Bean Pest Management in East Africa –

A scientific evaluation of organic insect control practices used by Tanzanian farmers

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Beans have been introduced to Africa more than 400 years ago. Since then they became the second most important source of protein and third most important source of energy for the African people. The pest complex is characterised by a combination of endemic insects as well as seed borne cosmopolitan insects. Over time, African farmers developed pest management strategies adapted to their situation. With intensification, some of those strategies became insufficient and new approaches are sought after. This dissertation explores local knowledge and evaluates effectiveness of selected practices throughout the production cycle. It combines research in close collaboration with farmers with research on station and in the laboratory.

An endemic field pest, *Ootheca bennigseni*, eats the young bean leaves, before it oviposits its eggs close to bean roots, where the larvae feed and develop. Farmers want a field spray to reduce the leaf damage and the resulting yield loss. As industrial insecticides are too expensive and often unavailable, they suggest using local substances such as an extract of *Vernonia lasiopus* (vernonia) and organic substances such as cow urine. In a researcher managed trial on a farmer’s field, three applications of an aqueous extract of vernonia, diluted cow urine, and two controls (water and lambda cyhalothrin) were applied. Insect abundance of adults and larvae were measured and leaf damage assessed. Cow urine proved to be highly effective in reducing adult insect abundance for at least 24 hours. In comparison, Vernonia reduced adult abundance less effectively but effects lasted for at least seven days. Leaf damage was significantly reduced by application of vernonia during the peak infestation period, but urine treated plants were not less damaged than control plants, which shows that the frequency of the treatments was not sufficient. Larvae abundance assessed at harvest time and yield were not
improved in any of the treatments including lambda cyhalothrin, which controlled the adult abundance successfully and reduced leaf damage significantly.

The cosmopolitan insect _Acanthoscelides obtectus_ is mainly known as a storage pest. But it is also a field pest in its own right and infests beans while they ripe in the field. Several field and laboratory trials were conducted to establish pre-harvest infestation preferences. The adult insect was found in fields six weeks before harvest in research fields, but only one week before harvest in farmers’ fields. Pods from fields close to homesteads were more often infested than those from fields at least one kilometre away from habitation or storage facilities. Amongst the pods collected from farms, only pods at the end of wilting stage or drier were infested by _A. obtectus_. Delayed harvest increased infestation in dry bean pods. In laboratory no-choice trials, pods at physiological maturity or maturer were infested similarly. However, when given the choice, the insect preferred the maturer pods. Infestation rates did not differ between open or closed pods. Dry mature pods stimulated oviposition more than less mature pods. The pod alone stimulated oviposition in _A. obtectus_ more than an empty dish (no pod and no bean seed), but it stimulated oviposition less than the seeds alone or the complete pod with beans seeds.

Storage losses are mainly due to a pest complex of two insects: _Acanthoscelides obtectus_ and _Zabrotes subfasciatus_. Farmers traditionally use dried botanicals for controlling storage pests in beans. Some traditional botanicals and some other locally available plants were tested against both bruchids on farm and in the laboratory. In laboratory trials, _Chenopodium ambrosoides_ was most effective with an insect mortality of 100% in less than three days for _A. obtectus_ and _Z. subfasciatus_. Powdered _Tagetes minuta_ increased mortality significantly more than no botanical or powdered bean leaves. Entire _T. minuta_ leaves did not increase mortality, nor did _Cupressus lusitanica_ or _Azadirachta indica_ or bean leaves in either powder or leaf form. In on farm trials, _A. indica_ seed powder was the most effective treatment. The on-farm trials suggested that _A. indica_ seed powder is effective in protecting stored products for up to four months (or for two to three generations of insects). However, _C. ambrosioides_ and _T. minuta_ (both dried and ground young plants) and to a lesser degree _C. lusitanica_ (leaves in powdered form) also have a good potential for short term storage (up to two months or one to two generations of insects).
In the synthesis five theses on farmers’ pest management are discussed in the light of the author’s personal experiences.

(1) Farmers use treatments that control pests, but effectiveness and duration of control varies greatly.

(2) Farmers concentrate their pest management efforts to where it is most effective: more control practices are used in storage than in the field crop.

(3) Farmers observe, experiment, and adapt production and storage with respect to local conditions.

(4) Farmers know the damage done by pests, but their knowledge on the pest ecology is limited.

(5) When farmers understand the lifecycle of the pest in more detail, they gain confidence and are more likely to teach other farmers about their control practices.

In conclusion this research shows the need to include farmers in learning trials. Only what they experience and see can be internalised to bring about change. It is crucial that farmers learn to understand life cycles of insects, or how diseases spread, so that they can take simple measures to reduce their losses.
Zusammenfassung


mindert während der Hauptinfestationszeit. Aber Pflanzen, die mit Urin behandelt wurden wiesen gleich viel Schaden wie unbehandelte Pflanzen auf. Dies zeigt, dass häufiger hätte behandelt werden müssen. Larvenabundanz, zur Erntezeit, und Ertrag waren bei keiner Behandlung verbessert, auch nicht bei Lambda Cyhalothrin, das sowohl die Adultenabundanz erfolgreich kontrollierte, als auch den Blattschaden signifikant verminderte.


Verluste bei der Lagerhaltung werden vor allem von einem Schädlingskomplex von zwei Insekten verursacht: *Acanthoscelides obtectus* und *Zabrotes subfasciatus*. Traditionellerweise gebrauchen die Bauern getrocknete Pflanzen, um die Lagerhaltungsschädlinge in Bohnen zu kontrollieren. Traditionelle und andere örtlich erhältliche Pflanzen wurden im Labor und bei Bauern auf Ihre Wirksamkeit gegen beide Schädlinge getestet. In Laborversuchen, war *Chenopodium ambrosioides* am wirkungsvollsten. Die Mortalität war 100 % in weniger als drei Tagen für beide Arten. Pulver von *Tagetes minuta* erhöhte die Mortalität signifikant, verglichen mit keinem

In der Synthese werden fünf Thesen betreffend der Schädlingsbekämpfung durch die Bauern aus persönlicher Erfahrung diskutiert.

(1) Bauern benützen Schädlingsbekämpfungsmassnahmen, aber deren Effizienz und Wirkungsdauer unterscheiden sich erheblich.

(2) Bauern benützen Schädlingsbekämpfungsmassnahmen vor allem dort, wo es am effizientesten ist: In der Lagerhaltung werden mehr Massnahmen durchgeführt, als im Feldanbau.

(3) Bauern beobachten, experimentieren und passen ihre Anbau- und Lagerhaltungsmethoden an lokale Umstände an.

(4) Bauern kennen den durch Schädlinge verursachten Schaden, aber ihr Wissen der Insektenökologie ist beschränkt.

(5) Wenn die Bauern den Lebenslauf der Insekten besser verstehen, gewinnen sie mehr Selbstbewusstsein und geben ihr Wissen eher an andere Bauern weiter.

Abschliessend hat diese Forschung gezeigt, dass es wichtig ist, Bauern in Lernversuche einzubeziehen. Nur wenn sie selbst mitmachen und das Insekt sehen, kann das neue Wissen einverleibt werden. Es ist paramount, dass Bauern die Lebensläufe der Insekten verstehen lernen, oder dass sie die Vermehrung von Krankheiten verstehen, damit sie in der Lage sind, mit einfachen Massnahmen ihre Verluste zu vermindern.