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INTEGRATED PEST MANAGEMENT of the SWEETPOTATO WEEVIL: A Pilot study in South Central Jamaica

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ABSTRACT

The sweetpotato Weevil, *Cylas formicarius* (Coleoptera: Apinoidae) is one of the most yield limiting pests affecting sweetpotato, *Ipomoea batatas* (Family: Convolulaceae) production in Jamaica. Losses as high as 50 percent of total yield have been reported. Effective low resource biologically based technologies which are readily adaptable including the use of selected cultural practices and mass trapping with high doses of sweetpotato weevil sex pheromones, have been successfully used in Asia to manage the weevil. Under the CARDI/CRSP IPM research programme, six farmers in three districts in South Central Jamaica were selected to demonstrate the effectiveness of this sweetpotato weevil IPM technology under local growing conditions. An initial baseline survey was conducted to determine the farmer's perception of the pest and the production practices being utilised. A modified farmer field school approach was used to disseminate the IPM technology to the pilot farmers. At harvest, weevil populations were estimated traps baited with low doses (10 ug) of weevil sex pheromones and crop loss assessments executed on IPM pilot farms and neighbouring farms within the target districts. Depending on the socio-economic factors, pilot farmers utilised the IPM technology to varying degrees. In comparison to neighbouring farms, IPM pilot farmers had significantly less weevil infestations and root damage ($P<0.050$). Marketable yields were also higher on the majority of IPM farms but, overall this was not significant ($P>0.05$). With special considerations to the socio-economic factors identified, refinement of the IPM practices currently being recommended are discussed. Also, the observations on the improvements in the knowledge base and competence of the pilot farmers in IPM are examined in relation to the principle based approach used to transfer the technology.

INTRODUCTION

As far back as 1669, the sweetpotato weevil, *Cylas formicarius* (Coleoptera: Apionidae) was identified as a yield limiting pest of sweetpotato in Jamaica (Fielding and Crowder 1993). Today, the weevil is still one of the most destructive pests affecting sweetpotato production, reducing marketable yields by more than 60 percent in some areas. Damage occurs when female weevil lay eggs within the vines as well s the surface of the roots and developing larvae tunnel and feed within the roots. In response to the presence of the weevil, roots produce terpenoids which render them unpalatable (Sata et al 1983).

A review of the research report over the past 100 years describe several control methods to manage the weevil; including cultural practices, resistant varieties, chemicals, charcoal, and wood ash. Yet the weevil has not been successfully managed after all these years. Non-adoption of the recommended tactics by farmers due to socio-economic factors (labour, marketing, lack of knowledge and/or understanding by farmers of the problem and the recommended practices) have been cited by several authors as possible reasons (Payne 1983), Fielding and Van Crowder 1993).

Farmer-participation should therefore be integral in the development or refinement of any technology for the weevil so that socio-economic factors which may constrain adoption are identified and addressed before implementation. In addition, it is critical that the knowledge base of farmers be improved such that they can actively make decisions on the management of pests. The Farmer Field School (FFS) method of technology transfer which focuses on the transfer of a system of principles and decision-making tools rather than pre set recommendations can assist greatly in the empowering of farmers.

During the past four years, CARDI, under the Integrated Pest Management Collaborative Support Programme (IPM CRSP), evaluated the potential of a sweetpotato weevil IPM technology, which has been successfully used in Asia to manage the pest. The weevil IPM technology combines low input biologically based technologies with traditional cultural practices.

The objective of the study described herein was to determine the potential this IPM technology under Jamaican conditions. Specifically the study investigated the impact of cultural methods and mass trapping with female sweetpotato weevil sex pheromone on weevil infestations and root quality.

METHODOLOGY

Baseline Survey: An initial baseline survey was conducted in three sweetpotato growing districts (Ebony Park, Heifers Run, Prospect) in South Central Jamaica to determine production practices, pest composition and management practices being utilized by farmers. Based on the survey findings, six farmers were selected to evaluate the utilizing and integrated approaeh to reduce root damage.

Technology Transfer of Sweetpotato Weevil IPM Technology: The integrated approach to manage the sweetpotato weevil recommended a set of options including cultural practices (field sanitation(removal of abandoned-crop residues and alternate hosts e.g. - *Ipomoea sp* "wild slip"), irrigation, quick harvesting, clean planting material) and mass trapping weevils with high doses of sweetpotato weevil female sex pheromone (Z)-3-dodecen-1-o1(e)-2-butenoate).

Farmers were exposed to the technology through a modified approach involving interactive seminars which included discussions on sweetpotato weevil biology, economic importance of the pest, current management practices and the principles of sweetpotato weevil IPM. Field demonstrations where farmers participated in the implementation of the technology were also conducted as further reinforcement. During demonstrations, farmers were shown how to use, construct pheromone traps from local materials including plastic bottles, sticks and bamboo, and maintain traps.

Impact Assessment: Two to four seasons after the farmers were introduced to the technology, weevil infestations and root damage were assessed on the 6 ilot farms. Similar parameters were assessed on 8 neighbouring farms where farmers utilised limited cultural practices only (Non-IPM).

Sweetpotato Weevil Infestation Assessment: Immediately before harvest (approximately 4 months after planting), traps were baited with 10 ug of female sex pheromone (Z-3-dodecen-1-o1(E)-2-butenoate) were placed in the sweetpotato fields for 48 hours. The numbers of weevil caught were recorded. Weevil catch was estimated by counting 5 sub-samples of 500 weevils, determining the average weights of the samples and extrapolating the weights to the total catch.

Yield Quality: At harvest, losses due to the weevil were determined. Total harvest was weighed and sorted into marketable and unmarketable yields. The weight of each category was recorded and unmarketable yields sorted further with respect to various categories of damage (weevil, white grub, rat, cracks, immature, bruising, other). Each category was then weighed.

Analyses: Restricted Maximum Likelihood Estimation (REML) using the GENSTAT statistical package was used to compare root damage on IPM and Non-IPM farms. Adjustments were made for district effects. Weighed analyses were utilized with total yield being used as the weighting actor. Weevil counts were analysed by Analysis of Variance (ANOVA) using the IMP statistical package.

RESULTS AND DISCUSSION

Significantly lower numbers of weevils were caught on IPM pilot farms when compared to NON-IPM farms; mean weevil catch per hectare of sweetpotato after 48 hours was 187 (SE 57) and 8266 (SE 1675), respectively. Similar trends were observed for losses in yield due to the weevil. Those farmers exposed to the IPM technology experienced significantly lower weevil damage than Non-IPM farmers (P=0.007); weevil damage averaged 1 percent (SE 3%) and 16 percent (SE 3.4%) of total harvested yields respectively.

In relation to productivity, IPM farmers had significantly higher yields than Non-IPM farmers (P=0.01), yields were 8,556 kg/ha (SE 1121) and 2,607 kg/ha (SE 1,303) respectively.

No significant difference was observed in marketable yields between the groups (P= 0.9). Perusal of the crop loss profile indicated that significantly higher levels of damage resulting from immatures of the sweetpotato leaf beetle (16%) were observed on IPM farms when compared to Non-IPM (3%) (SED 4.45%) (P>0.005). No significant differences were therefore observed in marketable yields between the groups. Overall, marketable yield was 78.4 % of total harvest.

The findings of the study indicate that the IPM measures adopted by farmers were in part responsible for the reduction in weevil populations and the reduced levels of weevil damage observed. However, in order to ensure sustainability of the approach, it is critical that the socio-economic factors identified for non-adoption by IPM farmers, be considered in the further development and refinement of sweetpotato weevil IPM. For example, in order to accommodate farmer practice of allowing animals to graze in old fields, pheromone traps may have to be used to hold populations down until these fields are ploughed under. Additional training sessions need to be conducted to reinforce the relationship between trap maintenance and trapping efficiency. On 30 % of pilot farms, traps were not frequently rotated and/or had debris in the catchment container.

Moreover, it is critical that other tactics are investigated so as to optimize the number of components available for farmers. Ideally, these tactics should be effective against the weevil and other major pests such as the larvae of the sweetpotato leaf beetle, *Typhorous sp.* Which caused high levels of damage on IPM farms. Joint investigations between CARDI and USDA under the IPM CRSP programme, have demonstrated the potential of USDA multiple pest resistant lines as a pest management option under Jamaican conditions (Lawrence et al 1998). Several of these lines showed moderate resistance to the weevil as well as the leaf beetle larva. Lines which meet market standards and consumer acceptability will be integrated into the current pest management programme. Based on the cross cutting nature of these resistant lines, they will be able to be utilized , not only within a management programme for the sweetpotato weevil, but also other soil pests which limit sweetpotato potato production.

Another dimension to the study which should be highlighted was the improvement observed in the competence and knowledge base of farmers who were trained in the management of sweetpotato weevil. Indicators of farmer improvement were reflected by:

Improved execution of the recommended tactics: The type of cultural practices as well as the number of practices did not differ between pilot IPM farmers and non-IPM farmers. However, IPM pilot farmers conducted the cultural practices more thoroughly and this may be attributed to the farmers gaining a better understanding of the biology (relationship between weevil life stages) and behaviour and thus the rationale behind the tactics recommended.

Diffusion of knowledge from pilot farmers to other farmers within the districts: Farmers established pheromone traps within friends fields and in some cases farmers from neighbouring parishes came to observe fields in which IPM was being conducted.

More structured experiment: Testing cóntrol strategies is not novel to farmers; however, farmers appeared more stimulated to conduct more structured experiments independent of the researcher.
Improved decision-making in relation to when and how to apply control practices was also observed.

In summary, the study identified that an integrated approach can effectively reduce sweetpotato weevil populations. Empowerment of farmers and their continued participation in the building of integrated pest management programmes for the control of the weevil will enhance the programme in the future.