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Potential for biological control of leafy spurge in woodland communities[1]

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Abstract:

Leafy spurge (*Euphorbia esula*) is only one of a great number of problem plants that the Agricultural Research Service (ARS) and the Animal and Plant Health Inspection Service (APHIS) address in their search for biological control organisms. Leafy spurge has become a very troublesome plant by reducing forage growth on rangelands. Livestock grazing potential is severely inhibited with invasion by this plant. Typical land manipulation and chemical control procedures are ineffective and extremely costly for control of leafy spurge. Biological control of the plant with introduction of carefully selected control organisms including insects and pathogens can provide long term, relatively low cost control of the plant. Quarantine laboratories and insectories of the USDA are assisting with screening and growth of target organisms.

Introduction

I am not trained in either weed science or entomology and I have little background in biological control technology. So how does an old range scientist get on the program with a topic like this?

As a range scientist I have been on a soapbox preaching the horrors of leafy spurge (*Euphorbia esula*) since 1951. I wasn't very effective, because although a lot of people

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U.S. Forest Service and I spent several days talking about the problem. Then we started building fires under people who could help. This led to the Leafy Spurge Symposium in Bismarck in June of 1979. It was a success in that almost everybody was there who knew anything about the leafy spurge plant and the problems it was causing. The proceedings of this meeting were the state of the art at that time. But when the wrap-up session came along and plan of action time, everybody got tongue-tied. Dr. Claude Schmidt, area director at Fargo and at that time my boss, was sitting next to me and he leaned over and said "I think the whole idea for an action program is going to die." No way could I let this happen so I made a three-minute impromptu presentation outlining a plan of action. Somebody recorded it and it was printed as the final summary of the symposium.

From then on I was pegged to keep the leafy spurge control effort going. I took it on as a side-line to my assigned job but often it has taken a lot of time. I don't mind. We have made progress in chemical control methods but chemicals available at this time are costly and not effective in reducing leafy spurge to an economical management level. We are getting nearer to having a bio-control program in the field.

Discussion

What is biological control? It is the deliberate use of natural enemies to reduce the density of the target organism below an economic threshold. Biological control is not an eradication program. In fact it is necessary that residual populations of the target remain in order to maintain the control organisms. I use the plural organisms because more than one control organism is generally required for successful control.

In the case of leafy spurge, there are insects in Europe and Asia that attack almost all parts of the plant. Some are defoliators. They feed on the leaves. Others are stem or root borers. The adult lays its eggs in the stem of the plant, the "worm" that hatches from the egg feeds on the inside of the stem, often going into the crown and root of the plant. Some of the insects lay eggs in the developing flowers and the "worm" eats the seed. Some insects inject a hormone into the tip of the stem, causing the plant to deform so no flower or seed can develop. To obtain an economic level of control, it will take at least four or five different species of insect, working together on any given patch of leafy spurge.

Perhaps I should elaborate on some words I have been using here. When I talk about a target organism, that is the weed or the plant or the insect that we are trying to control. The control agent is the insect or disease that we are bringing in or introducing into the area where the problem exists in an effort to control the target organism.

Now to continue on with what biological control is or isn't. It is definitely not a fast fix. It requires a lot of time for implementation, and after implementation it takes time for the agent to reduce the target population. We have been spoiled by chemical methods. Apply a chemical and see the pest curl up or turn an unnatural color and eventually die. We expect to see something happen in minutes or at least in hours. We are not used to waiting days or weeks or months or even years for results. Once it is in operation, biological control is an economical means of dealing with a widespread problem.

A major advantage of biological control is that once the control organisms or the agents are established, there is little or no continuing cost. Monitoring is necessary to insure timely redistribution of the agents to new areas of infestation or to be sure residual populations remain in old areas of infestation.

Management of each bio-control agent will require specific techniques. Only experience over time will tell how intensive the management program must be. I expect that an integrated control program will be necessary for leafy spurge. That is integration of biological/chemical/cultural methods and all of this must be integrated with any other pest control programs imposed on the same land area. For example, if you are using insects to control leafy spurge in a given area, then any plans to control grasshoppers (family Acrididae) or crickets (family Gryllidae) or any other insect in that area must be coordinated and integrated with the leafy spurge control program.

And programs that work on grassland may not work per se in woodlands. Some bio-control agents may not work in both environments. This is another reason for having several bio-control agents working in the same general area.

What is required to establish a bio-control program? First, find the natural enemies of the target organism. Leafy spurge has no major enemies in North America because it was introduced from Europe without bringing any of its enemies along. Our forefathers failed to bring them when they brought weed seeds in as contaminants in the seed grain they brought to North America. Now protection laws require years of screening and testing before an organism can be brought into North America.

The U.S. Department of Agriculture has a laboratory in Rome, Italy. Canada and the other commonwealth countries have a center in Zurich, Switzerland. These serve as screening and testing labs for potential agents collected in Europe and Asia. More than 130 insect species have been found to be specific feeders on leafy spurge. In fact some are so specific that they will survive on only one or a few of the many leafy spurge types or species or bio-types, whatever they turn out to be.

After an agent is collected and identified as being a potential candidate it takes about two years of testing in these overseas labs before the insects can be brought to quarantine labs in North America. Albany, California is the USDA quarantine lab of the Agricultural Research Service (ARS) and the Animal and Plant Health Inspection Service (APHIS) for entry into North America and a lab in Ottawa is used for the Canadian imports. It takes about two more years of testing at these quarantine labs in order to document that the agents will not go to alternate hosts and that the agents are free from disease and parasites. That is, the agents must not feed on plants other than the leafy spurges. We have to be sure that they are not going to switch to eating some of our other crop plants or some of our native North American plants.

After sufficient documentation is in place, a committee called the Biological Control Working Group reviews the case and rejects or approves release of the insect in North America. If approved for release, the agent then goes to state and federal research stations where controlled field releases are made and carefully monitored to identify any survival problems. For example, the effects of environment on rate and success in reproduction and the interaction of the organism with other organisms in the area and with cultural

management practices. If problems arise, further research may be needed before large uncontrolled releases are made.

Rearing to build large populations for release becomes a real challenge. Large insectories or pathology facilities are needed, often requiring very sophisticated controlled environments and diets. This can be a very costly phase of the program and if large numbers of the insects are to be reared it requires development of an artificial diet. An artificial diet is something other than leafy spurge, that can be used to feed them in captivity. One of the advantages of using pathogens or diseases rather than insects is that generally pathogens can be reproduced more easily in a controlled environment.

The Plant Protection and Quarantine section of APHIS (PPQ-APHIS) has such a facility at Mission, Texas. They have worked on such things as the screwworm, (*Cochliomyia hominivorath*), the Mediterranean fruit fly (*Ceratitis capitata*) and the Mexican fruit fly (*Anastrepha ludens*). In February of 1987, I spent a week at the facility in Mission, Texas. Looking at the thousands of trays, each containing thousands of larvae or pupa of Mexican fruit flies I could visualize those as being some agent for use in controlling leafy spurge. Hopefully some day soon we can see tens of thousands of spurge-feeding insects, ready for release.

I got ahead of my story. After the 1979 symposium in Bismarck, planning meetings were held at Billings, Montana; Rapid City, South Dakota; Medora, North Dakota and other places. I was asked to chair a steering committee to lay out a plan of attack. This steering committee outlined a plan for a coordinated research/education/control program. Later the committee was converted to a Great Plains Agricultural Council Committee-GPC-14. It meets each year to allow exchange of ideas, coordination of research and control programs, and to help keep administrative support behind these projects.

In 1985, I prepared a proposal on behalf of GPC-14 to get APHIS involved in the leafy spurge project. The proposal was chosen for implementation in 1987. This was the reason for my trip to Mission in February of 1987. No new dollars were available but as APHIS phases out of completed programs they phase into new ones. In 1986 they moved Dr. Bob Richard to Bozeman to work with the Montana State University and ARS people on knapweed (*Centaurea* spp.) and leafy spurge bio-control agents. Montana built an insectory in Bozeman and ARS is moving three scientists from the Albany, California lab to Bozeman. ARS has a grasshopper lab at Bozeman and a part of that facility will also be involved in weed control work.

If we are to keep this program moving it is essential that we keep our legislatures informed of the urgency and importance of this project so funding remains available for APHIS to work with us. It is also important at the federal and state levels that research monies be available for these projects. And on the local level monies need to be available for the implementing the program once technology and the control agents become available.

After insects have been approved for release, APHIS coordinates releases through State Departments of Agriculture. So keep in touch with your State Department of Agriculture if you wish to become involved. Montana, North Dakota and Wyoming have been designated by APHIS as the primary states in the program. At least nine other states are anxious to get involved in the biological control programs. In spite of the tight dollar

situation, many scientists in various states and federal agencies have been doing what they can to learn more about leafy spurge so we can come up with more effective control programs.

Summary

In the biological control area both insects and diseases are being looked at. We have about a half-dozen insect species approved and several others in various stages of testing. We don't know how many of these will be successful so we have to keep the pipeline filled as best we can all the way from collection in foreign countries to controlled release.

With a weed that is as aggressive and as troublesome as leafy spurge, the best control is to make every effort to keep it out of un-infested areas. Until we have an effective integrated control program, including biological agents, we have to do the best we can with the technology that is now available. And that is primarily chemicals. Biological control is going to be particularly important to wooded areas, the woodlands, brushlands, and areas close to water where we have problems with chemical use now. But it is still my philosophy that if you have a relatively clean area, and you find a small patch of spurge or knapweed, use the best technology available to control it, even if you have to sacrifice desirable plants to protect the rest of them. If you don't, the rest of the desirable plants are in extreme danger. I have watched areas in western North Dakota and eastern Montana practically disappear from productive roles and from the tax roles due to leafy spurge. There is quite a lot of land that has been abandoned from grazing because of leafy spurge. Once these large areas are infested it is just too costly to use the chemical technology we now have to control leafy spurge on those relatively low productive areas. That is why some small sacrifice areas may be a whole lot more practical than eventually abandoning the entire area.

Remember, no patch of leafy spurge is too small to spray and you cannot afford not to spray especially when the leafy spurge patches are relatively small. And above all, don't sit back and wait for the biological control efforts to be perfected, because if we should fail to develop a workable bio-control program, we don't want the problem to be more serious than it is now.