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Objectives of the leafy spurge symposium

PETER FAY

Montana State University

Welcome to Bozeman. You have come from 9 states and 2 provinces for this symposium at great expense. In order to make your participation worthwhile we are going to work tonight as well as tomorrow. We have scheduled several discussion sections in addition to the formal presentations in an attempt to integrate our efforts.

The major objective of this years' symposium is INTEGRATION. No one discipline (chemical or biological) can bring spurge under control. I hope we can initiate a meaningful dialogue between the biological control researchers and those testing chemicals.

Our spurge program profited greatly from our symposium last year in Fargo and I hope we can integrate your ideas into our forthcoming work. If there is anything any of us from M.S.U. can do to make your stay in Montana more enjoyable and constructive let me know.

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Informal group discussion topics and notes; Monday afternoon, June 21, 1982

1. "The use of growth regulators and herbicides for studies in the control of leafy spurge."

Mike Foley began the discussion with his ideas on an approach for studying leafy spurge root bud initiation. He feels that understanding the mechanisms controlling root bud dormancy as well as bud initiation are the primary factors involved with controlling leafy spurge.

Harold Alley asked if research done on Canada thistle could be applicable to leafy spurge. Mike thought probably not.

Mike then presented several questions to the group for discussion: Can growth regulators be used to stimulate leafy spurge growth? How much is known about the latex system? Is cell culture the best way to attack the problem?

Harold Alley mentioned that there are problems with growing leafy spurge in the greenhouse to assimilate field plants.

Dave Davis is presently working on cell culture techniques. He may have some results that are applicable.

Mike Foley talked about the idea of synergism, using 2,4-D at low rates as a plant growth stimulator in combination with herbicides at effective control rates.

2. "Potential strategies of the integrated management of leafy spurge."

Leafy spurge is an extremely variable plant, occurring in a wide range of habitats and often exhibiting different responses to chemical and other control methods. To explain this variability and allow for the comparison and extrapolation of control methods from one area to another, attention should first be directed to the proper physiological and morphological identification of leafy spurge throughout its range in North America. This should be done immediately. Spurge identification will influence all control strategies, namely the direction of the biological control studies, with both insects and plant pathogens, grazing management with sheep, and chemical and cultural controls research.

3. “Alternative herbicide programs for leafy spurge control.”

A discussion on alternative programs for leafy spurge control was directed by Chairman, Dr. Harold Alley, Professor of Weed Science at University of Wyoming, Laramie, Wyoming. Herbicides discussed and available for leafy spurge control are 2,4-D, glyphosate (Roundup), picloram (Tordon), dicamba (Banvel) and amino triazole.

The use of Phenoxy compounds to control leafy spurge has limited application because the translocation of the chemical into the root system is restricted. Low rates, one-half pound per acre, will prevent flowering and thus eliminate seed formation. Studies show that leafy spurge populations can be reduced to 90 to 95 percent in ten years if treated with 2,4-D twice a year at two pounds per acre. Populations are reduced 30 to 40 percent in three to five years. The use of fertilizers to improve plant activity and translocation of 2,4-D does improve results.

The application of SULV for the control of leafy spurge has no advantages over 2,4-D. One study with the application of SULV by airplane with no carrier responded better than 2,4-D applying the same rates. The study will be repeated to determine if application by air with undiluted spray has any advantages. The use of SULV over 2,4-D must show an increase of leafy spurge control because of the higher price per gallon.

Roundup has been used in some studies with limited success. The best time to apply Roundup for leafy spurge control appears to be in July. A rate of 3/4 pound per acre kills grass and eliminated competition to help control the spurge.

Leafy spurge infestations in shelter belts and tree nurseries have created concern in some areas. Dichlobenil (Casaron), ammonium sulfamate (Ammate) and atrazine have been used with limited results. Researchers have found that low rates show stimulation of vegetative buds. Rates applied will determine percent control and amount of residue in the soil.

It was suggested that sweet clover may be a good competitor for leafy spurge in specific sites. Observations made indicate that it may be more competitive than some grass species.

Amino triazole has been applied on leafy spurge infestations in non-crop areas. A rate of four to six pounds per acre showed control but had a great effect on the grass. Since it is registered for only non-crop areas it will have limited use.

Dicamba (Banvel) applied at six to eight pounds per acre received 75 to 90 percent control with some effect on grass populations. Rates of eight to 12 pounds per acre were evaluated at 90 percent control one year following treatment and 40 percent the second year. Two pounds per acre reduced spurge populations 40 to 60 percent the first year after treatment and a two pound retreatment increased control the second year after treatment.

Picloram (Tordon) has given the best control of leafy spurge but the high cost has encouraged the use of herbicide combinations. The combination of Tordon plus 2,4-D is used in many states. North Dakota studies show that rates of Tordon less than 1/2 pound per acre plus a maximum rate of one pound of 2,4-D per acre showed the best results. Tordon rates of 1/4 and 3/8 pound per acre with one pound of 2,4-D indicated better control of spurge than the 1/2 pound per acre of Tordon.

Wyoming studies on the control of leafy spurge have evaluated translocation of herbicides in the root system by excavation. The depth of root kill is important in determining success of herbicides used but it is a time consuming and expensive approach. Methods to determine depth of root kill should receive high priority in research studies made.

Research is being conducted to determine uses of leafy spurge. Hydrocarbon studies do not appear to be favorable. A number of landowners are using sheep to graze leafy spurge infestations. Observations made in some areas show no toxic effect on ewes or lambs and under proper management the sheep are preventing spurge from spreading without over grazing. Montana studies show that sheep will consume 40 to 50 percent leafy spurge for their daily forage intake.

4. "Compatibility of herbicides and biocontrol agents on leafy spurge."

Compatibility will not be a problem in most of Montana, since leafy spurge will not be sprayed due to economics. Information on compatibility is lacking. The first step to determine interactions would be to identify the plant characteristics and ecotype differences. Compatibility may vary from one ecotype to another.

When using insects as biocontrol agents, the insect's life cycle is important. Timing of application of the herbicide should not interrupt the insect's life cycle. Herbicide application may be made at different times throughout the growing season depending upon the specific herbicide. Time application at such stages when the insect is protected, i.e., when the *Oberae erythrocephala* (root boring beetle) larva are in the roots in the fall. Translocation of the herbicide should also be considered for stem and root boring insects.

To stop new infestations of leafy spurge use flower or seed feeders to decrease the amount of viable seed. A seed feeder would help in decreasing the dissemination of seed by birds.

Use mobile insects which would seek out new leafy spurge infestations. One insect that spreads quite far is the Spurge hawkmoth. Pheromones may be used to move the insects to new infestations. Not much information is available on insect migration in Europe but it could be studied. Mobility of insects vary. Flea beetles move quickly.

Pathogens may be used as biocontrol agents. Rusts are easily disseminated by wind and have a relatively narrow host range. Soil borne pathogens may be moved in water, by animals and machinery. Because of wide host ranges soil borne pathogens are usually not considered as good classical biocontrol agents. Herbicide timing would also be important when using plant pathogens. Plant growth regulators may enhance or hinder disease development. Generally, the more stress on the host, the more stress on an obligate pathogen, whereas damage from a facultative pathogen may be enhanced by stressing the host plant.

Maybe a herbicide could be used to weaken leafy spurge to assist insect or pathogen attack. The herbicide mode of action would be important to consider in this case.

There are 85 species of endemic grasshoppers. Maybe a chemical could be found to alter leafy spurge chemically to make it more palatable to grasshoppers.

5. “The usefulness of leafy spurge.”

Batson began the discussion by requesting information of the use of sheep to control spurge. This question set the tone of the discussion for the majority of the period. Havstad responded by outlining the previous and present research examining the interaction of sheep and spurge on rangelands. It was indicated that previous research quantified 40 to 50% of sheep diets containing spurge. These consumption levels occurred independent of level of spurge infestation and when other herbaceous forage was available to the grazing sheep. Current work is examining the nutritional value of spurge for both ewes and lambs. Havstad indicated that there are other species such as cheatgrass and greasewood classified as noxious plants on rangelands that can be utilized effectively as forages under certain management conditions.

Jackson mentioned the visual evidence in Montana of the impact of sheep grazing over long periods on spurge presence on ranges. He indicated that sheep impacts are very substantial. Fahlgren asked if further work at MSU would address the use of sheep as a control of leafy spurge. Havstad responded that enough evidence from various sources has accumulated to indicate that given the appropriate management circumstances, sheep could control this plant. However, it was felt that these management circumstances might be met in only 5% of the areas infested by leafy spurge.

McNeal inquired about the passage rates of both spurge seeds and plant material. He reported that on some BLM allotments in eastern Montana holding pasture could be utilized for sheep leaving spurge infested pastures. The holding areas would allow for passage of spurge material and a reduction in the possibility of infestation of new areas. Maxwell indicated that a graduate student in Plant and Soil Sciences at MSU is examining this and related questions and results should be available soon.

Other questions by both Blan and Davis regarding possible uses of spurge as a source of hydrocarbons or as natural insecticides remained unanswered. In a final comment, Bjugstad reported that a beekeeper in South Dakota attributed bee survival during early spring, prior to honey formation, to the presence of early forming flowers of leafy spurge.

6. “The year is 2020, leafy spurge is now a minor weed in the Great Plains, how did this come about?”

Peter Fay opened the discussion with this scenario: Leafy Spurge is a genetically diverse plant. As a consequence after several years all biological control activities have failed miserably. A new wonder chemical has been developed that has a unique dispersal mechanism, is safe and selective.

The scenario is unrealistic as pointed out by biological weed control specialists. An integrated approach will result in control by 2020.

Chemical companies lack economic incentives to develop a leafy spurge selective herbicide. IR-4 activities may provide help and cooperatives might also help resolve the problem. The economics of control has been used as an excuse for not controlling leafy spurge infestations. This may not be a valid excuse. Perhaps bankers could encourage their clients to control leafy spurge.

Natural plant products may afford a solution to leafy spurge control. Organic and natural product chemists should cooperate.

Leafy spurge has spread rapidly in the past several years. This has been attributed to the spread by birds and wildlife. Environmental conditions specifically, poor early cool season grass growth and sufficient rains in July and August has let small uncontrolled patches grow into large infestations. The question was raised, what will keep the plant from spreading to non infested states? Different land use, temperature, rainfall and wild-life may prevent a similar spread.

Planting of American leafy spurge ecotypes in Europe will help the biological control program. This would allow great exposure to potential pathogens. There should be adequate personnel in Europe to support such an effort.

From the discussion it is apparent we do not know the answer to what control strategy will reduce leafy spurge by the year 2020.

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Why I didn't get rid of leafy spurge in Montana in 1952

JIM KRALL

Montana Agricultural Experiment Station

There are several factors that are important when analyzing the history of the leafy spurge infestation in Montana.

In 1952 a bulletin was published by the Montana Agricultural Experiment Station on the Control of Leafy Spurge. It was the world's worst seller. There was very little interest by ranchers and farmers to control the weed. They did not know that it would become so widespread and felt that there would be a chemical to control it some time in the future.

Methods to control leafy spurge like frequent tillage, applications of 2,4-D (every 4 weeks), and sterilization of the ground were all effective but were rarely followed up with replanting of competitive species. Introduction of competitive species that could eventually replace leafy spurge was viewed as an important element for control. Experiments were conducted where winter wheat as a competitor was planted in late spring, then applications of different rates of 2,4-D surpressed the spurge.

The success of biocontrol depends on syncronizing the populations of both the pest and the biocontrol agent. Keeping the pest that controls weeds in place is a problem. Different genotypes may make the pest ineffective, i.e., late flowering musk thistle.

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Results of original and two repetitive herbicide treatments for leafy spurge shoot control and resulting forage production; and Effect of treatments and combinations on leafy spurge root control

DR. HAROLD P. ALLEY

University of Wyoming, Laramie

The original herbicide treatments were applied to a dense stand of leafy spurge on May 25, 1978. Retreatments were applied in 1979 and 1980. Shoot and root counts have been recorded each year since the original treatments.

Data on leafy spurge shoot control obtained in 1981 show 100% control on all original treated plots, irregardless of the original herbicide, when retreated with 1.0 lb ai/A of Tordon 22K in 1979 and 1980. Possibly the most economical treatment would be the 0.5 lb ai/A of Tordon 22K as an original treatment and retreated in 1979 and 1980 with 0.5 lb ai/A of Tordon 22K.

Although 100% shoot control has been recorded on several plots the maximum reduction in root biomass is only 60% as determined by soil probes at 0 to 8, 8 to 16 and 16 to 24 inches.

Air-dry forage production, as determined in 1981, 3 years following the original treatment, has increased from 451 lb/A on the untreated sites to a high of 1,313 lb/A on the plots treated with Tordon 22K at 2 lb/A.

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Screening exotic pathogens of leafy spurge

SHERRY TURNER

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The Plant Disease Research Laboratory (PDRL) is a component of the Agricultural Research Service, USDA, and is located in Frederick, Maryland. PDRL serves as the primary U.S. quarantine facility for receiving and handling foreign plant pathogens. Research is conducted to investigate the potential biological control of weeds using exotic plant pathogens. Pathogens were collected from *Euphorbia* sp. in eight European countries from 1978 to 1982. Liquid nitrogen refrigerators were used for storing the pathogens. Screening the collection for high potential biocontrol agents began in January, 1982. Each isolate must be tested for pathogen virulence, host range and environmental factors important in disease development. Because of the genetic diversity of leafy spurge, many spurge ecotypes were inoculated with each pathogen isolate. Seedlings and mature plants were also inoculated to determine if mature resistance occurs. Low germinability of stored spores resulted and may be contributed to storage and handling methods or spore dormancy. Lack of information about weed diseases has been an obstacle in this research. Freshly collected diseases are being received from contacts in Europe throughout the growing season. Both generically and species specific organisms will be tested. More information about the pathogens and the screening of many isolates will be needed in the future.

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Leafy spurge control with herbicide, growth regulator combinations; The pipe-wick applicator for leafy spurge control; A nursery study of leafy spurge plants from North America

DR. ALEX MARTIN

University of Nebraska, Lincoln

Herbicides evaluated for leafy spurge control include fosamine, dicamba, picloram and 2,4-D. Spring applications were generally more effective than fall. Leafy spurge control was greater on sandy soils than fine textured soils with picloram. Picloram at 1 lb/A provided 70-80% control 1 year after treatment on a sandy soil and 20-50% control on a silt loam soil. Dicamba, 2,4-D and combinations of 2,4-D + dicamba provided 20-40% control 1 year after treatment. Fosamine applied in the fall caused significant grass injury and provided fair leafy spurge control.

Chlorflurenol improved leafy spurge control with picloram applied in the spring but not the fall. Nitrogen applications, the fall preceding a spring herbicide application, were inconsistent in improving leafy spurge control.

Ropewick applicators were compared with a field sprayer as a method of applying picloram for leafy spurge control. The ropewick applicators provided leafy spurge control that was approximately proportional to the amount of picloram applied.

Research on leafy spurge biology and taxonomy is being conducted in a large field nursery at Lincoln, Nebraska by Dr. M. K. McCarty, USDA, SEA. This nursery contains 38 leafy spurge selections from across North America and Europe. According to Dr. McCarty the majority of the plants in North America are *Euphorbia pseudovirgata* rather than *Euphorbia esula*.

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Utilization of leafy spurge as a source of hydrocarbons

DR. STAN WIATR

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Chemical composition and energy content have been determined for leaves of leafy spurge (*Euphorbia esula*). The extraction method of Buchanan *et al* (1978: J. Am. Oil Chem 55:657) was employed to partition whole leaf tissue into four fractions: polyphenols, oils, hydrocarbons and residual biomass. Air-dried or lyophilized leaf tissue yielded 7-8% polyphenols, 11-12% oils, 0.2% hydrocarbons and 82% residual biomass. Drying fresh leaf tissue at 105° C prior to extraction reduced the polyphenol and oil yields to 3% and 7%, respectively. Extraction of fresh tissue gave a much higher yield of polyphenols (25%) with no appreciable difference in oils.

Based on calorimetric analyses, energy content of air-dried whole leaf tissue was 4873 cal/gm, polyphenols – 5070 cal/gm, oils – 9504 cal/gm and residual biomass – 4303 cal/gm. The apportionment of energy in air-dried leaf tissue was as follows: 5% polyphenals, 20% oil, 75% residual biomass. Hydrocarbons comprised less than 1% of the chemical bond energy associated with leaf tissue and therefore did not represent a significant energy resource associated with whole leaf biomass.

Based on a standing crop estimate of 5 tons/acre (shoot dry weight), production of extractives and residual biomass from leafy spurge would be on the order of 645 lb. polyphenols, 440 lb. oils, 45 lb. hydrocarbons and 8490 lb. residual biomass. It is noteworthy that these estimates do not take into consideration seasonal fluctuations in chemical composition and biomass apportionment throughout the plant.

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Update on leafy spurge control in North Dakota

DR. ROD LYM

North Dakota State University, Fargo, N.D.

Experiments were conducted to evaluate various designs of wick applicators for leafy spurge control. All wicks consisted of 3/4 in. PVC pipe with 1/8 in. holes drilled every two inches which were covered by polyfoam and canvas. Two wicks were rectangular with two or three horizontal bars 1 foot apart and a third had diagonal bars between the two horizontal bars. Two passes with the diagonal wick gave 100% leafy spurge control. Control ranged from 80 to 90% regardless if two or three bars were used or one or two passes made.

Picloram, applied with a wick or roller applicator required 50 to 70% less herbicide but gave similar soil residues compared to broadcast applied at 2 lb/A. Research with ^{14}C-picloram has shown a two-fold increase in translocation to the roots when picloram was applied to the bottom of a leafy spurge leaf, rather than the top or stem. Also, of the ^{14}C-picloram entering leafy spurge over half was exuded by the roots and only 2 to 15% translocated from parent to daughter plants connected by a 10 to 15 cm root. The wick and roller apply most of the picloram to the bottom of the leafy spurge leaves which probably accounts for the similar soil residues with broadcast or wick application.

An experiment to evaluate synergism with 2,4-D and picloram on leafy spurge was begun at two sites in August 1981. Spring evaluations indicated a 20 to 30% increase in leafy spurge control when 2,4-D at 1.0 lb/A was tank mixed with picloram at 0.25 or 0.375 lb/A compared to picloram applied alone. Previous research has indicated that annual treatment of low rates of picloram or picloram plus 2,4-D give 80 to 90% leafy spurge control after 3 to 5 years.

Three field days were held around North Dakota in June 1982 with attendance ranging from 85 to 150 people. There has been extensive press coverage of the importance of leafy spurge control in 1982 and the public appears to have become more aware of the leafy spurge problem.

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Discussion section topics, notes, and attendants from Tuesday morning breakfast, June 22, 1982

"Will the recent publicity concerning Tordon affect present labeling for leafy spurge?"

Harold Alley – Leader, Gene Arnold, Jack Evans, Alex Martin – Secretary, and Cal Messersmith.

During our breakfast discussion I was the secretary for the group discussing "Publicity concerning Tordon and its effect on present labeling." Our group arrived at two main points in this discussion:

1. Adverse publicity will have a negative effect on future Tordon registrations. Damage has already been done by adverse publicity even if the allegations later turn out to be unfounded.
2. Adverse publicity is likely to influence policy on Tordon used by public agencies. Public opinion and political pressure readily influence public agency policies. Adverse publicity may result in curtailed use of Tordon by public agencies.

"How can we study the control mechanisms of leafy spurge root bud induction?"

Mike Chessen – Secretary, David Davis, Mike Foley – Leader, Ed Schweitzer, and Tom Whitson.

A major topic of discussion was the use of cell culture techniques in leafy spurge research. Methods currently being used and developed at the Radiation and Metabolism Lab at Fargo, ND were discussed. Biotype identification and selection must be considered in cell culture work as well as in experiments carried out in the greenhouse and growth chambers. Methods of culturing whole plant material under controlled conditions was discussed.

The use of herbicides to reduce lipid or wax production, reduced winterhardiness and released buds prior to unfavorable conditions such as winter was explored. Some work in these areas is currently being done.

Physiologists were interested in determining if environmental, physical, or other factors cause the patchy pattern of leafy spurge distribution. Is allelopathy, soil miroflora, or microenvironment important in leafy spurge distribution? It was resolved that there is much work to be done.

“Is leafy spurge a good candidate for biological control?”

Lloyd Andres, Bob Carlson, Joseph Julian, Bob Nowierski – Leader, Robert Pemberton, Norman Rees, Jim Story, Sherry Turner – Secretary.

Will genetic diversity and the tendency to hybridize predispose leafy spurge to biological control failure? It would depend on the biocontrol organism's specifity. Use of a generically specific organism may attack a wide range of spurge ecotypes. Strains of rusts may produce differences in virulence on various host ecotypes which may result in control of one ecotype and not another. A potential pathogen for biological control would have to be aggressive on many ecotypes or several strains could be used to attack different ecotypes.

More knowledge of the genetics of leafy spurge is needed. Insects or pathogens could be used to classify ecotypes. This may be more accurate than using morphologic characteristics. To do this all experimental procedures would have to be standardized. Observation of spurge fauna may also indicate ecotype differences and be of taxonomic importance.

Maps of ecotype distributions would be helpful. This would indicate where the diploid and tetraploid populations occur. When more knowledge about ecotypes is known distribution maps may be able to indicate where certain biological control agents would be most beneficial. An example would be if a seed feeding insect was ready for release, the map may be able to tell you where the ecotypes producing the greatest number of seeds occurred. In this case releasing a seed feeder on a low-seed producing ecotype would be avoided.

Information is lacking about the susceptibility of released biological control insects to predators or parasites. These interactions occur in Europe and could be used as an example.

A conflict of interest may occur. Are the economic values of oils, waxes and hydrocarbons from leafy spurge high enough to forego biological control? Yellowstar thistle in California was used for honey production but was also a weed. The detrimental effects were more economically damaging than the beneficial aspects, therefore, biological control was implemented. A conflict of interest is hard to deal with until economic damage can be more accurately measured. Aesthetic values are important. Aesthetics may change from one generation to the next since aesthetics are learned. Substitution of another plant for the weed may be an answer. Damage to native plants should be avoided when using biological control.

The need for more input on what tests should be conducted when screening for biocontrol agents was mentioned. Do laboratory tests really indicate what will happen in the field. Insect starvation tests indicate results may vary between the field and the lab tests.

Can collecting, rearing and redistributing methods be improved? A workshop may be helpful for people involved in biocontrol research. A protocol for enhancing establishment should be written. Because of a lack of information, small releases should be made and observed closely. One way to obtain more information would be to work with the organism in Europe.

“Could leafy spurge ever be classified as a beneficial plant?”

E. H. Cronin, Kris Havstad – Leader, Bruce Maxwell – Secretary, and Stan Wiatr.

The discussion began on the use of leafy spurge as a source of oils and possibly hydrocarbons that would serve as a substitute for petroleum products. This brought up the subject of producing leafy spurge as a crop, which included the agronomic aspects of suitable growing sites, methods and timing of harvest, and control of weeds. A suggestion was made to try seeding spurge and managing it as an annual.

Kris Havstad talked about his project of using sheep to control leafy spurge by summer grazing. Leafy spurge is a moderate value forage plant for sheep. The question of why leafy spurge is intolerable to cattle was presented. Kris discussed several reasons. There are chemicals in leafy spurge that act as an irritant to cattle and not sheep. The microflora populations in the stomach of sheep have the ability to adjust and are capable of fluctuations where other ruminants are not as adaptable.

“What is the role of the chemical industry in the leafy spurge problem?”

Ken McMartin, D. England, Keith Price, Galen Schroeder, and Jeff Tichota.

Our group agreed that to maximize herbicide effectiveness, those treating leafy spurge should use a program with proven results. An effective program would include using recommended rates and retreatment to control seedlings and ascapes.

New herbicides would probably not be developed specifically for leafy spurge due to limited acreage and cost. If new chemicals are developed, they will probably be as costly as current compounds.

Keith Price commented that spurge control in Canada is not a priority in many areas due to limited infestations and grower concern. He speculated that it would be much better to combat the weed now before it becomes more widely established.

We agreed that cost to control leafy spurge is prohibitive to some ranchers, yet the weed must be controlled before it spreads even farther. Often growers will put off application because they are waiting for a “magic bullet” either chemical or biological that will be low cost and effective. Press releases often extoll the virtue of a promising new tool but often fail to inform the rancher that the research is preliminary and probably years from commercial application.

Government assistance may be necessary to help share costs so that more acres can be treated. Our group felt that many landowners with leafy spurge recognize the problem but many are reluctant to commit to a control program.

We concluded our greatest contribution may be in educating those landowners with leafy spurge, that it is in their best interest to control this pest.

“What should the Extension Service be doing to create awareness of leafy spurge among producers?”

Don Anderson, Mike Jackson – Secretary, and Oliver Russ.

A discussion on how the Extension Service can assist in making producers aware of the leafy spurge problem was held after breakfast, the second day of the symposium. It was suggested that the news media should be informed of all activities regarding leafy spurge control. Radio broadcasts and TV programs can help keep the public aware of the serious problem. More TV stations are getting interested in filming activities during field days and scheduled tours. The important thing is to keep the news media informed of all meetings, tours, field days and research studies being held to give them an opportunity to participate.

Chemical distributors throughout the Northern Region are supporting leafy spurge control activities and are encouraging their dealers to also participate. A lunch or dinner sponsored by them has certainly helped to get landowners to attend educational programs conducted on leafy spurge.

The problem many states are having is to get producers to educational programs that need the information to apply better management practices for better leafy spurge control. Some landowners do not seem to be concerned about the leafy spurge infestation on their ranch or farm. It was suggested that maybe signs should be placed on lands infested with leafy spurge. This would possibly encourage the landowner to do a better job of keeping the infestation under control.

A cost share program is being conducted by some counties having leafy spurge problems. They are offering recommended herbicides to producers at a reduced cost or are making payments to producers cooperating in a control program. Others are offering the herbicide to producers at no cost if they apply it to road right-of-way infestations, adjacent to their land.

A program to inform the landowner of when to treat leafy spurge, indicating stage of growth for maximum control may also help. A reminder as to when leafy spurge should be treated, and what herbicides are available to the producer, could encourage more cooperators.

Incentive programs are also needed to encourage more producers to participate in a control program. Awards and recognition programs are always helpful. Emphasis could be placed on a different weed species each year. It was felt that if emphasis is placed on one weed too long, producers would lose interest. It was suggested that recognition be given to individuals doing a good job in controlling weed infestations. A program naming a weed fighter of the year would give recognition to a landowner making every effort to keep this weed problems under control. Such a program is being considered in Montana. A county weed fighter of the year will be considered for area recognition and thus be eligible for state competition. A state weed fighter of the year would make landowners with serious weed problems aware that a weed management program can be accomplished and is beneficial to the producer.

“What should the State and Federal government agencies be doing about the spurge problem?”

Ardell Bjugstad, Ken Blan, George Hittle – Leader, O. Wendell Holmes – Secretary, Larry Holzworth, Russ Lorenz, John Fahlgren, Fred Batson, and Barbra Mullen.

1. Funds:

   Private organizations spraying spurge through mill levys but Federal and State lands not treated due to lack of funds or environmental regulations (no spraying in areas described as riparian or riparian zones – woody draws).

   Hittle briefly described Wyoming's program on leafy spurge management where state and federal lands are treated, however, they are looking at a 20% reduction. They are looking for other avenues of funding with weed control getting priority through alternative funding – permit fees, mineral to provide maintenance money, additional dollar tacked on to hunting license.

2. Carlson-Foly Act:

   Never been funded, monies come through range improvement funds, etc.

   Gives state authority to work with Federal agencies to secure funds as through add-ons to license (user fees).

3. Enforcement of State laws reduced due to economic limitations of land managers.

4. Environmental regulations are demanding but can be worked around, such as riparian zones can and must be treated but done so with special techniques.

5. State-Federal regulations – These whether state or federal must be recognized by other party to reduce repeated conflicts. North Dakota has unique problem with wetlands program which prohibits chemical control – this is not State law but a management policy.

   > Most of this is emotional issue and not based on fact. Need to describe and discuss tolerance limits of fish, etc., to certain chemicals.
   >
   > Need to continue to hold meetings at negotiate management policies to promote understanding between groups, i.e., weed control committees and wildlife groups.
   >
   > State need weed coordinators such as Wyoming, seems other states just can't get this through their legislators, this would also promote understanding between groups.

   People unclear as to avenues of transferring ideas and concerns. Where does GPC-14 fit in as to the promise of such avenues.

   Lorenz described leafy spurge task groups, etc., for the development of leafy spurge program. Much effort came through state weed coordinator or similar thereof. Lawsuit (individual) considerable concern with various county weed committee which encourages low key efforts and help your friends system.

6. GPC-14 Committee could be a contact for concerned individuals but not sure who's on the committee. People attend due to interest, concern and knowledge that public relations needed.

   Best idea was Kelly Miller's efforts where grass-roots people went to the source of the problem – Eurasia – where plant is not a serious problem due to natural controls.

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Characterization of soil nutrients from leafy spurge patches

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Soil samples were taken from 10 sites in Marshall and Roberts counties, South Dakota which were infested with leafy spurge. Analysis of these samples indicated differences in nutrient levels between soils inside and outside of the infestation. However, little consistency was found among the sites as to the nutrients which varied or the depth at which differences occurred.

Nitrate levels were higher inside the leafy spurge infestation than outside in the upper 30 cm of soil at one site and at the 30 to 45 cm depth at another site. In contrast, at two other sites nitrate levels at the 30 to 45 cm depth were lower in infested areas than uninfested areas. Phosphorus and potassium levels were high inside infested areas than outside on two and three sites respectively. No differences were found in calcium levels at any of the sites. Magnesium levels were higher inside infested areas than outside on two sites and lower inside than outside on one site.

High pH inside a leafy spurge infested area may have affected micronutrient availability at one site. Differences in magnesium and iron levels observed at three other sites appeared to be unrelated to pH. Zinc levels were higher inside of infested areas than outside at one site. No differences in copper levels were noted.

Statements that leafy spurge becomes established because of nutrient imbalances are not supported by these results. Research to determine the effect of fertilizing on control of leafy spurge is continuing.

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Morphology and anatomy of leafy spurge plants and tissue cultures: Interactions with herbicides

DR. DAVID G. DAVIS

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Leafy spurge, *Euphorbia esula* or *E. podperae*, depending on the preference of names (1), is a perennial weed in pastures and other non-cultivated areas. Its control is a serious problem because it is spreading extensively and the cost of control is expensive partly due to the high cost of the chemicals used, and partly because those same chemicals are not translocated to the subterranean buds that are a major source of new plants. Morphological and anatomical studies of leafy spurge now in progress will serve as a basis for physiological studies aimed at chemical and biological control. This report is a preliminary survey of morphological features of seeds, leaves, and other structures of leafy spurge plants at various stages of growth. A scanning electron microscope (SEM) was used for detailed morphological observations. Freshly harvested leaves were coated with gold and palladium and examined directly without further processing. The leaves became dehydrated and distorted somewhat, but the wax structures and many stomata remained in good condition. Wax platelets on leaves and stems of greenhouse grown plants are about 0.5 to 1 µm (young leaves) and 1 to 3 µm (mature leaves) and appear to be similar on adaxial (upper) of abaxial (lower) leaf surfaces or on stems. The structures are also very similar between several biotypes grown in various parts of the United States and one from Austria. Wax structure on a field grown plant is similar to that on the same biotype grown in a greenhouse. One biotype (selected for physiolgical studies) was examined in greater detail than the others.

Seeds were also observed with a SEM. The raphe is a prominant feature that resembles a heavy log chain. Prominent pores occur near the raphe. The pores are roughly 15-20 µm in diameter and penetrate the seed surface about the same distance. Their function is unknown, but they trap fungal spores, and presumably bacteria. The hilum also is a structure that retains fungal spores.

Leaf replicas were made using red finger nail polish:acetone (1:1). The replicas were observed under a light microscope for stomatal patterns and to determine the numbers of stomata per unit area. The stomatal pattern of leaves from greenhouse-grown plants of this biotype varies according to the position of the leaf on the plant. Upper surfaces have stomata over the entire surface, but the numbers vary from about ten per mm^2 on the lower leaves to about 200 per mm^2 on the youngest leaves. The lower surfaces are more uniform than the upper surfaces, with about 150 to 200 stomata per mm^2 for all leaves.

However, the stomata are found only over the laminae on the lower surfaces and not over the midribs as on the upper surfaces. In general, the stomata appear to follow the pattern of the minor veins, being positioned directly over the veins. Stomata also occur on stems, but no detailed study of these structures was made.

Anatomical studies have been limited, but several prominent features were observed by means of light and transmission electron microscopy. Developing buds were fixed with buffered 2% glutaraldehyde followed by 1% osmium tetroxide, dehydrated and embedded in Spurr resin. Thick sections were stained with methylene blue-azure II for light microscopy. Thin sections were stained with lead and uranium and then were observed with a transmission electron microscope. Some light microscopy was done at low magnifications using hand sections of mature organs stained with coomassie brillian blue, safranin, and several other stains. Laticifers were observed within the phloem tissues of developing buds and mature stems. Anatomical features in general appear to be those described by Myers *et al.* (2) except that the underground horizontal structures that contain the numerous buds do not appear to have a typical root anatomy (as claimed by Myers *et al.*) nor a typical stem anatomy. Other preliminary light microscopic studies have been done on the basic anatomy of leaves and developing root buds, using wax embedding techniques to obtain serial sectioned material of large structures.

Cell suspension cultures of eight leafy spurge biotypes are being maintained in our laboratory. The cultures grow well on at least two media that are used frequently for cell suspensions. One medium uses salts of Murashige and Skoog (3) and the growth regulators 2,4-dichlorophenoxyacetic acid (2,4-D) (0.4 mg/L), naphthaline acetic acid (0.4 mg/L, and kinetin (0.2 mg/L). Another medium designated as B5 (4) containing 0.1 to 1 µg/L 2,4-D, also works well and is used in most of our studies. These cultures are being used to determine the potential of several compounds derived from natural products and/or chemical synthesis as possible herbicides for leafy spurge control. The cultures are also being used to study basic physiology of organogenesis and plant growth regulation. Secondary cell wall formations have been observed in cells from cultures of all eight biotypes, and organogenesis has been observed in one biotype.

Acknowledgements

The help and ideas of Norm Olson and Drs. D. S. Galitz and T. Freeman, Botany Department, N.D. State Univ. and of Rosa Stolzenberg and K. Dusbabek, USDA Metabolism and Radiation Research Laboratory, are gratefully acknowledged.

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Histology of picloram and dicamba-treated leafy spurge

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Leafy spurge plants grown in a growth chamber at 80º F were treated with picloram and dicamba herbicides at 2.0 and 8.0 lb ai/A, respectively. Root, shoot and leaf sections were taken at 2, 4, 6 and 8 weeks after application of herbicides. Root sections were made at points 1, 5, 10 and 20 cm below the soil surface, stem sections were made at 1 and 5 cm above the soil surface, and a single leaf section was taken 2 cm from the main stem.

Two and four weeks after plants received picloram there was moderate deterioration of xylem and phloem in the stem at 1 and 5 cm as well as in the root at 1 cm. Leaf tissue was shown to be deteriorated after 4 weeks. Sections made 6 and 8 weeks after picloram treatment exhibited approximate equivalent deterioration at the 1, 5, 10 and 20 cm points, whereas stem deterioration was greatest at the 5 cm point. Leaf cells were distorted in the 6 and 8 week samples.

Plants receiving dicamba had moderate disruption of xylem, phloem, cambium and cortex tissues at all stem and root points for all sampling times. Leaf sections taken at 4, 6 and 8 weeks showed cell distortion.

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Field trip manual – Leafy spurge symposium Ray Gillespie Ranch, Whitehall Montana

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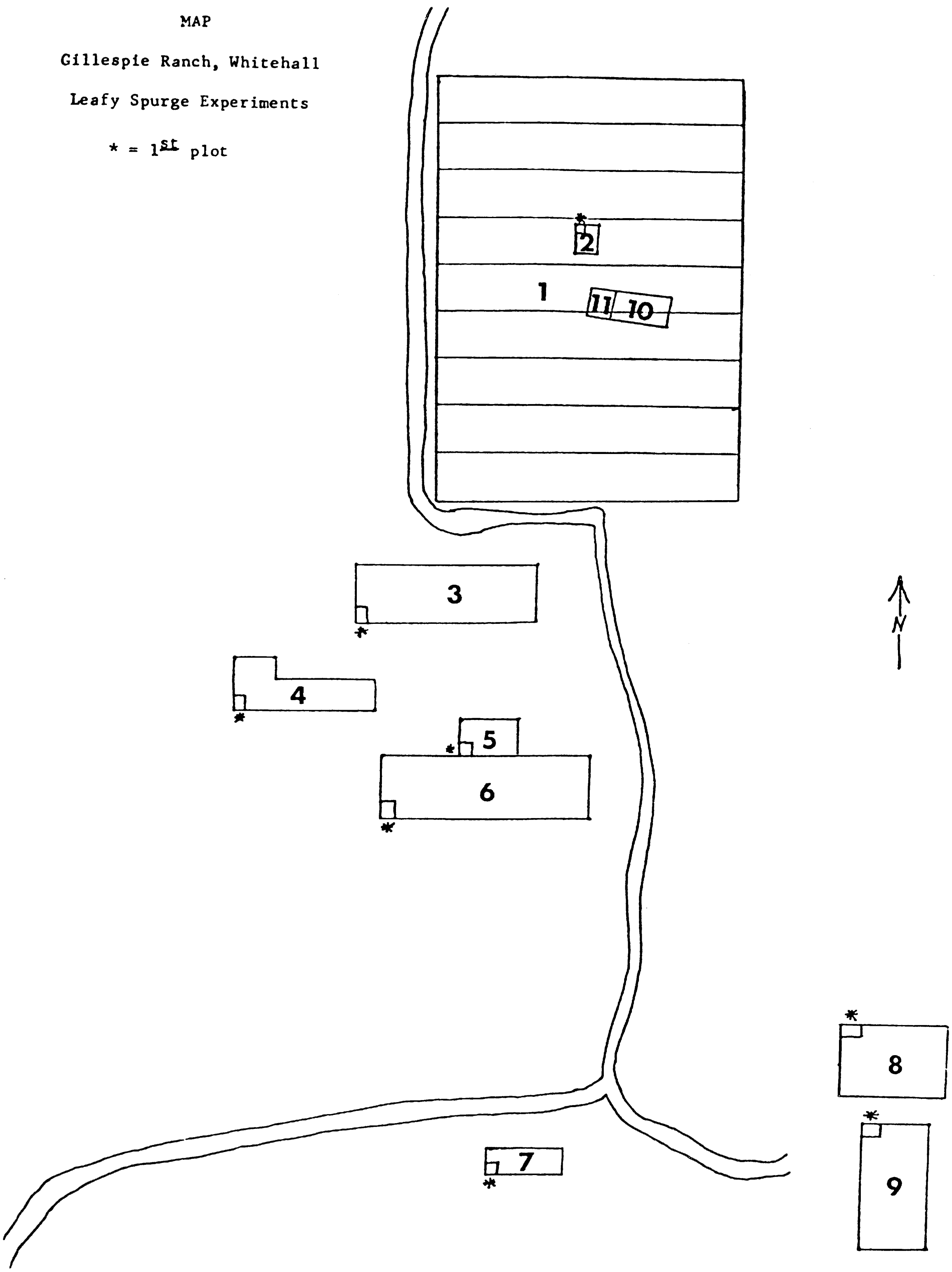
* = 1st plot



The Forage Value of Leafy Spurge for Ewes and Lambs

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K. M. Havstad, Assistant Professor

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Montana State University

A recently completed study (a cooperative effort between MSU's Plant & Soil Science and Animal & Range Sciences Departments) quantified the consumption of leafy spurge by ewes grazing summer rangeland in central Montana. In general, this previous study indicated that ewes, following a period of adjustment, would consume 40 to 50% of their diets as leafy spurge. These consumption levels were irrespective of the degree to which leafy spurge had infested these summer grazed rangelands.

Following this data analysis, an additional study was designed to further examine the nutritional value of this noxious species as a forage for both ewes and lambs. On a cooperative basis with the Montana Agricultural Experiment Station and Ray Gillespie, Whitehall, MT, 45 ewe/lamb pairs have been placed on summer rangeland infested with leafy spurge. Nine 4½ acre pastures have been divided into three treatments. These treatments are: 1) leafy spurge controlled with chemicals, 2) light levels of leafy spurge infestations (about 10% of the plant composition), and 3) heavy levels of leafy spurge infestations (about 20% or more of the plant composition).

Lamb weight gains will be monitored throughout the summer grazing season. Additionally, the ewes will be used to collect data on quantity of forage intake and quality of the diet selected by these animals on the three treatments. From this information, an analysis will be presented on the value of this range plant for the grazing sheep. This study will be continued through 1983.

EXPERIMENT NO.: 82101001

TITLE: Effect of pulling on leafy spurge regrowth. Gillespie Ranch, Whitehall.

Crop Information

Crop	pasture	Seeding depth	
Planted		Row width	
Experimental design	RCB	Seeding rate	
Replications	3	Plot size	7 x 15'

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	2-6" pre bud	1-9 plts/ft^2

PURPOSE: Very little force is needed to pull leafy spurge plants from soil. Approximately 1 to 5 inches of root system are removed with pulling which produces a great deal of root damage.

We are constructing a machine to pull leafy spurge. This experiment is designed to measure the regrowth potential of spurge which will be hand-pulled at several dates during the season.

Experiment No.: 82101001

Map No.: 4

Title: Effect of Pulling on Leafy Spurge Regrowth

Notes: Plot Size = 7 ft. x 15 ft.

Treatment No.	Date of Pulling	Plot Number		
		Rep I	Rep II	Rep III
1	5/11/82	101	204	308
2	6/1/82	102	205	303
3	6/17/82	103	206	301
4		108	207	306
5		105	203	302
6	Check	106	201	305
7		107	208	304
8		104	202	307

EXPERIMENT NO.: 82101003

TITLE: Effect of rate of application of Glyphosate for Leafy Spurge control, Gillespie Ranch, Whitehall.

Crop Information

Crop pasture	Seeding depth
Planted	Row width
Experimental design RCB	Seeding rate
Replications 3	Plot size 7 x 20'

Herbicide Application

Sprayer Backpack Date 5/11/82	Pressure 30 Volume 13 gpa
Propellent CO_2	Nozzles 8002
Time 2:00 p.m.	Rel. humidity 47%
Wind: 0-2 mph	Air temperature 52°F
NE direction	Soil temp.: 2" 50°F 4" 44°F

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	2-7" pre bud	1-7 plts/ft^2

PURPOSE: It has been reported that low rates of glyphosate stimulated uncontrolled root bud initiation in spurge. We will measure regrowth by counting stems per square meter after application of glyphosate.

Experiment No.: 82101003 Map No.: 5

Title: Effect of Rate of Glyphosate Application for Leafy Spurge Control.

Notes: Plots = 7ft. x 20 ft.

Treatment No.	Rate lb/A	Plot Number		
		Rep I	Rep II	Rep III
1	1/8	101	207	302
2	1/4	102	206	304
3	1/2	103	204	307
4	1	107	201	306
5	2	105	203	305
6	4	106	205	301
7	check	104	202	303

EXPERIMENT NO.: 82101004

TITLE: Control of Leafy Spurge with SULV and 2,4-D amine at several application dates, Gillespie Ranch, Whitehall.

Crop Information

Crop	pasture	Seeding depth	
Planted		Row width	
Experimental design	RCB	Seeding rate	
Replications	3	Plot size	7 x 20'

Herbicide Application

Sprayer	Backpack	Date	5/11/82
Pressure	30	Volume	13 gpa
Propellent	CO_2	Nozzles	8002
Time	1:00 p.m.	Rel. humidity	47%
Wind:	0-2 mph	Air temperature	52°F
	NE direction	Soil temp.:	2" 50°F 4" 44°F

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	2-7" pre bud	1-8 plts/ft^2

PURPOSE: 'Ded-Weed SULV' is a 2,4-D amine formulation sold by the Thompson-Hayward Chemical Company. It is being promoted as the "Poor Man's Roundup" by several dealers in the state. We are trying to determine if SULV is more effective than conventional amine formulations. We will measure regrowth this year and next year.

Experiment No.: 82101004 Map No.: 6

Title: Control of Leafy Spurge With SULV and 2,4-D Amine at Different Application Times.

Notes: Plot size: 7 ft. x 20 ft.

Treatment No.	Herbicide	Rate lb/A	Timing	Plot Number Rep I	Rep II	Rep III
1	SULV	.5	Early Spring	101	223	310
2	SULV	1.0	Early Spring	102	209	315
3	SULV	2.0	Early Spring	103	204	307
4	2,4-D Amine	.5	Early Spring	104	214	313
5	2,4-D Amine	1.0	Early Spring	105	205	317
6	2,4-D Amine	2.0	Early Spring	106	202	321
7	SULV	.5	Early June	107	218	311
8	SULV	1.0	Early June	108	224	304
9	SULV	2.0	Early June	109	225	312
10	2,4-D Amine	.5	Early June	110	208	306
11	2,4-D Amine	1.0	Early June	125	201	325
12	2,4-D Amine	2.0	Early June	112	222	318
13	SULV	.5	Early July	113	219	301

Experiment No.: 82101004

Treatment No.	Herbicide	Rate lb/A	Timing	Plot Number Rep I	Rep II	Rep III
14	SULV	1.0	Early July	114	212	323
15	SULV	2.0	Early July	115	216	320
16	2,4-D Amine	.5	Early July	116	203	302
17	2,4-D Amine	1.0	Early July	117	210	305
18	2,4-D Amine	2.0	Early July	118	211	314
19	SULV	.5	Early August	119	215	303
20	SULV	1.0	Early August	120	217	319
21	SULV	2.0	Early August	121	206	324
22	2,4-D Amine	.5	Early August	122	220	316
23	2,4-D Amine	1.0	Early August	123	213	309
24	2,4-D Amine	2,0	Early August	124	207	322
25	Check			111	221	305

EXPERIMENT NO.: 82101005

TITLE: The effect of shocking on Leafy Spurge regrowth.

Crop Information

Crop	pasture	Seeding depth	
Planted		Row width	
Experimental design	RCB	Seeding rate	
Replications	3	Plot size	3 x 6'

Herbicide Application

Sprayer	Date 5/7/82	Pressure	Volume
Propellent		Nozzles	
Time		Rel. humidity	
Wind:	mph	Air temperature	
	direction	Soil temp.: 2"	4"

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	2-6" pre bud	1-8 plts/ft^2

Purpose: The cell walls of Leafy Spurge laticifers dissolve soon after differentiation so continuous tubes of latex occur near the vasular tissue.

We wanted to determine if latex was an efficient conductor of electricity which would make electric shocking an effective means of control. Latex is a fairly efficient conductor of electricity.

Soil grounded any charge we applied to the plant.

Experiment No.: 82101005 Map No.: 7

Title: The Effect of Shocking on Leafy Spurge Regrowth

Notes: Plot size = 3 ft x 6 ft

First 4 treatments - the electrodes were touched to top of plants.
Second 4 treatments - the electrodes were touched to ground on 2 sides of the plant.

Treatment No.	Voltage	Timing	Plot Number		
			Rep I	Rep II	Rep III
1	1000	Early May	101	204	308
2	3000	Early May	102	209	303
3	5000	Early May	103	206	301
4	7000	Early May	108	207	306
5	Check		105	203	309
6	1000	Late May	106	201	305
7	3000	Late May	107	208	304
8	5000	Late May	104	202	307
9	7000	Late May	109	205	302

EXPERIMENT NO.: 82101006

TITLE: Hydrocarbon study

Crop Information

Crop pasture	Seeding depth
Planted	Row width
Experimental design RCB	Seeding rate
Replications 3	Plot size 15 x 30'

Soil Information

Fertilizer used 380# P_2O_5 / 150# 34-0-0	Previous crop

Herbicide Application

Sprayer Backpack Date 5/5/82	Pressure 40 Volume 19 gpa
Propellent CO_2	Nozzles 8002
Time 4:00 p.m.	Rel. humidity 46%
Wind: 5-10 mph	Air temperature 55°F
SW direction	Soil temp.: 2" 54°F 4" 50°F

PURPOSE: We are producing pure spurge which we have fertilized and will irrigate. We will compare 1 versus 2 cuttings and measure hydrocarbon production per acre. Preliminary results indicate that spurge contains very little hydrocarbons.

Experiment No.: 82101006 Map No.: 8

Title: Hydrocarbon Study

Notes: Plots = 15 ft. x 30 ft.

Fertilizer Applications: P_2O_5: 80#/A, 10/29/81
34-0-0 150#/A, 4/27/82

Treatment No.	Treatment	Plot Number		
		Rep I	Rep II	Rep III
1	Non Irr. Fert.	101	202	301
2	Non Irr. Non-Fert.	102	201	302
3	Irr. Fert.	103	204	303
4	Irr. Non-Fert.	104	203	304

EXPERIMENT NO.: 81101004

TITLE: Fertilizer effect on grass growth and herbicide activity on Leafy Spurge, Gillespie Ranch, Whitehall.

Crop Information

Crop	pasture	Seeding depth	
Planted		Row width	
Experimental design	RCB	Seeding rate	
Replications	3	Plot size	7 x 20'
		Sod seed plots	8 x 20'

Soil Information

Soil type		Previous crop	
O.M.	pH	Fertilizer used	0-45-0 380#/A

Herbicide Application: Trt. 4,5

Sprayer	Backpack	Date	10/29/81
Pressure	30	Volume	29 gpa
Propellent	CO_2	Nozzles	8003
Time	3:00 p.m.	Rel. humidity	
Wind:	0 mph	Air temperature	50°F
	direction	Soil temp.:	2" 4"

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	dry-up	1-10 plts/ft^2

Herbicide Application: Trt. 8,9,11,12

Sprayer	Backpack	Date	5/11/82
Pressure	30	Volume	13 gpa
Propellent	CO_2	Nozzles	8002
Time	3:00 p.m.	Rel. humidity	47%
Wind:	0-2 mph	Air temperature	52°F
	NE direction	Soil temp.:	2" 50°F 4" 44°F

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	4-7" prebud to bud	1-10 plts/ft^2

Grasses Seeded:

Slender Wheatgrass
Pubescent Wheatgrass
Western Wheatgrass
Thickspike

PURPOSE: We will measure the effect of fertilizer on grass growth after controlling leafy spurge. We will measure the regrowth of spurge following vigorous grass competition.

Experiment No.: 81101004 Map No.: 9

Title: Fertilizer Effects on Grass Growth and Herbicide Activity on Leafy Spurge

Notes: Plot size: 7 ft. x 20 ft.

Fertilizer Application: P_2O_5, 80#/A, 10/27/81 (On Treatments 1, 2, 3)
N, 50#/A, 10/27/81 (On Treatments 1, 2, 3)
N, 100#/A, 10/27/81 (On Treatments 4-12)

Treatment No.	Grass Seeded or Herbicide	Rate lb/A	Timing	Plot Number Rep I	Rep II	Rep III
1	Slender Thickspike	2 8		101	203	303
2	Slender Pubescent	2 8		102	201	302
3	Slender Western	2 8		103	202	301
4	Tordon	1	Fall	104	207	305
5	Tordon	2	Fall	105	210	309
6	Tordon (G)	1	Fall	106	205	304
7	Tordon (G)	2	Fall	107	208	310
8	Banvel	2	Spring	110	209	308
9	Banvel	4	Spring	109	204	306
10	Check	(Fertilized)		108	206	307
11	Tordon	1	Spring	112	211	312
12	Tordon	2	Spring	111	212	311
13	Check	(Unfertilized)		113	213	313

EXP. NO. 81101004. THE EFFECT OF FERTILIZER ON HERBICIDE ACTIVITY ON LEAFY SPURGE. GILLESPIE RANCH. WHITEHALL, MT.

TREATMENT

TRT NO	HERB	RATE LB/A		6-1-82 % SPURGE CONTROL	6-1-82 % GRASS INJURY
1	TORDON	1	FALL	88.0	6.0
2	TORDON	2	FALL	99.7	9.0
3	TORDON(G)	1	FALL	67.0	3.3
4	TORDON(G)	2	FALL	96.7	14.3
5	CHECK			.0	.0
6	BANVEL	4	SPR	56.7	4.0
7	BANVEL	2	SPR	56.0	3.3
8	TORDON	2	SPR	77.3	7.7
9	TORDON	1	SPR	60.7	5.0
10	UNFERTILIZED CHECK			.0	4.3
			C.V. -	23.27	67.69
			LSD 5% -	24.03	6.62

EXPERIMENT NO.: 81101006

TITLE: Screening trial of new herbicides for control of Leafy Spurge, Gillespie Ranch, Whitehall.

Crop Information

Crop	pasture	Seeding depth	
Planted		Row width	
Experimental design	RCB	Seeding rate	
Replications	3	Plot size	7 x 20

Herbicide Application

Sprayer	Backpack Date 7/2/81	Pressure	30 Volume 19 gpa
Propellent	CO_2	Nozzles	
Time	Afternoon	Rel. humidity	58%
Wind:	2-8 mph	Air temperature	72°F
	SE direction	Soil temp.:	2" 4"

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	seed set to reddening	1-12 plts/ft^2

Purpose: Each year we test herbicides for control of spurge. There are no promising new candidates at this time which are as effective as Tordon or Banvel.

Experiment No.: 81101006 Map No.: 10

Title: Screening Trial for Herbicide Control of Leafy Spurge

Notes: Plots = 7ft. x 20 ft.

Treatment No.	Herbicide	Rate lb/A	Plot Number Rep I	Plot Number Rep II	Plot Number Rep III
1	X-77 .12% Krenite	2.0	101	208	312
2	X-77 .12% Krenite	4.0	102	212	305
3	X-77 .12% Krenite	6.0	103	207	310
4	Roundup	1.0	104	205	309
5	Roundup	2.0	105	204	311
6	Roundup	4.0	106	209	302
7	Tordon	0.5	107	211	304
8	Tordon	1.0	108	206	303
9	Check		109	202	308
10	Tordon	2.0	110	203	307
11	Banvel	2.0	111	210	301
12	Banvel	4.0	112	201	306

EXPERIMENT NO.: 82101002

TITLE: Control of Leafy Spurge in rangeland. Gillespie Ranch, Whitehall.

Crop Information

Crop	pasture	Seeding depth	
Planted		Row width	
Experimental design	RCB	Seeding rate	
Replications	3	Plot size	7 x 20'

Herbicide Application

Sprayer	Backpack Date 5/11/82	Pressure	30 Volume 13 gpa
Propellent	CO_2	Nozzles	8002
Time	Afternoon	Rel. humidity	47%
Wind:	0-2 mph	Air temperature	52°F
	NE direction	Soil temp.:	2" 50°F 4" 44°F

Crop Stage

Weeds Present	Stage of Growth	Population Density
Leafy Spurge	2-7" pre bud	0-8 $plts/ft^2$

Experiment No.: 82101002 Map No.: 3

Title: Control of Leafy Spurge on Rangeland

Notes: Plots Size = 7ft. x 20 ft.

Treatment No.	Herbicide	Rate lb/A	Plot Number Rep I	Rep II	Rep III
1	DPX T6376	.5 oz	101	208	306
2	DPX T6376	1.0 oz	102	207	308
3	DPX T6376	2.0 oz	103	214	312
4	DPX T6375	4.0 oz	104	202	305
5	Banvel	4.0	105	210	311
6	Banvel	5.0	106	205	313
7	Banvel	6.0	114	201	307
8	Tordon	.5	108	209	310
9	Tordon	1.0	109	206	304
10	Tordon	1.5	113	213	309
11	Tordon	2.0	111	203	301
12	Hoe 00661	1.0	112	211	314
14	Check		107	212	303