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Systems approach with biological agents for leafy spurge control

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The flea beetle, *Aphthona nigriscutis* Foudras, can be successfully integrated with herbicide treatment for control of leafy spurge. The compatibility of these methodologies (biological, chemical) is exemplified by an accidental overspray of established *A. nigriscutis*. The beetle population increased and leafy spurge density decreased the following season. The biological basis for this potential synergism will be investigated.

The effect of date of picloram and 2,4-D application on *A. nigriscutis* population in leafy spurge will be determined. This experiment will be conducted at two locations, Chaffee and Fort Ransom, North Dakota. Leafy spurge at Chaffee and Fort Ransom averaged 90 and 63 stems/m^2, respectively. Approximately 350 *A. nigriscutis* adults were released into 1.8- by 1.8- by 1.8-m screened cages on June 22, 1995. An additional 100 *A. nigriscutis* adults were released on July 14. Leafy spurge and *A. nigriscutis* will be oversprayed with picloram plus 2,4-D at 0.56 plus 1.1 kg ha-respectively, beginning August 15 and continuing every two weeks until October 1.

The *A. nigriscutis* population will be monitored in three ways. First, adults will be collected from soil cores harvested in the fall. Second, *A. nigriscutis* larvae will be counted from soil cores harvested in the spring the following year. Third, adults will be collected in the spring from emergent trap chambers in the field.

Emergence of *A. nigriscutis* adults in the laboratory will be quantified with four soil cores taken from each *A. nigriscutis*-infested subplot. Soil samples will be harvested in late October with a golf-cup cutter. The soil cores will be 10.8-cm diameter to a depth of 15 cm and held at 3º C for 75 days. Each sample then will be placed into a 0.9-L plastic cup and covered by a clear plastic cylinder with a mesh top. Trap chambers with soil cores will be maintained in the laboratory at 21º C with a 16-hour photoperiod. Adult *A. nigriscutis* will be collected and quantified for each soil core. The second estimate of population will be with soil cores harvested from *A. nigriscutis* infested subplots in the middle of May of the following year. Two soil cores will be harvested from each subplot and dissected to quantify *A. nigriscutis* larvae. Adult emergence in the field will be evaluated using trap chambers. Trap chambers consist of 20-cm diameter and 20 cm-long PVC pipe recessed into the soil even with the soil surface. A mesh screen will cover the

PVC pipe to capture adults. Two trap chambers will be placed in each *A. nigriscutis*-infested subplot.

Leafy spurge root material will be harvested in subplots not infested with *A. nigriscutis* to quantify carbohydrate and protein content. Root material will be collected beginning August 15 and continuing until soil freeze-up. Root samples also will be collected in April and May the following spring. Leafy spurge roots cannot be sampled in the presence of *A. nigriscutis* because larvae inhabiting root tissue will alter protein and carbohydrate quantitation. Quantitation of leafy spurge root material may explain potential differences in counts of *A. nigriscutis* adults and larvae across herbicide application dates. Root nutrients will be compared between caged and uncaged leafy spurge to determine the effect of caging on the chemical composition of roots.

The effect of *A. nigriscutis* larval feeding on picloram, 2,4-D, and photosynthate translocation in leafy spurge will be determined through a series of greenhouse studies. Leafy spurge plants will be subjected to *A. nigriscutis* larval feeding for 60 days prior to application of ^{14}C-2,4-D, ^{14}C-picloram, or ^{14}C-sucrose. Plants will be sectioned and combusted, with ^{14}C tissue concentration determined by liquid scintillation techniques.

Data collected from the field experiment will illustrate the most beneficial herbicide application date over *A. nigriscutis* populations. Combined biological and chemical control will likely shorten the time needed to reduce leafy spurge populations to acceptable densities. In addition, integration will establish long term control, reduce chemical inputs, and reduce the economic losses on both private and public lands. The greenhouse experiments will clarify the biological basis for synergism between biological and chemical control observed in the field. Understanding the basis for this synergism may lead to the integration of additional biological and chemical control methodologies on noxious weeds.