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Industrial By-product Research Continues

Russell Mathison, Agronomist

A paper mill was recently opened in Duluth that manufactures paper products from recycled paper. A by-product of this process is a sludge composed primarily of short cellulose fibers. The current method for disposing of this sludge is landfilling. A better disposal method may be applying the sludge to agricultural fields, thereby returning the valuable organic matter more quickly to the environment from which it came, and also keeping this material out of landfills which are becoming increasingly scarce due to their potential for adverse effects on our environment.

There are several potential benefits of applying paper mill sludge to agricultural systems in addition to the major environmental benefit of returning these organic compounds to the ecosystem. The sludge has some liming properties which can be very beneficial to crop production especially in northern Minnesota where acidic soils and acid rain are common. The sludge is primarily organic matter, and the addition of organic matter to soil can increase the nutrient and water holding capacity of the soil as well as promote beneficial activity of soil microbes.

One of the main problems involved with land spreading of sludges is their effect on the nitrogen economy of soils. Paper mill sludge is very high in carbon and low in nitrogen. The microbial decomposition of sludge requires nitrogen, more nitrogen than the sludge contains. Thus, if sludge is added to a cropping system, additional nitrogen must be added to the soil, both to satisfy the decomposition process and to satisfy the needs of a crop. One of the primary objectives in research on land-application of sludges is determining the amounts of additional nitrogen required. Also, sludge also has the potential to increase the biological oxygen demand in surface water, so sludge must be applied only in areas where it will not be washed into streams or lakes.

Deinked paper mill residue is applied at various rates to randomized plots in research at North Central.

Research is currently underway at the North Central Experiment Station to assess the agronomic benefits and environmental impacts of applying deinked, recycled paper mill sludge from Lake Superior Paper Industries plant in Duluth to cropping systems. Key components of the research include the use of a legume in the cropping system to minimize or eliminate the need for additional nitrogen and the use of organic sources to supply nitrogen when necessary, such as livestock manure. 1993 research results show that alfalfa dry matter and oat grain yield were significantly improved with the addition of paper mill sludge to the soil at rates of 30 and 45 tons per acre. Also, alfalfa dry matter yields were not improved by adding additional nitrogen. Soil pH was elevated from 5.8 to 6.3 with the addition of 30 tons per acre of sludge, and from 5.8 to 6.4 with the addition of 45 tons per acre. A study was begun in the fall of 1993 which will evaluate higher sludge application rates, another crop (corn), and additional nitrogen application rates. Data will also be collected on effects of sludge application on groundwater quality.

NOTICE

This is your last issue of *The North Central Quarterly* unless you have completed a renewal form. Please return the enclosed card to our office to remain on our mailing list.

Fall Planting Pansies For Spring Bloom

David K. Wildung, Horticulturist

In recent years there has been renewed interest in pansies. There have been three recent pansy All America winners—Jolly Joker, 1990; Padparadia, 1991; and Maxim Marina, 1991. In addition, 1993 was celebrated as the "Year of the Pansy" by the National Garden Bureau. Pansies are considered to be an excellent item for bedding plant sales and their use by gardeners is increasing.

Botanically pansies are a biennial or perennial plant but in most gardens they are grown as annuals (planted each year). They can reseed themselves and if snow protected, can survive our winters to bloom a second year. Because of their frost tolerance and preference for cooler temperatures, pansies make an excellent choice for northern Minnesota landscapes and gardens.

Recent breeding programs have developed new cultivars in almost every flower color imaginable from the vivid yellows, blues or even black, to the delicate pastel colors or mixes. Cultivars can be selected with flowers that can be either solid color, bicolors or have faces. The three All America winners mentioned above are examples of the color variations possible. Jolly Joker is a purple and orange bicolor, Pad-

paradja a solid dark orange, and Maxim Marina a dark and light blue bicolor with face. Each is very unique and shows great color variety from older cultivars. Gardeners can also select different flower sizes ranging from over two inches across down to one half inch across with the small viola mini pansies. Pansy breeders also have developed heat tolerance in cultivars that will bloom better during the heat of the summer. Finally, breeders are trying to develop cultivars that will over-winter and bloom well during a second season. It is this objective that we are evaluating at North Central Experiment Station.

During the spring of 1992 while visiting my daughter in Texas, I saw fall planted pansies blooming profusely in mid March. The idea of fall planting certainly is not a new one, but would it work with pansies in northern Minnesota? We decided to try fall planting. Seed planted about August 1, 1992, in the greenhouse resulted in small plants (less than 3 inches) that were transplanted outside at the end of September. The planting survived the winter and in the spring (1993) bloom started in early May and continued profusely into July. Plant growth, development and survival were excellent despite the very small plants with which we started. In 1993, another fall seeding was started in the greenhouse ten days earlier than in 1992, and this spring (1994) we will be evaluating 23 different cultivars transplanted both in the spring of 1993 and the fall of 1993 for survival and bloom. Part of the key to over-wintering pansies is having good snow cover, which we have had the last two winters. The true test of fall planting and over-wintering will occur when there is an open winter to cold stress the plants.

Pansy F_1 Maxim Marina

If you want to try fall planting you will probably have to start your own seed which can easily be done from late June to mid July. When the plants are 3 to 4 inches (anywhere from 8 to 10 weeks after seeding) they can be transplanted outside. These young plants usually have to suffer several hard freezes in late September and October, but they appear to be able to do so fairly well. Ideally, pansies should be planted in full sun but 7 will tolerate partial shade. For fall planting or overwintering also select a site that has fairly good snow cover most winters. As fall planting becomes more popular, the local garden stores probably will also have plants for sale in late summer and early fall.

While we have evaluated fall planting only one winter (1992-93), it appears very possible for northern Minnesota gardeners. Certainly the prospect of early spring flowers is exciting for home gardens and landscapes of Minnesota following our long cold winters.

New Aspen Research at the North Central Experiment Station

Bailian Li and Scott Enebak

Aspen breeding and research has been accelerated at The North Central Experiment Station with the initiation of two new research projects with grants from the Blandin Foundation and Blandin Paper Co.

Screening for Hypoxylon Canker Resistance. Of all the insects and diseases associated with aspen, Hypoxylon canker is one the most destructive disease of quaking aspen and its hybrids. Tree mortality and timber loss due to this fungus typically is 1 to 3% per year and is the limiting factor in the production of timber throughout Minnesota's aspen stands. Progress with the current aspen breeding program at the Aspen & Larch Genetic Cooperative is severely limited because disease resistant genotypes of aspen can not be identified in field progeny tests until they reach the age of 10 or beyond. If one could select for resistant genotypes at an earlier age, such as seedling stages, the aspen breeding program could be speeded up significantly. This would result in a much shorter breeding cycle as well as an increase in the genetic gain per unit of time spent per cycle. As part of the accelerated aspen breeding program, screening for hypoxylon canker resistance has been initiated with a grant from the Blandin Foundation. The objective of the new research is to evaluate the host-pathogen interaction during the first year of seedling growth. The goal is to develop a reliable technique for early screening for Hypoxylon canker resistant aspen.

A number of *Hypoxylon mammatum* isolates have been collected from aspen stands in Rosemount, MN and Appleton, WI where long-term hypoxylon infection data were collected. Differences in pathogen virulence among 28 isolates of *Hypoxylon mammatum* were determined using three culture media, an apple test and by inoculating aspen stems. Based on 30-year field progeny tests, putatively-resistant and -susceptible aspen material will be inoculated with a couple of isolates that differ in virulence. Gross morphological markers indicating resistance or susceptibility will be examined over time in the greenhouse. These include the rate of canker expansion, callus growth, branch death and the production of pigments on seedling stems. Ideally, the resistant/susceptible material may exhibit differences in host response to fungus which will correlate to their known field performance. These gross morphological markers will then be used when unknown aspen planting material is challenged with the pathogen. These planting materials can then be either used for future breeding programs or eliminated at an early age.

Aspen Propagation from Stem Cuttings. Increased pulpwood use has resulted in several Minnesota companies to plant short-rotation aspen and its hybrids on their lands to meet future demands. While fast-growing and disease resistant aspen clones have been developed by the Aspen & Larch Genetics Cooperative breeding program, their commercial use has been restricted somewhat by a limited seed supply and the inability to propagate aspen vegetatively. To develop a practical propagation system for its current aspen planting program, Blandin Paper Company has provided a grant of $30,000/year for two years for the research. The objective is to develop a commercially feasible propagation system using aspen stem cuttings.

Aspen can not be rooted from stem cutting like other poplar species. The propagation of aspen by greenwood cutting and tissue culture are possible, but the high cost and intensive labor associated with theses techniques make them impractical for large-scale commercial use. It is known that *Agrobacterium rhizogenes*, a common soil-inhabiting strain of bacteria, is capable of causing a proliferation of secondary roots as well as "hairy-root" in several woody species. This can be found both naturally in the field and done intentionally in the laboratory. The mechanism underlying the root induction is believed to be an increase in either auxin sensitivity or in endogenous auxin levels. This newest project at the Aspen & Larch Genetics Cooperative will screen several strains of *A. rhizogenes* for their potential to induce the formation of secondary roots on aspen micro-cuttings. The most effective strains will then be used to treat hardwood cuttings by dipping them in either a liquid suspension or to a solid agar media which have been inoculated with *Agrobacterium*. After infection, the bacteria will be eliminated from the hardwood cuttings by exposing them to either hot water or by raising the rooting soil temperature. The infected cuttings will then be rooted with traditional techniques in either greenhouse containers or on nursery beds. The techniques developed in this program should be easily transferred to commercial greenhouses and nurseries with a minimum adjustment in protocol. In addition, this technique could be adaptable to other difficult-to-root woody species which include many commercial fruit trees and conifer species.

Rotational Grazing is for All Species

Dan Brown

There has been a lot of talk, published material and research on intensive rotational grazing over the past few years. This effort has been mostly directed toward the dairy producer due to the reduction in costs and labor when compared to a conventional dry-lot system. It is rather easy to show the advantages, cost savings and effects on production for the dairy industry. It is not as clear cut for producers of other species which are already on a pasture system. How do you decide if intensive rotational grazing will work for you?

First, let's define intensive rotational grazing (IRG). This is a system in which livestock are in a grazing area that contains the forage they will consume in a short period of time—12 hours to two days. Animals are then removed from this area and return when the forage has reached a specific stage of development; this could be from 14 to 32 days depending upon the growing season and forage type. Livestock consume plants in a lush vegetative state, prior to maturation and not too early to reduce plant vigor and regrowth. The plant is also high in nutritional value. The rest period allows the forages to recuperate and maintain growth.

This type of grazing system takes additional labor and fencing when compared to turning stock out into a 40-acre pasture for the entire summer. Improvements in electrical fencing make such a system possible at a lower cost than in past years. There are advantages and problems that can be solved which may compensate for the increased input requirements.

Increased carrying capacity—higher return/acre

Rotationally grazed pastures, properly set up, should look like a haybine went through once the animals are removed. When stock return to re-graze the pasture, the plants are once again at a very palatable stage, reducing livestock's tendency to selectively graze plants. Selective grazing stresses the eaten plants and causes the uneaten plants to mature. Both reduce dry matter production of the pasture. Rotationally grazed pastures, properly fertilized, can yield up to 3 times greater than those under continuous grazing systems.

Higher nutritional value

As plants mature, nutritional value decreases (Fig 1). Always having forage available that is in a growth stage maintains a high quality for the grazer. This is especially important for younger animals which start getting a larger portion of their nutrition from grazing toward the middle or later part of the grazing season.

Weedy pastures & erosion

The grazing patterns of livestock under continuous grazing systems stress plants. These less vigorous plants can be choked out by weeds or lead to erosion on susceptible ground. Forages in rotational grazing shouldn't be as stressed and should be managed to create a heavier sod, preventing both problems.

Mid or late summer pasture decline

Regular growth cycles of forages (Fig. 2) show periods of reduced production, especially for cool season grasses which are the major pasture for northern Minnesota. Overgrazing during the periods of reduced growth can practically eliminate the early fall growth peak. Rotational grazing, planned ahead, will help maintain a forage supply with only cool season grasses or with the inclusion of a legume.

These are some of the advantages and problems that can be overcome with intensive rotational grazing. You must decide if any are reason enough for you to fine tune your pasture management. Your management level will definitely have to increase for this type of pasturing to work.

A rotational grazing system must be planned ahead with consideration for lanes, water access, ease of moving cattle, forage types available and other particulars in your production system. Talking to others who have been using rotational grazing is the best way to plan a system.

Perimeter fencing should always be solid type fencing material, barbed wire or woven wire. Lanes and divisional fences can be temporary or movable electric fencing. Low impedance, high energy electrical power units work best. Some animals may need to go through a training session in order to become accustomed to an electric fence prior to spring turnout. Fertilization of most pastures will be beneficial; but you will receive a higher return for that input under rotational grazing. Rotational grazing won't work well without proper soil nutrient levels.

Overgrazing or untimely grazing will reduce yields from your pastures. The number of animals and number of pastures must be matched to the forage available in order to allow adequate rest periods. Be prepared to harvest some of the small pastures for hay during periods of fast growth. Don't be discouraged if it takes a year or two to learn how to manage rotational grazing. Each year you will learn something to make the following year easier and more successful.

Research continues on rotational grazing management in areas of parasite control; forage species to utilize, including legume and warm season grasses for this area; and supplementation of feeder classes on pasture.

With time being a precious commodity for most people lately, you may hesitate to try a system that requires more from you. Look at the possible advantages; if you might benefit, lay out a plan for a small portion of your land under this type of pasture management. You may be able to develop a system that works very well with minimal time and truly enjoy the benefits of a properly managed pasture.

Figure 1

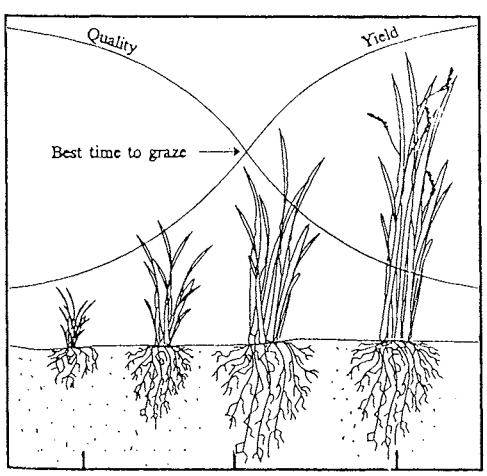
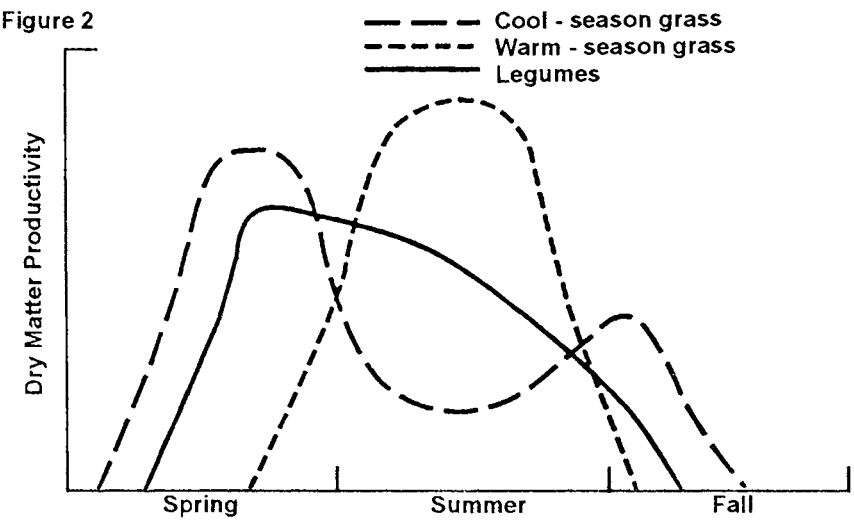


Figure 2



News from North Central

David L. Rabas

Ahh Spring! If you were like me you probably thought it would never come. By the time this issue of the *Quarterly* reaches you we will be in the middle of spring field work and at the beginning of what we hope will be another successful field, forest and horticultural crops research season.

Spring is an exciting time. We look forward to implementing the research plans we developed with our colleagues and coworkers this past winter. We join many of you as we observe our perennial plants in field and garden to see how well they have survived the winter. Our expectation is that the snow cover and more moderate March temperatures will result in limited winter injury on forage legumes and other perennials.

Spring also brings new life in our livestock research areas. Swine farrowings have continued throughout the year, but calving for our Angus cows and kidding in our Angora goat herd are springtime activities. Thus far this has been a good spring season for our livestock. The weather has been cool and relatively dry which prevents yard and disease problems associated with spring rain, wet snows and warmer temperatures.

We have begun the search process to fill the livestock/forage research position which has been vacant at our station for some time. Russ Mathison and Faye Mostoller from our NCES staff are on the search committee. If you have any comments or suggestions regarding the position, please communicate them to Russ or Faye. Bids have been let for our beef barn and yard facilities at our south farm. The barn will be 50 x 216 ft with eight pens and a handling area. The facility is designed to handle 160 to 180 cows and calves. Most of our beef herd will be housed at the south farm this coming winter.

Station research budgets continue to be extremely tight. We are becoming increasingly more dependent on grant funding to support our research programs. Our staff have been very successful in obtaining grant funding for new research. Grants are typically short term and therefore limit opportunities for long term research planning. Continued erosion of our state supported research base requires us to constantly reassess whether we can or should continue to sustain some of our existing research initiatives. We believe our ongoing research programs and new research initiatives into biological control of weeds, genetic factors relating to leanness and tenderness in beef, hybrid tree species for increased wood and fiber production, industrial by-product utilization, carrot production and dehydration, farm machinery safety, wild rice genetics, forest harvest management, environmental issues and forest/tourism interactions are important to our state and area and need to be continued.

Please pay special attention to the mailing list card contained in this issue. We are in the process of updating our mailing list and we don't want to lose any of our regular *Quarterly* readers. This will be your last chance to remain on our mailing list. Members of our advisory committee and contributors to our North Central Research Fund will automatically be retained on the list. We are asking our readers to help us bring our list up to date.

NSCA Alumni News

Tom Carpenter

Time has sure gone by; it seems like I just finished putting together something for the last *Quarterly*. I am finishing up on the reservation form for the NCSA Alumni Reunion on Saturday, July 16. We hope to have the letters in the mail before this article is printed. If you did not get one, contact me. It would be of great help if you could fill out and return your reservation as soon as possible. My biggest concern is having enough people here to be able to have a bus load to send on the tours. The busses are paid for by the hour; we will be leaving North Central between 9 and 9:30 for the morning tours and 1 and 1:30 for the afternoon tour. Weather permitting, we will have tours to the Hill Annex mine and Pokegama Lake in both the morning and afternoon. Alumni will be able to take both tours. Those that are waiting will have time to tour North Central Experiment Station.

I've also been trying to set up a photographer for the class picture. The price would be $7.50 for an 8x10 picture, including mailing to you. You will be asked on the reservation form if you would like a picture taken. If enough would like it, I can set it up and have us all together at one time.

So for now, be looking for and return your reservation. Please try to find classmates and bring them along. If there is anything of interest that you can think of, let me know.

Stanley H. Tweeten, class of 1929, passed away in Solway, Minnesota on November 12, 1992. We also heard from Donald Burt, class of 1935, that Walter Deeby from Verndale passed away in December of 1992. Walter worked with the horses while going to school and during the summer months at North Central.

North Central alumni met at Dan Dailey's in Apache Junction, Arizona, the end of January, according to a note from Walt Johnson. Alumni meeting for the noon pot luck with their spouses were Don Oyster, Louis Krieger, Walt Johnson, Alvin Reed, Velma (Charles) Gustafson, Roman Radniecki, Don Johnson, Bob Ober, Gene Duhamel and Paul Warble. Dave Radford, retired Carlton County extension agent, talked about the North Central Experiment Station Research Fund.

I would like to thank the individuals from NCSA alumni for their donation to help pay for the *Quarterly* postage. Thank you.

Hope to see you all July 16 for a fun day together.

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