



Leafy Spurge *News*

Agricultural Experiment Station
NDSU Extension Service
North Dakota State University, Fargo, ND 58105

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From the Editor's Desk

In this issue we have more summaries of the material presented at Spurgefest II. In addition you will find a very interesting item from the folks of Team Leafy spurge in Sidney, Mt. All sorts of goodies are now available to you, the end user, which will help you do a better job controlling leafy spurge so please contact them. I also have included an informative interview done by Carol Flaherty of MSU News Service on Dr. Robert M Nowierski, our September issue Leafy Spurge Honoree. I will resume the Leafy Spurge Honoree section in the March 2002 issue.

I wish you all a happy holiday season, and please let me hear from you. Please remember I cannot operate in a vacuum!

Claude H. Schmidt

Editor

1827 N 3rd Street, Fargo ND 58102-2335
(701) 293-0365, Fax (701) 231-8474
e-mail cschmidt@ndsuxt.nodak.edu

Teamwork Extended

TEAM Leafy Spurge, The Ecological Area-wide Management of Leafy Spurge, has gained an extension of its five-year life span. Due to expire in 2001, the program has been so successful that a one-year extension has been granted to allow for continued work and to further increase the impact of the project.

Dr. Gerry Anderson, program director said he is pleased that TEAM Leafy Spurge efforts will continue for another year. "The extension will allow us to improve upon and broaden our knowledge in a number of different project areas including assessment, research and technology transfer," he said. "The extension also provides for new, limited, short-term research initiatives identified by our National Program Staff." Anderson said the extension reflects the strong support TEAM Leafy Spurge has developed in the four-state area it serves. "Ranchers and land managers alike have spoken and the USDA, Agricultural Research Service has responded," he said. Given the added time and resources now available as a result of the extension, Anderson noted that the TLS staff is "committed to using these new resources to improve our scientific understanding and — of equal or more importance — to ensure that end user needs are better met."

In other TEAM Leafy Spurge news, the long awaited "Purge Spurge: Leafy Spurge Database" update has arrived. Purge Spurge was first published in 1995 and received a federal technology award at that time. This latest version, produced by TEAM Leafy Spurge,

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contains more than 900 journal articles, workshop proceedings, Extension bulletins, photo pages and TEAM Leafy Spurge posters and publications. The CD is a useful reference and educational tool for researchers studying the weed and for landowners hoping to learn how to control it. In addition to articles discussing the ecology, biology, taxonomy and economics of the weed, the CD includes numerous other documents and resources outlining successful integrated pest management techniques used in its control.

A trial version of Purge Spurge Version 4.0 debuted at Spurgefest II in June 2001. In this final version, new links have been added to speed navigation, along with several more documents including the last two Leafy Spurge Symposiums, meaning the new CD boasts a complete collection of the proceedings beginning with the event's inception in 1979 through 2001.

But Purge Spurge is not the only CD-ROM TEAM Leafy Spurge produced this past year. Currently in press, is the first installment of Team Leafy Spurge's Integrated Pest Management Information Series on leafy spurge control. The series focuses on how to use the most effective weed control techniques currently available. IPM techniques featured in the series include biological control, multi-species grazing and herbicides. Information on each is provided through an in-depth, "how-to" manual paired with an interactive CD-ROM that incorporates additional information that can be used by individuals or groups.

The series' first "matched set" focuses on the "Biological Control of Leafy Spurge." The how-to guide was originally published in April of 2000 and is now in its third printing with more than 38,000 copies distributed in 27 states and four Canadian provinces. Its companion CD-ROM was designed to provide a variety of other pieces of useful information about using biological control and how it can be integrated with other management tools. An innovative part of this multi-media product was the development of a fully automated, 20-minute, "how to" PowerPoint presentation. TEAM

Leafy Spurge biological control experts developed the presentation, which includes a voice-over that actually puts the expertise of the experts in the hands of the end user. Additional information products available on the CD, include; a photo gallery, bibliography, posters, publications and a variety of other useful information.

The CD set also incorporates photos and poster materials from another TLS CD product issued in January 2000: "Leafy Spurge Biological Control Information and Photo Resource Gallery." That CD was produced by R.D. Richard, Lana R. King and Harold W. Ziolkowski of USDA-APHIS in Bozeman, MT. Its contents have been combined with this latest offering to give end users a convenient, single source of reference on the biological control of leafy spurge.

New additions to TEAM Leafy Spurge's IPM information series will follow the same format as the Biological Control example, combining how-to manuals and interactive CD-ROMs for a one-two punch. Already completed is the "how-to" handbook on multi-species grazing. Like "Purge Spurge" it debuted at Spurgefest this past June. This latest handbook will be followed shortly by another on herbicide use. The supplemental CD-ROMs on multi-species grazing and herbicide use are also in various stages of production. In every case, the information presented will be built around the premise of bringing the expert to the end user.

Like "Purge Spurge 4.0," all publications, will be available through the Northern Plains Agricultural Research Laboratory, 1500 North Central Avenue, Sidney, MT 59270.

Please contact us by mail at the address previously mentioned, phone (406) 433-2020, fax (406) 433-5038, email bredlin@sidney.ars.usda.gov, or jmiller@sidney.ars.usda.gov or also through the internet website <http://www.team.ars.usda.gov>.

Finding a Home on the Range — For Beetles

There. Right there. That black dot on this page looks just like one on Bob Nowierski's graphs. Except where the dot is positioned on his graph tells him what kind of a home his bugs like. A little to the right, drier habitats with sandier soils. A bit up and left, heavier clay soils with a richer plant community and more leafy spurge.

Leafy spurge is the key. The insects that Nowierski works on are flea beetles that feed on leafy spurge, a noxious weed that is damaging Western rangelands. Until Nowierski's work, there was little scientific evidence of what habitat the beetles need to thrive. Consequently, many flea beetle releases failed when they were released in the wrong habitats.

To make his graphs showing flea beetle habitat preferences, several years ago Nowierski took sabbatical leave in Europe, spending months collecting (and keeping alive) leafy spurge flea beetles, caring for

them both in a small car and a series of hotel rooms. Though that's not something everyone would do for a beetle, these are insects that think a mouthful of leafy spurge tastes better than a hot-fudge sundae with whipped cream.

He had to keep the beetles alive for later identification by genetic analysis, because the differences between beetles can be too subtle for anyone to trust field identification, even with a trained eye. Though some flea beetles are brown and others black, some are only a few hairs different than their cousins who prefer a different habitat. Rearing thousands of, say, the hairy cousin, and then taking the critters to the wrong environment would be a waste of time and money, not to mention a setback in scientists' efforts to reclaim land from leafy spurge.

Which was why Nowierski found himself collecting beetles, soils and spurges in Europe, with both his sedan and hotel room serving as home for the collection. He collected in a circuit of 17 research sites, then went back and repeated the circuit two more times. Many of the sites were in Hungary, but a number of them were in Switzerland, Italy, Austria and Germany. Nowierski's research group helped with the genetic analysis of the flea beetles and later data analysis, and scientists in the countries visited helped as well. "I had to keep the beetles alive in the car and then in the hotel room at night, because back then the genetic analyses we used to identify the beetles wouldn't work if the insects were dead." Nowierski also had to open the soil containers in his room each night so the organic material in them would dry enough to avoid decay. Each foliage and root sample also had to be opened at night and set around the room. It certainly takes the image of a dirty bug-infested hotel to a new level.

Though Nowierski developed graphs showing flea beetle associations with certain European habitats, that didn't prove that similar Western U. S. sites would be appropriate for release of the beetles. So in 1998, he and his research group sampled 48 research sites

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International Cooperators in Leafy Spurge Studies

BOZEMAN - Many scientists are working to minimize the problem of leafy spurge on Western United States rangeland.

Bob Nowierski's research group working on leafy spurge at Montana State University - Bozeman includes Bryan FitzGerald, Nik Wiman and Kelly Hering. In addition, formal doctoral student and postdoc Zheng Zeng still collaborates on leafy spurge research.

Nowierski also is a participant in "TEAM Leafy Spurge," a project headquartered at the USDA-Agricultural Research Service Sidney, Mont. Other cooperators include researcher David Kazmer at the University of Wyoming and David Horvath at North Dakota State University and Rich Hansen, with APHIS-PPQ at the Forestry Sciences Research Lab at MSU in Bozeman.

In Europe, his collaborators included Dieter Schroeder and Andre Gassmann from Switzerland, and Massimo Cristofaro formerly with the USDA-ARS laboratory in Italy.

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in Montana, North Dakota and Wyoming to determine which beetles succeeded at each type of site.

Nowierski says the results of the analysis of U.S. and European data are similar, though statistical comparisons are still underway. If valid, it “means we can better predict the habitats where certain flea beetles can establish and live, rather than letting mortality tell us where not to release,” says Nowierski.

Basically, Nowierski says flea beetles are “finicky about the habitats” in which they live. One species might like the wide open spaces and a sunny south side, while another may prefer quite different conditions. A flea beetle species with the Latin name *Apthona nigriscutis* likes sandy loam soil and no shade. Its cousin *Apthona lacertosa* likes moister sites, heavier clay soils and denser leafy spurge canopies.

“In the late 1980s, we were failing to get the insects established where we wanted. Out of that frustration, in 1991 I took sabbatical leave to go to Europe to see if I could characterize their habitat associations by looking at their relationship with micro and macro nutrients and physical properties of the soil, nutrients in spurge foliage and roots and general levels of plant productivity. I did this across all kinds of sites, from sunny to shady, wet to dry.” All of that fed into what Nowierski terms an “ordination analysis” — a graph with almost literally an “x marking the spot” with conditions that a certain type of flea beetle seems to prefer.

“The most important thing about Bob’s work is the realization that there are certain areas where biological control should be a success and certain areas where it may never be a success given current biocontrol agents,” says Jerry Anderson, principal investigator for TEAM Leafy Spurge, research and demonstration project funded by the USDA-Agricultural Research Service and managed in conjunction with the USDA-Animal & Plant Health Inspection Service.

“Unfortunately,” says Nowierski, “at the moment we don’t have flea beetle species available to limit spurge in shady sites or streamside sites, which spurge does just fine in. But we’re hopeful that *A. lacertosa* will be able to at least impact spurge at the moister sites in the future. It’s important to point out that the best strategy for managing leafy spurge is good range management combined with the use of herbicides, controlled grazing and biocontrol, says Nowierski. Small patches of leafy spurge are controlled best with herbicides. However, for extensive and well-established infestations, once the roots go down 20 to 30 feet into the soil, applying herbicides is usually not effective nor economical since they have to be repeatedly applied. In such situations, biocontrol and grazing may be the most cost effective tools available for managing leafy spurge.

Many of the flea beetles are now “fairly available” to the public. For more information about obtaining some to put on a spurge-infested site, contact Jerry Marks, Missoula County Extension Office, (406) 721-4095. Marks coordinates the release of flea beetles and other biocontrol agents for the Montana Weed Control Association.

Carol Flaherty

MSU News Service 6/14/2000

Contact: Bob Nowierski 406 994-5080;

Jerry Anderson 406 433-2020

L, D, W, Ag-in. You can receive this article by direct Email or the state press association’s INN system. Some articles are also added to the MSU Communications Services Web pages located at http://www.montana.edu/wwwpb/com_serv/csfeatur.html. Look for “sprgbn” and the headline above.

Proceedings (continued)

from Spurgefest II, June 19-21, 2001

Ecological Barriers for the Establishment and Population Increase of Flea Beetles on Leafy Spurge

Ecological barriers were investigated that may negatively affect the establishment and population increase of the five flea beetle species released against leafy spurge. Habitat association models of the flea beetles, developed from European data, were validated with insect, plant, and soil data collected from 48 research sites in Montana, North Dakota, and Wyoming. European and U.S. habitat association models were found to be statistically similar. The genetic variability of leafy spurge is being evaluated using AFLP (Amplified Fragment Length Polymorphism) techniques. Preliminary results have shown relatively little genetic polymorphism either within or among spurge populations. The results of Flea beetle sex ratio studies showed that populations of *Aphthona nigricutis* have a highly female-biased sex ratio, while those of *A. cyparissiae*, *A. flava*, and *A. lacertosa* are close to a 50:50 sex ratio. Greater than 85% of the *A. nigricutis* populations were infected with parasitic bacterium, *Wolbachia* spp., which has been shown to cause female-biased sex ratios in other insect species. None of the other *Aphthona* species sampled were infected with *Wolbachia* spp.

The ecological amplitude of leafy spurge is being assessed using geographic, soil, and plant community information obtained from TEAM leafy spurge research sites. The impact of the flea beetles on plant species richness and diversity was evaluated at four research sites in Montana and North Dakota. By reducing high cover levels of leafy spurge the beetles may increase the diversity and species richness of forbs and may contribute to a substantial increase in the cover of grasses compared to areas still dominated by spurge.

Robert Nowierski

Department of Entomology
Montana State University, Bozeman, MT

David Kazmer

Department of Renewable Resources
University of Wyoming, Laramie, WY

David Horvath

USDA-ARS, Fargo, ND

Richard Hansen

USDA-APHIS-PPQ

Montana State University, Bozeman, MT

The Utilization of *Oberea Erythrocephala* as an Additional Bio-Control Agent on Leafy Spurge in the Little Missouri River Basin, and in Southeast and North Central North Dakota

Leafy spurge inhabits a wide range of different environmental habitats. Leafy spurge placement in the soil appears to limit the success of *Aphthona* spp. to only a particular range of environmental conditions. The beneficial cerambycid beetle, *Oberea erythrocephala* has a different reproductive and feeding behavior and therefore, may be better suited for successful establishment in the environmental habitats where *Aphthona* flea beetles are less than satisfactory. The successful establishment of *Oberea* will support the efforts of managing leafy spurge with another bio-control agent. *Oberea erythrocephala* was released at four sites in the little Missouri River basin, and five sites in southeast and one site in north central North Dakota. Each site was examined for the presence of *Oberea* population development and activity (stem girdling and oviposition punctures). At all the sites (not including north central North Dakota) *Oberea* was present the following year after release. An average of 3.7 adults per sweep and 8.5 adults were collected two and three years after release in southeast North Dakota. An average of 5.7% and 4.9% of the spurge plants were damaged by *Oberea* among the release sites in the Little Missouri River basin during the initial release year and one year following release. Leafy spurge stand counts were reduced an average of 4.22 stems/m² at two of these locations and increased by 4.6 stems/m² at one location. This study indicates that *O. erythrocephala* will establish under different environmental conditions that vary in annual temperature and precipitation, soil composition, and landscape.

Denise Olson

Assistant Professor, Department of Entomology
North Dakota State University, Fargo, ND 58105

Donald Mundal

Assistant Professor, Department of Entomology
North Dakota State University, Fargo, ND 58105

Proceedings (continued)

from Spurgefest II, June 19-21, 2001

Impact of Grasshopper Treatments on Established Populations of Biological Control Agents (*Aphthona* spp.) for Leafy Spurge

Established populations of flea beetles (*Aphthona* spp.) on leafy spurge may be in jeopardy in areas of western rangelands where damaging populations of grasshoppers require insecticide treatments. The impacts of actions to manage grasshoppers on flea beetles have not been determined and are of great concern.

Do treatments applied for controlling grasshoppers on rangeland infested with leafy spurge cause mortality to adult flea beetles? Which treatments if any, do not cause mortality? Of those that do, what is the immediate mortality level? What level of suppression on the population of biological control agents results after one year? How long is required for the affected population to return to pretreatment population levels?

Laboratory bioassays and field evaluations were conducted to determine the impacts of grasshopper control treatments. In laboratory bioassays, diflubenzuron produced no significant mortality. Malathion spray produced moderate (25%-41%) mortality while carbaryl spray produced high (86%-96%) mortality. No differences in mortality in direct impingement studies were detected between *A. nigriscutus* and *A. lacertosa* with malathion, carbaryl or in untreated populations. However, on treated

vegetation *A. nigriscutus* was observed higher on the plants and demonstrated higher mortality than *A. lacertosa*. In the season of treatment, field evaluations showed that diflubenzuron resulted in 18% and 0% mortality at 1 and 2 weeks post treatment respectively. Carbaryl bait resulted in low (17%) mortality while malathion spray resulted in moderate (21%-44%) mortality and carbaryl spray resulted in high (60%-82%) mortality. The impacts at one year after treatment will be determined in 2001.

R. Nelson Foster

Supervisory Entomologist, USDA-APHIS-PPQ
Phoenix Plant Protection Laboratory
Phoenix, AZ 85040

K. Chris Reuter

Technician, USDA-APHIS-PPQ
Phoenix Plant Protection Laboratory
Phoenix, AZ 85040

Loren K. Winks

State Plant Health Director, USDA-APHIS-PPQ
Bismarck, ND 58501

Terry E. Reule

Technician, USDA-APHIS-PPQ, Bismarck, ND 58501

R. D. Richard

Laboratory Director, USDA-APHIS-PPQ
Bozeman Plant Protection Laboratory
Bozeman, MT 59715.

Development of a GIS Database for the TEAM Leafy Spurge Project

The value of a geographic information system (GIS) lies in its ability to link spatial data (the location of leafy spurge on the earth's surface) with descriptive data (the characteristics of the infestation, controls, history) and analyze to answer complex questions.

During the past three years, Theodore Roosevelt National Park staff has developed GIS data for the TEAM Leafy Spurge (TLS) project area — a land base of 17 million acres. Project staff have acquired and processed over 1,000 individual data layers including: federal, state and county boundaries; digital elevation models (DEM); digital ortho-quarter quads (DOQQ); land use; leafy spurge biological control sites; leafy spurge infestations; public land survey; soils; streams; topographic contours; transportation and wetlands.

The layers are organized into a logical structure and contain Federal Geographic Data Committee (FGDC) compliant metadata. Map products have been produced and distributed illustrating leafy spurge infestations and controls by all cooperating agencies. All processed GIS data have been distributed on CD-ROM including free GIS software for viewing data and producing maps. This project has established the GIS data foundation for technology transfer into the future. Land managers and the research community now have a valuable set of data to analyze leafy spurge and develop techniques for its long-term control.

Steve Hager

USDI, Theodore Roosevelt National Park
P.O. Box 7, Medora, ND 58645

Proceedings (continued)

from Spurgefest II, June 19-21, 2001

Nutritional Composition of Selected Invasive Species

It has long been recognized that weed management systems on rangelands could incorporate grazing as an effective tool using an integrated pest management system. The objective of this study was to evaluate the nutritional composition of spotted knapweed (*Centaurea maculosa* Lamarck), diffuse knapweed (*Centaurea diffusa* Lamarck), leafy spurge (*Euphorbia esula* L.), and Canada thistle (*Cirsium arvense* L.) near Big Timber, MT and Bowman, ND. Samples from the aforementioned species were collected monthly during the growing season (May-October). Plant specimens were separated into rosettes, leaves, stems, and whole plant. Crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (lignin), in vitro dry matter digestibility, and minerals were analysed on each of the plant parts. Preliminary data to date include CP and ADF from the Bowman study site. Crude protein was greater ($P < 0.05$) and ADF lower ($P < 0.05$) in leaf tissue than stem material for all clipping dates (22 May, 22 June, 19 July, 22-August, 10 October) for all species. Crude protein content of leafy spurge stems was 8.0, 6.1, 4.1, 3.1, and 3.2 % for the aforementioned dates while 27.0, 17.5, 20.6, 13.5, and 12.4 % for leaf tissue. The ADF content ranged from 51.7 % on 22 May to 60.6 % on 10 October for leafy spurge stems and 16.1 % on 22 May to 16.9 % on 10 October for leaves. Only leafy spurge contained a low ADF content in leaf tissue from 22 May through 10 October (16.1, 20.5, 23.5, 14.2, and 16.9 %). Nutritional quality was much higher in leaf tissue than stem tissue for all four plant species. It appears leafy spurge provides the highest CP content and a lower ADF content during the second half of the growing than the other plant species.

Kevin Sedivec

extension rangeland specialist
Department of Animal and Range Sciences
NDSU, Fargo, ND 58105

Chad Prosser

ecologist
Northern Plains Agricultural Research Laboratory
Sidney, MT 59270

TEAM Leafy Spurge Survey of Ranch Operators, Land Managers and Local Decision Makers

A 1998 survey of ranchers, local decision makers and public land managers reported on perceptions and attitudes regarding weed management in general and specifically on perceptions and weed management practices regarding leafy spurge. The survey identified and evaluated managerial, institutional and social factors that affect the rate and extent of implementation of various leafy spurge controls. Overall, respondents shared similar concerns about controlling leafy spurge and understood that leafy spurge is a long-term management problem. Results of the 1998 survey have been used by the TEAM Leafy Spurge (TLS) effort in implementing Integrated Pest Management (IPM) research and demonstration projects to address concerns and constraints to leafy spurge control identified in the survey.

A second survey of the same ranchers, local decision makers and public land managers is scheduled for June 2001 to measure changes in perceptions of weed management issues as well as to identify needs for future research, demonstration and outreach efforts and compare the results to the initial survey. The survey will also include a number of questions designed to measure the producers' interaction with the TLS program and their evaluation of various TLS products and activities.

Nancy M. Hodur and F. Larry Leistritz

Research Associate and Professor
Department of Agribusiness and Applied Economics
NDSU, Fargo, ND 58105

Claude Schmidt
Agricultural Experiment Station
North Dakota State University
Fargo, ND 58105

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Proceedings (continued)

from Spurgefest II, June 19-21, 2001

Evaluation of Diflufenzopyr Applied with Quinclorac and Dicamba for Leafy Spurge (*Euphorbia Esula* L.) Control

Chemical control of leafy spurge continues to be the most common and effective method used. Picloram plus 2,4-D has historically been the standard herbicide treatment for leafy spurge. Preliminary research found that diflufenzopyr applied with auxin herbicides can dramatically increase leafy spurge control compared to auxin herbicides alone. The purpose of this research is to evaluate quinclorac applied alone or with diflufenzopyr for leafy spurge control and herbage production. Quinclorac is an auxin herbicide registered in non-cropland and fallow for control of annual grass, broadleaf, and some perennial weeds including leafy spurge. Diflufenzopyr is an auxin transport inhibitor that inhibits the flow of indoleacetic acid (IAA) and other synthetic auxin-like compounds within the plant. Currently, diflufenzopyr is not available to land managers alone; however, diflufenzopyr is included in a premix with dicamba. The premix consists of a 2.5:1

ratio of dicamba plus diflufenzopyr and is registered for corn and non-cropland weed control. Quinclorac, diflufenzopyr, and dicamba plus diflufenzopyr (premix) were applied either alone or together for leafy spurge control in a series of field and greenhouse experiments. Field treatments were applied to dense stands (approximately 20 plants/m²) of leafy spurge at two locations. Studies included an application timing experiment, which compared spring and fall applied treatments and a herbicide rate experiment that will help determine optimum treatment rates. A greenhouse experiment was established to evaluate grass injury from the various herbicide treatments on four warm-season and six cool-season perennial grass species.

Kenneth J. Deibert and Rodney G. Lym

Graduate Research Assistant and Professor
Plant Sciences Department

North Dakota State University, Fargo, ND 58105