AMADEPA

Association Martiniquaise pour le Développement des Plantes Alimentaires

29ème
CONGRES ANNUEL
ANNUAL MEETING
REUNION ANNUAL

Agriculture Intensive dans les Iles de la Caraibe : enjeux, contraintes et perspectives
Intensive Agriculture in the Caribbean Islands : stakes, constraints and prospects
Agricultura Intensiva en la Islas del Caribe : posturas, coacciones y perspectivas

INDIGENOUS EGG PARASITOIDS OF ROOT WEEVILS, EXOPHTHALMUS SPP. (COLEOPTERA : CURCULIONIDAE) IN JAMAICA, W.I.

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ABSTRACT

The egg parasites of citrus root weevil complex of the Caribbean and Florida have been known to contribute appreciably to the control of these pests for decades. In Jamaica however, no emphasis was placed on developing biological control strategies as chemical pesticides had the confidence of the citrus industry. Field sampling of egg masses for parasitism levels at two plantation sites from August 1990 to April 1993 showed levels of 94 % and 71 % for United Estates, St. Catherine and Greenwood Farms, St. Mary respectively. Since April 1991,139, 160 F. citri and 197,850 A. haitiensis have been released at United States. Assessment of release activities showed higher parasitism levels in areas where releases were carried out though these observations were not consistent over time.

INTRODUCTION

Historically, citrus root weevils have been a major problem facing citrus farmers in the Caribbean and Florida. For years the problem had been tackled by bombarding foliage and drenching soil with various chemical formulations. This unilateral approach to pest control led to the rapid build up of pest resistance. Reduced efficacy of the increasingly expensive chemicals, other growing concerns for the environment and toxic pesticide residues on fruit, intensified the need for a suitable alternative. Biological control addresses all these problems and the diversity of the natural enemy complex of root weevils provides a good selection of candidates to use in biological control strategies. In the Caribbean and Florida natural enemies recorded include: parasites; egg parasitoids, entomogenous nematodes

and fungal pathogens and predators; ants, beetles, neuropterans, birds, frogs,etc (Biggs- Allen,1990).

The species of root weevils have a high fecundity. Diaprepes abbreviatus has a reproductive potential of 5,000 eggs/female (Cruz and Segarra, 1992), Exophthalmus vittatus, approximately 5,900 eggs/female, Pachnaeus citri, 4,200 eggs/female (van Whervin, 1968). These eggs give rise to the larvae which inflict the major economic damage caused by these pests. Attacking the pest at the egg stage is therefore an important must in control programmes.

Egg parasitoids are among the most researched group of natural enemies of the citrus root weevils. Etienne (1990) reports 10 species occuring in the Caribbean four of which were cited as occuring in Jamaica, namely, Aprostocetus (=Tetrastichus) haitiensis, A gala, Fidiobia (=Platystasius) citri and Eutetrastichus fennahi.

In the Caribbean, field parasitism levels reported have shown egg parasites making substantial contribution to egg mortality. Wolcott (1929) reported 50 percent parasitism of E. vittatus eggs by A. haitiensis in Haiti. In Jamaica, Edwards (1937) reported parasitism of 25 percent of the total number of eggs and 50 percent by T. haitiensis. Bennett (1976 unpublished) reported 50% parasitism from a collection of egg masses which were parasitised by T. haitiensis and Fidiobia citri.

The egg parasites have been used in classical biological control against root weevils. In Florida, T. haitiensis was imported from Puerto Rico in 1969 (Sutton et al, 1972) it was confirmed to be established in 1978 (Beavers et al, 1980).

Our studies investigate the performance of egg parasitoids on two Jamaican plantations and the impact of augmentation on natural parasitism rates.

MATERIALS AND METHODS

Field parasitism of eggs

Two field sites, Greenwood Farms, St. Mary and United Estates Limited, St. Catherine were visited every 28 days. The foliage of citrus trees in areas known to be attacked by root weevils were searched and leaves bearing egg masses were removed and taken to the laboratory where they were isolated individually and observed for parasitism and emergence. The number of eggs per mass, eggs showing

signs of parasitism (turning brown) and parasites emerging were recorded.

Augmentation of natural population

Egg masses laid in the laboratory by cultures of E. vittatus and E. similis were individually isolated and exposed to species of parasites emerging from field collected eggs. When substantial numbers of parasites were emerged they were released at a designated site.

Assessment of augmentation

For the assessment of the effect of releases on parasitism, two field sites were selected at United Estates, fields 117 and 148. Ten trees were tagged in each field. Egg traps (laboratory laid eggs secured to foliage by clips) were placed three on each tagged tree and left in the field. After approximately 48 hours the egg traps were retrieved and taken back to the laboratory where they were isolated individually and observed for parasitism.

This experiment was divided into two treatment periods. In each treatment period fields 117 and 148 were treated respectively as follows : (i) period 1, no releases and releases; and (ii) period 2, releases and no releases. A minimum of 3 replicates were done per treatment period.

The data were subjected to a Chi-squared Test and Analysis of Variance. Further analyses are yet to be performed.

RESULTS

Field parasitism

The total number of egg masses collected at United Estates Limited and Greenwood Farms for the period August 1990 to March 1993 were respectively, 342 and 206. Of these the percentage showing signs of parasitism 94 % and 71 % correspondingly. The total number of eggs in these masses were 11,201 and 6,852 with the percentage showing signs of parasitism being 84 % and 57 %. An important observation was that no grubs emerged from parasitised masses although some eggs in these masses showed no signs of parasitism. 37%

and 21% of the egg masses from United Estates and Greenwood Farms respectively, having no successful emergence from eggs.

The impact of augmentation

A. haitiensis and F. citri have been successfully reared in large numbers in the laboratory. These were used in augmentation exercises. Since April 1991 the total number of parasites released at United Estates Limited were 197,850 and 139,160 respectively.

The augmentation exercises showed the overall proportion of egg masses parasitised for the release area to be significantly higher than for the non-release area. The percentage parasitism observed were 23 % and 11 % for release and non-release, respectively. The difference between these treatments was significant ($p= 0.001$).

DISCUSSION

The efficacy of a parasitoid can be indicated by its host finding ability (control agent reaching target), successful oviposition (pest mortality/control) and successful emergence (persistence). These criteria are analogous to those used for chemical formulations (shown in brackets above). From the results presented from investigations, it is clear that the role of the egg parasitoids should not be overlooked in the development of a biological control strategy for root weevils in Jamaica.

The observation of egg masses with no emergence from eggs suggests the possibility of non-viable eggs or mortality of the organisms (grubs or parasites) before the completion of their development. These possibilities would have to be considered in correcting the parasitism levels calculated above. Van Driesche (1983) comments that egg parasites as a mortality factor is very complex, in that aside from the obvious mortality induced by successful and unsuccessful parasitism other modes of attack result in host death eg. host feeding. Groden et al (1990) calculate that unparasitised host density was overestimated by those individuals sampled as healthy prior to attack and that this error becomes increasingly significant as parasitism increases above the 20 per cent level.

The objective in using egg parasites, is to reduce the number of larvae successfully emerging to subsequently attack root systems. The

overall survival of larvae for the period of investigations was 40 % for Greenwood Farms and 10 % for United Estates Limited. This is likely to be an over-estimate of larval survival under natural conditions as post emergence mortality of neonates before they attack roots is not factored in. In Florida, Whitcomb et al (1983) reports an average of 47 % of Diaprepes abbreviatus neonates left in the field for twenty minutes, in petri dishes, were removed by predators. These predators were mainly ant species.

Augmentative releases were found to increase the rate of parasitism. The actual parasitism figures obtained from the egg traps are not necessarily representative of natural feild parasitism and control, as the exposure time in the field was way below that of natural conditions. The objective of this experiment was to compare parasitism rate in release areas with that in non-release areas. The experiment was designed to facilitate timely retrieval of egg masses before unparasitised eggs hatched. The egg to larva development of Exophthalmus spp. is approximately 7 days.

Classical biological control is also being looked at, to increase parasitism levels. A new species Ceratogramma etiennei was imported and trials to rear the parasite on eggs of Exophthalmus spp. are now being carried out.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the untiring assistance and support of Mr. Oral James and Mr. Donald Simpson, the technical assistants and Mrs. Heather Reid the biometrician working on this project. We would also like to thank the management and staff of the participating farms for their cooperation throughout the three years of these investigations.

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