Preliminary indications of success in the biological control of Harrisia cactus (*Eriocereus martinii* Lab.) in Queensland

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SUMMARY

During a three year program commencing in 1973, four species of insects were sent to Queensland from South America as biological control agents against Harrisia cactus (*Eriocereus martinii* Lab.). Three, *Alcidion cereicola* Fisher (Col: Cerambycidae), *Hypogeococcus festerianus* (L.yT) (Hem:Coccid), and *Eriocereophaga humeridens* O'Brien (Col:Curcul.) have been released in the field, and the first two are now widely established. Three years after initial releases damage to the cactus at the release sites is severe, growth and seed formation is greatly reduced, and the indications are that successful biological control will be achieved.

INTRODUCTION

Harrisia cactus (*Eriocereus martinii* Lab.), a native of Argentina and Paraguay, is a serious weed in the Collinsville district of north Queensland, where in a total of 3,000,000 ha, 68,000 are infested (32,000 ha heavy, 19,000 ha scattered, and 17,000 ha isolated). The infestation overlaps the northern limits of the Brigalow (*Acacia harpophylla* F.v.M.) belt, and the potential for plants to spread into this area is well recognized (Mann, 1967). Both chemical and mechanical control methods have been used since 1951, and expenditure for the 1977 calender year is $670,000.00, with approximately 50 personnel employed on a full-time basis.

After brief surveys in 1958 and 1972 (J. Mann, unpublished report 1958; F.D. Bennett, unpublished report 1972), a 3 year program financed by the Queensland Government was initiated in 1973 to find, study and introduce suitable insects into Australia as potential biological control agents.

RESULTS AND DISCUSSION

Seventeen insect species were encountered feeding on Harrisia cactus in South America and four of these were tested, found to be host-specific and sent to Australia (McFadyen, unpublished report 1976). One, *Cactoblastis* indet. sp., a gregarious stem-feeding phycitid similar to *C. cactorum*, died out in quarantine and was never released; arrangements are being made to obtain further stocks. The three species released are:

a stem-boring beetle *Alcidion cereicola* Fisher

a mealy bug *Hypogeococcus festerianus* (Lizer y Trelles), and

a stem-boring weevil *Eriocereophaga humeridens* O'Brien.

Alcidion cereicola - Between August and October 1974, 703 insects were sent to Australia as larvae on artificial diet. The adult beetle is nocturnal, active and a strong flier. The oval translucent eggs are inserted individually about 1 mm deep into the cactus. They hatch in 7 to 10 days and the larvae feed in the cactus at first superficially and subsequently tunnelling into the vascular tissue. Pupation occurs in a fibrous cocoon in the larval tunnel. The life-cycle from egg to adult is about two months in summer (McFadyen and Fidalgo, 1976). In the field the insects overwinter as feeding or prepupal larvae and there are 2 to 3 generations a year.

Females show a preference for older woody stems with well developed xylem as oviposition sites, in lieu of succulent younger growth in which young larvae drown. Damage to the plant is severe, as females tend to lay many eggs in the one area before moving on. Three to four eggs are laid per night per female.

A suitable method for large scale rearing was developed and 11,110 adults have been released at 28 different sites in the field at Collinsville.

Following liberation adults remain in a confined area about the release point and initial damage is both severe and obvious. Measurements of larval density at this stage vary from 5 to 15/m^2, with counts as high as 72/m^2 being recorded. Colonies have established and expanded at all sites, migration to new areas occurring over distances of 0.75 km. The largest area now covered from a single release site is 3 ha.

The larval tunnelling is accompanied by wet rots as well as secondary attack by other arthropods, which spread microorganisms and increase the total damage caused. One fungus has been isolated and identified as a *Rhizopus* sp; others such as *Gloeosporium* sp, and *Cladosporium* sp, known to accompany *Cactoblastis* in the *Opuntias*, may also be present, though this is not yet determined. The role played by "wet" rot producing microorganisms is considered highly significant.

Sub-surface tuber systems are not affected, and regrowth from these organs is rapid. This masks the damage caused and new stems are not reattacked for a period of 3 to 4 years.

Hypogeococcus festerianus - One shipment of infested cactus was received on 28 November 1974 and initial rearing was carried out at Sherwood. The first field release was made in the Collinsville area in 1975 and establishment was immediate. As with *Dactylopius* spp. (mealy bugs used for the control of *Opuntia* spp.), natural dispersal is slow but cactus plants can readily be infested by placing infested pieces of cactus on them. During 1975, 1976 and 1977, the mealy bug was reared on cut stems in large numbers in Collinsville, and by December 1977, 580 releases had been made over an area of 200,000 ha. Nearly all releases resulted in establishment. Laboratory rearing has now been abandoned in favour of using infested material collected from areas of dense mealy bug attack. Three predators are common in the field, the coccinellid *Cryptolaemus montrouzieri* Muls., the lacewing *Chrysopa ramburi* Schneider, and a lepidoteran *Anatrachyntes* sp., but none significantly reduces the mealy bug populations. This contrasts with the situation in Argentina where seven parasite species and

two predators maintained the mealy bug at a very low level (Cruttwell, unpublished report 1974).

The mealy bug in appearance and life history closely resembles *Dactylopius* spp. but the effect on the plant is very different. Even heavy infestations have no effect on mature stems, but growing tissue is drastically affected. Feeding by a single mealy bug arrests growth unilaterally at the stem or bud tip resulting in distorted and spiral growth. Feeding by several individuals on one tip completely arrests growth. As the crawlers are strongly phototactic and thigmotactic and tend to congregate at stem tips, buds, etc, moderate attack on a growing plant (e.g. after rain in spring) produces masses of twisted and distorted stems. Heavy attack prevents all growth and thus also flowering and fruiting. Young plants and regrowth are freely attacked.

Eriocereophaga humeridens - The adult weevils are flightless and nocturnal; the 1.5 mm diameter, round, white eggs are laid singly onto the cactus surface and covered by a protective layer of earth and faeces. The larvae feed in the stem and pupate in a fibrous cocoon in the stem. The life-cycle from egg to adult takes about 3 months in summer, but the adults live for 18 to 26 months laying up to 290 eggs per female (McFadyen, unpublished report 1976).

Three shipments totalling 471 adults were received between January and May 1976, the first field releases made in November 1976, and by December 1977, 1700 adults had been released at six sites in the Collinsville area. Initial results were disappointing; adults survived and laid eggs for 2 to 3 months but few larvae were found and larval survival was poor. Releases made in August 1977 were more promising with reasonable numbers of larvae, eggs and adults being found 3 months later. It is thought that larval survival may be adversely affected by the fungal rots which attack damaged cactus in the wet season, and that a higher percentage may survive in drier weather. As the adults are long lived, this should not prevent establishment but it is still too early for comment on this species.

Effect of the insects released and assessment techniques

In spite of a large expenditure over 25 years, the aim of eradicating the plant is still unfulfilled. Control methods used are scrub clearing and stick raking, followed by ploughing, or tracking and spraying with fenoprop (2,4,5-TP ester), and since 1974 with nopalmate. These methods have greatly reduced cactus densities. Insect releases are generally made in otherwise inaccessible areas such as stony ground or gullies. Plant density varied from dense to sparse, being in general patchy.

Because of the growth pattern of Harrisia cactus, with stems rooting in the ground and establishing new plants, accurate plant counts must be destructive, so estimates of cactus density in the insect release sites were based on the proportion of ground covered. It is realized that this does not give an accurate measure of biomass, as dense mature cactus may reach one or even 2m average height, while regrowth may be 30 cm or less, though both covering the same ground area.

Nevertheless it is felt that successful control must result not only in a reduction of biomass but also in an eventual reduction in the ground covered by cactus. Measurements of area covered, which can be made easily and non-destructively, will thus show if control is effective. For the same reason, counts of the insects present per m^2 were only occasionally made, though the area of establishment of the insects was frequently estimated.

The plant density was measured using permanent line transects in the release sites. A bearing was randomly chosen and a 20 m transect measured along the bearing from a central point. A second bearing was chosen at random and another 20 m transect measured along that bearing from the end of the first transect. This procedure was followed until 10 transects were established and marked at each site. The proportion of each transect line crossing live cactus was then recorded.

The first such transects were measured in November 1976 and no change in plant cover is observable as yet. Damage by *Alcidion* is significant over large areas; initial dense stands of cactus 1 to 2 m high have collapsed to form a mat of dead stems with regrowth 30 to 50 cm high.

In areas where the mealy bug has been established since 1975, i.e. for three summers, no flowering or fruiting occurred in spring 1977, and virtually none in spring and summer 1976/77. All growth has been arrested or deformed, consequently as stems die from age, pathogenic fungi, or wild pig attack, there is no replacement and the amount of cactus present is greatly reduced. This is particularly noticeable where *Alcidion* and the mealy bug are established in the same area, and the regrowth which normally occurs after *Alcidion* attack, is prevented by the mealy bug.

Where the mealy bug has been established for only one or two summers, the effect is proportionately less. Fruiting is not significantly reduced in the first summer after establishment, the low mealy bug population allowing many flowerbuds to escape attack. In the second summer, nearly all buds are attacked and little fruiting occurs, but early season flowers may produce fruit.

It is therefore anticipated that 3 to 4 years after the establishment of mealy bug in an area of cactus, the proportion of ground covered by cactus will begin to decrease and will continue to decline until a much lower average density is reached. Where other factors such as wild pigs, fungus, *Alcidion*, or other insects are causing cactus death, the decline will be much more rapid. At this stage it is impossible to predict the average cactus density which would be maintained in the presence of the mealy bug, but there is every indication that it will be sufficiently low that other control measures will not be necessary.

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REFERENCES

Mann, J. (1967).- The Harrisia cactus. Govt. Printer, Brisbane, pp 14.

McFadyen, R.E. and Fidalgo, A.P. (1976).- Investigations on *Alcidion cereicola* (Col: Cerambycidae) a potential agent for the biological control of *Eriocereus martinii* (Cactaceae) in Australia. *Entomophaga* 21 (1) : 103-111.