STIMULO-DETERRENT DIVERSION TO DECREASE INFESTATION IN SUGARCANE BY *ELDANA SACCHARINA* (LEPIDOPTERA: PYRALIDAE).

DE CONLONG AND B KASL

SASEX, P. Bag X02, Mt Edgecombe, KZN, South Africa

Introduction

Eldana saccharina Walker (Lepidoptera: Pyralidae) occurs in the tropics and subtropics from sub-Saharan West Africa, across to East Africa, and down the African east coast to coastal Kwazulu-Natal in South Africa. Its indigenous host plants occur in the families Cyperaceae (sedges), Graminae (grasses) and Juncaceae. Sedges commonly attacked include *Cyperus papyrus, C. dives, C. fastigiatus and C. digitatus*. Large solid stemmed grasses such as *Pennisetum purpureum, Sorghum arundinaceum, Coix lachryma-jobi* and *Rottboelia* spp are also favoured, especially in West Africa where sedge distribution is restricted. *Pryonium serratum* and *Juncus exsertus* (Juncaceae) are sometimes heavily attacked in South Africa.

Its crop hosts include maize, various varieties of cultivated sorghums, millet and sugarcane. In the latter particularly, the stalk-boring habit of *E. saccharina* larvae causes substantial yield loss. In sedges, larvae and pupae are normally found in umbels, if these are large enough and present, and in the bract covered rhizomes. In grasses, these life stages are found in stalks themselves, generally in the lower half.

The female moth has an extendable, prehensile ovipositor, used to hide eggs between dead leaf sheaths, cracks and curls in dead leaf blades, cracks in stalks, and even in exposed mesophyll cells in dead leaf and sheath material. Eggs, which are laid either singly or in batches of up to 20 (mean = 400 eggs per female), are thus mostly concealed from egg parasitoids and larger predators. Neonate larvae also are protected to some extent by leaf sheaths or bracts on which eggs were laid, but are slightly more prone to predation, parasitism and desiccation than their older kin which have already bored into their host plants. A tough cocoon, formed with silk and frass from the larval boring, protects pupae. The mature larva normally pupates at an exit window it has chewed in the rind of the stalk, or in the dead leaf sheaths or bracts covering its boring. All life stages are therefore very cryptic, making the insect very difficult to control by conventional pest management strategies.

Biological Control

The South African sugar industry has invested heavily in a biological control programme against *E. saccharina*. Early efforts included obtaining egg parasitoids from Ivory Coast, and egg, larval and pupal parasitoids from related borers in other parts of the world. Literature pertaining to this part of the programme are published in the South African Sugar Technologists Annual Congress Proceedings, and/or Annual Reports of SASEX.

In 1995, investigation for indigenous natural enemies in other African countries where *E. saccharina* was known to occur commenced. Because *E. saccharina* is indigenous to Africa, conventional classical biological control is not possible, as it has a number of indigenous host plants into which it could 'retreat'. It was with this in mind that the most recent phase of the biocontrol programme was implemented, involving the following steps:

- Investigation of different indigenous host plants and adopted crop hosts in various African countries for parasitoids of different life stages of *E. saccharina*
- Notes taken of types of habitats in which parasitoids were found, so that possible habitat manipulation could take place
- Use of stimulant and/or deterrent properties of different plant species, in addition to crop species, on herbivores and their indigenous parasitoids in the agricultural context to minimise stalk borer infestation.

Searches in different indigenous host plants have revealed in excess of 30 species of parasitoid attacking juvenile *E. saccharina.* Fly parasitoids (Diptera: Tachinidae) are often found, but more common are wasp parasitoids (Hymenoptera) belonging to the families Braconidae, Bethylidae and Ichneumonidae. Even in crop hosts such as maize, sugarcane and Sorgho (a variety of sorghum used as a cereal in West Africa) under certain circumstances, parasitoids have been found.

The question has often been asked (by commercial sugarcane farmers especially), why, if parasitoids are so common in indigenous hosts of *E. saccharina*, do they not attack this borer in sugarcane?

The answer can be two-fold. Either the parasitoids are not entering commercial plantations in high enough numbers to make an impact on *E. saccharina* populations, or there are no cues emitted by sugarcane 'under attack' from *E. saccharina* to 'tell' parasitoids that their particular host is invading sugarcane.

Mass Rearing

One avenue to explore is mass rearing and release of suitable natural enemies in high enough numbers, and at the right times, to make an impact on *E. saccharina* populations. This is the route SASEX has followed. It has been expensive, and, in addition to good insect rearing facilities to make it pay, requires constant input from specialists, and fully trained staff to produce high quality insects, at times and in numbers needed, to

make the project work (Conlong and Mugoya, 1996). This approach is normally out of the budgetary range of organizations in developing countries.

Habitat Management

However, as *E. saccharina* is an indigenous insect, with its own preferences as to which indigenous host plant it prefers to occupy, a habitat management approach may be one that can be followed. This is backed by parasitism of *E. saccharina* recorded in crop hosts of small or subsistence farmers in various African countries. In these situations, crops such as sugarcane and maize are grown in a mosaic of vegetation comprising various crops, indigenous grasses and sedges. Parasitoids in these situations are moving between various plant species, because they are so interspersed, and can find their host almost 'by accident'. This is in the strict sense not true, because some specialist advice has been forthcoming as to what indigenous plant species could be planted in these situations (Conlong and Mugoya, 1996), and local knowledge has dictated which crop and indigenous plant species can be planted together. If this situation can be emulated in commercial crops, similar biological control may be attained. This would, however, depend on the commercial grower's inclination whether to adopt this type of control or not.

To expand this point: Insects are known to respond to various chemical cues, whether it is pheromones used to find mates, or kairomones (or allelochemicals) to find host plants and/or host plants under attack by herbivores. It is hypothesised that because of selective breeding of sugarcane to produce more sucrose, defence mechanisms used by this plant against herbivory have been lost. There are therefore no cues to 'tell' indigenous parasitoids that its normal host has moved into a new habitat. Recent research using indigenous plants on which indigenous (and exotic) stalk borers prefer to oviposit over their crop host, in conjunction with plant species which emit particular 'alarm' pheromones as a natural by-product of their metabolism (e.g. *Melinis minutiflora*), shows borer populations decreasing by up to 30% in planted crops (Khan *et al*., 1997).

It is proposed that such a stimulo-deterrent approach be used against the indigenous *E. saccharina* in its adopted exotic host sugarcane, so that infestations in this crop can be minimised.

REFERENCES

Conlong, D E and C F Mugoya (1996). Rearing beneficial insects for biological control purposes in resource poor areas of Africa. *Entomophaga* 41: 505-512.

Khan, Z R, K Ampong-Nyarko, P Chiliswa, A Hassanali, S Kimani, W Lwande, W A Overholt, J A Pickett, L E Smart, L J Wadhams and C M Woodcock (1997). Intercropping increases parasitism of pests. *Nature* 338: 631-632.