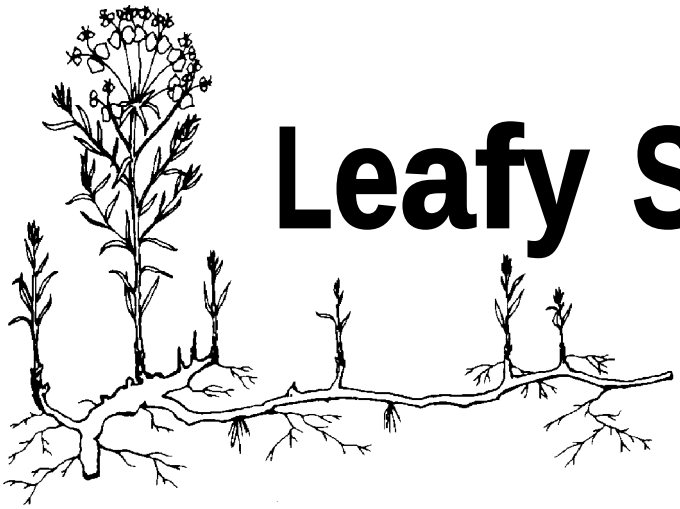

Leafy Spurge *News*

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

Volume XXII, Issue 3 September 2000

From the Editor's Desk

Summer is over and so are the leafy spurge demonstrations and beetle collections. We have a great issue packed with information, from a summary of the work of TEAM Leafy Spurge to the finding of a new gall midge found in Southern France. The Letters to the Editor column is really picking up, we have some interesting letters in this issue. Please keep them coming, and let others know what you are thinking about leafy spurge.

Your editor was fortunate to attend the first Leafy Spurge International Information Day, held June 27, 2000 at Frost Fire Mountain, Walhalla, ND. Over 150 people attended, including a large contingent from Manitoba. The morning and early afternoon were devoted to an update of the leafy spurge situation in the United State and Canada. Included in this issue is an excellent summary of "Leafy Spurge Impact Assessment in Manitoba," presented there. In the afternoon lots of beetles were collected.

The person that is being honored in this issue is an old friend of mine, fellow ARS researcher Bob Masters located in Lincoln, Nebraska who has done a lot of research on leafy spurge.

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Leafy Spurge Honoree
Robert A. Masters, Ph.D.

Bob Masters received a B.S. degree in wildlife biology in 1978 and a M.S. in range science in 1981 from Texas A&M University, and a Ph.D. in range management from Texas Tech University in 1985. He joined the USDA, Agricultural Research Service in 1985. Currently, he is a rangeland scientist in the Wheat, Sorghum, and Forage Research Unit with the ARS in Lincoln, Nebraska. He is responsible for basic and applied rangeland improvement research. His research goal is to develop effective and economical integrated renovation and restoration strategies that increase rangeland productivity and quality. Specifically, he conducts research to identify constraints to establishment of grasses and legumes, develop practices to improve plant establishment, and identify weed management strategies that can be integrated to reclaim noxious weed-infested rangeland.

Bob's research with leafy spurge began in 1988 in collaboration with Robert Stougaard and Scott Nissen. This research demonstrated the potential for the imidazolinone herbicides (Pursuit, Scepter, and Arsenal) to control leafy spurge. In the mid-90's Bob began working with another imidazolinone herbicide, Plateau (imazapic). He found that this herbicide had two desirable attributes. First, the herbicide controlled leafy spurge when applied in the fall at 8 to 12 oz per acre without injury to legumes and warm-season grasses. Second, Plateau could be used to control weeds during establishment of native warm-season grasses and forbs.

Bob determined that productivity of leafy spurge-infested rangeland was not improved by just controlling leafy spurge with herbicides. He found that leafy spurge

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was a symptom of past mismanagement, which had led to loss of desirable forages and replacement with exotic and less palatable plants. Building upon knowledge gained from previous research, Bob designed a multifaceted approach to reclaim the potential productivity of these sites. This involved: 1) herbicide suppression of leafy spurge and other resident vegetation with Plateau and Roundup; 2) burning to remove dead plant residue; and 3) planting native prairie species without tillage into the herbicide suppressed sod. This strategy resulted in at least a 60% improvement in grass productivity and reduction in leafy spurge.

His research demonstrated the value and uniqueness of the imidazolinone herbicides to rangeland weed management programs. He shared research findings with American Cyanamid (now BASF) and conducted field tours of research sites to demonstrate the utility of the herbicides, especially Plateau. Plateau has since received section 18 registrations in Nebraska, North Dakota, South Dakota, Wyoming, and Montana for leafy spurge control on rangeland and pastures. BASF is currently seeking approval from the EPA for section 3 registration of Plateau for nationwide use on rangeland and pastures.

Bob was also a member of a research team with Scott Nissen, Martha Rowe, and Don Lee that successfully used molecular biological techniques to determine that North American leafy spurge genotypes were more similar to genotypes collected from Russia and Ukraine than those collected in Italy and Austria. He led two expeditions to collect leafy spurge genotypes from several locations in Europe, Ukraine, and Russia. These plants were used to determine the Eurasian origins of North American leafy spurge. This is the first time that a molecular approach to assess the genetic structure of weed populations has been used to improve efficiency of biocontrol agent collection and selection.

During Bob's time with the USDA-ARS, he has had many enjoyable experiences working with ranchers, county weed superintendents, public land managers, extension specialists, and scientists. These interactions have been invaluable in helping Bob keep his research focused on important targets. In a way, he is beholding to leafy spurge for bringing him in contact with such a diverse group of colleagues. His affiliations with the Nebraska Leafy Spurge Task Force and GPAC-Leafy Spurge Task Force have been gratifying. Interactions with these groups has been enriching and have demonstrated the awesome power that a group of dedicated and enthusiastic people with a common purpose can bring to bear on a seemingly intractable problem.

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A New Spurge Feeder is Coming to North America

(For more information about the European Biological Control Laboratory (EBCL) see the article in Ag. Research Vol. 48, #3, March 2000.)

My colleagues in the USA and Canada were telling me that 12 species of specific insects were established in the USA and Canada for biological control of leafy spurge, but none of these were adapted to the moist and shady areas. Searching for such an insect, I discovered a gall midge on leafy spurge, *Euphorbia esula,* in southern France. The spurge plants were growing along water channels and fruit orchards in shady and moist areas (Figure 1). This is the kind of habitat for which no insect was established on leafy spurge in North America. Adults of the insect were identified by R. Gagne at SEL, Washington, as *Spurgia capitigena* (Cecidomyiidae). A biotype of this insect from Italy was released earlier as *Spurgia esula* and became established in the USA and Canada. However, this insect is adapted to rather dry sites. Biology and host specificity of the midge, adapted to moist sites, was studied in collaboration with Jeff Littlefield (MSU, Bozeman) and Massimo Cristofaro (ENEA, Rome). Subsequently, Neal Spencer obtained a release permit and arrangements are on the way for the first release of this biotype in Montana during May 2000.

The insect has several generations per year and produces tip galls preventing flower and seed formation (Figure 2). Apparently if the spurge plants along the

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Figure 1. The kind of habitat in which *Spurgia capitigena* occurs in France (moist, shady).

Figure 2. Leafy spurge branch tip turned into a gall, which cocoons of *Spurgia capitigena* dissected from the gall.

Leafy Spurge Impact Assessment In Manitoba

Executive Summary

Data from a study undertaken by the Leafy Spurge Stakeholders Group estimates that the net economic impacts associated with the leafy spurge infestation in Manitoba may be approaching **$20 million per year.** It is estimated that at least **340,000 acres are impacted.** Without control actions being initiated to limit the growth rate of the infestation, it is possible that the impacted acres (and associated economic impacts) could increase rapidly.

What is the impact of the infestation on pasture land? The total annual economic impact on pasture land is estimated at **$16 million.** An estimated 225,000 acres of grazing land is infested in Manitoba with a potential impact of a reduced herd size of 16,540 head. Leafy spurge costs Manitobans more than **$5 million per year** in reduced producer income ($1,940,040 per year) and reduced production expenditures ($3,104,044). Potential secondary economic impacts on other business sectors are estimated at **$11 million per year.** Additionally, land values are potentially reduced by over $30 million. This brings potential property tax implications for owners of croplands. While taxes on infested acres may be reduced, other lands will have to make up the lost revenue.

What is the impact of the infestation on public lands? The potential direct and indirect economic impact on public lands is **$2.5 million.** In terms of recreation, direct impacts could be **$674,000** per year with secondary economic impact of **$1.55 million per year.** These estimates are related to a reduced carrying capacity reflected in reduced expenditures on consumptive and non-consumptive wildlife-associated recreation. Some 107,000 acres of public lands are infested. Most of these acres are primarily identified in the sandy-soil and dunned-sand terrain associated with the Assiniboine and Souris River basins. The Riding and Duck mountains and the sandy-soil areas east and southeast of Winnipeg are also vulnerable to this weed.

Potential watershed impacts were estimated at **$281,000 per year** (direct impacts $157,000 and secondary impacts $124,000).

What are the costs of control of leafy spurge on rights-of way? Estimated control costs for rights-of-way are $400,000 per year. This includes:

- Weed Control Districts costs of $300,000,
- Highways Department $53,000,
- Railways $12,000, and
- An undetermined cost for Pipelines and Hydro.

The **Leafy Spurge Stakeholders Group** (LSSG) was formed in the fall of 1998 to examine the issues and impacts of leafy spurge. This plant is a formidable noxious weed that infests thousands of acres in agro-Manitoba. The LSSG is a broad coalition of agricultural and conservation groups and the three levels of government, spearheaded by the Weed Supervisors Association of Manitoba and coordinated by WESTARC Group Inc. of Brandon University. The current objectives of the group are:

- To raise the awareness of the leafy spurge problem and the need for action by all levels of government, private landowners, producer groups and conservation organizations;
- To provide accurate and locally based information on the extent and economic impact of the leafy spurge problem in Manitoba;
- To provide information to landowners to enable them to effectively control and manage leafy spurge on their properties; and
- To coordinate leafy spurge efforts in Manitoba to ensure the best use of resources by all agencies.

In the summer of 1999, the Leafy Spurge Stakeholders Group embarked on a project to develop an estimate of the leafy spurge infestation in Manitoba and its potential impact. Data on infestation levels was obtained from three main sources: 1) a survey of weed control districts conducted by Weed Supervisors, 2) reports from Manitoba Agriculture Representatives on estimates of infestations in 112 rural municipalities and 3) a 1981 survey from which data was extrapolated to provide information for those rural municipalities for which there were no other sources of data.

The LSSG recognizes there are gaps in the data that leads to potentially underestimating the total infestation and economic impacts. Infestation rates for many municipalities were not provided. Based on a 1981 survey, it is known that some municipalities, not included in weed districts, had moderate to heavy infestations of leafy spurge at that time and several other municipalities had light infestation. The amount of infested public land may be understated as some parks and provincial forests were not included in the sample.

A LSSG working group analyzed the data and prepared this report on the potential impact of leafy spurge in Manitoba. This group relied on the analysis model developed at North Dakota State University (NDSU). Millions of dollars have been devoted to impact studies and control of leafy spurge in North Dakota and other infested states in the Great Plains.

Impact Analysis Methodology

Step 1: Identify the potential impact of the infestation by land-use type. (e. g., reduced carrying capacity, increased soil erosion, reduction of species diversity).

Step 2: Determine the impact in quantitative terms. (e.g., calculate the reduced carrying capacity of the land in terms of Animal Unit Months).

Step 3: Calculate the direct economic impacts in financial terms.

Step 4: Estimate the secondary impacts.

The following chart summarizes the estimated net economic impact of leafy spurge infestation in Manitoba today.

Total Direct and Indirect Economic Impacts

	Grazing Land	Public Land	Rights of Way
Direct Annual Impact	>$5 M	$.08 M	$0.4 M
Secondary Annual Impacts	>$11 M	$1.7 M	N/A
Total Annual Impacts	**>$16 M**	**$2.5 M**	**$0.4 M**

Over $19 M per year

Beth Peers
Coordinator
Leafy Spurge Project
"Beth Peers" <peers@brandonu.ca>

Summary of TEAM Leafy Spurge Summer Work

The collection and redistribution of 16.5 million flea beetles, expansion into three new drainages and production of a new biocontrol manual highlighted another busy summer for TEAM Leafy Spurge. "The weather wasn't as cooperative as we would have liked to start the season, but other than that, it was a very good year for us," said Gerry Anderson, co-principal investigator of the USDA-ARS area-wide integrated pest management program. One focus of TEAM's summer efforts was collecting and redistributing leafy spurge flea beetles to ranchers and landowners within the program's study area. Despite rainy, cool weather, TEAM personnel collected and redistributed 16.5 million leafy spurge flea beetles during a three-week span in June. TLS used some of the flea beetles to expand beyond the program's original study area, the Little Missouri River drainage. The Heart (N.D.), Grand (S.D.) and Powder (W.Y.) river drainages are heavily infested with spurge, Anderson said, and will provide "excellent release sites." "We wanted to move into the new drainages to supplement existing management efforts, and to increase interest in biological control and integrated pest management," he said. "So far, we're seeing an extremely high level of interest in biocontrol and integrated pest management." TEAM Leafy Spurge has now collected and redistributed 40 million flea beetles, enough for more than 13,000 new release sites during the past three years.

Another highlight of the field season was the production and distribution of "Biological Control of Leafy Spurge," a full-color, 20-page guide that provides step-by-step instructions for using leafy spurge flea beetles. The manual was originally intended for ranchers in the four-state study area, but was ultimately distributed to 16 states and four Canadian provinces. "Demand for the manual was just incredible. We distributed more than 14,000 copies in a six-week period," Anderson said. "It's a great resource for people who want to learn more about successfully using biological control, and we're still getting calls from people who'd like to get a copy." The manual can be viewed online or downloaded as a PDF file from the TEAM Leafy Spurge web site at http://www.team.ars.usda.gov/aphisman.html

TEAM personnel are now planning for an October meeting of the ad hoc committee and program participants, and several state weed control association meetings and agricultural trade shows. Another priority for the fall and winter will be the planning of Spurgefest II, which has been scheduled for June 19-21, 2001. More information will be available later. "We're really excited about Spurgefest 2001," Anderson said. "The original Spurgefest was a big success, and the follow-up will be even bigger and better." TEAM Leafy Spurge is a five-year Integrated Pest Management research and demonstration program funded and headquartered at the USDA-ARS Northern Plains Agricultural Research Station in Sidney, Montana, and managed by the USDA-ARS in partnership with the USDA-Animal & Plant Health Inspection Service. Its goal is providing landowners and land managers with effective, affordable and sustainable leafy spurge control techniques based on IPM strategies. For additional information on TEAM Leafy Spurge, leafy spurge biocontrol or Integrated Pest Management, see the TEAM Leafy Spurge website at http://www.team.ars.usda.gov or send an e-mail to teamls@sidney.ars.usda.gov

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Letters To The Editor

Dear Leafy Spurge News,

I attended the leafy spurge meeting in Walhalla last week and would like to be included in the mailing list for LEAFY SPURGE NEWS.

I have 80.0 acres 1 mile east of Frostfire and put out about 25,000 beetles following the meeting.

Mike Ratzlaff
RR 1 Box 272
Newfolden, MN 56738

Dear Leafy Spurge News,

Thank you for sending the past issues of the news letter and for adding my name to the mailing list. I find the news letter both interesting and informative.

I would also like to mention that the Leafy Spurge Information Day I attended on June 27 in Walhalla was very helpful and informative. The presenters provided a lot of very pertinent information which I know will be very helpful in dealing with the "Spurge" up here in Manitoba. I was very impressed with the research and work that you folks are doing on this weed. I really appreciated the opportunity of being able to learn from your work and experiences. While attending the Information Day I was able to get several beetle colonies which were promptly released on some land up here that has a moderate infestation of the "Spurge." I hope the beetles are able to do their job and I will let you know the progress in due time. Again thanks for being such good neighbors and allowing me to learn more about controlling the "Spurge."

Yours Truly,

Gordon Machej
MB Canada
E-mail gmac@mb.sympatico.ca

Dear Leafy Spurge News,

There are currently 36 Weed Control Districts or member Rural Municipalities belonging to our association from across agro-Manitoba. Most of the Weed Districts represent joint Boards operated under between 2 and 6 municipal councils (R.M.s & Towns). Six Rural Municipalities are members while operating within a single municipality situation. Many of our Districts also carry out weed control, regulatory, and/or extension work for neighboring municipalities that are not members of a weed district.

Our members have been extensively involved in the battle with Leafy Spurge since before our Association was formed. Control and extension efforts date back to cooperative efforts between the Manitoba Dept. of Agriculture and various municipalities in the late 1930's. The Weed Districts program was developed in the early 1960's. From 1960 until 1992, the Weed Districts program was operated directly under the Dept. of Agriculture with a supporting grant system. This funding and formal association, was dropped in 1992 as part of Provincial government cut-backs at the time. While we continued to cooperate with Manitoba Agriculture in most of our efforts, we are currently funded only by the contributions of our local municipalities and fee-for-service weed control work.

Our involvement, both at the control level and in extension, regarding leafy spurge has been extensive. While we are charged with managing municipal weed control programs and weed control extension work, we are also responsible for enforcing the Provincial Noxious Weeds Act within our jurisdictions. We have also been very involved in the leafy spurge biocontrol program, both as promoters and extension personnel, and as active distributors of the biocontrol agents that were available to us.

We were also able to access some funding sources in order to assist Dr. Peter Harris of Ag Canada in his research into potential biocontrol agents for leafy spurge and other weeds. Our members have been responsible for a large proportion of the spurge biocontrol releases made in Manitoba since the first successful sites in the Province (primarily *Aphthona nigriscutis*) became harvestable. In cooperation with Manitoba Agriculture, we were also able to introduce new releases of *A. cyparissiae* from the successful site at Lake Maxim, Saskatchewan in 1990. During the late 1980's, Manitoba Agruculture personnel also made releases of several other biocontrol agents. While having limited impact on existing spurge, the leaf-tiers were a successful release, and managed to spread for many

miles of their own accord. During the 1990's, we were able to make several additional releases of these insects to other areas of the Province. As of 1993, we only had one surviving release of *A. czwalinae/lacertosa*. In 1997, the M.W.S.A. were able to obtain several releases of *A. lacertosa* through a cooperative efforts with agents in North Dakota. We are in hopes that these releases, along with those obtained recently at the Leafy Spurge International event, will add to our arsenal of available biocontrol agents for the control of this problem perennial.

Our Association has also been instrumental in the formation of the Manitoba Leafy Spurge Stakeholders Group. This affiliation was able to bring together interested parties from very diverse areas of interest in a common recognition of the problem. This group includes representatives form the Manitoba Cattle Producers Association, the Sheep Association of Manitoba, Manitoba Equine Ranchers Association, and Keystone Agricultural Producers as representatives of primary producers. It also includes representation from: MB Agriculture and Food, Prairie Farm Rehabilitation Administration, Ducks Unlimited, Canadian Forces Base Shilo, Canadian Wildlife Service, MB Habitat Heritage Corporation, Assiniboine Community College, Agriculture and AgriFood Canada, Nature Conservancy of Canada, MB. Dept. of Natural Resources, Association of Manitoba Municipalities, Manitoba Conservation, and MB Dept. of Highways and Transportation.The goal of this group has been three-fold, to increase awareness and education regarding this weed problem, to more clearly identify the extent and impact of this weed in Manitoba, and to develop a management plan for the control of this weed. Since its initiation in 1997, this group has already produced a preliminary survey of the extent of spread of spurge, and acres involved in Manitoba. Based on these numbers, we have been able to produce an initial impact assessment using cost associations similar to those used in North Dakota, combined with local production and control values. We have also then able to access some funding that is currently enabling a post graduate student to study the results of our earlier *A. lacertosa* releases, along with a follow-up study on the extent of the spurge problem in Manitoba.

It is our hope that continued co-operation and extension will help reduce the financial and environmental impact of this weed.

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Dear Leafy Spurge News,

Your Leafy Spurge Newsletter was passed on to me by Ann Haines. I'm very interested in finding a biological remedy for leafy spurge. We own 56 acres northwest of Brainerd, MN. We have an open field which had once been hayed which is now covered with leafy spurge. I had hoped to restore it to a prairie, but know the leafy spurge will win-out. I've read about beetle trials and wonder if there would be any available for us? Any help you could offer would be greatly appreciated

I did receive the information requested from Dr. Lym. He suggested chemical control because of the size of the infestation. But I really don't want to go the chemical way. I contacted the county weed control officer and found they had a project underway near the local airport. He thought they would be harvesting beetles in mid June. When I contacted him again in mid June, he acted like he'd never heard of me and said no beetles are available. The Northland Arboretum (about 1 mile away from our property) had a release of beetles this year. I think it was through the USDA. But no more beetles are available.

So no luck so far. Rather frustrating. I'll be on top of the weed officer next year and hope to work with the arboretum too and try to get some beetles from one or the other. Meanwhile, the spurge continues to flourish and spread.

Bill Blum
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streams and other moist and shady places remain as a source of seed production, the areas that were eventually cleared from leafy spurge could be re-infested by seeds. It is known that water, animals, birds, wind, etc. can spread the spurge seeds.

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The TEAM Leafy Spurge Website

The TEAM Leafy Spurge website at http://www.team.ars.usda.gov/ has received a major facelift. USDA-ARS ecologist Gerry Anderson, co-principal investigator of the area-wide program, said the revised site provides "a wealth of information about the program and integrated pest management strategies for leafy spurge. The new site is pretty comprehensive, but we'll keep working to make it even better," he said. Included are summaries of TEAM Leafy Spurge program participants and their projects, downloadable PDFs of TLS informational products, an archive of papers presented at leafy spurge symposiums, an extensive list of contacts, a photo library of biological control agents, a frequently asked questions page and more.

Also featured is The Leafy Spurge News, which can be viewed online or downloaded as a PDF. Interested readers can use a hyperlink to correspond with the editor and subscribe to the popular publication. The website also features links that can be used to e-mail questions and comments to TEAM Leafy Spurge personnel and other leafy spurge specialists. Anderson encouraged weed warriors and web surfers to provide input. "If you have any ideas for improving the site, let us know," Anderson said. "We want it to be as useful and complete as possible. Almost all of the web site's content, Anderson said, is entirely new. All told, the site consists of approximately 270 web pages, 2,300 total files in 55 folders, and nearly 700 megabytes of images concludes summer field season. The collection and redistribution of 16.5 million flea beetles, expansion into three new drainages and production of a new biocontrol manual highlighted another busy summer for TEAM Leafy Spurge. "The weather wasn't as cooperative as we would have liked to start the season, but other than that, it was a very good year for us," said Gerry Anderson, co-principal investigator of the USDA-ARS area-wide integrated pest management program. One focus of TEAM's summer efforts was collecting and redistributing leafy spurge flea beetles to ranchers and landowners within the program's study area. Despite rainy, cool weather, TEAM personnel collected and redistributed 16.5 million leafy spurge flea beetles during a three-week span in June. TLS used some of the flea beetles to expand beyond the program's original study area, the Little Missouri River drainage. The Heart (N.D.), Grand (S.D.) and Powder (Wyoming) river drainages are heavily infested with spurge, Anderson said, and will provide "excellent release sites. We wanted to move into the new drainages to supplement existing management efforts, and to increase interest in biological control and integrated pest management," he said. "So far, we're seeing an extremely high level of interest in biocontrol and integrated pest management." TEAM Leafy Spurge has now collected and redistributed 40 million flea beetles — enough for more than 13,000 new release sites — during the past three years. Another highlight of the fieldseason was the production and distribution of "Biological Control of Leafy Spurge," a full-color, 20-page guide that provides step-by-step instructions for using leafy spurge flea beetles. The manual was originally intended for ranchers in the four-state study area, but was ultimately distributed to 16 states and four Canadian provinces." Demand for the manual was just incredible — we distributed more than 14,000 copies in a six-week period," Anderson said. "It's a great resource for people who want to learn more about successfully using biological control, and we're still getting calls from people who'd like to get a copy." The manual can be viewed online or downloaded as a PDF file from the TEAM Leafy Spurge web site at http://www.team.ars.usda.gov/aphisman.html. TEAM personnel are now planning for an October meeting of the ad hoc committee and program participants, and several state weed control association meetings and agricultural trade shows. TEAM Leafy Spurge is a five-year Integrated Pest Management research and demonstration program funded headquartered at the USDA-ARS Northern Plains Agricultural Research Station in Sidney, Montana, and managed by the USDA-ARS in partnership with the USDA-Animal & Plant Health Inspection Service. Its goal is providing landowners and land managers with effective, affordable and sustainable leafy spurge control techniques based on IPM strategies. For additional information on TEAM Leafy Spurge, leafy spurge biocontrol or Integrated Pest Management, see the TEAM Leafy Spurge website at http://www.team.ars.usda.gov or send an e-mail to teamls@sidney.ars.usda.gov

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Evolution of the APHTHONA Accelerator

I remember the days, way back in the 80's, when an individual *Aphthona* beetle was worth far more than it is today. Back then it was necessary to place netted beetles in a sleeve cage and sort them from debris and other insects with an aspirator, counting them one at a time.

As time went on and the beetles became more numerous, it was determined that the insects could be measured volumetrically. I believe it was the Bozeman BioControl Facility (BBCF) that first counted the 100, 200, 500 and 1000 beetles and marked their volume on a small plastic vial.

But the problem of obtaining a pure sample of only *Aphthona* beetles was still an issue. We would still suck them up with an aspirator and fill the vial later. More commonly, we would simply allow the netted insects to crawl up the side of the net. Once most were on their way up and out, we'd pull whatever debris was still in the bottom of the net out and shake the beetles back down. Then we'd scoop them up with the calibrated beetle vial. The problem with this method is that you'd still get quite a number of grasshoppers and bees in the sample.

Tim McNary, then a PPQ Officer from Wyoming, created the first *Aphthona* sorter that I'm aware of. It was made of 8" stove pipe taped to a fence post with a piece of 1/8" mesh hardware cloth placed half way down. He would dump a net full of insects and stuff into the pipe. The insects would, for the most part, fall through while the larger plant matter was caught by the screen. The beetles would be collected in a vial at the bottom for measuring. This was a great improvement over aspirating. The problem with this method is that weed seeds would also fall through the screen into the vial and not all the insects would cooperate. They would hang onto the pipe and plant material and crawl back up and out the top.

Anyone who ever tried to place these little flea beetles into a container for shipping knows that the little critters will find there way out of a pin hole. They are prone to crawl towards any light source when placed in the dark. Dave Hirsch, PPQO in North Dakota and his crew capitalized on this trait. They developed a means of drilling small holes in PVC pipe, filling the pipe with net collections, capping the pipe and placing the whole thing in a net bag. The *Aphthona* would crawl out the holes while the weeds and large insects would remain in the pipe. Later the pipe could be removed, the *Aphthonas* shaken down and measured volumetrically as a pure sample.

I happened to notice the same trait and took a different approach. I also realized that the insects were prone to crawl upwards, and that large insects, plant matter, and weed seeds needed to be separated out. At the same time it was necessary to funnel the sorted insects into a container for easy measuring. There had to be a way to utilize the insect's energy to complete this task instead of expending human effort.

I had my brother, then a high school Vocational Agriculture teacher, make a separator. The design consisted of a 3'x3'x1' box with a lid on the top and a funnel on each of two sides. The funnel had the 1/8' hardware cloth to keep the larger insects in the box and the funnel led to the only light source, a plastic pop bottle. For whatever reason, this apparatus was a complete failure. However, it was constructed well and I have other plans for it.

I had been working with Russian Wheat Aphid (RWA) BioControl in which we used cardboard cylindrical containers with funnels on the end leading to a small

vial. These were called emergence canisters used to collect minute parasites of the RWA. I also had an old roll of clear acetate that was used to cover wall maps and I had some aluminum wire rings, which represented a square foot used for grasshopper surveys.

I determined that the first thing needed was a receptacle for holding the plant material and weed seeds. I utilized the RWA emergence canisters for that. Then there had to be a way to let the little flea beetles out and keep the large insects in. So I left 2-3" of the bottom of the canister and cut out the remaining sides of the cardboard canister and replaced it with the 1/8" mesh hardware cloth. Knowing the habit of the *Aphthona* beetles I knew they would crawl up and out but needed to get them to fall into a container for measuring. So, I rolled the acetate into a long funnel, place the manipulated aluminum grasshopper rings inside to both give the funnel rigidity and to hold the canister, and connected a plastic pop bottle to the bottom of the funnel. The cardboard canister was placed into the funnel, filled with the net's contents, and capped.

The contraption worked like a charm. The beetles practically boiled out, falling into the pop bottle below. However, it basically fell apart after one or two days of collection. That fall, Gary Brandenburg with the MT Department of State Lands heard about the contraption and came to look at it. He and his help created a very large prototype with several modifications, with a welded frame, wheels, and other gadgets. The one improvement that interested me was that they used the clear vinyl used on convertibles and collapsible campers instead of the brittle acetate.

I was still confident that we needed something smaller, easy to carry in the field, and affordable for the average "bug catcher." PPQ Aide, Mike Winks, and I considered using one of the large plastic bottles used for office drinking water. We determined that the angle of the neck was not right to funnel the insects into a receptacle. It was the following spring when Mike and I started walking through the local hardware store trying to brainstorm. It was there that we eyed the tomato cage. It was the ideal shape for the contraption, could maintain the structural integrity of the gadget and could be used outside of the funnel minimizing things for the critters to hold onto. I bought various parts and Mike was off and running.

Mike created the first of many of these contraptions. He utilized the tomato cages, the Tupperware for the internal cage, modified the funnel and created the prototype that has been copied many times since. The BBCF took that very prototype, made a few more improvements, dubbed it the *Aphthona* Accelerator, developed a parts list and instructions on building them, and now they are seen where ever leafy spurge flea beetles are seriously collected.

This contraption has save the world of weedfighters thousands of hours of labor, reduced chance of spreading weed seed and other insects, and has helped sort and redistribute millions of leafy spurge flea beetles around the west. Last summer, I noticed a group of vehicles in an unlikely place in the badlands of North Dakota. As I passed, I looked back and noticed several of these *Aphthona Accelerators* mounted and ready to go. I even understand someone is now building and selling them for profit. It is a classic example of how building on ideas can create something great.

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Molecular Pharming continued from back page

viruses are very specialized, and weed scientists, be they trained in agronomy, plant physiology, entomology, or even plant pathology, lack knowledge and skills in virology. In line with our mission to discover new weed management strategies, we are seeking support for a new plant molecular virology position in Plant Science to investigate the use of viruses as biological control agents on leafy spurge and other invasive perennial plants. In the coming year we will begin a dialog with stakeholders to gain input into the need for this position and this strategy for managing weeds.

As a final note, in the vein of "if you can't beat 'em – join 'em," perhaps leafy spurge could be turned into a crop for the production of high value products just as well as tobacco. Production of a product in the latex might lend itself to easy isolation. This is all food for thought as you kick back during the holidays and admire that poinsettia on the dining room table!

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Proceedings (continued from September 1999 Leafy Spurge News)

from the Leafy Spurge Symposium, June 26-27, 1999

Seedbank Study of a Leafy Spurge Infestation

Abstract. Approximately 15 to 20% of the Sheyenne National Grassland in southeastern North Dakota is infested with leafy spurge (*Euphorbia esula* L.). The purpose of this research was to determine seedbank composition, which may play a role in future site revegetation during leafy spurge control efforts. Herbicide efficacy trial plots were established to determine herbicide rates to be used in controlling leafy spurge in areas that also contain the western prairie fringed orchid (*Platanthera praeclara* Sheviak and Bowles). These plots were also used to determine seedbank composition. Three herbicides at two rates each were applied in the fall of 1997, glyphosate plus 2,4-D (0.5 and 1 lb/A), AC 263,222 (0.0625 and 0.125 lb/A) plus Sunit (0.25 lb/A) plus 28% N (0.25 lb/A) and quinclorac (0.8 and 1 lb/A) plus Sunit (0.25 lb/A). Soil cores 2.5 cm deep were taken in May 1998 and were washed through a 4 mm sieve and a 0.2 mm sieve to remove coarse and fine materials. Samples were then spread 3 to 5 mm deep on a layer of sterile sand (approximately 1 cm), which prevented contact between sample and potting soil. Seed from a total of 56 composited (4 blocks, 7 herbicide treatments, 2 subsamples) soil cores were grown in the greenhouse. Seedlings were counted and removed after identification. Unidentified seedlings were transplanted until identification was possible. Removal of seedlings was necessary due to high seedling density. Identification continued until no further germination was noted approximately eight weeks after planting. Seedlings were identified by species and placed in categories of leafy spurge, forb, grass, grasslike and other species for statistical analyses. No statistical significance ($p<0.05$) was determined between the treatments using Tukey?s mean separation test. Leafy spurge comprised 40% of all germinated seedlings, with grasses 25%, forbs 22%, grasslike 10% and other species 3%. Thirteen grass species were identified, four were desirable native warm season species [big bluestem (*Andropogon gerardii* Vitman), sideoats grama (*Bouteloua curtipendula* (Michx.) Torr.), little bluestem (*Schizachyrium scoparium* (Michx) Nash) and sand dropseed (*Sporobolus cryptandrus* (Torr.) Gray)] and three were desirable native cool season species [prairie junegrass (*Koelaria pyramidata* (Lam.) Beauv.), needle and thread (*Stipa comata* Trin. and Rupr.) and green needlegrass (*Stipa viridula* Trin.)]. Eighty-five percent of all grass seedlings that germinated were *Poa* spp. and would be considered undesirable at that level of presence. Twenty-eight forb species were identified of which 86% were considered undesirable (23 species) while 14% (5 species) were considered desirable natives [white prairie aster (*Aster ericoides* L.), wild strawberry (*Fragaria virginiana* Duchense), wood sorrel (*Oxalis* spp.), common evening primrose (*Oenothera biennis* L.) and black-eyed susan (*Rudbeckia hirta* L.)]. The competitive nature of leafy spurge and its high representation in the seedbank will present continuing control problems for revegetation efforts.

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Effects of Prescribed Burning and Herbicide Treatments on Leafy Spurge (*Euphorbia esula*)

Abstract. A 3-year experiment to evaluate herbicide treatments with prescribed burning to improve long-term leafy spurge (*Euphorbia esula* L.) control compared to herbicide alone was established on the Gilbert C. Grafton South Military Reservation in North Dakota. Six treatments were evaluated including an untreated control, prescribing fall burning with no herbicide, spring applied picloram (4-amino-3,5, 6-trichloro-2-pyridinecarboxylic acid) plus 2,4-D [(2,4-dichlorophenoxy) acetic acid] applied at 0.28 plus 1.1 kg ha^{-1} (normal) and unburned, spring applied picloram plus 2,4-D applied at 0.56 plus 1.1 kg ha^{-1} (heavy) and unburned, spring applied picloram plus 2,4-D applied at 0.28 plus 1.1 kg ha^{-1} following a fall burn, and spring applied picloram plus 2,4-D applied at 0.56 plus 1.1 kg ha^{-1} following a fall burn. A prescribed burn was conducted on the predetermined treatment plots in mid October of 1994 with herbicides applied in 1995 and 1996. Study objective was to evaluate burned and unburned treatments in conjunction with differing

rates of herbicide on leafy spurge control. All herbicide treatments, regardless of burning, reduced ($P<0.05$) the density of leafy spurge compared to the control. No differences ($P>0.05$) were noted between the burned and unburned plots after 12 months and 24 months on any treatment. Burning alone did not affect leafy spurge stem densities as new spring growth grew uniformly and with vigorous sprouting occurring following the fall prescribed burn. Leafy spurge stems were reduced ($P<0.05$) 69 % and 95 % on the normal and heavy herbicide rates of picloram plus 2,4-D on the burn treatment, respectively, compared to the control after 12 months of herbicide treatment. After 24 months of herbicide treatment on the burn plot, leafy spurge stems were reduced to 88% on the normal herbicide rate of picloram plus 2,4-D which was a reduction ($P<0.05$) of 19% compared to 12 months following treatment. No change ($P>0.05$) in leafy spurge stems was noted on the heavy rate of picloram plus 2,4-D between the 12 months and 24 months herbicide application on the burned treatments. Leafy spurge stems were reduced ($P<0.05$) 62% and 82% on the normal and heavy herbicide rates of picloram plus 2,4-D on the unburned treatments, respectively, compared to the control after 12 months of herbicide application. No change ($P>0.05$) in leafy spurge stems was noted on either the normal or heavy rates of picloram plus 2,4-D between the 12 months and 24 months following herbicide application on the unburned treatments. A fall prescribed burning program alone did not affect leafy spurge stem densities or improve herbicide control when compared to unburned treatments. However, fall prescribed burning did enhance leafy spurge control using picloram plus 2,4-D applied at 0.28 plus 1.1 kg ha^{-1} under a 2 year spraying program compared to unburned treatment results.

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Site Characteristics of Established Flea Beetle Colonies in Western North Dakota

Abstract. A total of 59 USDA-APHIS flea beetle release sites were located and evaluated in 1998 on the Little Missouri Grasslands near Medora, North Dakota. Five hundred flea beetles were released at each site during 1993, 1994, or 1995. Five flea beetle species were released: *Aphthona cyparissiae*, *A. czwaline / lacertosa, A. flava*, and *A. nigriscutis*. Physical characteristics of release sties measured were aspect, soil texture, landscape position and site micro-topography. Biological information recorded was control area, leafy spurge density and cover, and cover of co-dominant plant species in the control area. No pre-release site data was available. The data set was subjected to principal component analysis which reduced the dimensionality and eliminated random background variation. The number of significant PC's was determined using Fisher's Proportionality Test. No PC's were significant for any data set. However, area of leafy spurge control appeared to be the parameter with the greatest influence in graphically separating sample units (release sites). Nine sites having the greatest leafy spurge control (avg. 5,000 m^2) separated when plotted on an XY-graph. A stepwise comparison was then made on these nine sites to determine the magnitude of importance of each physical parameter. The physical site variables ranked from most to least importance are as follows: (1) aspect, (2) micro-topography, (3) landscape position, and (4) soil texture. The nine sites had aspects ranging from 90E to 270E, a micro-topography of level to convex, were located on the upper portion of the landscape (upland or summit), and had sandy to silty loam soil textures. These physical characteristics would all contribute to the nine successful release sites having warm and dry habitats for the larvae to live in.

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Molecular Pharming, Leafy Spurge and Viruses

Three years ago while I was still on the faculty at Purdue University, I attended a seminar on "molecular pharming." Molecular pharming is an off-shoot of biotechnology where plants are transformed with a gene (called a transgene) to achieve stable or transient expression of a recombinant protein (recall genes give rise to proteins). Most of the research in molecular pharming is aimed at producing very high-value products for use in human medicine, e.g., biopharmaceuticals. I was struck by how techniques in molecular pharming might be used to devise new approaches to weed management. Although I had not conducted research on leafy spurge since I left Montana State University more than 10 years ago, my first thought was about leafy spurge. Why? Because one of its close relatives — poinsettias — contains an endemic, non-pathogenic RNA virus. If this or some other virus could somehow be engineered to selectively attack leafy spurge, we might have another management tool.

The host plant and virus being used in research by BioSource Technology (Vacaville, CA) are tobacco and the tobacco mosaic virus (TMV), respectively. TMV and the Euphorbia mosaic virus fall into a class called RNA viruses. RNA viruses have advantages over DNA viruses for some applications because the transgene does not get incorporated into the genome of the host plant (tobacco or poinsettia). This virus uses the plant's cellular machinery to obtain gene expression for limited purposes or a limited period of time. At the time I saw the seminar on molecular pharming, the company had engineered a strain of TMV with reduced pathogenesis. Using this strain as a vector, they inserted (cloned) a variety of plant genes into the TMV, applied the modified TMV in the field, and examined the tobacco plants for interesting chemical or physical changes. They called this "phenotype fishing." Phenotype is the outward sign of gene expression. It occurred to me that phenotype fishing for a lethal phenotype might have some practical value in weed management.

The concept of using viruses to manage weeds has not received much attention although some weeds are secondary hosts for economically important plant pathogenic viruses. At the 2000 annual meeting of the Weed Science Society of America, I saw a presentation on using unmodified strains of TMV to control tropical soda apple. Tropical soda apple is an emerging invasive weed in parts of the southern United States and is in the same family as tobacco. An obstacle to exploring the concept of viruses as biological control agents is that

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