

constraint. Large quantities of spores, the active ingredients of this potential bioherbicide, were produced on solid substrate in this study. However, spore production in liquid culture has been successful in pilot experiments and research to develop a cost-effective mass-production system is continuing. Issues relating to the safe use of this fungus are currently being considered by testing for the presence of mammalian mycotoxins in the system and determining the host range of the pathogen.

## Habitat analyses of *Euphorbia* species and associated flea beetles in the *Aphthona* complex from Europe: can we learn something about habitat associations of natural enemies prior to release?

ROBERT M. NOWIERSKI<sup>1</sup>, ZHENG ZENG<sup>1</sup>, DIETER SCHROEDER<sup>2</sup> and ANDRÉ GASSMANN<sup>2</sup>

<sup>1</sup> Department of Entomology, Montana State University, Bozeman, MT 59717, USA

<sup>2</sup> IIBC, European Station, 1 Chemin des Grillons CH-2800, Delémont, Switzerland

Habitat associations were characterized for four different spurge species and their associated flea-beetle species in the *Aphthona* complex from dry, moist and wet habitats from 18 field-sites in Europe. Micro- and macro-nutrient analyses were conducted on soil and spurge foliage and roots, physical properties of the soil were measured and plant productivity was estimated at each of the 18 sites during spring, early-summer and mid-summer. The spurge species included *Euphorbia cyparissias*, *E. lucida*, *E. seguieriana* and *E. virgata*. Flea-beetle species included *Aphthona cyparissiae*, *A. czwaline*, *A. lacertosa*, *A. nigriscutis*, *A. pygmaea*, *A. venustula* and *A. violacea*. The results of ordination analyses and other multivariate approaches revealed that the spurge species and various flea-beetle species were each associated with particular chemical and, or, physical properties of the soil, chemical properties of the spurge roots and foliage (*Aphthona* spp. only), and levels of plant productivity. Flea-beetle species such as *A. lacertosa* and *A. czwaline* were found to be associated with higher levels of clay and organic matter, higher moisture levels, higher levels of plant productivity and higher levels of potassium in the spurge foliage. In contrast, *A. pygmaea*, *A. cyparissiae*, *A. nigriscutis* and *A. venustula* were associated with higher levels of sand, lower moisture levels, lower levels of plant productivity and higher levels of calcium in the spurge roots and, or, foliage. *Aphthona violacea* appeared to be associated with increased levels of clay and organic matter, higher moisture levels, higher levels of plant productivity, higher levels of phosphorous, copper, potassium, manganese and nitrogen in the spurge roots, and higher levels of nitrogen and manganese in the spurge foliage. This information will be helpful in guiding the release of flea-beetle species in the appropriate types of habitats in the future, and hopefully improve their chances for establishment on leafy spurge in North America.