South America focus of bio-control search

Alligator weed apparently originated in the lowlands of the Parana River, near Argentina's borders with Brazil and Uruguay, a region which lies at a similar latitude to Sydney. But the weed tolerates much cooler climates.

It has become widely distributed in China south of the Yellow River, and is a serious problem in irrigated soybean crops in the southern United States, where herbicide costs run to $50 per hectare. It has prospered even in rice-growing regions of Texas that experience heavy winter frosts; the weed can even survive in ice-covered ponds. Alligator weed apparently does not set seed in Australia. It reproduces vegetatively, budding from nodes along the stem.

If alligator weed were to become established in the Murray River and its tributaries, it could disrupt wetland ecosystems and severely disrupt horticulture and irrigated crops in Australia's most important food-growing region. With exports of irrigated crops contributing $4.5 billion annually to Australia's economy, alligator weed could cause great economic damage.

Mick Julien, of the CSIRO Division of Entomology's laboratories at Indooroopilly in Brisbane, coordinated a research project into the biological control of the weed in the late 1970s. He agrees with Dr Kath Bowmer's view that a new search must be made for biological controls for the weed's terrestrial form.

Julien says that while the weed appears to have reached the limits of its range in North America and China, the outbreak in the New South Wales Riverina serves as a warning that it has yet to reach its climatic range in Australia.

Julien and co-workers at the division imported several insect species found feeding on alligator weed on the Parana River. Two of these, the flea beetle *Agasicles hygrophila* and the moth *Vogtia malloi*, have helped to control some NSW coastal infestations, but Julien doubts that they would survive or breed fast enough to suppress alligator weed in the cooler inland and southern regions of Australia.

Julien recently used the computer-based

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The flea beetle, *Agasicles hygrophila* (pictured) and the moth *Vogtia malloi*, both from Argentina's Parana River, have helped to control the aquatic form of alligator weed in Australia. But the insects are unlikely to survive in much of the weed's potential range, especially in inland areas.

climate-matching program CLIMEX (see 'Where will that pest go next', *Ecos* 80) to predict where alligator weed might become established in Australia. CLIMEX considers such climatic factors as temperature range, rainfall and relative humidity, and various stress indices – combinations of hot/dry, hot/wet, cold/dry and cold/wet conditions – encountered in the species' native range, as well as in areas where it has become established as a pest. From this data, CLIMEX can predict where else the weed is likely to grow.

CLIMEX predicts that alligator weed will survive in most of the continent's coastal zone, as far north as Queensland's Cape York Peninsula and the Northern Territory's Top End, and in the temperate inland as far south as southern Victoria and southern Western Australia. The only limiting factor is water.

When Julien performed the same exercise for the weed's most effective predator, A. hygrophila, CLIMEX predicted that the flea-beetle would not survive in much of the weed's potential range, especially in inland areas. Alligator weed would thus be free to proliferate in the absence of its natural enemies. But this is only part of the problem. Even in areas where the flea beetle and moth prosper, they do not provide control over the terrestrial form of alligator weed.

'These insects have evolved with the aquatic form of the plant, which has a different growth habit to the terrestrial form,' Julien says.

The beetles and moths released on the Georges River infestation in 1976 have provided effective long-term control. Julien says the beetle's efficiency, in particular, has made it difficult to assess the moth's contribution to the control program. But biological control has been less effective, or ineffective, on non-aquatic infestations in the Sydney and Newcastle region.

The adult beetle eats the plant's leaves; its larvae also eat the leaves and then burrow into the hollow stems to pupate. Because the terrestrial form is under a degree of water stress, it is usually smaller and produces thinner, tougher stems with no hollows at the apices to accommodate the beetle larvae. Because the terrestrial form is less attractive both to its adult and larval forms, the flea beetle causes little damage.

Alligator weed grows mainly in summer, achieving peak growth rates in January when temperatures are highest. Effective control depends on the insects emerging towards mid-spring and building up large populations by completing several successive generations before early autumn. In cooler areas, emergence is delayed and the insects do not have time to develop populations large enough for effective control.

Julien says that to some extent, moth larvae compete with the beetle larvae by burrowing into the stems to feed and pupate. The moth larva girdles the stem from the inside, cutting off water flow through xylem vessels, so that stems and leaves above the damage zone wilt and die. Each moth larva destroys an average of nine stems before it pupates.

In the 1970s, Julien experimented with another flea beetle, *Disonycha argentinensis*, a leaf-eater like *A. hygrophila*, but found that the species seemed intolerant of low humidity under Australian conditions. It also failed in New Zealand. Nearly two decades on, it is time to go back to the Parana River to search again.