Introduction of Insects for the Biological Control of Leafy Spurge in North Dakota

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Introduction of insects for the biological control of weeds is not a new concept, but it has been gaining support with the continued scrutiny of chemical control agents and their potential side effects on the environment and their potential for contaminating water resources. Efforts toward identifying and screening insect species which attack leafy spurge have been ongoing since the 1960s by Canadian, European and U.S. scientists with these efforts being significantly expanded in the 1970s and 1980s (Harris, 1984; Pemberton, 1985).

Leafy spurge is a particularly promising candidate weed for biological control because of its propensity to infest low-valued land, particularly along waterways and areas where the primary land use is grazing of cattle. Spurge is also a perennial weed, which means that a continuous food source is available to organisms which are capable of utilizing certain portions of the plant. Unfortunately, the defensive mechanisms possessed by leafy spurge make utilization of the plant difficult except for well adapted insects that have evolved means by which to overcome these defenses.

Very few insect species native to North America have been determined to utilize spurge as a food source, at least not the vegetative portions of the plant (Julian, 1988). Many native species readily utilize the flowers as a nectar source. Native species have not had time to evolve means of overcoming the defensive barriers such as latex exudates which arise at points of damage to the plant. In Europe and Asia, however, a large number of insect species have been identified as capable of attacking spurge, with many being host specific. These host-specific species are the primary focal points in the search for organisms suitable for release in North America. Bot Agriculture Canada and the U.S. Department of Agriculture have been actively scrutinizing the different species and some have been cleared for release and study in both countries.

Messersmith (in this issue of NDFR) briefly outlines the history of the biological control efforts in North Dakota. We will attempt to summarize some of the highlights in this continuing research effort.

INSECTS RELEASED

Table 1. summarizes the species that have been released at at least one site in North Dakota. This table also includes the information on the portions of the plant which are attacked by the insect and the point of primary damage. A general strategy that has been proposed for control of leafy spurge has been one of the multiple species attacking various portions of the plant. This approach is predicated on creation of reduced vigor in the plant and thus reducing stem densities at infested sites that would be tolerable in terms of forage production and site utilization by grazing animals. A second consideration in the selection of species for release must be the different habitat requirements of the insects themselves. The inclusion of four flea beetle species in the release effort, all in the same genus, reflects the assumption that the larger number of species in this genus in Europe and Asia are more suited to certain habitats and thus avoid competing with one another for the food resource. One of the primary objectives of this research program is to attempt to identify these requirements to maximize the potential for successful establishment when new releases are made.

Table 1. Biological control agents released to date in North Dakota.

Species	Insect type	Feeding characteristics
Aphthona flava	flea beetle	Adults leaves; larvae roots Primary damage by larvae
Apthona cyparissae	flea beetle	Adults leaves; larvae roots Primary damage by larvae
Aphthona czwalinae	flea beetle	Adults leaves; larvae roots Primary damage by larvae
Aphthona nigriscutis	flea beetle	Adults leaves; larvae roots Primary damage by larvae
Oberia erythrocephala	long-horn beetle	Adults stems; larvae stem Primary damage by larvae
Spurgea esulae	Gall midge	Adults none; larvae form galls; Primary damage by larvae
Hyles euphorbiae	Hawk moth	Adults wildflower nectar; larvae foliage; primary damage by larvae.

STATEWIDE DISTRIBUTION OF RELEASE SITES

Insects used for release in North Dakota have been obtained from USDA-ARS, USDA-APHIS and Agriculture Canada. Without the cooperation of these agencies, any efforts at biological control in North Dakota would not be possible since they have primary responsibilities in assuring that the species released meet the host range requirements for import into the United States and Canada. Table 2. gives

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Table 2. Locations and first year of insect releases in North Dakota by NDSU research program.

County	Year	Number of Sites
Barnes	1985	3
Benson	1989	2
Billings	1987	1
Cass	1988	1
Eddy	1989	1
Grant	1989	2
LaMoure	1988	1
Ransom	1989	1
Richland	1988	1
Rolette	1989	2
Ward	1989	2
Wells	1989	1
Williams	1989	1

the counties in which insects have been released and the year in which the first releases were made. The large number of sites established this past year reflect the contribution of insects from two established populations in Canada that were originally released by Dr. Peter Harris. The earlier releases were made with insects collected in Europe and screened through the USDA agencies. The numbers of insects released at any given site ranged from 40 to 500.

OBSERVED IMPACTS

The most striking impact of an insect on leafy spurge density to date has been at a site in Manitoba, Canada, south and west of Winnipeg. *Apthona nigriscutis* was released at this site in 1985, and by 1989 the density of spurge stems around the release point was approximately 10 percent of the beginning density. This encouraging performance of a single species was responsible for a strong effort at getting approval for release of the species in the U.S. and the granting of approval in early summer of 1989. Since that time, eight releases have been made in North Dakota. It is too early to assess the success of these releases. Based on soil samples taken in the fall of 1989 and emergence of adult beetles from these samples in the laboratory, after cold-exposure, we are cautiously optimistic that at least some of the releases will result in self-sustaining populations from which future collections may be made for redistribution to other sites.

Aphthona cyparissiae has also established high populations at a site south of Regina, Saskatchewan, Canada. We visited this site with Dr. Harris of Agriculture Canada in the summer of 1989 and made collections for release in North Dakota. The density of spurge stems at the site did not appear markedly reduced, but with adult populations at such a high level it would seem only a matter of time before the larvae begin to impact the root systems.

In North Dakota, the 1986 release of *Apthona flava* showed initially encouraging population increases, enough so that some collections were made in 1988 for release at new sites. Populations did not show comparable increases in 1988 and 1989 and it is surmised that the drought conditions may have slowed the population growth. Recent examinations (1990) of the original release site appear to reflect some stem density reduction and reduced vigor of the spurge.

Aphthona czwalinae was released in North Dakota in 1988, and based on adult emergence in the summer of 1989 and larval damage on root samples taken in the fall of 1988 and 1989, this insect has successfully established and overwintered at the site. No evidence of impact on spurge density has been obtained, but the original release number was less than 100 and the point of release has a very high and vigorous spurge population. Soil samples taken in the fall of 1989 yielded adults in February and March of this year when removed from cold storage. This is the first establishment of this species on leafy spurge in North America.

Spurgea esula, a gall midge, established strong populations after its release in 1987. However, in 1989 a parasite was found in a high proportion of the galls and it remains to be seen as to how this will impact further population growth and spread. This insect may be capable of reducing seed production in low density spurge situations but did not have a noticeable impact of the high density situation in which it currently occurs. Attempts to establish this species in new locations have not been successful to date.

Oberia erythrocephala, a cerambycid beetle which tunnels in the stems and root collar, has been observed in low numbers every year at the original release site. It appears that this insect does not have a very high reproductive potentil and may also be most effective in low density spurge conditions.

CONCLUSIONS

Based on results of releases of insects in North Dakota and other areas of North America, it is evident that not every insect will adapt to every release site. Much more research must be done on the biology and behavior of the various species already approved to release and a continuation of efforts at identifying new species suitable for release in various parts of the world. Recent surveys in Russia and China may help to identify logical candidate species from climatic areas similar to the Great Plains. Patience is needed when working with biocontrol agents. Populations need to build to effective levels and many factors can influence how rapidly this buildup occurs. In the meantime, it is imperative that chemical controls must continue to be used to limit the spread of this noxious weed. Current research efforts are being carried out to assess herbicide-insect interactions. This type of information is necessary for development of an integrated approach to management and suppression of leafy spurge.

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