash.

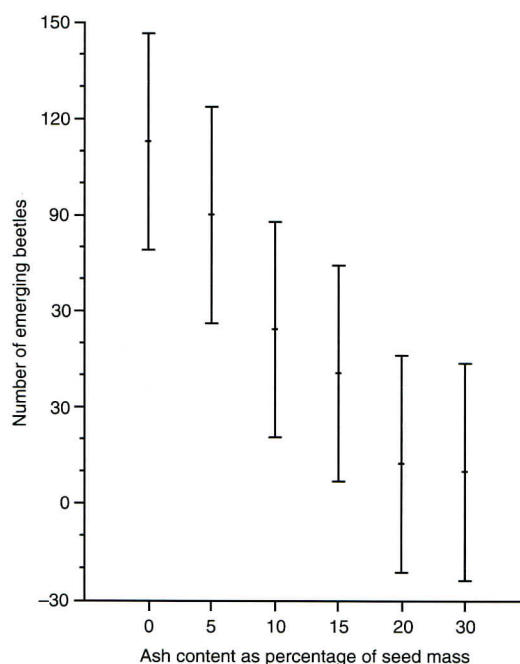


Fig. 2. Means and 95 % confidence intervals of the numbers of bruchids raised from five pairs of adults in 20 g of dry cowpeas mixed with various ratios of ash.

The level of damage to seeds was found to range from a mean of 63 % in the ash-free control, to a mean of 1.3 % in seeds treated with 30 % (w:w) ash (Fig. 1). The number of progeny ranged from a mean of 148.0 offspring in the control, to a mean of 2.5 offspring in seeds treated with 30 % (w:w) ash (Fig. 2). Both measures varied significantly ($F = 28.5$; $P < 0.0000$, and $F = 3.3$; $P = 0.0269$ respectively) between treatments.

Observations showed that ash protected the seed by restricting the movement of beetles among the seeds, which hampered oviposition directly onto the seed. This suggests that any dry, powdery substance might serve as a good protective medium for stored seeds. Moist materials could induce premature germination or mould. Whether thick layers of ash interfered with the respiratory ability of eggs, larvae and adult bruchids, or caused debilitating abrasion to delicate immature stages outside the seed was not clear, but cannot be ruled out.

Multiple range tests showed that the lowest rate of ash mixture that produced a statistically significant difference was 20 % (w:w) in both cases

(Figs 1, 2). This treatment, *i.e.* 1 part ash to 5 parts seed (by weight), gave very satisfactory protection to seeds from bruchid damage, with low numbers of seeds being damaged, and fewer offspring emerging than there were parents. If the same result occurs with other pests and other stored crops, this method of storage-pest control could have a significant role in ensuring post-harvest quality of stored legumes, especially in rural areas of developing countries where harvest crops are stored until the next growing-season. Additional benefits of the technique are its low cost and apparently minimal health risk. Ash is available in areas where other forms of protection against insect pests of stored products are difficult to obtain. Ash residues are also easily seen and washed off seeds before consumption.

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