FIRST INVITATIONAL PAPER

BIOLOGICAL CONTROL OF CENTRAL AND SOUTH AMERICAN WEEDS IN AUSTRALIA[1/]

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This paper will review the present status of biological control of three weeds belonging to the Compositae and one belonging to Verbenaceae which originated in the Americas.

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2/ Paper delivered by Dr. D.F. Waterhouse.

COMPOSITAE

Noogoora burr (*Xanthium pungens* Wallr.)

Noogoora burr is an annual weed of North American origin which has colonized a very large area of grazing country in eastern Australia and occurs to a lesser extent elsewhere. It grows in the flood plains of streams and other suitable locations over the greater part of Queensland from the Gulf of Carpentaria southwards, and down into New South Wales as far south as Sydney. Noogoora burr causes considerable economic loss by contaminating wool, displacing pasture and, at the colyledom stage of growth, is poisonous to stock. Although it can be killed by herbicides this is, generally, far too costly. In an attempt to reduce seeding a trypetid seed fly, *Euaresta aequalis* Loew, was liberated in 1932. Liberations were continued for a number of years but this fly became established over only a very restricted area and has not contributed to control of the weed.

Two cerambycid beetles, *Mecas saturnina* Le C. from North America and *Nupserha antennata* Gahan from India, were first liberated in 1961 and 1964 respectively. *Mecas* has not shown any promise as a control agent but *Nupserha* is now firmly established at four liberation sites. To date the most successful establishment is at Pine Hill in Queensland where approximately 40% of plants appear to be attacked over an area of more than 100 acres and the insect has spread up to three miles from the liberation point. Attack has resulted in some suppression of seed production.

Wide fluctuations in rainfall, seasonal conditions and burr germination have influenced greatly the establishment of these insects.

Groundsel-bush (*Baccharis halimifolia* L.)

Groundsel-bush is a native of eastern and southern United States of America, where it occurs in the more brackish, swampy coastal and sub-coastal regions. The plant is seldom of economic importance although it appears quickly on newly-cleared lands; these infestations generally soon disappear with competition from other woody plants.

In Australia the plant occurs again in coastal and sub-coastal regions from northern New South Wales to Miriam Vale in Queensland. It is an aggressive, rapid-developing weed which is well established in the swampy and inaccessible coastal lands and offshore islands; these areas are the source of a vast amount of wind-blown and water-borne seed. Its main significance is in its invasion of pastures, which can be over-run in a comparatively short time and, because the plant is unpalatable to stock, the land soon becomes completely unproductive. At present a continuing and expensive eradication campaign is needed to keep coastal grazing country free from the pest. Chemical destruction with 2,4-D is satisfactory, but expensive due to the large areas involved and the inaccessibility of many of them.

During the period 1967-69 six insects host-specific to groundsel-bush were imported into Australia. Of these a leaf beetle, *Trirhabda baccharidis* Weber, shows most promise as a control agent. Although it has only a single generation each year, the life history of *Trirhabda* is synchronised with that of the plant so as to cause maximum damage. Peak hatching of eggs in the field in 1971 preceded the formation of male flowers by about two weeks and female flowers by four to five and, consequently, larvae were feeding voraciously prior to and at flowering. Damage to heavily attacked plants is spectacular, all flowers and all foliage being eaten. The insects overwinter as mature larvae and prepupae, and emergence of adults coincides with the flush of growth on stems in September/October; the feeding of these adults also causes significant damage. Residual effect on plants also appears significant as those defoliated last season did not flower this year.

Another promising species is a leaf skeletonizer *Aristotelia* sp. In contrast to *Trirhabda*, this insect seems to disperse before large populations build up and it may be some time before its full potential in the field is apparent. However, it is capable of causing considerable and continuous defoliation under cage conditions and could prove a valuable control factor, particularly at times when *Trirhabda* is not active.

Crofton weed (*Eupatorium adenophorum* Spreng.)

This weed is a Mexican shrub of the family *Compositae*. It was first reported in Queensland in 1930, it increased and spread very aggressively between 1940 and 1950 in the south-eastern border districts and threatened to overrun large areas of improved dairy pastures and of horticultural lands.

A Trypetid gall-forming fly, *Procecidochares utilis* Stone, was introduced from Hawaii in 1952, became established immediately, and increased to large numbers at several release sites. Within two years, however, dense populations of the fly were greatly reduced by indigenous parasitic Hymenoptera which have continued to exercise a high degree of control. Despite this limiting factor *P. utilis* has dispersed to the extent that its galls occur on virtually every Crofton weed plant.

Cercospora eupatorii, a leaf spot fungus native to the United States and present on Crofton weed in Hawaii, was first recognized in Queensland in 1954 in an area where *P. utilis* had been released. It is now distributed in all Crofton weed areas where its lesions cause leaf fall and at times major defoliation. Adults of *P. utilis* have been found to carry the fungus spores and to be capable of transmitting the disease.

Since 1952 Crofton weed has not spread or increased; heavy infestations have been reduced in vigour and in density; scattered plants and groups of plants have become less frequent and seedling growth has been less prolific. This definite measure of control appears to be due primarily to the activities of *P. utilis*, notwithstanding its comparatively low population level. Control is assisted by the damage caused by *Cercospora* and by a cerambycid, *Dihammus argentatus* Auriv., which is a native stem and root borer. The weed is gradually coming under control in all except the higher rainfall areas.

VERBENACEAE

Lantana (*Lantana camara* L.)

Current Status as a Weed

Lantanas are amongst the most serious weeds in forestry and pastoral areas of eastern Queensland and north-eastern New South Wales. In New South Wales, they are more important in forestry than in agriculture. They include some of the major poisonous plants of Queensland and are a continuing cause of stock losses. Although they may have receded in more highly developed areas the density of infestation is slowly increasing within the present limits of distribution.

Lantanas have been spread by man to practically all climatically suitable areas of the world and have become pests in many areas. All of the troublesome *Lantanas* probably originated in Mexico, Central and South America, including the West Indies, but many now naturalized in various regions may have been developed by horticulturalists. This has resulted in a complex taxonomic situation and it has not been found possible to attach technical names to the various strains, or to determine the origin of the *Lantanas*, totalling some 21, that are naturalized in Australia. All except three of those so far tested are toxic to cattle.

Chemical control of *Lantana* is possible but is impracticable and too costly in most situations.

Biological Control

Eleven insects which attack *Lantanas* are established in Australia and liberation of two more is in progress. These insects depress growth and reproduction of the plants but their importance as controlling agents varies in different localities and on different *Lantanas*. Insect populations are greatly influenced by seasonal conditions, and the strong preferences shown by several of the insects result in some *Lantanas* being heavily attacked, whereas others are only very lightly attacked. Under favourable circumstances, competing plants may suppress *Lantanas* which have suffered severe insect damage.

The introduction of a number of biological control organisms into Hawaii has resulted in widespread and striking reduction of *Lantana*. Insects already imported into Australia have lowered the competitiveness of some of the *Lantanas*, but so far reduction has been very much less than in Hawaii. This may at least partly be because most of the *Lantanas* in Australia differ from those in Hawaii, and because the beneficial insects involved were originally obtained from regions where the native *Lantanas* resembled the Hawaiian kinds more closely than the Australian kinds.

In Australia the more important control agents are:

The tingid bug *Teleonemia scrupulosa* Stål. which is capable of seriously damaging and even killing, plants in some lantana taxa. A small colony with a presumably very limited gene pool was imported into Australia in 1935. The value of *T. scrupulosa* as a control agent is limited by the insect having decided preferences for particular taxa of the weed and because populations are severely reduced under wet or cold conditions. Recently, in 1969, CSIRO imported colonies from a wide variety of habitats scattered over the insect's extensive indigenous range in Central and South America. Incorporation of this genetically variable material into the established population appears to be improving its effectiveness under conditions which formerly were unfavourable.

The hispine beetles *Octotoma scabripennis* Guérin and *Uroplata girardi* Pic were imported in 1966, they were readily established and, during last summer, populations rose very rapidly. Plants were completely defoliated over extensive areas and it appears that these species are going to be very effective. Both species are well established south of the Tropic of Capricorn, whereas only *U. girardi* is well established further north.

Other species recently established which may be valuable are a cerambycid stem borer *Plagiohammus spinipennis* (Thoms.) and a tingid *Leptobyrsa decora* Drake. At present it appears that they may be of most value in coastal New South Wales.

Future Prospects

In their indigenous range in the Americas *Lantanas* occur as scattered plants and do not constitute a problem. They are under attack by a wide range of insects and other organisms which evidently have a very severe effect on the vigour and aggressiveness of the plants. Many areas in their indigenous range are homoclimatic with heavily-infested areas in Australia and there are good prospects that biological control agents may be found that will reduce appreciably the pest status of *Lantanas* in Australia.

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DISCUSSION

BENNETT I was interested to learn of developments following the introduction of Trirhabda into Australia for the control of Baccharis and the apparent seasonal shift in its life cycle. In Florida Trirhabda overwinters in the egg stage; the eggs hatch in the spring and the plants are defoliated by the larvae and again a few weeks later by the adults. Eggs are laid during May and June but do not hatch until the following spring i.e. the species is largely univoltine. My impressions, gathered from short visits to Florida, are that most plants following the successive defoliation by larvae and adults have time to recover and by autumn they flower quite profusely. Eggs laid by adults moved to the Southern Hemisphere in May hatch within a few weeks, rather than after a few months, and defoliation occurs later in season. This apparently drastically reduces flowers and seed production. It will be interesting in a few years time to see whether this pattern continues in Australia or whether egg hatching will become synchronised with the advent of spring as it appears to be in Florida.

ZWOLFER I was very interested in what you said about the effect of Procecidochares utilis on Eupatorium because we have been working five years with a trypetid (Urophora cardui, L.) which attacks creeping thistle and makes similar stem galls. We have some difficulty in assessing the damage of the insect attack on the plant and I'm wondering if you could measure the effect of the number of galls or the site of the galls on the vigor of Eupatorium or its reproductive capacity.

WATERHOUSE We haven't investigated this. However, evidence could be obtained by protecting some of the plants from seedling stage onwards with insecticides. The whole question of trying to evaluate the effect of introduced organisms is a very important one. This is not so much because it will make any difference to the control of the weed but it might make quite a lot of difference to the amount of financial support that one can obtain for further and mor extensive operations.

Crofton weed is still quite a common weed, even though many of the stems are galled. If you just took a superficial trip through the area you would hardly imagine that these galls were having a significant effect on the plant, but it has just made all the difference. No longer is the plant aggressive. If the plant is mechanically destroyed or destroyed with herbicides, then there is no rapid regeneration and it isn't moving into new areas. What one needs more frequently than elimination of a weed is a reduction in its aggressiveness, so that it no longer is an important component of the plant complex.

WAPSHERE If I may add something to Dr. Waterhouse's statement, Mr. Hasler, who is at present director of the Queensland Government, Department of Lands, Biological Section, Sherwood Brisbane, wrote a thesis on this problem. He showed that the reduction of seed and the reduction of the vigor of the plant was proportional to the number of galls.

RAMSAY You mentioned that man has introduced these lantanas into Australia and other parts of the world. I wonder if you could expand a little on the avenues of entry of these weeds into Australia.

WATERHOUSE I regret that I don't know the precise details. The pink flowering form, which is common in New South Wales was apparently brought in about 1852 and spread rapidly. It appears that it was brought in as a horticultural variety, and in those days there was little or no attempt to decide whether the organisms

one might bring in were likely to be desirable or not. We have many legacies from introductions during the 19th century. One of the problems is that some of these early introductions were fertile plants. Many of the more recent and more beautiful lantanas are sterile hybrids and do not cause any problems at all. I think there is a little information on the introduction of lantanas into Australia, but, I don't think it is very well documented.

ANDRES In Hawaii they have had considerable success with the various lepidopterous larvae they have introduced. These are defoliators. Have these had much impact on the plant in Australia?

WATERHOUSE No, they haven't unfortunately. We have a wide variety of hymenopterous and dipterous parasites of other lepidopterous larvae which have transferred very happily onto the various species of lepidoptera that attack Lantana. At one stage, we thought that our Hypena strigata was possibly a different strain from the strain that does such a terrific job in some areas in Hawaii. So we introduced the Hawaiian strain, but this didn't seem to increase the frequency of the occasional massive outbreaks. You can generally find Hypena in low numbers and occasionally, the conditions are right for them to outbreak.

But perhaps we have been looking in the wrong areas. Australian and Hawaiian entomologists have jointed in various expeditions but all of these went to Mexico and Central America and almost always the material was sent to Hawaii. If it was found to be safe for liberation in Hawaii then we did the extra tests necessary for its clearance for Australia. I believe that we should examine more throughly the possibility of obtaining suitable strains of some of the species that are apparently effective in Hawaii but are not showing any special effectiveness in Australia.

Perhaps I might mention that we are beginning work again in Brasil. We hope to have additional species before long and, as usual, we will be very happy indeed to share any new organisms with those who might want species that attack the various Australian lantanas

END OF DISCUSSION

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