Control of Bruchids (*Acanthoscelides obtectus*; Coleoptera: Bruchidae) in Beans Stored on Small Farms in Colombia

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Postharvest treatments for control of *Acanthoscelides obtectus* were evaluated throughout two seasons in Darien (Valle), Colombia. Beans cv. 'Calima' were stored on four farms in a randomized complete block design (farms being blocks) with three replications on each farm. Percent damage, intensity of infestation, cooking time, water absorption, germination capacity and seedling vigor were evaluated. Treatments were tested under two infestation regimes: natural and artificial. Adoptability by farmers and consumer acceptance of treated beans were determined. Interviews were conducted with farmers and bean buyers to clarify production practices and marketability of treated beans, and to establish an economic threshold for insect damage.

Beans purchased at harvest-time received the following treatments: soybean oil; threshing residues; ash; malathion; bitter orange; and *Eupatoria* sp. (local weed). All were stored in 5 kg burlap sacks for 39 weeks. Samples were evaluated every three weeks to determine intensity of infestation (number of bruchid emergence holes per seed) and percent of seeds damaged. The experiment relied on natural infestation by *Acanthoscelides* under farmer-managed field conditions. Germination and vigor (dry weight per seedling) were evaluated after eight months; cooking time (with a modified Mattson cooker) and quality, after 4 and 8 months.

A subsequent harvest of beans received treatments as follows: soybean oil; threshing residues; ash; malathion; and black pepper. Artificial infestation was used to facilitate evaluation within a shorter storage period. Recently emerged (1-4 day old) adult *A. obtectus* were added to sacks (200 adults/2 kg beans). Infested beans were left undisturbed for 19-20 days before application of treatments to approximate the stage of bruchid development when farmers prepare beans for storage. Beans were evaluated 8, 13 and 17 weeks after infestation, thus evaluating damage caused by two generations. Seed and cooking quality were evaluated after four months.

Soybean oil (5 ml/kg, hand-mixed by shaking) provided excellent control of *Acanthoscelides obtectus* in both seasons. Damage remained below the economic threshold of 4% for eight months after harvest, at which time renewed bruchid activity was observed. This treatment significantly reduced emergence of first generation bruchids from artificially infested beans and prevented bruchid reproduction. Germination, seedling vigor, water absorption, cooking time and flavor were unaffected. The cost was less than 1% of the value of the beans. However, oil-treated beans may not always be accepted for sale because of their change in appearance; beans are bright and shiny for the first few months of storage but later appear somewhat dull.

Ash (20% by weight; sufficient to fill all empty space between the beans) prevented reproduction of *Acanthoscelides*, with no
renewed activity after more than nine months under natural infestation or four months in artificially infested beans.

Emergence of first generation bruchids was significantly lower than the control. At one location beans stored with ash had significantly reduced germination (globally insignificant), and required increased cooking time. Highly significant treatment by location interactions suggest that ash should be used with caution to treat seed beans. Ash is inexpensive and readily available to those who cook with wood. Quantities of ash needed to effectively treat beans may be increasingly difficult to obtain as more rural people convert to other fuels. The method itself was cumbersome. Marketing of ash-treated beans is problematic due to their unacceptable appearance.

Ground black pepper (12 g/kg mixed and stored with beans in synthetic fiber sacks to prevent leakage of pepper powder) effectively controlled high levels of infestation by preventing reproduction of *A. obtectus*. While pepper did not reduce emergence of first generation bruchids already developing within the seeds (percent and intensity of damage not significantly different from the control), it did prevent their reproduction. Emerged adult bruchids died without reproducing. There were no subsequent generations and no further increase in damage. Bruchid damage to beans was significantly lower in pepper-treated beans after four months' storage. Pepper treatment met all criteria for successful preservation of beans: effective bruchid control, good condition for consumption, planting and marketing (beans maintained good appearance). While high cost (12% the value of the beans) may be justified given favorable market prices, high initial investment and farmers' unfamiliarity with pepper may deter adoption of pepper as insect control. Cheaper, locally produced materials having similar properties should be explored.

Malathion (3 ppm) slowed bruchid reproduction slightly; damage exceeded the economic threshold five months after harvest with field infestation. Emergence from artificially infested beans was not significantly less than the control. Germination and vigor were unaffected by treatment. Beans treated with insecticide are not recommended for consumption.

Threshing residues (20% by weight), bitter orange (one whole immature orange per 5 kg beans) or crushed leaves of *Eupatoria* sp. did not provide adequate bruchid control. Damage exceeded the economic threshold less than two months after harvest with natural infestation. Damage caused by emergence of first generation bruchids was higher in artificially infested beans stored with threshing residues than in the control.

Bruchid damage renders beans unacceptable for market, consumption and seed. Germination potential decreases, and cooking time increases with storage time. Degree of change varied among farms, but was not significantly affected by treatment. Untreated beans stored eight months were sorted for a replicated trial with ten treatments: 0-9 emergence holes per bean. Bruchid-damaged beans suffered rapid decreases in germination and vigor with each additional hole. Seedlings which germinated normally from seed with more holes were significantly smaller. Greater numbers were deformed, incapable of survival or production.