Reprinted with permission from: 1989 Leafy Spurge Symposium. Bozeman, MT. July 12-13, 1989. pp. 76-80.

Published by: Montana Agricultural Experiment Station, Montana State University, Bozeman, MT.

Leafy spurge control: Reflections on 17 years of research

CALVIN G. MESSERSMITH

Professor, Crop and Weed Sciences Department, North Dakota State University, Fargo, ND 58105.

Introduction

My specific involvement with leafy spurge began in 1972 when I established a research project for perennial weed control with emphasis on leafy spurge. Leafy spurge was first reported in the northern Great Plains in the early 1900's; 1909 in North Dakota. As I reviewed the literature, it was evident that plant scientists as early as the 1930's recognized that leafy spurge probably would become a serious weed problem. Reports in the 1930's on leafy spurge biology and control were by H. C. Hanson and V. E. Rudd in North Dakota and A. L. Bakke in Iowa and on grazing by sheep by E. A. Helgeson in North Dakota.

Following World War II, the most extensive research was by Canadians in the 1950's and 1960's; the names R. T. Coupland, J. F. Alex, G. W. Selleck, and M.V.S. Raju were especially common. In the United States, L. A. Derscheid in South Dakota and M. K. McCarty in Nebraska had modest programs for leafy spurge control. Many people recognized the importance of leafy spurge control and "bootlegged" research, i.e., conducted a limited number of leafy spurge control experiments as an adjunct to their specified research responsibilities. The results of most of these experiments were reported only in annual research reports in their state or in a regional publication.

My first knowledge of cooperative political action came in 1978 when I spoke at the Montana State Weed Control Conference and learned of their efforts to obtain legislative support for leafy spurge control. Near the same time, I learned of the Wyoming Leafy Spurge Control Act passed in 1978 that provided state funding for leafy spurge control.

Cooperative regional program

Ad hoc program

The current coordinated regional research effort began with the Leafy Spurge Symposium, June 26 and 27, 1979, Bismarck, ND. The innovator was Dan McIntyre, Supervisor, Custer National Forest, U.S. Forest Service, Billings, MT. He visited H. Ronald Lund, Director of the North Dakota Agricultural Experiment Station, Fargo, and the outcome of the discussion was establishment of a steering committee to conduct a symposium in Bismarck; Edwin H. Amend, Associate Director of the North Dakota Cooperative Extension Service, was chairman. About 125 educators, scientists, land managers, farmers, ranchers, legislators, and concerned citizens attended the symposium. A follow-up meeting, the Northern Regional Leafy Spurge Conference, was held in Billings, MT, on December 17-18, 1979, with a similar total attendance as the Bismarck symposium.

The administrators of several key agencies, e.g., Directors of the Agricultural Experiments Stations, Area Directors for the USDA-ARS, Supervisors for the U.S. Forest Service formed an ad hoc committee to sustain the momentum for enhanced leafy spurge control. These people made some personnel and funding changes within their own administrative units to support the effort. They appointed a Regional Leafy Spurge Working Committee, Russ Lorenz, USDA-ARS, Mandan, ND, chairman, as a group of research and extension scientists to develop a plan of action.

Permanent program

One outcome of the plan was approval by the Great Plains Agricultural Council of a research committee, GPC-14 Leafy Spurge Control in the Great Plains, as a recognized organization to facilitate program coordination. The first GPC-14 meeting was held in June 1981, Fargo, ND, and annual meetings have been held since then.

1982-Bozeman, MT

1983-Sundance, WY

1984-Dickinson, ND

1985-Bozeman, MT

1986-Riverton, WY

1987-Fargo, ND

1988-Rapid City, SD

1989-Bozeman, MT

Enhanced funding

An immediate objective adopted at the Bismarck symposium was to submit a request to the Old West Regional Commission for research funding. A cooperative project of the Agricultural Experiment Stations of all five states, Montana, North Dakota, Nebraska,

South Dakota, and Wyoming, with North Dakota as the lead state, was funded from March 1981 through February 1982. To provide continuity, the USDA-ARS, through the Metabolism and Radiation Research Laboratory in Fargo, ND, established separate cooperative agreements with Montana, North Dakota, and Wyoming that provided funding for various durations during 1981-1985.

Grant funds supported most of the initial research. However, the major boost to the program was through redirection and enhancement of research efforts by the Agricultural Experiment Stations and by the USDA, initially by the ARS and in the last couple years by APHIS. To use North Dakota as the example, enhancement occurred when Director H. R. Lund immediately committed $100,000 at the Bismarck symposium to fund a non-tenure research associate position that subsequently was adopted by the 1983 Legislature as a tenure-track position, and redirection occurred when a position in the Entomology Department was converted to biocontrol of leafy spurge. Several similar examples could be cited, especially in the Montana Agricultural Experiment Station and the USDA-ARS and APHIS.

An early cooperative effort was the Leafy Spurge News, a newsletter initially edited and published by the Montana Agricultural Experiment Station. Publication began in April 1980, and there have been 3 or 4 issues per year with up to 1200 recipients per issue since then. Editors have been Clare Barreto, Bruce Maxwell, and Celestine Lacey of Montana State University and currently by Dr. Russ Lorenz, North Dakota State University.

Chemical control

Herbicides have been the backbone of control efforts to date, because they are the most available and effective developed technology. However, many refinements have been made in the past 10 years. For example, the paper on chemical control presented at the 1979 symposium refers to “light rates” of 2,4-D as 2 to 6 lb/A and “heavy rates” as 20 to 40 lb/A, and picloram was used frequently at 2 lb/A. Now, picloram usually is applied at 0.25 to 0.5 lb/A in combination with 2,4-D at 1 to 2 lb/A. Also, we understand that the most effective time of treatment is during true flower development with a secondary peak for control during the fall when leafy spurge has established regrowth.

Among other herbicides, dicamba has provided better results in the Intermountain states than further east but is less effective than picloram. Glyphosate can be used under trees, on cropland, and near water, but may cause too much injury to be acceptable on grazing land. Many other herbicides have been evaluated; especially fluroxypyr, sulfometuron, fosamine, triclopyr, and clopyralid, but none have provided control comparable to the older herbicides.

Several other generalizations about herbicide use have been developed in the past 10 years. Wipe-on applicators, e.g., roller and pipe-wick, can be used to apply picloram to leafy spurge, but control generally is not improved over a broadcast application of picloram plus 2,4-D. Withdrawal of the granular formulation of picloram from the market meant loss of one tool for leafy spurge control, especially for spot treatment of small (usually new) patches of leafy spurge. Herbicides generally provide longer-term control

in drier areas but more grass injury occurs also. Awareness of adverse effects of herbicides, especially of picloram, on the environment has increased, so they are being applied at lower rates and with more care. Despite the advances, most herbicide treatments for leafy spurge control are not economical.

Cultural control

Options for cultural control of leafy spurge are limited. Leafy spurge is occurring more frequently on tilled land now due to reduced tillage. Mowing and burning haven't been effective for reducing leafy spurge, except they may result in uniform regrowth that can be treated more timely with herbicides. Nitrogen fertilization in combination with herbicide treatment has not resulted in improved control. There may be differences in competitive ability of forage species with leafy spurge, but they will not eliminate the weed.

Sheep and goats can be considered as a means of cultural control. The cases where sheep or goats are an economical alternative to raising cattle or to using other control methods are limited, but they can be used to fill special niches.

Biocontrol with insects

Insects for biocontrol have been considered a viable research goal for many years. The spurge hawk moth (*Hyles euphorbiae*) was released as early as 1966 and 1973 in Gallatin Co., Montana. Spurge hawk moth introductions frequently have not survived, and when they do, they provide too little control too late in the growing season. A root borer, *Oberea erythrocephala*, was released in 1979 in Canada and in 1980 in Wyoming and Oregon. Additional releases of this insect have since been made in several other states. However, establishment at the release sites has been inconsistent, and no demonstratable impact by this insect has yet been realized on leafy spurge.

Through increased research, primarily by Agriculture Canada and the USDA-ARS, several insects have been screened and approved for release on leafy spurge. For example, two flea beetles, *Aphthona flava* and *A. cyparissias*, were released in Saskatchewan in 1982 and in Montana in 1985. A gall midge, *Bayeria capitigena,* was released in Montana in 1985. Releases of several other insects and establishment of many more release sites have been reported at this meeting. This currently is the most rapidly growing area of research activity.

Biocontrol with diseases

One native disease, *Alternaria tenuissima* f. sp. *euphorbiae*, has shown the most virulence on leafy spurge. It effectively controls leafy spurge when infection occurs, but environmental conditions are not favorable over a broad area to provide effective control. Other species, especially *Melampsora* spp. and *Uromyces striatus*, have been evaluated

as potential biocontrol candidates, but effective strains that can be reproduced effectively have not been identified. At this point, better organisms are needed before diseases can contribute to leafy spurge biocontrol.

Plant physiology and basic research

The general morphology, anatomy, and ecology of leafy spurge has been studied fairly extensively. Although many unanswered questions remain, the knowledge base in these areas probably are not the limiting factors to developing better weed control programs. Conversely, the basic understanding of leafy spurge physiology and genetics is limited.

Taxonomic studies indicate that leafy spurge is a genetically diverse species. Although some taxonomists divide this plant complex into several species, most scientists believe it is one species, *Euphorbia esula* that is diverse. Studies of chemotaxonomy, allelopathy, and natural product chemistry indicate this diversity exists, but the role of these compounds in leafy spurge physiology or how to use specific chemical characteristics to improve leafy spurge control remains largely unknown.

Physiological characteristics of the roots and of latex are not well understood. Picloram and 2,4-D are released rapidly from roots. The carbohydrate content of roots fluctuates rapidly from day to day; for example, soluble carbohydrate content of roots changes within hours and varies inversely with temperature. Starch storage in the latex is irreversible.

Physiological characteristics regulating bud growth and survival are not well understood. Crown buds that begin growth in the fall stop development apparently when exposed to light. Crown buds and root buds differ in susceptibility to freezing temperatures. Whether bud growth can be altered to increase winterkill is not known.

Miscellaneous observations

Benefits of leafy spurge

Latex with its high hydrocarbon content has been evaluated as an alternate source either for fuel or rubber. Neither alternative is of high enough quality to be economically viable at this time. Honey from leafy spurge is of low quality for human preferences. However, it is desirable for bees, because it is an early season food source and it does not granulate easily which is desirable for over winter-feeding. As somewhat “tongue in cheek” benefits, many of us are employed to provide leafy spurge control and sometimes leafy spurge competition is less detrimental to survival of native plant species than overgrazing by cattle.

Miscellaneous projects

Unique attempts at control have included using high voltage to electrocute plants or paired rollers to pull plants. Neither alternative was effective.

Public awareness

Many meetings, newspaper articles, extension bulletins, radio and television reports have been presented to the public. Leafy spurge control was the impetus that lead to formation of the North Dakota Weed Control Association and has been a goal of similar associations in Montana, Wyoming, and probably other states. All of these efforts have lead to state and federal legislative action including financial support for some new research positions and buildings in the agricultural experiment stations and the USDA, cost-sharing for chemical control in several states, and projects like USDA-APHIS programs to establish insectaries to expedite redistribution of biocontrol agents.

Overall there probably is as much public awareness of leafy spurge as any other weed, although we all recognize that more must be done. Because so many people in North Dakota are aware of the adverse impact of leafy spurge, they responded immediately when they were informed of the possible adverse impact of spotted knapweed in the state.

Future for leafy spurge control

In the next 5 to 10 years, herbicides will remain the backbone of the leafy spurge control program. Any improvements in the efficacy of control with herbicides will be small, although there may be advances either in minimizing adverse environmental impacts or reducing the cost of control.

Biocontrol with insects includes many promising leads, so a widespread distribution program and localized visible success should be accomplished in the next 10 years. A breakthrough in using diseases for biocontrol apparently is not imminent; perhaps diseases as biocontrol agents can advance in 10 years to the point where insects are today.