Proceedings of the X International Symposium on Biological Control of Weeds
4-14 July 1999, Montana State University, Bozeman, Montana, USA
Neal R. Spencer [ed.]. (2000)

Long-term Monitoring of the Impact of *Aphthona nigriscutis* on Leafy Spurge: the Beverly Bridge Sites

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Aphthona nigriscutis Foudras (Coleoptera: Chrysomelidae) was introduced into Alberta, Canada, from Hungary in 1983 as a biological control agent for leafy spurge (*Euphorbia esula* L.). The adult beetles feed on leafy spurge leaves and the larvae feed on the roots. It has been most effective against leafy spurge on lighter soils, in spurge stands with flowering heights of less than 70 cm, and on well drained sites such as upper slopes or hill tops. In 1988 and 1989, a total of 1,350 *A. nigriscutis* were released at six sites in a heavy leafy spurge infestation in Edmonton, Alberta. These were located along a south-facing railway embankment above the North Saskatchewan River, just west of the Beverly Bridge. Initial leafy spurge densities ranged up to 272 shoots m^{-2} and percent cover was 15 - 40%. Each year in August since these releases, vegetation parameters have been measured on fixed transects located at each of the original release points. Leafy spurge density, percent cover and biomass are measured, as well as percent cover and biomass of grasses, forbs and woody plants. All sites are also photographed from standard viewpoints each year in early July. *Aphthona nigriscutis* established at all the release points and increased to very high population densities 3 - 4 y after the releases, coinciding with a dramatic drop in leafy spurge populations. By 1993 leafy spurge densities had dropped to 1 - 14 shoots m^{-2} and cover was below 1%, with a corresponding increase in the biomass of grasses and other vegetation. The reduced leafy spurge growth and increased grass production have been maintained since then. Over 100,000 beetles have been collected and redistributed from this site.

Evaluating the Use of Pheromones for Monitoring Establishment of *Agapeta zoegana* (Lepidoptera: Cochylidae), a Biological Control Agent of Spotted Knapweed

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Although there are many examples of pheromone applications to monitor or regulate populations of insects considered pests, little work has been done on using phermones to

monitor population numbers or trends of beneficial insects such as *Agapeta zoegana* Haw., a biological control agent of spotted knapweed, *Centaurea maculosa* Lam. *A. zoegana* is a root boring insect that has been propogated and released for spotted knapweed control across Montana over the past 15 years. This study evaluated the attractiveness of *A. zoegana* to four pheromone formulations in 1998, and in 1999, evaluated the most attractive pheromone formulation and compared effectiveness of pheromone trapping to larval and adult visual sampling. There were significant differences (p=0.05) between both Z11-14Ac formulations and the control. Traps baited with Z11-14Ac plus Z11:14OH caught significantly fewer moths than traps baited with Z11:14Ac alone, suggesting the Z11:14OH may have an inhibitory effect on male attraction. In 1999, the higher strength (2.5ug)/trap attracted significantly more (p=0.05) male moths than the lower concentration (0.5ug)/trap and the control. There was a strong relationship between 1999 trap catches and relative abundance of adult moths (r=0.75) and with significance (p=0.01) and an even higher correlation between larvae found in 1998 and 1999 (r=0.90). This study identified an attractive pheromone formulation for trapping *A. zoegana*, and appears to be an effective monitoring tool for assessing populations without capturing large numbers of males as to adversly impact the population.

Pre-Release Studies and the Selection of Biological Control Agents

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Pre-release studies were conducted on meadow hawkweed to determine how it compensates for stolon and scape damage. This information may be useful in the selection of biological control agents in the near future. Meadow hawkweed produced the same number of scapes and stolons regardless of treatments, which included artifically removing none, one half, or all of the scapes and stolons in a randomized block factorial experimental design. The ability of meadow hawkweed to compensate for damage suggest multiple agents imposing cumulative stress will likely be needed for biocontrol of this clonal weed. This study is one of three that were initiated in 1997 to evaluate how plant damage affects individual plant performance, the subsequent development of the clone, and how damage, in combination with fertility and interspecific competition, mediates the population dynamics of an established meadow hawkweed infestation.