

# NATURAL INSECT ENEMIES FOR THE CONTROL OF *CHROMOLAENA ODORATA*

L W STRATHIE

*Agricultural Research Council – Plant Protection Research Institute,  
P/Bag X6006, Hilton, 3245, South Africa  
E-mail: [ntlws@natal1.agric.za](mailto:ntlws@natal1.agric.za)*

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*Chromolaena odorata* (L.) King & Robinson (Asteraceae: Eupatorieae), a shrub of neotropical origin, is a primary threat to the conservation of biodiversity, and to pastoral and crop agriculture and forestry in the subtropical regions of South Africa. It invades much of the sugarcane growing areas in KwaZulu-Natal and thus impacts negatively on the South African sugar industry. The plant presents similar problems in other parts of Africa, as well as in south-east Asia and Australia.

Since the inception of the chromolaena biocontrol research programme in South Africa in 1988, three species of *Pareuchaetes* moths (*P. pseudoinsulata* Rego Barros, *P. aurata aurata* (Butler) and *P. insulata* (Walker) (Lepidoptera: Arctiidae)), the larvae of which defoliate chromolaena, have been released into the field, but with minimal success. These agents have a mixed record worldwide, and no single factor has been pinpointed in determining their establishment or non-establishment. In conjunction with the Agricultural Research Council – Plant Protection Research Institute and the Department of Water Affairs and Forestry's 'Working for Water' programme, the South African Sugar Association Experiment Station has been, and is currently, involved in the production of substantial numbers of healthy *Pareuchaetes* larvae for release in the field (Muir and Conlong, 2003). Despite two years of releases of more than 800 000 *P. insulata* originally from hot, humid Florida (Muir and Conlong, 2003; Parasram, 2003), there has been limited success, possibly due to the exceptionally dry conditions that have been experienced in many areas of KwaZulu-Natal. Releases of two strains of *P. insulata* from Jamaica and the dry regions of Cuba are now being attempted, as these should be better suited to the local climate or host plant biotype, two factors which may have complicated establishment of previous releases.

Surveys, largely opportunistic, in Central and South America where *Chromolaena odorata* is native, have yielded various insects and pathogens on chromolaena, several of which have been investigated as potential biocontrol agents (Strathie and Zachariades, 2002; Zachariades *et al.*, 1999). Some, such as the butterfly *Actinote thalia pyrrha* Fabricius (Lepidoptera: Nymphalidae) from Brazil, the larvae of which feed on chromolaena foliage, and the leaf sap-sucking tingid *Leptocysta sexnebulosa* (Stål) (Hemiptera: Tingidae), from Venezuela could not be released due to their unacceptably wide host range (feeding and development occurred on more than just chromolaena) (Zachariades *et al.*, 2002). Rearing difficulties, such as shortened longevity or an inability to induce mating or oviposition, have been experienced with certain agents such as the stem-tip mining moth *Mescinia* sp. nr *parvula* (Zeller) (Lepidoptera: Pyralidae). Host biotype incompatibility problems have been experienced with other candidate agents such as the stem-galling fly *Cecidochoares connexa* Macquart (Diptera: Tephritidae), which has established widely throughout south-east Asia but could not be sustained on the southern African chromolaena in quarantine.

Several candidate agents have been successfully reared, and host-specificity testing has been completed or is under way. Ten insect agents are being focused on currently in the chromolaena biocontrol research programme. Two of these are *Lixus aemulus* Petri (Coleoptera: Curculionidae), a stem-boring weevil, and *Calycomyza eupatorivora* Spencer (Diptera: Agromyzidae), a fly that forms blotch mines on leaves (Gareeb and Zachariades, 2003). Both have been shown to be host-specific and are ready for release as soon as the relevant authorities grant approval (Zachariades *et al.*, 2002). Due to the additional approval required from environmental government departments, there have been lengthy delays in obtaining approval to release *C. eupatorivora*. The fly was collected from Jamaica and seems to prefer hot, humid, moist environments, so may be best suited to coastal areas of KwaZulu-Natal and areas where chromolaena does not experience reduced leaf vigour during the dry winter seasons. *Lixus aemulus*, with larvae that kill individual stems, has been shown to be damaging in laboratory trials (Zachariades *et al.*, 2002). It is difficult to predict how biocontrol agents will fare when released in the field, but it is expected that, should they establish, these agents will stress chromolaena and reduce photosynthetic ability and plant growth. As with most insect agents, it is not anticipated that these species alone will be sufficient to control chromolaena; other agents will be required to attack different parts of the plant before substantial levels of control can be attained.

Several other candidate insect agents are still at the stages of investigation, culturing and host range testing. A root-feeding flea beetle, *Longitarsus horni* Jacoby (Coleoptera: Chrysomelidae), that originates from Venezuela, is of particular interest as no root-attacking agents have yet been targeted for chromolaena. Although this agent was collected off a hairier form of chromolaena than the South African chromolaena biotype, neither *L. horni* nor an equivalent have been found on *C. odorata* in the northern Caribbean, which is considered to be the origin of the southern African form of chromolaena (Zachariades, 2003). Thus, *L. horni* is still of interest. It is present in the drier, coastal regions of Venezuela and may thus be well adapted to South African conditions with distinct wet and dry seasons, another reason for its priority. Adult feeding creates 'shot-holes' on the leaves, but larval root-feeding is more damaging.

Following the discovery of the origin of the South African form of chromolaena as the northern Caribbean, a recent initial survey of the entomofauna associated with chromolaena in Cuba revealed no new agents at the sites visited, but this will be followed up with a more intensive survey. At the same time, several priority agents were collected from Jamaica, Venezuela and Florida and new cultures were established or existing cultures boosted. Chromolaena stem-tips containing larvae and pupae of the shoot-tip mining fly *Melanagromyza eupatoriella* Spencer (Diptera: Agromyzidae) were collected from Florida. This candidate agent has been imported into quarantine on several occasions, but on those occasions could not be induced to oviposit and survive in adequate numbers to sustain a culture. A breakthrough was obtained when a culture was established by releasing flies into a large walk-in cage with numerous potted chromolaena plants in the glasshouse. However, for unknown reasons, the population declined in subsequent generations and the culture died out. *Melanagromyza eupatoriella* will be imported again but instead from Jamaica, where it is known to be present on the southern African form of chromolaena, which should eliminate any possible problems with biotype incompatibility.

Studies on agents that have proved difficult to rear are being undertaken in conjunction with universities in Venezuela and Jamaica. A stem-tip mining moth on *C. odorata* in Venezuela is a new species of *Carmenta* (Lepidoptera: Sesiidae); it will be described and its biology investigated.

*Conotrachelus reticulatus* Champion (Coleoptera: Curculionidae), a weevil that galls the shoot tips of chromolaena in Venezuela, was in culture in quarantine for a few years before gradually declining for reasons unknown, but thought possibly due to biotype incompatibility or incorrect environmental conditions. Further biology and host-specificity studies will be conducted on *C. reticulatus* in Venezuela. Both agents seem damaging, stunting the growth of chromolaena stems.

By planting South African chromolaena plants in a field plot in Jamaica and surveying insects that are attracted, the most compatible agents can be found. *Polymorphomyia basilica* Snow (Diptera: Tephritidae) is a stem-galling fly in the northern Caribbean that fills the equivalent niche of the mainland fly *Cecidochares connexa*, which was released in south-east Asia and is now widespread and damaging. A culture of *P. basilica* could not be established in quarantine, probably due to a critically low number of adults. Its biology and host specificity will be examined in Jamaica. Further studies on the biology of the damaging agent, *M. sp. nr parvula* will also be conducted in Jamaica.

A very damaging stem-boring cerambycid beetle was collected off *C. jujuiensis* (Hieron.) King & Robinson in Argentina in 2002, and is developing on *C. odorata* in quarantine. The larvae tunnel into the main stem and root crown. Its biology will be investigated and identification determined before further decisions are made on its incorporation into the biocontrol research programme.

With the forthcoming release of two biocontrol agents on chromolaena and several more insects that attack the stems and roots of chromolaena under investigation, it is envisaged that in forthcoming years insect natural enemies will have a large role to play in the reduction of chromolaena to manageable levels in South Africa. This will have wide-ranging benefits for all landowners in the subtropical regions of the country.

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