Insect Rearing and Area Wide Pest Management

In recent years, the South African Sugarcane Research Institute (SASRI) has adopted an area-wide integrated pest management (AW-IPM) approach to its insect and plant pest control in the environment in which sugarcane is planted.
This holistic approach includes issues such as good soil health and nutrition, wetland and riverine health, plant and animal ecological conservation principles and a knowledge of the behaviour of potential pests and their natural controlling factors, all combined with state-of-the-art plant breeding and agronomic support.

Insect rearing unit

In the mid 1980s, SASRI established its insect rearing facility. The main focus at the time was to rear parasitoids of the African sugarcane stalk borer, *Eldana saccharina*, commonly known as eldana, a moth whose larvae bore into sugarcane stalks, reducing their quality, and thus sucrose yield.

Over the years, about 80 different species of parasitoids, sourced from eldana and other stalk borers, fromAfricaand elsewhere in the world have been tested against our South African eldana population. Over half of these could be successfully reared on eldana in the laboratory, but very limited success has so far been achieved with establishment in the field. The research focus is now on AW-IPM, which uses a host of techniques to make the environment favourable for natural enemies of eldana.

SASRI's Insect Rearing Unit has tested over 80 different species of parasitoids since the 1980s.

Alien weed biocontrol

Alien plant biocontrol, a component of SASRI's AW-IPM, entails finding host-specific plant damaging insects and/or pathogens from the region of origin of the invasive plant and introducing them in numbers to the invaded area, in order to reduce the invasive plant's growth rates. The potential agents are imported via the Weeds Division of the Agricultural Research Council's Plant Protection Research Institute and investigated thoroughly by them in a series of stringent experiments in approved quarantine facilities to ensure that they will not be harmful to any other plants or insects except the target weed.

Usually, other chemical and mechanical control methods are still necessary to achieve the desired level of control, but at a reduced rate. Biological control is a low-cost, long-term and sustainable way to control invasive weeds. It is also potentially more valuable than other methods as it has less environmental impact and targets the pest specifically and thus effectively.

Chemical and mechanical control methods are often still necessary to achieve the desired level of control. Shown above, contracted workers, part of a team of unemployed people paid by Poverty Relief Funds, work on eradicating the invasives in the Zinkwazi catchment.

SASRI's focus on alien weed biocontrol developed in the early 1990s because it recognised that this could be another weapon against eldana. Prior to the introduction of sugarcane into South Africa, eldana lived in wetland sedges where its population was controlled by a complex of natural enemies.

Unfortunately, these wetland habitats were encroached upon by sugarcane fields, and more recently alien invader plants, which have drastically reduced the density of eldana's host plants and natural enemies. The re-establishment of eldana's indigenous host plants and habitat by biologically controlling the alien plants encroaching it will help considerably by attracting this insect back into the habitat, which it prefers to sugarcane anyway, to utilise its effective natural enemies in SASRI's AW-IPM approach.

Chromolaena (Triffid weed)

One of the first insects reared at SASRI as an alien plant biocontrol agent was *Pareuchaetes insulata* (commonly known as a Pareuchaetes and/or tiger moth, because of its yellow colour and black stripes on its abdomen) whose larvae feed on triffid weed (*Chromolaena odorata*) leaves. This plant is recognised as the largest alien weed threat to indigenous biodiversity in KZN and other tropical and subtropical areas in South Africa, especially in waterways, disturbed areas and game reserves where it devastates the environment.

The release of thousands of larvae in the late 1990s reared at SASRI's insect unit led to its establishment in the Umkomaas area, and its spread has now recently been recorded as far as Mount Edgecombe in the north, and Port Edward in the south, as well as on triffid weed up to 10 km inland.

SASRI's capacity and skills to rear alien plant biocontrol agents, as demonstrated by the successful Pareuchaetes programme attracted the interest of the Department of Water Affairs and Forestry (DWAF) who, through their Working for Water

(WfW) programme, have been entrusted with the control and/or eradication of alien plants in South Africa. SASRI was contracted by DWAF in 2006 and 2007 to raise a small fly (*Calycomyza eupatorivora*) whose larvae mine triffid weed leaves so that they cannot photosynthesise properly and therefore die. These flies are now well established on triffid weed throughout coastal KZN, especially in shaded areas.

Pereskia control

Further contracts followed, in 2009 and 2010, to rear the flea-beetle *Phenrica guerini*, the adults and larvae of which eats leaves and growing shoots of the pereskia plant (*Pereskia aculeate*) – an invasive creeping cactus from South America that smothers indigenous plants.

Jack Singery stands in front of the indigenous forest, situated on his farm, which he has rehabilitated over the past fifteen years. Jack holds up a branch of pereskia, largely responsible for almost destroying the forest which he has eradicated from his farm.

Releases of Phenrica have recently commenced on Jack Singery's farm in the Mtunzini/Gingindhlovu area of the KwaZulu-Natal north coast but it is still too early to measure their impact. Singery is therefore following a good IPM approach, by combining beetle releases with continued manual removal of the invader weed (that he has been practising for the past 15 years), whilst re-establishing indigenous riverine forest on his farm.

Prior to Singery's releases, good impact of the beetles has been seen on stands of pereskia on the banks of the Siphon Dam at Tongaat, behind the Maidstone sugar mill of Tongaat-Hulett Sugar(THS), who have funded biocontrol work on the dam and its banks over the last three years. SASRI has also had good success on this dam with mass releases of biocontrol agents reared by them against water lettuce and water hyacinth, the rearing of which has also been funded by THS. Continued water weed successes have been recorded on farms in the Umfolozi and Eston sugarcane areas, and WfW sites on the Sabie River, Engelhard Dam and Mkhadzi Spruit in the Kruger National Park.

An exciting development is that SASRI's most recent agent, the weevil *Cyrtobagus salviniae* (Cyrtobagus), first released in early 2009, has reduced kariba weed (*Salvinia molesta*) on growers' dams in the Greytown area drastically, in comparison to the previous infestations on those dams, and current infestations on dams in the same area where the weevil was not released.

Sterile Insect Technology

Sterile Insect Technique (SIT), is used successfully in a number of other agricultural industries against their insect pests, and shows promise as part of the AW-IPM arsenal against eldana.

It uses a cobalt source to produce radiation which affects the sex chromosomes of adult insects exposed to radiation (but not their behaviour), especially

males, to render them infertile, or partially fertile, which allows them to mate with "wild" partners, the off-spring of which will be sterile.

SASRI, in collaboration with the Department of Conservation Ecology and Entomology at the University of Stellenbosch and the Deciduous Fruit Producers Trust (DFPT) have completed a radiation biology study which shows eldana to be susceptible to low doses of radiation which do not affect its behaviour, but induces male sterility in the off-spring. This has encouraged SASRI to commence trials to determine the efficacy of reducing eldana populations established in cage trials, and also in pilot field releases of sterile adults. The F1 male sterility SIT approach is very successful and works by focussing on the irradiated male moths, which pass their inviable gametes through mating with "wild" females, onto their off-spring, which are born sterile, and thus when these off-spring mate with field or "wild" populations, produce no further off-spring.

The SIT approach would require a reliable supply of large numbers of quality insects for irradiation, which will have to be produced from well managed insect rearing factories.

This ability to produce reliable quantities of good quality insects from a rearing facility whether for insect and/or weed biocontrol, and in future for SIT is an area where SASRI has already shown its competence.

The benefits of biocontrol reach beyond pest control, and into environmental stewardship, which in modern agriculture should receive increased attention by all land-owners and custodians. Its incorporation into an effective AW- IPM programme will become the most effective way of managing alien invasives in the future.

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