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Impediments to Controlling Leafy Spurge in the Northern Great Plains

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ABSTRACT

Leafy spurge is an invasive noxious weed, which by definition means it is inordinately difficult to control. The objective of this report is to present the results of focus group meetings and personal interviews with ranchers, local decision makers, and public land managers to discover strategies to improve leafy spurge management. Participants in the interviews and focus group meetings managed property in Fallon, Carter, and Wibaux Counties of Montana; Golden Valley, Bowman, Billings, and Slope Counties of North Dakota; Harding County of South Dakota; and Crook County of Wyoming.

Ranchers and local decision makers believe that leafy spurge control must become more proactive rather than reactive; current strategies are largely reactive. Interviews with ranchers and local decision makers revealed that a considerable gap in understanding how to control leafy spurge exists between researchers and those attempting to combat the weed. Interviewers often mentioned that they have been unable to eradicate leafy spurge, which indicates that the current mind set of ranchers and land managers needs to change to one focusing more on controlling and managing leafy spurge rather than eradication. Specific recommendations would include 1) reducing the current levels of herbicide application rates - which are often two to three times higher than rates recommended by weed scientists, 2) must appreciate that herbicides are but one tool in the battle against leafy spurge, 3) must understand that in many cases eradication of leafy spurge will not be possible - the goal should be trying to control it, and 4) rangeland rental rates need to reflect current levels of weed infestations. Records of weed infestations (e.g., acreage, location, rate of spread, attempts at control) on public lands are woefully inadequate. Cooperation between ranchers, county weed boards, and public land agencies could be improved to enhance the effectiveness of existing control programs. Weed control regardless of land ownership is important for ranchers, absentee landowners, and public agencies to effectively control leafy spurge. In general, ranchers and land managers need to generate a broader base of support for control of leafy spurge, since the weed attacks the entire ecosystem and is not just an agricultural problem.

Key Words: leafy spurge management, ranchers, county weed boards, public land managers, policy makers

HIGHLIGHTS

The TEAM Leafy Spurge research project was funded by the USDA and is focused in the four-state region of Montana, North Dakota, South Dakota, and Wyoming. The goal of this research is to ascertain potential managerial, institutional, and social impediments which may inhibit adoption of various leafy spurge control strategies, suggest possible strategies to enhance use, and reduce impediments to leafy spurge controls. Comments, ideas, and suggestions gathered in focus group meetings and interviews with local decision makers, public land managers, and ranchers are summarized below.

Ranchers:

★ Need economic incentives to control weeds on rented rangeland.
★ Are frustrated with neighbors not controlling weeds which pose a threat to their land.
★ In some cases, there is a lack of a "good faith" effort to attempt to control leafy spurge.
★ Herbicide application rates are often at double to triple the current recommendations from University weed management specialists.
★ Need more help in understanding and implementing alternative controls; often ranchers believe that 'herbicides' are their only control alternative.

Local Decision Makers:

★ County weed board members need to be proactive in campaigning for better control of leafy spurge.
★ More financial support at local, state, and Federal levels is necessary to support existing noxious weed programs for both private and public land managers.
★ County weed boards must attempt to enforce noxious weed laws regardless if the land owner is public or private.
★ Local decision makers must attempt to generate a broader base of support for control of leafy spurge specifically, and all invasive weeds in general. Invasive weeds attack the entire ecosystem which impacts many more people than just farmers and ranchers.

Public Land Managers:

★ Need for better documentation and monitoring of current infestations.
★ Need to work more closely with lessee toward improving timing and application of existing controls.
★ Need to be aware that changing policies can negatively impact long-term weed control efforts (especially those control programs developed by local weed boards).
★ Public land managers must also attempt to generate a broader base of support for control of invasive weeds. Sportsmen, recreational users, and naturalists must be educated into understanding that invasive weeds can impact the natural environment that they enjoy.

In general, there appears to be a lack of coordination between these groups. More teamwork in the approach to controlling leafy spurge would benefit all parties. Furthermore, herbicide application rates were often double and triple rates recommended by weed management

specialists. Finally, many individuals who have been struggling with attempts to eradicate leafy spurge are becoming disenchanted. Leafy spurge is now part of the ecosystem, and eradication may be an unattainable goal which leads to frustration. It may be more realistic to talk to producers about “managing” leafy spurge rather than “eradicating” it.

IMPEDIMENTS TO CONTROLLING LEAFY SPURGE IN THE NORTHERN GREAT PLAINS

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Introduction

Leafy spurge is an invasive noxious weed which has caused significant economic damage for both individuals and local economies in the upper Great Plains (Leitch et al. 1994). The problems caused by leafy spurge are well documented (Watson 1985; USDA 1995; Sell et al. 1998a; Sell et al. 1998b; Sell et al. 1999). This research was funded by the USDA and specifically resulted from the efforts of individuals associated with TEAM Leafy Spurge. The TEAM Leafy Spurge research project is focused predominantly in the four-state region of Montana, North Dakota, South Dakota, and Wyoming. The ultimate success of TEAM Leafy Spurge depends on the extent to which control strategies are adopted by private land owners and public land managers in the region. However, experience regarding acceptance of new controls has revealed that adoption rates can differ substantially based on a variety of factors.

The initial phase of this study involved conducting a survey of ranchers, local decision makers, and public land managers of grazing and non-grazing land located in, or property managed within Fallon, Carter, and Wibaux Counties of Montana; Golden Valley, Bowman, Billings, and Slope Counties of North Dakota; Harding County of South Dakota; and Crook County of Wyoming. The survey effort was complemented with personal interviews and focus group meetings with each of these groups. The thrust of the research presented here is to ascertain potential managerial, institutional, and social factors that may affect adoption of various leafy spurge control methods, suggest possible strategies to enhance use, and reduce impediments to leafy spurge controls. In this report, comments and ideas gathered in focus group meetings and interviews with local decision makers, public land managers, and ranchers have been consolidated. Pertinent information gathered from the survey is summarized to provide some background about each of the groups.

Approximately 47 percent of the 565 ranchers, local decision makers, and public land managers of grazing and non-grazing land who were surveyed returned completed questionnaires. In addition, separate focus group meetings were held with local decision makers and ranchers from the TEAM leafy spurge study area. Ranchers attending the focus group meetings typically resided within a one hour commute from the meeting place and had leafy spurge on property they managed. The local decision makers' focus groups were generally composed of county weed board members, local legislators, county commissioners, and persons in similar positions who lived within a reasonable commuting distance of the meeting place. Personal and telephone interviews were completed with several public land managers of grazing and non-grazing organizations. The purpose of the focus group meetings and personal interviews was to discuss issues which are not conveniently addressed in a mail questionnaire.

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Recognized Impediments to Leafy Spurge Control

Rancher Survey

Among a list of problems faced by ranchers, dealing with weeds ranked in the middle. Weeds in general were considered a greater problem for those ranchers who have leafy spurge. However, ranchers did not feel that weeds were the most important problem they faced, regardless of whether they had leafy spurge on their ranch.

Of the troublesome weeds that ranchers typically face, leafy spurge was clearly the most important and problematic. Impediments to using various controls were generally categorized as 1) environmental, 2) financial, and 3) educational. In most cases, little can be done to remove environmental constraints (especially those presented by topography, water, or trees). Financial constraints could be addressed through cost-share programs financed locally or through state or Federal agencies. Finally, available control methods often are not practiced (or not used in an efficient manner) because of a lack of knowledge. Ranchers may not have sufficient knowledge to use grazing or biological controls. These educational impediments could be addressed through workshops, demonstrations, and other educational opportunities provided by TEAM Leafy Spurge, universities, or government agencies.

Local Decision Makers' Survey

Leafy spurge was ranked as the most important problem weed encountered by local decision makers (Sell et al. 1998a). The majority of local decision makers used herbicides to control leafy spurge where possible; about two-thirds thought using herbicides was economical. The local decision makers understand that leafy spurge management is a long-term problem. The effectiveness and economics of herbicide and biological controls were the types of information most often requested. The local decision makers tended to rely most heavily on their county extension agents for information on weed control.

Public Land Managers' Survey (grazing and non-grazing property)

There are fundamental differences between managers of grazing and non-grazing property in their approach to weed management. Weed management for managers of grazing property is often a primary concern because of the negative impact weeds have on land productivity. Weed management for managers of non-grazing property is often done to comply with existing weed management laws or ascetics, rather than out of a concern for how weeds would affect rangeland productivity, as is generally the case for managers of grazing property. According to survey results, about 7 percent of public land managers' overall budgets are spent on weed management (Sell et al. 1998). A greater share of managers of grazing property expect their weed management budgets to decrease in the future than the managers of non-grazing property. Both types of public land managers are concerned about leafy spurge; however, it appears that public land managers of grazing property (i.e., the U. S. Forest Service and the Bureau of Land Management) expect to have less resources available in the future to combat further expansion of noxious weeds.

Rancher Focus Groups and Personal Interviews

Ranchers, as a group, perceive that they are losing the battle against leafy spurge. Many ranchers mentioned that they are unwilling to put more resources into herbicides and other

methods of control because the controls they have used in the past have not worked. There is the underlying feeling that ranchers thought, or were led to believe, that the use of herbicides or other control methods in the past would result in the eradication of leafy spurge. Since this has not happened, many ranchers have become discouraged and untrusting of new control methods or recommendations. Land owners frequently mentioned that they "could've paid for the land many times over" with all the money they have spent on leafy spurge control to date. More emphasis needs to be placed on managing rather than eradicating leafy spurge.

Absentee landowners are more of an issue in some areas than others. In Harding County, South Dakota, many respondents did not feel that absentee landowners were a problem because not much rangeland is rented. North Dakota and Montana respondents indicated that absentee landowners were a big problem because the absentee landowners are not aware or are indifferent to the weed problems existing on their land. Furthermore, there does not seem to be an economic incentive for landowners to control their weeds because, in many cases, land rents are not adjusted to reflect lower carrying capacity of the pasture. Most land is rented by the acre ("landowners got wise to that a while back") implying that stipulating the rental arrangement per acre would result in the greatest revenues for the landowner while simultaneously disconnecting market forces that would adjust revenues downward, based on reductions in carrying capacity caused by weeds. Having most rental arrangements in a given area based on a per-acre basis also favors landowners by allowing them to make a quick comparison of the cost or price of renting on one tract of land versus other tracts. Landowners can quickly determine the going rate ($/acre) regardless of the land's carrying capacity. Renters know what their total cost will be but are forced to figure out their cost per AUM based on how many animal units they can get out of a tract of land. There appears to be quite a bit of variance in the terms of contracts between ranchers and landowners renting/leasing rangeland.

Available labor can be a critical limitation to the effective control of leafy spurge. It is particularly a big factor for ranchers because they have limited time to scout rangeland and treat patches, especially during the time of year when it is most beneficial to treat. Elderly ranchers also may face physical limitations to scouting and treating leafy spurge. Many ranchers mentioned the loss of availability (labeling) of "Tordon Beads" as a hindrance to their battle against leafy spurge. They indicated it was more convenient to carry a small container of the beads with them as they attended to the cattle on rangeland and immediately treat new patches as they were discovered. However, many ranchers also suggested that the loss of "Tordon Beads" was tied to their misuse.

Overall, the item most often mentioned as a constraint to ranchers treating leafy spurge with herbicides revolves around cost. Either per-acre cost of chemical or total cost of treatment, due to large acreage, is considered excessive. On the other hand, the limits to using biological control most often revolve around knowledge. Probably the most important factors regarding the use of insects to control leafy spurge are 1) knowing where to obtain the insects and 2) knowing what location or micro-environment in which the insects should thrive (therefore resulting in the best opportunity for establishment), 3) when to collect and release, and 4) need to monitor release sites. Another problem faced by some ranchers is the cost inflicted by neighbors who do not practice sound weed control. Ranchers often mentioned situations where extra resources were

devoted to stopping weed infestations from advancing onto their land from adjoining land, primarily due to the lack of control on adjoining lands.

Use of sheep and/or goats for grazing of leafy spurge did generate enthusiasm, especially if there were some type of cost-share available on additional fencing or cooperation with state or Federal officials for predator control. Finally, there was concern by ranchers regarding the apparent differences in enforcement of noxious weed control laws across state boundaries and even across county boundaries. Ranchers indicated a lack of "good faith" effort on the part of some neighbors to control leafy spurge, whether those neighbors were public or private land managers.

Local Decision Maker Focus Groups and Personal Interviews

Many of the participants were involved with treating infestations, including county weed board members and weed inspectors. Some local weed board members commented that they knew who was likely to participate each year, so they concentrated on getting those who generally do not take advantage of weed control programs to sign up. Also, county weed boards often set up strategies to get individuals in "target areas" to control problem weeds. County weed boards are often involved in selecting sites for releasing/implementing biological controls on ranchers' property. County weed board members also offer advice on economics of herbicide treatment of leafy spurge infestations or on methods to enhance the effectiveness of herbicide treatments.

The impact of small ranchers (hobby farms) on weed control is varied. In some cases, the small ranch owners are not familiar with leafy spurge or the problems it causes, while in other cases, the small operators are quite knowledgeable about noxious weeds and will aggressively treat their infestations.

Wyoming has dedicated a significant amount of public resources during the past 10 years in an attempt to control leafy spurge. It is difficult to determine what the current level of leafy spurge infestation would be in Wyoming if the state had not devoted a high level of public resources to treat the weed. Currently, questions are being raised about whether they (the public) are getting an acceptable return on public investment in weed control (specifically leafy spurge). Consequently, as the state is faced with fiscal pressure, the share of resources dedicated towards weed control is facing more critical scrutiny.

Many local decision makers will talk with a rancher about their weeds. Most county weed board members prefer cooperation with ranchers rather than enforcing weed control laws. North Dakota weed control boards have the power to serve a "notice of control" on ranchers, pursuant to North Dakota noxious weed law. After posting a "notice of control," the owner can voluntarily treat the weeds, or be billed for treatment by the local weed board. Refusal to pay results in having the bill assessed to the individual's property taxes. (However, actual implementation of that portion of the law was unclear from the participants.) However, most boards are hesitant to apply "notice of control" because of future problems associated with trying to solicit cooperation from that individual. Many of the decisions regarding enforcing North Dakota's noxious weed law fall victim to local politics.

South Dakota, Montana, and Wyoming have noxious weed laws which are largely similar to North Dakota both in terms of compliance and penalties. Although some county weed board members mentioned differences in the states' noxious weed laws as difficulties in forcing control, it seems more likely that existing laws are not being effectively enforced rather than fundamental differences in their noxious weed laws.

Most weed boards are involved with some type of cost-share programs. The specifics of those programs vary by county and state, but usually result in a reduced cost of herbicide to the rancher, with the rancher responsible for application.

Controlling weeds by one agency or entity, regardless of land ownership was suggested by some members of weed control boards. The application of weed control across land ownership has some merit if those actions could be fairly implemented, adequate funding secured, and actions could be clearly defined and focused on noxious weeds. This approach to weed control could allow a more rapid response to move in and treat new noxious weed infestations, providing resources are available to treat infestations.

Herbicide application rates, in some cases, were much higher than are currently recommended by weed management specialists. The quantity of herbicides available to treat leafy spurge infestations on a cost-share basis is limited. If herbicides are being applied at two to three times more than recommended rates, the same quantity of herbicides available through cost-share programs could be used to provide an effective amount of control over a two to three times greater area. This potential increase in acreage treated, with no increase in overall herbicide cost, could substantially benefit leafy spurge treatment programs.

An obvious impediment to effective herbicide control is the terrain where leafy spurge infestations exist. Also, many local decision makers mentioned the need for a tool to effectively manage the spread of leafy spurge. Some local decision makers commented that ranchers are frustrated with the ongoing battle to control leafy spurge. Local decision makers indicated they felt ranchers in their areas were mislead into thinking that four or five applications of herbicide would eradicate the weed. Now that the weed still exists after multiple years of herbicide application, ranchers are frustrated, have lost hope, and more importantly, many ranchers are currently not attempting to stop the spread of existing infestations.

Financial constraints were very prevalent, both to purchase chemical and to find time (constraints on manpower during peak treatment periods) to treat all the areas infested with weeds. Some local decision makers were frustrated by the pressure to handle an increasing noxious weed problem with lower levels of state support.

Other impediments to control include a decrease in the number of certified commercial applicators. This problem is largely caused by the increased cost of the requirement for more liability insurance, which caused many commercial applicators to quit. Application of herbicides on Federal lands requires a certified commercial applicator licence. These restrictions force many ranchers to pay others for application when they used to apply their own chemicals. One possible solution may be to allow private lessees to obtain necessary training/certification which would allow them to apply herbicides on Federal lands that they lease. The benefit would be magnified

as more of the infestations would be treated when they are initially discovered by the ranchers. In some cases where Federal and state owned land is intermingled with privately owned land, the ranchers are saddled with the cost of treating weeds on public land in an attempt to prevent infestations on their land.

Public Land Manager Focus Groups and Personal Interviews

Rotating leadership or changing policies by those in charge of public lands was indicated as a major problem. Problems with public land managers changing their weed control focus (e.g., changing from a chemical approach to one focusing on bio control) and problems bringing new personnel up to speed on what the local weed boards are trying to accomplish were mentioned. Furthermore, it takes resources to re-educate public land managers on local strategies. Overall, public land managers lack the financial resources to effectively combat invasive weeds.

Opportunities for Improved Management

Weed and land use inventory systems at all levels of weed control management (ranchers, local weed boards, regional public land management offices) are woefully inadequate. Acreage estimates are sketchy at best. Location of weed infestations is non-specific. Acreage and location of infestations by land types (range, wildland, riparian, wooded, etc) are unknown. Rate of spread of current infestations is unquantified. Technology is currently being developed and tested (through the TEAM Leafy Spurge project) to better document infestation levels and rates of spread through the use of aerial photography and global positioning satellite technology.

For the most part, public land managers of grazing property (i.e., U. S. Forest Service and Bureau of Land Management) have severe financial limitations preventing them from adequately addressing their weed problems. Also, changing agenda's and priorities of different administrations are often detrimental to long-term weed control efforts, and public land management policies often change with personnel.

Financial and time constraints are real problems for both ranchers and local/county weed boards. Much of the financial problems can be attributed to poor agricultural economy, high cost of herbicide, high cost of application (especially with aerial applications or applications in rugged terrain), and time consuming nature of control, which is complicated by having a narrow window of opportunity to obtain optimal leafy spurge control (e.g., June and September). Other factors include high property tax burden on land in South Dakota. Reductions in mineral and natural resource revenues in Wyoming have curtailed or will curtail the amount of public resources devoted to weed control.

All of the states have noxious weed laws which include penalties for non-compliance. Enforcement of the noxious weed laws varies by county and state, and ultimately depends on the county weed board's strategy in pursuing non-compliant landowners. In many cases, the county weed board members are relatives/friends/neighbors with many or most of the land-owners within the county, and it is personally unsavory to the county weed board members to pursue penalties associated with non-compliance against their neighbors. A mechanism which would allow the county weed board members to enforce the noxious weed laws without seeming to take personal action against their neighbors may enhance enforcement.

The biggest problem with rented land appears to be that there is no economic mechanism (or less than effective) to adjust rent/lease rates for reduced carrying capacity due to weeds. No market mechanism exists to either entice the renter to treat weeds or force the landowner to do so. Rental rates usually remain constant regardless of the reduction in carrying capacity that results from weeds. As a result, other (uninfested) areas of the rented tract of rangeland then get over grazed as ranchers attempt to extract the grazing capacity paid for, but lost due to problem weeds in other parts of the rented land. This overgrazing has been cited by some individuals as another factor contributing to weed spread. Other ranchers do control weeds on rented property, but only when there is an economic benefit for them to do so.

Adoption of bio controls suffers from a lack of information on where, how, when, and what biological agents to release. Also, availability of biological agents was perceived as a major problem. Getting more ranchers using bio controls will require substantial efforts in education and assistance in collection of the biological agents. Also, many (most) ranchers are older (50+ years old), and the mind set of using only herbicides also needs to be addressed. Convincing them to reduce herbicide use (or use more selectively) while adopting biological agents and/or other methods will require diligence upon the part of weed control managers and policy makers. Older land managers may be slow to change ranching techniques or to adopt seemingly radical practices. Again, more needs to be done to educate ranchers on the benefits of integrated control.

The use of herbicides is expensive; chemical and application costs are high relative to land values. However, examples of applying Tordon® at double/triple the recommended rate are prevalent. Considering the financial constraints of most ranchers and local weed boards, there needs to be a changing of the mind set that more is better. Lower rates (than those indicated in our meetings) need to be adopted, which would allow more acres to be treated and lower the per acre cost of treatment, while simultaneously retaining the current level of control and reducing environmental risk.

Concerns that public land agencies' policies change with changes in personnel was voiced by participants from each state. These fundamental changes hamper local efforts to control weeds by shifting resources away from cooperation between public and private control efforts. Local weed control boards must expend resources to educate and inform new managers of their programs. Control that may have been achieved (or about to be reaped from years of effort) can be lost when an agency cancels (curtails) one type of control for another (e.g., stop spraying and rely or switch to bio controls).

Ranchers are becoming weary of treating leafy spurge. This issue was prevalent among ranchers in all four states. The problem is probably most widespread, based on discussions, with Wyoming and North Dakota ranchers (areas of TEAM Leafy Spurge that have the greatest concentration of leafy spurge). TEAM Leafy Spurge could help improve attitudes towards controlling/managing leafy spurge by getting the word out that "control" of leafy spurge is possible–this issue can be helped by getting ranchers to visit the demonstration sites, and when visitation by ranchers is not possible, provide video or other documentation of the results. Also, broad-based education of ranchers would help–move away from the idea of eradication to one of managing the weed.

Weed control should be viewed as an environmental problem, not just an agricultural issue. The need to develop a broader base of support for weed control is clear. Examples of target groups include sportsman groups (e.g., Rock Mountain Elk Foundation, Ducks Unlimited, Pheasants Forever), environmental groups (e.g., Audubon Society), farmer organizations (Farmers Union, Farm Bureau), and education of youth through various groups (4-H, FFA, County Fairs, introduction of weed control issues in public schools).

Weed control regardless of land ownership was an idea proposed that has some merit. Also, along this theme was the perceived need to allow weed managers to move quickly on weed control decisions. Too much delay (bureaucratic red tape) in making timely decisions is complicating control efforts, and hampering efforts to prevent the rapid spread of problem weeds. Perhaps a joint county/public land weed control board or designated weed control districts could be created/used to alleviate some of these problems.

Leafy spurge infestations are so widespread and such a problem that it is difficult to pinpoint an easy solution. However, the dynamic expansion of leafy spurge provides a perfect example of why new invasive species need to be aggressively fought before they become widespread.

REFERENCES

Leitch, Jay A., F. Larry Leistritz, and Dean A. Bangsund. 1994. Economic Effect of Leafy Spurge in the Upper Great Plains: Methods, Models, and Results. Agricultural Economics Report No. 316. Department of Agricultural Economics, North Dakota State University, Fargo.

Sell, Randall S., Dean A. Bangsund, and F. Larry Leistritz. 1999. Perceptions of Leafy Spurge by Ranch Operators and Local Decision Makers: An Update. Agricultural Economics Statistical Series Report No. 56. Department of Agricultural Economics, North Dakota State University, Fargo.

Sell, Randall S., Dean A. Bangsund, F. Larry Leistritz, and Dan Nudell. 1998a. Perceptions of Leafy Spurge by Public Land Managers, Local Decision Makers, and Ranch Operators. Agricultural Economics Report No. 406. Department of Agricultural Economics, North Dakota State University, Fargo.

Sell, Randall S., Dean A. Bangsund, F. Larry Leistritz, and Dan Nudell. 1998b. Ranch Operators' Perceptions of Leafy Spurge. Agricultural Economics Report No. 400. Department of Agricultural Economics, North Dakota State University, Fargo.

Watson, A.K. 1985. Integrated Management of Leafy Spurge. pp. 93-105 in Leafy Spurge, A.K. Watson, ed., Weed Science Society of American, Champaign, IL.

U.S.D.A. 1995. Purge Spurge: Leafy Spurge Database. CD-ROM Ver 3.0. U.S. Department of Agriculture, Agricultural Research Service, and Montana State University, Bozeman.