UNIVERSITY OF MINNESOTA

The North Central Quarterly

Published by the North Central Experiment Station

GRAND RAPIDS, MINNESOTA NOVEMBER 1995 VOLUME 65 NUMBER 4

Controlling Plant Diseases on Wild Rice Without Fungicides

Robert Nyvall, Plant Pathologist

Fungal brown spot is a serious and confusing disease of cultivated wild rice. Cultivated wild rice is grown on about twenty-three thousand acres and contributes millions of dollars to Minnesota's economy, especially northern Minnesota. Fungal brown spot is capable of causing large losses of cultivated wild rice; indeed, antidotal evidence has suggested losses of 100 percent have occurred in the past.

One of the most confusing aspects of fungal brown spot is that it is really two different plant diseases caused by two different fungi. Historically, the two fungi were considered to cause the same disease. However, our research has shown that the two fungi, called *Bipolaris oryzae* and *B. sorokiniana*, each cause a different disease. Therefore, fungal brown spot was divided into two different diseases. The old name of fungal brown spot was retained for the disease caused by *B. oryzae* and spot blotch was the name given to the disease caused by *B. sorokiniana*. Spot blotch occurred early in the growing season and is normally not as severe as fungal brown spot. Fungal brown spot occurs late in the growing season and can be severe enough to destroy the crop before it can be harvested. The implication for this discovery is that not one disease is being controlled but two different diseases must be controlled. This often presents twice the problems.

Fungal brown spot can be controlled but at great expense At the present time, the only feasible control of this disease is applying fungicides at a cost of thirty-five dollars or more per acre. Additionally, my research in the past suggested that control with a fungicide was sometimes very erratic with unexpected results. There is also the very real danger the fungi may develop resistance to repeated use of the fungicide. When a pesticide is repeatedly applied to control a pest, regardless if its an insecticide to control insects or a fungicide that controls fungi, individuals within the insect or fungal populations will not be affected by the pesticide. Theoretically, within time these resistant individuals multiply and increase becomingly the largest component of the pest population. The effectiveness of the pesticide is then lost.

One aspect of my research has concentrated on where the causal fungi overwinter. If the overwintering site for the disease organisms is known, then theoretically the disease can be attacked when the causal fungi are most vulnerable. The ultimate result is to reduce the costs of controlling plant disease, to save the farmer money and reduce the wild rice grower's production costs.

Previously, the accepted idea was both fungi survive in infested crop residue. Theoretically the spores then originated from the mycelium that had successfully overwintered in the residue and were blown by wind to the susceptible wild rice plants. However there was a big problem with this theory. Fungi could not be isolated from the previous growing season's residue except at a very low incidence. Indeed, these causal fungi were rarely isolated from old residue and not in an incidence consistently large enough to account for inoculum that would cause disease the subsequent growing season. Where, then, were these fungi overwintering? To find the answer to this question it was necessary to take a look at the agronomic practices of a cultivated wild rice grower. The most important agronomic practice in this context was the flooding of the rice

Reed canarygrass growing around wild rice field.

paddies either in the autumn or early the next spring. Experiments were conducted to mimic this practice and it was quickly found that both fungi do not survive after a few weeks or even days immersed in water. Any fungi that survived this treatment survived-only in residue not immersed in water and appeared to survive in a higher incidence in residue in organic soil but not mineral soil. The exception to this is a "clump" of residue that may escape immersion in water or may float on top of the water. However, this is a rare occurrence in a flooded wild rice paddy.

The puzzle deepened. If disease did not originate from residue, where did it come from? Isolations from plants growing on paddy dikes have been conducted the last two years and the source of disease has probably been found in grasses that are commonly grown on these dikes. *Bipolaris sorokiniana* is a fungus with a wide host range and it was found, not surprisingly, in approximately one to five percent of the leaf spots found on the miscellaneous grasses growing on the dike. This fungus then originates in a low number of leaf spots on plants uniformly scattered around a field. *Bipolaris oryzae*, for the first time, was found to overwinter, not on all grasses, but more specifically in a low incidence, about one percent of leaf spots, on reed canarygrass. A grass that is commonly grown around many fields. Although the number of overwintering sites per plant may be low, the number of leaf spots per plant add up a large number of leaf spots surrounding a field. Additionally when the number of spores produced in each leaf spot is determined, the number of potential disease producing agents (spores) floating around a wild rice field is enormous.

The mystery of where the fungi overwinter seems to be solved. What are we going to do with this information? This remains to be determined but practices that destroy these sites will be investigated. Practices such as mowing, burning or applying small (and cheaper) amounts of fungicide to the dikes instead of the field may be the answer or answers. These destructive diseases can then be managed, saving the wild rice growers money.

Effects of Municipal Sludge on the Growth of Forest Tree Species and the Environment

Tim O'Brien, Forestry Research Plot Coordinator and Russ Mathison, Agronomist

Field studies evaluating the agronomic benefits and environmental impacts of industrial by-products applied to cropping systems have been conducted at the North Central Experiment Station since the mid-1980s. Pulp and paper companies produce millions of tons of sludge and ash every year in the United States, more than 70 percent of which are disposed of in landfills. Increasing expenses and the need to reduce landfill volume has initiated research into alternative ways to dispose of mill sludge and ash.

In 1995, the North Central Experiment Station, in cooperation with the City of Grand Rapids, Blandin Paper Compnay, the U of M Forest Vegetation Management Cooperative and the U of M Natural Resources Research Institute, established two research trials to evaluate the effects of Grand Rapids municipal sewage sludge (a mixture of approximately 90 percent paper mill sludge and 10 percent municipal waste) on the growth of forest tree species and the environment. One study will evaluate effects of sludge on containerized seedlings of white spruce (*Picea glauca*), Norway spruce (*Picea abies*), red pine (*Pinus resinosa*), and hybrid aspen *(Populus spp.)*. Preliminary greenhouse research indicated sludge acted as a mulch and inhibited weed seed germination and growth, which should enhance tree seedling growth. Decomposition of the sludge over time should add limited amounts of nutrients and organic matter increasing the overall productivity of coarse-textured forest soils. The second study will evaluate effects of sludge application on an aspen regeneration site. A regeneration site is an area which is allowed to regrow to native tree species, primarily aspen, after it has been logged. It is not known whether the inhibitory effect of sludge on weed seed germination and growth will also adversely affect aspen regeneration. Data to be collected will include seedling response, soil analysis, soil water analysis and weed competition.

Hopefully this research will identify management practices which will reduce the need to dispose of environmentally safe industrial by-products in landfills. Reapplying paper mill sludge to the forest area it originally came from may be an effective means of completely recycling the huge amounts of paper used by our modern society.

Dr. Gene Galletta, USDA, Beltsville MD (kneeling) and Ron Remington, Minnesota Agriculture in the Classroom summer assistant scientist.

Minnesota Agriculture in the Classroom

David K. Wildung, Horticulturist

This past summer I had the pleasure of working with and advising Ron Remington, a fifth grade science teacher from Annandale. Ron was one of four science teachers who completed internships at North Central Experiment Station in a program jointly sponsored by the University of Minnesota Agricultural Experiment Station and Minnesota Agriculture in the Classroom. I found the program to be both rewarding and stimulating. As Ron completed his program with us I asked him to write a report and evaluation of his experience during his internship. What follows is a summary of that report.

Ron Remington - Fifth Grade Teacher
Annandale Middle School - Annandale, MN

I was given the opportunity to be an assistant scientist with the North Central Experiment Station through a program for teachers called Agriculture in the Classroom. As a fifth grade science teacher, I have an interest in many areas of science. The area of horticulture seemed especially intriguing to me because of a unit we teach on the environment through the F.O.S.S. science program. I have taught school in the Annandale School District for the past 27 years and I looked forward to being offered the three-week training in the Grand Rapids area where I grew up.

When I arrived at North Central Experiment Station I immediately went to work in the strawberry fields under the guidance of Horticulturist, Dr. Dave Wildung and Fruit Breeder, Dr. Jim Luby. I had a very quick indoctrination into the strawberry fruit evaluation methods. Later in the day I had a chance to meet and work with one of the world's top strawberry experts, Dr. Gene Galletta, USDA, Beltsville, MD. He flew in from Maryland to look at this year's strawberry crop and lend his expertise in evaluating breeding selections and cultivars. Dr. Galletta was a real joy to work with and he certainly started me in the right direction by helping me understand the many qualities and characteristics that make a good strawberry cultivar. For almost a week I rated strawberries for their fruit qualities by picking clusters and testing individual fruit. Glooscap, Kent, Cavendish and Annapolis strawberry cultivars quickly became part of my everyday vocabulary after going through the strawberry plots. I ended my strawberry work by evaluating plant vigor, stand and diseases. Most of our ratings were based on a 0-9 scale, which I grew very accustomed to.

Next I was introduced to blueberries by Kay Sargent, Horticulture Scientist, and spent several days rating fruit qualities of the many blueberry breeding lines. I also had an opportunity to collect and stick blueberry cuttings of breeding selections for later field evaluation.

During the last week of my extensive horticulture training I had a chance to identify ornamental trees and shrubs, go through the experiment station orchard, evaluate the wide variety of flowers and, on the last day, I got a chance to look at the potential yield of the tomato plants.

Dr. Wildung introduced me to many different plants and gave me an understanding of the scientific process used to select the best horticultural methods and test top quality fruits and vegetables. A strawberry mulch removal study was a very good example of the use of the scientific method and led me to understand how horticulturalists introduce variables and collect data to complete a study. In this study, the science of phenology was used to determine when the best time is to remove spring mulch from strawberry plants for the best growth and highest yields. During my internship I observed many types of plant diseases and have a greater respect for the many problems faced by scientists and farmers.

There are many things that I have gained personally from being an assistant scientist at NCES. I have enjoyed the experience of working with scientists and I have felt like I was part of the scientific process because of the respect that others showed me. The benefits to the growers that I have observed are astounding. It has been a real pleasure to work with such dedicated people as Tom Carpenter, Kay Sargent, and Carol Cooper and I have enjoyed getting to know many of the other workers. I was very fortunate to work with Dr. Wildung and gained from his dedicated attitude toward his profession and concern for relating what I learned in the field to what I would do in the classroom. I have gotten many ideas that I can use with my fifth graders in science and many other areas of the curriculum.

I would highly recommend this program to science teachers. It was a terrific way to gain an understanding of what a scientist does on an every day basis. I discovered that the field work, including rigorous note taking, is extremely important. Data collecting and processing the data are certainly a major part of the scientific process. I have taken college courses that did not have the same value to me. I would encourage the University of Minnesota to continue this program and I know there are many possibilities of how this can be expanded upon in the future. I would recommend that the assistant scientists have a chance to get together and share what they have learned. It was a most enjoyable fifteen days to be back in northern Minnesota where my "roots" are.

25 Years of Service

Dr. David Wildung and Dr. David Rabas were recently recognized for 25 years of service to our experiment station. Dr. Wildung joined the NCES staff as a research horticulturist in 1970. He received his Ph.D. in Horticulture from the University of Minnesota in 1972. His current research concentrates on cultural management systems for small fruits and vegetables.

Dr. Rabas began his work at NCES in 1970 as a research agronomist. He received his Ph.D. in Agronomy from the University of Minnesota in 1970. His agronomy research concentrated on management systems for the production and utilization of legumes and grasses for pasture and stored forage. He was appointed Head of NCES April 1, 1991.

Joe Rust, Professor Emeritus (center) presents plaques for 25 years of service to NCES to David Wildung, Horticulturist (right) and David Rabas, Agronomist/Head (left)

News from North Central

David Rabas

The arrival of winter brings an end to another interesting summer season at NCES. Thirty rainy days in July through August and the mud of October made it easy to forget how hot and dry June had been. As usual, making hay was difficult. Wet spots reduced small grain yields but frequent moisture in summer kept pastures growing and warmer temperatures helped corn crops mature.

Summer field days in Horticulture, Agronomy and Animal Science were well attended and stimulated a lot of interest in research plans and projects for the 1996 season.

The NCES Advisory Committee met on October 25 to review station research programs. The names of several new committee members were forwarded to the Director of the Minnesota Agricultural Experiment Station for approval. Recommended new members include: John Gunvalson, Gonvick; George Sherzer, White Earth; Bob Olen, Duluth; Willy Lindquist, Kelliher; Dan Jordan, Chisholm, and Tim O'Hara, Duluth. Advisory committee members heard reports from station scientists and made suggestions for new research goals and directions. Thank you to the advisory committee for their support of our research and outreach programs and a special welcome to our new committee members.

We are beginning a strategic planning process at NCES to set the direction and goals for the station as we prepare to enter the next century and the second one hundred years of NCES. Readers are encouraged to comment on our station's current activities and to suggest directions and opportunities for future research and outreach activities to be included in our strategic plan.

In December our planning process for the celebration of our station's first one hundred years will begin. The station will be one hundred years old in April of 1996 and a celebration will be held in July when many of our friends from the School of Agriculture can attend. Please let us know if you have information that would be interesting for the centennial or would like to work on centennial activities. Your ideas and suggestions on how to recognize this significant milestone will be appreciated.

On behalf of the staff at NCES, I want to wish all our readers a very happy Christmas season and a peaceful and rewarding new year!

Seasons  *Greetings*

The North Central Quarterly
Issued by
THE UNIVERSITY OF MINNESOTA
North Central Experiment Station
1861 Hwy. 169 East
Grand Rapids, Minnesota 55744-3396
218-327-4490
DR. DAVID L. RABAS
Head
Published February, April, July, November
ISSN 0199-6347
by the North Central
Experiment Station
Grand Rapids, Minnesota

Second-class postage paid at Grand Rapids, Minnesota

MARLYS MCGUIRE
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ST PAUL MN 55108