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Leafy spurge management with sheep and flea beetles

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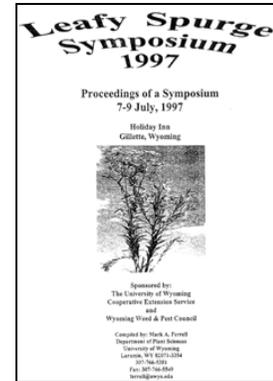
An experiment was initiated in 1993 along a riparian area to evaluate the effects of sheep grazing and flea beetles on leafy spurge populations and the associated plant community. The experiment was designed as a four by three factorial arranged as a split-plot. Main plots are four sheep stocking rates (2, 4, 6, or 8 sheep/A) and three grazing durations (10, 20, or 30 days); a control treatment also was included where no sheep grazing occurred. Each plot is 1 acre in size. The experiment was designed such that regression analysis was appropriate and response surfaces were generated. Only two replications were used because of experimental logistics and this represents a compromise between accuracy of the response surface and variability encountered across the experimental area. All plots were split in 1993 and 500 *Aphthona flava* were released on a single point in one-half of each plot. Sheep grazing began in 1995. Separate permanent transects were constructed in each plot to measure the effects of flea beetles plus sheep and sheep alone. Plots where only flea beetles were present were used to determine the effects of flea beetles alone. Cover and density of leafy spurge and cover of all plants present were measured four times each growing season; in early June before grazing began, half-way through each grazing treatment, two weeks after each grazing treatment ended, and in September.

June, 1996: Data collected in June, 1996 reflected the results of both animals from 1995. Where sheep grazed alone, leafy spurge density was greater compared to non-grazed plots. The lowest leafy spurge density was found in plots grazed by 4 sheep for 10 days but this was 17% higher than in non-grazed plots. Within each stocking rate, leafy spurge density increased as grazing duration increased from 10 to 20 days then decreased slightly as duration increased from 20 to 30 days. As a result of all stocking rates invoked in 1995, smooth brome cover in June, 1996 increased as duration increased from 10 to 20 days then decreased sharply as duration increased from 20 to 30 days. There was about 2.5 times more smooth brome in plots grazed by 8 sheep for 20 days in 1995 compared to non-grazed plots. Leafy spurge density where sheep and flea beetles were grazing simultaneously was influenced only by sheep grazing duration. Leafy spurge density at all stocking rates was about twice as much when sheep grazed for 30 days with flea beetles compared to 10 days.

September, 1996: Where sheep grazed alone, Kentucky bluegrass cover was influenced only by sheep stocking rate and all grazed plots had more cover than non-grazed plots. Kentucky bluegrass cover was greatest where 4 sheep grazed and was 2.5 times more than in non-grazed plots. Smooth brome, western wheatgrass, and blue grama were influenced by stocking rate and grazing duration. The pattern for smooth brome cover resulting from sheep grazing treatments was similar to that observed in June, 1996. At all stocking rates, western wheatgrass cover decreased as duration increased from 10 to 20 days then increased as duration increased from 20 to 30 days; all grazed plots had more western wheatgrass cover than in non-grazed plots except where 2 sheep grazed for 20 days. Within a stocking rate, blue grama cover was greatest at the 10 day duration, and among grazed plots, the most blue grama was found in plots grazed by 4 sheep for 10 days but this was about half that found in non-grazed plots. Where sheep and flea beetles grazed simultaneously, at each grazing duration leafy spurge cover and density increased as stocking rate increased and at each stocking rate, leafy spurge cover and density decreased as duration increased from 10 to 20 days then increased as duration further increased from 20 to 30 days. The highest leafy spurge cover was found where 8 sheep grazed for 10 days and the greatest density where 8 sheep grazed for 30 days. Maximum smooth brome cover (13%) was found where 8 sheep grazed for 20 days and coincided with a significant dip in leafy spurge cover and density.

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Foreword / Agenda

The 1997 Great Plains Agricultural Council Leafy Spurge Task Force Symposium was held July 7-9 at the Holiday Inn in Gillette, Wyoming. The Symposium was attended by approximately 40 scientists, weed district supervisors, land managers and others from the private and public sectors. The Leafy Spurge Symposium is an opportunity for interested people to assemble, listen, and discuss current scientific information concerning leafy spurge.

The primary purpose of the Leafy Spurge Symposium is for scientists working with leafy spurge to discuss and critique their research findings so that continual progress is made toward improving our understanding of this troublesome plant. It is hoped that others working on the control of leafy spurge will take the research information presented and incorporate it into their weed management practices and systems.

The 1998 GPAC Leafy Spurge Task, Force Symposium will be held July 21-23 at the Sheraton in Colorado Springs, CO. For information concerning the 1998 meeting, contact Dr. K. George Beck, President, GPAC Leafy Spurge Task Force 1998, 116 Weed Research Lab, Colorado State University, Ft. Collins, Colorado 80523 (970) 491-7568.

Those interested in receiving the Leafy Spurge News, a newsletter dealing with leafy spurge, or if you have information for the Leafy Spurge News contact:

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1997 Leafy Spurge Symposium Proceedings
Holiday Inn, Gillette, Wyoming
7th through 9th of July, 1997

Program Agenda

Monday, July 7, 1997

10:00 am to 12:00 noon Registration - **Holiday Inn, North Terrace**
11:00 am Coal mine tour-Leaves from Flying J Truck Stop
1:00 pm to end of day Free time

Tuesday, July 8, 1997

General session - Canyon Room, North Terrace- Paper Presentations

Moderator: **Mark Ferrell**, University of Wyoming

8:00 am Welcome - **Kent Drake**, Campbell County Cooperative
Extension Service, University of Wyoming, College of Agriculture,
Gillette, WY.

8:15 am Grass competition with leafy spurge and other perennial weeds -
Tom Whitson, Cooperative
Extension Service, College of Agriculture, University of Wyoming,
Laramie, WY.

8:45 am A 20 year effort to control leafy spurge in Fremont County, Wyoming -
John (Lars) L. Baker, Fremont County Weed & Pest Control District,
Lander, WY.

9:15 am Response of leafy spurge (*Euphorbia esula* L.) and associated vegetation
to Plateau® -**Robert A. Masters, Fernando Rivas-Pantoja, and Daniel
D. Beran**, USDA-ARS and University of Nebraska, Lincoln, NE.

9:45 am Leafy spurge management with sheep and flea beetles - K. George Beck,
Colorado State University, Ft. Collins, CO.

10: 15 am **Break**

10:45 am Evaluation of BAS-662 and BAS-654 for leafy spurge control - **Rod Lym**,
North Dakota State University, Fargo, ND.

11:15 am **Poster Session - Canyon Room, North Terrace (Authors need to be
present)**

11:45 am **Lunch - North Terrace (included in registration)**

Moderator: **Kent Drake**, Campbell County Cooperative Extension Service 1: 15 pm
Evaluation of imazameth for leafy spurge control - **Denise Markle**, North
Dakota State University, Fargo, ND.

- 1:45 pm Integration of herbicides with *Apthona nigriscutis* - **Jeff Nelson**, North Dakota State University, Fargo, ND.
- 2:15 pm Leafy spurge management for livestock production: A summary of techniques, tips, and integrated management tools that work - **Rich Bayers**, DowElanco, Buffalo, WY.
- 2:45 pm Leafy spurge work in Crook County, Wyoming - **Gene Gade**, Crook County Cooperative Extension Service, College of Agriculture, University of Wyoming, Sundance, WY.
- 3:15 pm **Break**
- 3:45 pm Update on Wyoming's leafy spurge program - **Mark A. Ferrell**, Cooperative Extension Service, College of Agriculture, University of Wyoming, Laramie, WY.
- 4:15 pm Discussion session and business meeting
- 6:00 pm **Adjourn Dinner - North Terrace (included in registration)**

Posters:

Role of leaves in maintenance of correlative inhibition in leafy spurge (*Euphorbia esula*) root buds -**David Horvath**, USDA/ARS/BRL, Fargo, ND.

Leafy spurge work in Crook County, Wyoming - **Skip Lewis and Clay Hutchinson**, Crook County Weed & Pest, Sundance, WY.

Apthona species movement along railroad right-of-way 1997 - **Katheryn Christianson**, North Dakota State University, Fargo, ND.

Wednesday, July 9, 1997

Field tour of leafy spurge sites in Crook County - Meet in lobby at 7:30 am. Leave at 7:45 am. Arrive at first stop at 8:45 am - UW leafy spurge studies. Arrive at second stop YO: 15 am - minirhizotron technology for studying leafy spurge roots - **Dr. Steve Merrill**, USDA/ARS, Mandan, ND. - Lunch at Devil's Tower (included in registration). 2:00 pm leave for Gillette. Adjourn - 3:00 pm. See you in Colorado for the 1998 leafy spurge symposium.

Many thanks to the following for their assistance in the 1997 Leafy Spurge Symposium:

Campbell County Weed & Pest District

Crook County Cooperative Extension Service

Campbell County Cooperative Extension Service

University of Wyoming, College of Agriculture

University of Wyoming, Conferences &

Holiday Inn, Gillette, WY

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A brief overview of Fremont County Weed and Pest Control District

JOHN L. (LARS) BAKER

Supervisor, Fremont County Weed and Pest Control District.

Fremont County is the second largest county in Wyoming covering a little over 6 million acres in the Wind River Drainage. The altitude runs from 4,800 to 13,000 feet. Precipitation averages 14"/year with half of the county receiving less than 10". Fremont County is home to about 40,000 people. There are two major towns, Riverton and Lander, the county seat. Over half of the land is owned by the United States, 3,105,106 acres. The Wind River Indian Reservation takes another 1,889,505 acres. State and local governments own 409,554 acres, and 743,682 acres are privately owned. There are 877 farms and ranches, 762 of which are irrigated to some degree. There are four major irrigation projects and hundreds of private ditches which water 185,000 acres of crop land. When you add water to the desert you raise crops and lots of weeds. Easily 250,000 acres of the county is economically infested with one or more species which include Canada thistle, Russian knapweed, hoary cress, leafy spurge, musk thistle, perennial pepperweed, Dalmatian toadflax, spotted knapweed, and diffuse knapweed.

Weeds have always been important to Wyoming and since 1904 there has been some kind of related legislation about every four years. The first weed law was passed in 1936 and authorized weed districts to "seize all infested lands". A weed district was formed in Fremont County in 1937. By 1939 there were four weed districts in the county, each associated with an irrigation project. World War II ended formal weed control activity for several years. After the war, weed control activity was poorly organized, and the lack of activity allowed many weeds to really get going. In 1948 the program was revitalized by combining all the districts into one. Minutes from meetings at that time show purchases of the first weed sprayer in the county, freight car loads of polyborchlorate and wages paid to men who traveled from farm to farm cultivating weed patches. Our present law was passed in 1972. It was less punitive and more extensive in nature with a positive reliance on technology. Every county in the state had a district formed on county boundaries which was autonomous. The State Department of Agriculture has a coordinating role, but district weed boards, appointed by the county commissioners, run the show. Districts are financed with a 1 mill levy on all real property in the county. This funding is separate from the county 12 mill tax so the district is rather independent.

In 1997, Fremont County had an assessed valuation of 260 million. Our mill was set at 1.9 to raise about \$490,000. We generate another \$250,000 through spray operations. With our cash reserves the total budget exceeds 1.1 million dollars. We spend about \$330,000 to \$350,000 annually on leafy spurge. We annually cost share \$250,000 with land owners on other weeds as well. We do not retail chemical except through our equipment. We cost share through the local ag chem dealers who deduct the cost share at the point of sale and bill the district at the end of the month. We cost share on products that are proven to be effective for the control of designated noxious weeds, i.e. Tordon and Roundup @ \$25/gal, Banvel @ \$20/gal, Stinger/Transline @ \$96/gal, and Escort/Telar @ \$8/gal.

The district is staffed with one supervisor, two assistant supervisors, a secretary/bookkeeper, GIS/Computer operator, a mechanic, two full time hands, and 16 to 20 seasonal spray hands. The annual payroll is about \$325,000. Our main office is in the County Court House in Lander. There is a shop in Riverton and chemical storage buildings in both towns. We have seasonal facilities in the Dubois/Crowheart area.

We focus on using tax dollars to treat weeds on public rights of way. The Wyoming Department of Transportation contracts with the district for vegetation management on 500 centerline miles of state highways where we treat delineators and guard rails for annual broadleaf weeds and designated noxious weeds. We contract with the Bureau of Indian Affairs to control weeds on 350 miles of tribal roads and 450 miles of irrigation canals. We treat weeds on 3,000 miles of county maintained roads. We handle vegetation management tasks for Midvale Irrigation District, which operates the largest canal system in the county with 500 miles of delivery system, 400 miles of drains, and thousands of acres of non-irrigated rangeland inside of the original irrigation take. As part of our operation we help the county maintain maps on a computer based GIS system for land ownership, weed inventory, roads, surface water and soil types, applicator records, topography, and rural addressing. We are now able to provide our customers with detailed maps of their property showing weeds, treatment activity, topography, and property boundaries. To cover all this ground we operate 17 vehicles, two with computer controlled injector spraying systems. We have 9 loaner spray rigs for owners of smaller acreages.

Biologically based weed control is a growing segment of our program. We have released 25 different species of biological control agents on 8 different weed species. Our largest effort is in leafy spurge where 7 species are released. Data is collected at many sites annually to monitor progress. About half of my time is spent on biocontrol and during the summer I hire a technician to move bugs and collect data. Altogether the district spends about \$50,000 annually on biological control of weeds and pests. Our first releases were on musk thistle which has been severely impacted to the degree that it does not pose an economic impediment to the use of the land. It is not really a weed any more. Since 1978 Fremont County Weed and Pest has made over 2,000 insect releases on leafy spurge. We maintain data on 325 sites and have exported over 400,000 insects to other counties and states. This is not a research program primarily, although some research does come out of the work. We noticed that leafy spurge was spreading faster than the insects at many sites. So we have worked hard to make saturation releases to insure that insects were within a quarter of a mile of all known spurge. In ten years they will spread

to all the spurge on their own. A hundred years from now it probably won't matter, but it will in twenty. The goal is not to watch as the insects spread across the landscape and report on their activities. We want to kill some spurge.

In 1978 the legislature passed the Leafy Spurge Act. It authorized districts with leafy spurge to go to two mils. It established an 80% cost share on leafy spurge control costs and provided funding for some of the poorer counties that had a lot of leafy spurge. The plan was based on the ideas that one treatment with picloram followed for two years with an annual treatment of 2,4-D would reduce the spurge to the point that land owners could then maintain control economically. Leafy spurge is tougher than that kind of chemical based approach. We were using 1,500 pounds of picloram every year. There was no incentive to do any thing else with the 80% cost share. In a few years there were 36 wells and several streams contaminated with Tordon. In 1992, the legislature broadened the approach with the Special Weed Management Act, a replacement for the sunseting Leafy Spurge Act. It allowed cost share on integrated programs with a heavy emphasis on biological control methods.

One of my assistants is in charge of weed free hay certification. He inspects 3,000 acres of hay and 400 acres of small grains. We certify about 10,000 tons every summer, less than half of which is sold as certified hay. It is a good tool to teach growers about weed control and get them to do a better job at controlling weeds. We charge labor after the first two hours in the field to try to discourage those who want to certify everything on the place even though they will feed most of the hay themselves. Some people just like to gold star and to be able to brag a little.

Fremont County Weed and Pest believes in personal service. We try to provide that every day of the year, all day long, face to face, and one on one. You have to teach weed control when the grower is willing to listen. It is on his schedule. We try to reduce bureaucracy in our programs, eliminate the red tape, and try to make something happen.

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Leafy spurge management for livestock production: A summary of techniques, tips, and integrated management tools that work

RICH BAYERS

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Leafy spurge (*Euphorbia esula* L.) grows on a wide variety of terrain from flood plains to river banks, grasslands, ridges, and mountain slopes. It is primarily found in untitled habitats such as abandoned cropland, pastures, rangeland, woodland, roadsides, and waste areas. The plant grows in diverse environments from dry, to subhumid and from subtropic to sub-artic. It occurs on many topographic positions from the flat bottom of glacial lakes to the slopes of sand dunes and glacial moraines. After leafy spurge is introduced into an area, there does not seem to be any topographic limits to its invasion of new areas.

Livestock producers in four states were interviewed to determine the keys to their on-the-ranch management techniques for controlling and/or containing leafy spurge infestations. Key elements in common were found on most of these ranches. Unique individual management techniques were also identified on several of the ranches selected.

Common management techniques included mapping infestations, selecting the right herbicide for the areas to be treated, treating twice per year, rechecking and retreating consistently, integrating with sheep grazing and cattle grazing management, cooperating with neighbors, working jointly through a planned program if available (Trust Fund grant), utilizing insects for long-term maintenance, persistence over time, and treating headwaters and top of drainages first.

Unique techniques included using Herbi sprayers to minimize water and herbicide volume and buying weed-free hay and forage to prevent reintroduction of weeds to clean pastures.

Progress reported varied from reductions of original infestation from 100% to 10% of original leafy spurge infestation to increasing animal unit months – (AUMs) from 25 AUMs to 40 AUMs. One rancher also reported the preservation of a Threatened and Endangered Species.

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Aphthona spp. flea beetles movement along railroad right-of-ways 1997

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Poster presentation abstract:

Leafy spurge is often found in long narrow corridors such as railroad right-of-ways and is difficult to treat. Two experiments were conducted to determine the establishment, population increase, and movement of *Aphthona* species flea beetles in confined area of leafy spurge.

A. nigriscutis was released in a dense stand of leafy spurge along a railroad corridor on June 28, 1993. There were five treatments consisting of 100, 200, 300, 400, and 500 adult insects released per treatment, plots were 260 feet apart, and replicated three times along a 2.5 mile stretch of the Burlington Northern railroad right-of-way near Buffalo, ND. Stem density and adult flea beetle population were monitored in the spring and summer, respectively, at the release point and at distances 10, 25, and 40 feet in a semi-circle pattern from the release point.

A. nigriscutis flea beetles were found in all treatments each year after release and leafy spurge stem density began to decline in 1995. The stem density decreased from an average of 18 stems/0.25m² in 1993 to 5 stems/0.25m² in 1997. The greatest stem density decrease was 72% when 500 beetles/plot were released. The maximum stem density decrease and highest beetle population occurred within 10 feet of the release point regardless of treatment. *A. nigriscutis* populations in the 100 and 400 insects/release treatments averaged 7 beetles/m² compared to 2 beetles/m² for the 500 insects/release treatment.

A similar experiment was established on July 10, 1995 with a mixed population of *A. czwalinae/lacertosa* along the Red River Valley and Western Railroad right-of-way near Lisbon, ND. The number of insects released was increased to 500, 1,000, 1,500, and 2,000 adults per treatment. Release points were 150 feet apart with four replications along a 3.5 mile stretch of the right-of-way. Stem density and adult flea beetle population were monitored in the spring and summer, respectively, at the release point and at distances of 10, 30, 50, and 70 feet in a circular pattern around the release point.

A. czwalinae/lacertosa were found at all release sites in both 1996 and 1997. The average stem density in the 2,000 insects/release treatment declined by 71% 2 years after

release from 21 stems/m² to 6 stems/m² within 10 feet of the release point. The average stem density declined 48, 60, and 23% within 10 feet of the release point for the 1,500, 1,000, and 500 insect treatments, respectively. *A. czwalinae/lacertosa* were found up to 70 feet from the release point. Flea beetles will establish on industrial sites such as railroad right-of-ways. The larger the release number the more rapid the site stem density declines.

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Update on Wyoming's leafy spurge research program

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The control of leafy spurge with initial and retreatments of picloram

This research was conducted near Devil's Tower, Wyoming to compare the efficacy of various rates of picloram for leafy spurge control. Plots were retreated to maintain or attain 80% control with light rates of picloram or picloram/2,4-D tankmixes. Initial treatments were 0.25 lb picloram to 2.0 lb picloram in 0.25 lb increments and 0.25 lb picloram + 1.0 lb 2,4-D. Retreatments were 0.25 or 0.5 lb picloram or 0.25 lb picloram + 1.0 lb 2,4-D. The initial treatment of 0.25 lb picloram was retreated only with 0.25 lb picloram and the initial treatment of 0.25 lb picloram + 1.0 lb 2,4-D was retreated only with 0.25 lb picloram + 1.0 lb 2,4-D. Plots were 10 by 27 feet. with four replications arranged in a randomized complete block. The initial herbicide treatments were applied May 24, 1989. Retreatments were applied June 6, 1990; June 13, 1991; June 10, 1992; September 22, 1993; and September 19, 1994. The soil was a silt loam (22% sand, 58% silt, and 20% clay) with 1.8% organic matter and a 6.3 pH. Leafy spurge was in full bloom and 12 to 14 inches in height for the initial treatments and in full bloom, 12 to 20 inches in height, for spring retreatments and 16 to 24 inches in height for fall retreatments. Infestations were heavy throughout the experimental area. Visual weed control evaluations were made June 6, 1990; June 13, 1991; June 10, 1992; June 21, 1993; June 15, 1994; June 27, 1995; June 18, 1996 and; June 19, 1997.

Plots with initial treatments of 1.25 lb picloram or greater in 1989 provided 80% or better leafy spurge control and did not require retreatment in 1990. Initial treatments maintaining 80% control or better in 1991 were 1.5, 1.75 and 2.0 lb picloram treatments. Initial treatments of 2.0 lb picloram were the only treatments maintaining 80% control or better in 1992. The only 1990 retreatment attaining 80% control or better in 1991 was 0.5 lb picloram over an initial 1.0 lb of picloram. None of the retreatments applied in 1991 attained 80% control in 1992. None of the retreatments applied in 1992 attained 80% control in 1993. All 0.5 picloram retreatments applied in the fall of 1993 attained 80% control or better in 1994. One 0.25 picloram + 1.0 2,4-D retreatment applied over an ini-

tial treatment of 1.5 picloram attained 80% control in 1994. None of the 2.0 lb picloram treatments have maintained 80% since 1993. No retreatments maintained 80% in 1995, 1996, or 1997 and control is declining. Spring retreatments of picloram at 0.25 or 0.5 have not been effective in attaining or maintaining 80% control. Spring retreatments of 0.25 lb picloram + 1.0 lb 2,4-D appear to be as effective as spring retreatments 0.5 lb picloram. However, spring retreatments of 0.25 lb picloram + 1.0 lb 2,4-D have not attained or maintained 80% control. Fall retreatments of 0.5 lb picloram or 0.25 lb picloram + 1.0 lb 2,4-D may be effective in attaining or maintaining 80% control. However, no 1994 fall retreatment attained 80% control in 1995. The most effective long-term treatment for control of leafy spurge was 2.0 lb picloram.

The control of leafy spurge with imazameth

The objective of this study was to compare the efficacy of imazameth for leafy spurge control. The plots were 10 by 27 feet in a randomized complete block design with four replications. Treatments were imazameth at one, two and 4 oz ai/a with or without a crop oil concentrate and picloram at 0.5 lb ai/a. Treatments were applied with a hand-held CO₂-pressurized six-nozzle sprayer (20' spacing) delivering 20 gpa at 40 psi. Treatments were applied September 26, 1995 and evaluated June 18 and Sept. 17, 1996 and June 12, 1997. Leafy spurge was mature and 16 to 24 inches tall. The soil was a silt loam with 22% sand, 58% silt, 20% clay; with 1.8% organic matter and pH 6.3. Depth to parent material is approximately 27 inches.

Imazameth at 4 oz ai/a plus a crop oil concentrate provided the best control (87%). Without the crop oil concentrate control was only 69%. The addition of a crop oil concentrate greatly improved leafy spurge control. No other treatments provided satisfactory control. There was little or no grass damage when imazameth was applied after grasses were mature in mid September. However, control had dropped to 0 by June 1997 for all treatments. It appears that imazameth may have potential fit for control of leafy spurge.

The control of leafy spurge with initial and retreatments of picloram and 2,4-D

This research was conducted near Devil's Tower, Wyoming to compare the efficacy of retreatments of picloram and 2,4-D low volatile ester (LVE) on the control of leafy spurge. The initial herbicide treatments (picloram at 0.25 through 2.0 at 0.25 lb ai/a increments; picloram at 0.25 + 2,4-D LVE at 1.0 lb ai/a; and 2,4-D LVE at 1.0 and 2.0 lb ai/a) were applied May 28, 1987. Initial treatments with less than 80% control were retreated with picloram at 0.5 lb, except for picloram at 0.25 lb, picloram at 0.25 + 2,4-D LVE at 1.0 lb, and 2,4-D LVE at 1.0 and 2.0 lb which were retreated with the original rates. Retreatments were applied July 6, 1988, June 6, 1989, June 6, 1990, June 13, 1991, June 10, 1992, Sept. 22, 1993, and Sept. 14, 1994. Visual weed control evaluations were taken on June 8, 1988, May 25, 1989, June 6, 1990, June 12, 1991, June 9, 1992, June 21, 1993, June 15, 1994, June 27, and Sept. 26, 1995, June 18, 1996, and June 19, 1997.

Plots with initial treatments of 1.25 lb picloram or greater in 1987 provided 80% or better leafy spurge control and did not require retreatment in 1988. The only initial treatment maintaining 80% control or better in 1989 and 1990 was picloram at 2.0 lb. This treatment maintained 80% control or better for three years. None of the 1988 retreatments attained 80% control in 1989. Retreatments of picloram at 0.25 have not been effective in attaining or maintaining 80% control. All of the 1989 picloram 0.5 lb retreatments attained 80% control or better in 1990. Subsequent fall retreatments at 0.5 lb have been effective when the initial picloram rate was 1.25 lb or greater. The 1989 picloram 0.25 lb + 2,4-D 1.0 lb retreatment attained 92% control in 1990 and maintained 85% control the following year. One or 2.0 lb 2,4-D LVE retreatments attained 80% control or better and maintained control for 2 to 3 years. Leafy spurge control has not been maintained and has dropped to 40% or less in 1997. The most effective long-term treatment for control of leafy spurge was 2.0 lb picloram. Retreatments of 0.5 lb picloram also appear to be effective when applied over initial rates of 1.25 lb or greater. Retreatments of 0.25 lb picloram + 1.0 lb 2,4-D did not maintain 80% control but were very close at 76, 79, and 78% control for 1995, 1996 and 1997, respectively.

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Role of leaves in maintenance of correlative inhibition in leafy spurge (*Euphorbia esula*) root buds

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Poster presentation abstract:

Earlier studies on the source of signals controlling correlative inhibition of root buds in leafy spurge indicated that either growing meristems (apical or growing axillary buds) by themselves or leaves by themselves could prevent root buds from breaking dormancy. In these experiments, the threshold level of leaves required to maintain correlative inhibition of the root buds was determined. It was observed that as few as 5 leaves remaining on budless stems would greatly reduce the growth of leafy spurge root buds. To determine if photosynthesis was necessary for the observed effect of leaves and buds, plants were placed in the dark for 1 week prior to removal of leaves, stem buds or both leaves and buds. The results from these experiments indicated that light was necessary for the leaf effects on root bud growth, but was not necessary for correlative inhibition by growing stem buds.

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Evaluation of BAS-662 and BAS-654 for leafy spurge control

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Abstract:

BAS-662 (formally known as SAN-1269) is a combination of dicamba plus BAS-654 (formally SAN-836) in a ratio of 2.5:1 dicamba: BAS-654. BAS-654 is called an auxin transport inhibitor (ATI), because it inhibits the transport of naturally occurring IAA and synthetic auxin-like compounds in plants. In general, BAS-654 interferes with the auxin balance needed for plant growth. The purpose of this research was to evaluate BAS-654 alone and in combination with dicamba and other herbicides for leafy spurge control in a series of greenhouse studies.

In the initial study, BAS-662 was applied to leafy spurge plants to achieve dicamba rates of 0.5 to 4 oz/A. The treatments were compared to dicamba applied alone. The plants were evaluated for top growth injury 1 and 2 weeks after treatment (WAT) Then all top growth was removed and the plants were allowed to regrow for 4 weeks (6 WAT), at which time the leafy spurge regrowth was harvested, oven dried, and weighed.

There were no visible differences in injury symptoms between dicamba applied alone or with BAS-654. However, leafy spurge regrowth was much less when dicamba was applied with BAS-654 compared to dicamba applied alone at the same dicamba rate. For example, leafy spurge regrowth averaged 385 mg/plant 6 WAT with dicamba at 4 oz/A and with BAS-662 that included dicamba at only 0.5 oz/A plus BAS-654. Leafy spurge did not regrow when dicamba at 4 oz/A plus BAS-654 was applied.

Leafy spurge control also increased when BAS-662 was applied with picloram, 2,4-D, and picloram plus 2,4-D, but not with quinclorac. In general, leafy spurge regrowth was reduced nearly 50% when picloram or 2,4-D was applied with BAS-662 compared to either herbicide alone and by 98% when picloram plus 2,4-D was applied with BAS-662 compared to the herbicide combination alone. It is not known what amount, if any, the dicamba portion was contributing to the increase in control when BAS-662 was applied with these herbicides. The combination of quinclorac plus BAS-662 resulted in precipitate formation, which probably reduced leafy spurge control. Perhaps this problem could be overcome if quinclorac was applied with just the ATI (BAS-654).

Research is in progress comparing perennial weed control with various auxinic herbicides applied alone or with BAS-662 or BAS-654. The addition of the ATI does not alter the visible topgrowth injury but seems to increase root kill. Perennial weed control would greatly increase if the greenhouse results are reproduced in the field.

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Evaluation of AC 263,222 for leafy spurge control

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Abstract:

AC 263,222, formerly known as imazameth, has shown promise for leafy spurge control in North Dakota. However, grass injury has been observed, especially to cool season species. The AC 263,222 labeled rate for optimal leafy spurge control is 2 oz ai/A applied with a methylated seed oil and nitrogen two weeks before a killing frost. The objective of this research was to evaluate leafy spurge control from AC 263,222 applied with and without adjuvants and applied in the spring or fall to maximize leafy spurge control and minimize grass injury.

The first experiment evaluated leafy spurge control from AC 263,222 applied in the spring or fall. The flowering stage of leafy spurge was treated in the spring and regrowth was treated in September, but plots were only treated once. The treatments included AC 263,222 at 2 or 4 oz/A; AC 263,222 plus methylated seed oil (MSO) at 1 or 2 oz/A plus 1 quart applied in spring or fall; and picloram plus 2,4-D at 4 plus 16 oz/A in the spring or at 8 plus 16 oz/A in the fall.

In general, leafy spurge control was better with fall applied AC 263,222 than spring applied at comparable rates, control averaged 70% and 100%, respectively. Control increased with spring applied AC 263,222 from an average of 7% at 3 months after treatment (MAT) to 70% at 12 MAT. The average grass injury was 2% at 3 MAT and increased only to 9% at 12 MAT with spring applied AC 263,222. Grass injury ranged from 10 to 35% with fall applied AC 263,222. Grass injury increased an average of 10% and leafy spurge control increased an average of 50% at 12 MAT when the AC 263,222 application rate increased from 2 to 4 oz/A. Grass injury also increased an average of 10% and leafy spurge control increased an average of 40% at 12 MAT when MSO was added to spring applied AC 263,222.

The second experiment evaluated AC 263,222 applied with or without adjuvants. The treatments were AC 263,222 at 1 or 2 oz/A alone, with 1 quart MSO, with 1 quart 28% N, or with 1 quart MSO plus 1 quart 28% N; and picloram plus 2,4-D at 8 plus 16 oz/A. Treatments were applied September 4, 1996 at the leafy spurge fall regrowth stage.

AC 263,222 at 1 oz/A plus MSO provided 96% leafy spurge control, similar to 2 oz/A alone at 9 MAT. AC 263,222 at 1 oz/A plus MSO gave leafy spurge control and grass injury similar to picloram plus 2,4-D at 8 plus 16 oz/A, which averaged 97% leafy spurge control and 5% grass injury. Adding nitrogen to AC 263,222 and AC 263,222 plus MSO did not affect control.

Research is in progress to evaluate the effect of fall application timing with AC 263,222 on leafy spurge control and grass injury. Application times range from August 15 through October 15. The effect of various adjuvants combined with AC 263,222 on grass injury is also being evaluated.

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Response of leafy spurge (*Euphorbia esula* L.) and associated vegetation to PLATEAU[®]

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Leafy spurge is a competitive exotic perennial weed on rangeland in the northern Great Plains. Experiments were initiated on range sites dominated by sandy soils near Ainsworth and Tilden, Nebraska and Jamestown, North Dakota to determine the response of vegetation on leafy spurge infested rangelands to PLATEAU. PLATEAU was applied in September 1994 and 1995 at 140 g ai ha⁻² (8 oz product per acre), 210 g ai ha⁻² (12 oz product per acre), and 280 g ai ha⁻² (16 oz product per acre) at Ainsworth and Tilden and at 140 and 280 g ai ha⁻² at Jamestown. Picloram at 0.6 kg ai ha⁻² + 2,4-D at 1.1 kg ai ha⁻² were also applied in September 1994 and 1995. PLATEAU was applied again at the Ainsworth and Tilden sites in June 1995 and 1996 to previously non-treated areas and to half of the areas treated in September 1994 and 1995 with PLATEAU. In August 1996, estimates of leafy spurge control on a scale of 0% (no control) to 100% (complete control), leafy spurge density, and dry matter yield of cool-season grasses, warm-season grasses, leafy spurge, and forbs were determined. Application of PLATEAU at 140 g ai ha⁻² or greater rates in the fall of 1994 and again in 1995 provided better than 95% leafy spurge control. Fall applications of picloram + 2,4-D provided less than 50% leafy spurge control. PLATEAU applied only in the spring of 1995 and 1996 provided less than 60% leafy spurge control. Regardless of rate, application of PLATEAU for two consecutive years in the fall and again in the spring resulted in 100% control of leafy spurge and suppressed cool-season grass yields. PLATEAU applied in the fall at 140 g ai ha⁻² for two consecutive years provided excellent control of leafy spurge with little adverse affect on cool- or warm-season forage grasses. Additional research is needed to assess the response of desirable forages and leafy spurge to long-term PLATEAU treatment regimes and efficacy of PLATEAU on sites with fine textured soils.

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Integration of herbicides with *Aphthona nigriscutis*

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Abstract:

Aphthona nigriscutis has reduced the density of leafy spurge at many locations. However, there are locations where *A. nigriscutis* has not established or is found at densities too low to be effective. Therefore, it may be necessary to integrate biological and chemical control to reduce leafy spurge densities to non-economic levels. The objective of this experiment was to integrate picloram plus 2,4-D and *A. nigriscutis* for leafy spurge control.

Experiments were conducted at Chaffee and Fort Ransom, North Dakota. Approximately 450 *A. nigriscutis* were released into 1.8- by 1.8- by 1.8-m cages. Picloram plus 2,4-D at 0.56 plus 1.1 kg ae /ha were applied on four dates, August 15, September 1 and 15, and October 1. The experiment at each location was repeated the following year on leafy spurge that was not infested with flea beetles.

The effect of picloram and 2,4-D on *A. nigriscutis* population was estimated by counting the number of adults emerging from soil cores harvested in the fall and spring. A golf-cup cutter was used to harvest soil cores which were 10.8-cm diameter to a depth of 15 cm. Soil cores harvested in the fall were held at 3° C for 75 days. Each sample was then placed into a 2-L paper container and maintained in the laboratory at 21° C with a 16-hour photoperiod until *A. nigriscutis* adults emerged. Soil cores harvested in the spring were placed directly in trap chambers and then treated identically to soil cores harvested in the fall.

The number of beetles collected from soil cores was similar among herbicide application dates both across locations and years. An average of 2 *A. nigriscutis* adults were recovered from each soil core harvested in the fall of 1995 compared to only 1 per core from spring harvested soil cores across both locations in 1996. Overwintering mortality decreased the number of flea beetles recovered from spring harvested soil cores. Overwintering mortality was not observed in the *A. nigriscutis* population from soil cores harvested in the second year of the study in 1996 and 1997. An average of 2 and 3 flea beetles were collected from each soil core harvested in the fall and spring, respectively.

Leafy spurge stem densities 12 months after treatment were lowest in the plots that were treated with picloram plus 2,4-D on or after September 1 compared to the August 15 application, insects only, and the check in 1996. Leafy spurge stem density was lower inside the cage when picloram plus 2,4-D was applied to established flea beetles compared to picloram plus 2,4-D and insects alone. This integrated treatment of flea beetles and herbicide has an additive/synergistic effect with respect to leafy spurge control.

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Establishing a sustainable vegetation ecosystem to replace noxious weeds

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Dealing with the revegetation of disturbed or degraded land is always a challenge that requires a systems approach to be long-lasting and successful. The system of combining a herbicide for weed control with a reseeding program has been tested at the University of Wyoming for 12 years and is providing excellent weed control with only the initial herbicide treatment.

Dealing with weed problems requires a prescription herbicide treatment before establishing a highly competitive perennial grass. Grasses should be cool-season, have moderate desirability for livestock and wildlife and establish well on difficult sites. They should be well adapted to an area and be long-lived. To determine most suitable grasses growers should visit the NRCS Plant Materials Center in their area to look at grasses best adapted for a revegetation site.

Vegetation management requires a different strategy for each weed species that can dominate if managers fail to properly establish perennial vegetation. Three types of weeds are always present no matter where we work. Those are annuals, biennials and perennials. Each species within these groups have to be managed a different way to give the most economical, successful and long-lasting vegetation management system. A herbicide must be applied at the proper stage of growth for the best and most economical control. Annual bromes or annual broadleaved weeds are best controlled before they produce seedheads.

Biennials such as musk thistle work best after all new seedlings have emerged but prior to the controls for two-year-old plants bolting or producing a seed stalk. If a control is effective in preventing seed production and can be uniformly applied every other year, eventually the seed bank will be exhausted and no new plants can come up.

Perennials such as Russian knapweed and leafy spurge are most effectively controlled shortly before or after the first major killing frost in the fall. At that time sugars are being stored in root systems for winter survival and herbicide applications even at reduced rates still take advantage of this natural translocation period.

The principle change we have made in the past 20 years in weed management has been the focus on the establishment of perennial grasses and forbs. Several examples of

revegetation replacing various weed problems have been done in Wyoming. These same problems are not as dominant in the eastern part of the U.S., but the principles of revegetation are very similar. Leafy spurge is a deep-rooted perennial that dominates over 3 million acres in the northern U.S. It is now adapting to areas of New Mexico and the Midwest. Solid stands near the Devil's Tower close to Sundance, Wyoming have been controlled with perennial grasses such as Luna pubescent wheatgrass and Bozoisky Russian wildrye for 12 years without herbicides, only grass competition. Grasses establish best in firm fine seedbeds with seeding depths less than 1/4 inch.

Perennial weeds such as Canada thistle grow best on moist soils near waterways and drainages. Grasses such as Regar brome are much better adapted in these sites which have higher moisture. Perennial brome grasses are more effective competitors on highly productive sites. Dalmatian toadflax, a newcomer in the western U.S. is spreading rapidly on various disturbed sites. This species can be controlled following a killing frost with 1 quart of Tordon or 0.5 lbs active ingredient (a.i.) of picloram/acre. Grasses seeded in early spring before toadflax can reestablish itself have been very competitive for the past three years following establishment. With an integrated approach using insects for maintenance or retreating areas with a herbicide, grasses can be maintained for an indefinite period of time.

Russian knapweed is found on sites having shallow water tables such as river bottoms or irrigation canals. Control of this perennial weed species can be done following a killing frost in autumn using herbicides such as Tordon or picloram at rates of 1 pint to 1 quart or 0.25 to 0.5 lbs ai/acre, Transline at 14 fluid ounces/acre, or Curtail at 2 quarts/acre. These applications should be followed by reseeding grasses such as Bozoisky Russian wildrye or Luna pubescent wheatgrass in the spring.

Studies conducted on dry sites such as Riverside, Wyoming, receiving less than 10 inches of precipitation each year, show us that seeding Luna pubescent wheatgrass, hycrest crested wheatgrass and Sodar streambank wheatgrass will effectively control downy brome, an annual, as well as musk thistle (a biennial).

On weed competition studies conducted on public lands such as the Grand Teton National Park revegetation is limited to the use of only native perennial species. Research studies are beginning in parks and on public land with native grass species such as thick-spike wheatgrass, Idaho fescue, western wheatgrass, bluebunch wheatgrass, mountain brome, slender wheatgrass and big bluegrass.

In the future we need to continue using a systems approach for weed management including insects, along with herbicides and grass competition to limit the spread of weeds on public areas and rights-of-way. We all have a lot to learn but I feel very committed to using a systems approach rather than a single tool approach such as a herbicide to provide long-term weed management.

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Leafy spurge symposium business meeting minutes – 1997

The 1997 Leafy Spurge Symposium business meeting was called to order at approximately 4:30 p.m. by Mark Ferrell. The cause of the low attendance at the 1997 symposium was asked. Some felt low attendance was because of the meeting date being earlier than in the past. The USDA, ARS scientists that normally attend the Symposium were at the Superintendent's selection at Sidney, MT while many biocontrol researchers were in the field because of insect collections. It was suggested that future meetings be held at a later date - perhaps the third or fourth week of July. It also was suggested that holding the Symposium in conjunction with other meetings may improve attendance. Bob Masters suggested that the Leafy Spurge Symposium group team up with the "TEAM Leafy Spurge" that was formed last summer to create demonstration projects that show how leafy spurge can be managed through integrated methods. There was further discussion that perhaps the Symposium in 2000 could be held in Rapid City, SD. This city would be close to the TEAM Leafy Spurge demonstration projects which are to be operated along the Little Missouri River drainage and having the Symposium at this location would be a good opportunity for a field tour. It was suggested that the 1999 Symposium return to Bozeman, MT and be held in conjunction with the International Biocontrol Conference being held in Bozeman next summer. The 1998 Symposium will be held in Colorado. Rod Lym suggested that we meet the third or fourth week of July and in a location that is easy and inexpensive to get to. George Beck will organize the 1998 Symposium and is looking into sites at Colorado Springs and Estes Park. The business meeting adjourned at approximately 5:15 pm.

K. George Beck

President, GPAC Leafy Spurge Task Force, 1998