Leafy Spurge A Candidate For Biological Control

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Editor

The years since World War II have increasingly become the chemical era for American agriculture. The appearance of a pest problem, be it weed, insect, or crop disease, is routinely followed by a decision about what to spray it with.

For the most part, agricultural chemicals have been a major success, allowing economical production of bountiful crops to the benefit of grower and consumer alike. But there are some red flags.

The consuming public is becoming more and more skeptical about routine use of pesticides to produce the nation's food supply.

Producers are conscious of environmental concerns, like damage to nontarget plants and animals and possible groundwater contamination.

And, there are times when a chemical solution is just not economical or effective, no matter how severe the problem is.

What is needed is a method that is environmentally benign. One that does its job naturally and doesn't require equipment, labor and diesel fuel to apply.

Enter biological control.

Actually, biological control of pest problems has existed as long as there has been agriculture. In nature, potentially damaging insects are kept in check by predators—birds or other insect species. Plants protect themselves with thorns or toxins or by developing resistance to disease. The plant breeder searching for lines resistant to specific diseases or insects, or for a sunflower that resists the ravages of blackbirds, is practicing biological control.

One example of a biological control effort currently under investigation involves an exotic plant that has become a costly pest to North American agriculture, and is thriving because it left its natural enemies back in the old country.

The plant is leafy spurge. Scientists call it *Euphorbia esula.* Ranchers call it some things that are not printable. NDSU research entomologist Robert Carlson, as part of a team of researchers tackling leafy spurge, is studying some insects that call it lunch.

A regional cooperative research effort on leafy spurge, including biological control, involves scientists from several disciplines and several agencies. This cooperative effort had its genesis with a leafy spurge symposium held in Bismarck in 1979. This event and a followup conference held in Billings, Mont., provided the momentum for development of a working committee of research and extension scientists chaired by Russell J. Lorenz, then with USDA-ARS at Mandan, to develop a plan of action.

The major outcome of this group's efforts was approval by the Great Plains Agricultural Council of a research committee on leafy spurge control in the Great Plains to coordinate programs. This committee first met at Fargo in 1981 and has held annual meetings since then.

Leafy spurge is native to Europe and Asia. It was first recorded in the U.S. in 1827, but it probably reached the northern Great Plains about a century ago as a contaminant in seed brought by European immigrants.

McHenry County Agent Mike Rose examines a sweep net, checking the population of flea beetles at the release site. If the release site is successful and populations are healthy, adult beetles can be transferred to other sites.

Neal Spencer, USDA-ARS scientist from Sidney, Mont., discusses an insect release site near Towner at a tour for county weed control officers. The leafy spurge stand has been depleted in a circular area that slowly expands as the insect population increases.

The leafy spurge seed made the voyage to America, but the natural enemies that keep the plant under control in its native habitat were left behind. No insects or diseases native to America did enough damage to prevent leafy spurge from becoming established. In some areas, very well established. Leafy spurge infests an estimated 1.2 million acres in North Dakota, with an estimated reduction in grazing land value of $137 million. Loss in grazing carrying capacity at the current level of infestation is estimated to be the equivalent of 77,000 cows.

Bob Carlson says leafy spurge is a promising candidate for biological control methods. It tends to infest rangeland and pastures, river flood plains and hayland, along with roadways, fence lines and other noncultivated areas. This means chemical control is often not economically feasible because it is not land producing high-value crops, although top quality rangeland is often infested. Also, terrain features like draws or hillsides typical of much grazing land may make chemical application difficult.

A possibly ominous trend, however, is that changing farming practices involving reduced tillage are leading to increased leafy spurge in cropland.

Leafy spurge has defense mechanisms, such as the latex in the plant, that are barriers to insects. Native insect species have not evolved with a means to overcome these defenses, so if control with insects is achieved it is necessary to identify spurge-attacking insects from the plant's home range.

A number of insect species capable of attacking leafy spurge have been identified in Europe and Asia, many of them specific to leafy spurge, an essential trait for introduced species. Efforts to identify and screen these insect species for possible introduction to North America have been going on since the 1960s, largely by scientists from Agriculture Canada and USDA-ARS.

Most of the insects that have been worked with in the U.S. and Canada have come from Italy, Austria and Hungary.

The black dot flea beetle (Aphthona nigriscutis) is a potential leafy spurge control insect that showed promising results in Canada and has been released at a number of sites in North Dakota.

The black flea beetle (Aphthona czwalinae) is doing very well at a release site near Valley City. NDSU researchers have the only significant population of this insect in North America.

Insects that are candidates for introduction are extensively screened. The first screening is to make sure the species is host-specific and will not attack commercial crops or other desirable plants. Once this test is cleared, insects are brought into quarantine and screened for parasites and diseases.

USDA-ARS, USDA-APHIS and Agriculture Canada are the agencies responsible for assuring that insect species released meet the host range requirements for import into the U.S. and Canada.

Insect releases on leafy spurge in North Dakota date back to about 1984. The first insect released, a leafy spurge hawkmoth, appeared to have control potential but apparently has not been able to survive. A stem-boring beetle released in 1985 has established an active population at the release site, but population growth has been very slow and effectiveness is questionable. A gall-forming midge established a healthy population at release sites but appears to be victimized by a native parasite. The midge is not capable of destroying spurge plants but may reduce seed production and stress the plants.

Carlson says the most promising candidates for spurge reduction to date have been four species of the flea beetle complex. Each of the four seems to be adapted to a slightly different habitat.

The black dot flea beetle (*Aphthona nigriscutis*), which has produced promising results in Canada, seems best adapted to dry, light soils. Carlson says he has been able to establish it successfully at several sites, and root sampling shows considerable damage to spurge roots by feeding larvae.

The brown dot flea beetle (*A. cyparissae*) has also been established at several sites and is showing considerable impact on spurge plants. It is more adapted to lowland areas with slightly heavier soils.

The copper flea beetle (*A. flava*) is giving ambiguous results, Carlson says. Original releases showed population increases for a while, then appeared to die out. Populations at some sites are holding on but not thriving as well as some of the other species.

The black flea beetle (*A. czwalinae*) appears to be doing extremely well at its original release site near Valley City. Starting with just 100 insects, Carlson was able to move some to other sites in the past year and is waiting to see if the new releases become established. This is the only established significant population in North America at this time.

At this point, insect releases are generally not being made for the sole purpose of controlling leafy spurge. The immediate goal is to learn about the insects, if they can survive and in what kind of habitat, and to produce more insects for redistribution.

A North Dakota Biological Control Coordinating Committee has been established under the North Dakota weed laws to coordinate cooperative efforts of the various agencies and organizations involved. These include USDA-ARS, USDA-APHIS, the North Dakota Department of Agriculture, the North Dakota Weed Control Association, the Agricultural Experiment Station and the NDSU Extension Service.

The first phase of the program is to establish field insectary sites to increase numbers of approved insects for future release. About 40 release sites are being established this summer.

Releases at some sites will not be successful. Learning which species adapt to various types of habitat is part of the learning process.

At a release site near Towner, Mike Rose, NDSU Extension Service county agent in McHenry County, shows a small sample of what the future might look like. In a sandhills pasture nearly totally infested with leafy spurge, the crest of a small rise has a roughly circular area where the leafy spurge is less dense. The plants that are there are shorter and not thriving like the rest of the spurge in the area.

In 1990, 500 black dot flea beetles were released here, one of many research release sites in North Dakota and Montana established by USDA-ARS researcher Neal Spencer of Sidney, Mont. Another 500 were released a year later. The beetles are reproducing, laying eggs in the soil near the roots of the leafy spurge plants. The hatching larvae burrow into the roots, feeding as they go.

This larval feeding on the roots is what damages the spurge plants. Adult beetles feeding on the foliage have little or no effect.

It may take three years or more from the time of release to notice significant stand reduction of spurge, and only a small area at the point of release may be affected. Biological control is not a quick fix, stresses Carlson, it is a long, gradual process.

An ideal scenario might be reduction of leafy spurge to just another member of the plant community, present in densities so low that it creates no problems.

This is basically the situation Kyle Miller, Towner area rancher, describes seeing on a tour to Europe. He tells of being shown what was considered a large infestation of leafy spurge in Europe. It was smaller than a football field, and the plants were sparse and puny by North Dakota standards, he says.

Eradication of leafy spurge is probably not possible. Under biological control it may not even be desirable, because with spurge gone the controlling insects would die off, leaving the environment vulnerable to a new spurge infestation in the future.

Biological control with insects is a long-term solution. Cal Messersmith, NDSU weed control researcher, says leafy spurge is a classic example of where biocontrol should be used and that he is cautiously optimistic that the insects being studied will do a lot of good.

But an integrated approach to control will be needed, combining selected chemical control, cultural control and grazing management with biological control, he says. It's not realistic to expect biocontrol to be the only answer to controlling leafy spurge.

Especially in the near term, while biological control methods are experimental and small scale, control with herbicides is needed. Chemical control has been refined so the costs of treating leafy spurge with herbicides are more reasonable than in the past, Messersmith says.

The integrated approach to leafy spurge control is being studied by Rod Lym of the NDSU crop and weed sciences department. His experiments are intended to provide information about the effect of herbicides on the insect population as well as the combined effect of chemical and biological control on leafy spurge and forage production. He is also studying integration of chemical control and grazing management, using herbicides before and after grazing by goats on spurge-infested pastures in the Sheyenne Grasslands.

Carlson says he can visualize a situation where herbicides are used to reduce the leafy spurge density so an insect population can destroy enough spurge to keep it at a sub-economic level.

Biological control of leafy spurge holds promise, but it is in its infancy. Researchers need to learn more about the insect species that are now being released, and additional species are likely to be cleared through the USDA screening program in the next several years. Some new candidates now in the screening pipeline are quite close to approval.

Other pieces of the leafy spurge puzzle are being investigated. At the USDA Biosciences Research Laboratory located on the NDSU campus, the research mission is to reduce crop losses due to weeds through basic research on weed biology and physiology, and to improve production efficiency and environmental safety through increased knowledge of the biochemistry of herbicides and plant growth regulators.

According to Stuart Frear of the BSR lab, initial research has been devoted to developing necessary procedures and techniques for growth and treatment of leafy spurge plants, tissues and cell cultures in greenhouse and laboratory studies. Starting this fall, the program will focus on new principles and technologies for leafy spurge control through increased knowledge of the processes that control the growth and development of leafy spurge, and a better understanding of the biochemistry and bioregulation of herbicide activity in leafy spurge.

BSR researcher Dave Davis is working to determine some of the critical biochemical pathways that might serve as target points for chemical control of leafy spurge.

Russ Lorenz, who is funded by the Agricultural Experiment Station to coordinate multi-state leafy spurge research efforts, says that cooperative efforts on a regional basis are pulling together a very successful leafy spurge control effort. The multidisciplinary research team at NDSU is recognized as being among the leaders in almost every effort, he says.

Leafy spurge is a formidable foe and is a long way from being defeated. But, thanks to the efforts of a lot of researchers and agencies involved in implementing biological control, a new army is quietly gaining strength—an army of insects that in the long term may be the factor that tilts the tide of battle against leafy spurge.