FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Inside Agroforestry

USDA Forest Service, Lincoln, Nebraska

Winter, 1993

Helping Trees Combat 2,4-D

Across the Great Plains, it is not uncommon to see many deformed trees with twisted young shoots and thin, abnormal leaves. These are the typical symptoms of 2,4-D injury.

Air drift of 2,4-D, commonly used to control broadleaved weeds in wheat crops, has caused severe damage to many trees in windbreaks, shelterbelts, and home yards. Some of the most sensitive trees include Siberian and American elm, boxelder, silver maple, and green ash. Many other woody ornamentals are susceptible to the damage as well. 2,4-D may also cause damage to tree roots and pollute ground water.

Thousands of trees in the Great Plains, particularly boxelder and Siberian elm, have died. The final cause of death is not certain, but many scientists believe that 2,4-D is the primary damaging agent.

The problem with 2,4-D has existed for decades and has not yet been solved through traditional research. Now with biotechnology, it may be possible to develop trees resistant to 2,4-D. Dr. Zongming Cheng, Assistant Professor, Department of Horticulture and Forestry at North Dakota State University is attempting to solve this problem by engineering trees with a 2,4-D degradation gene. The gene (a piece of DNA) originally came from bacterium in 2,4-D contaminated soils both in the United States and in Germany. The bacteria with the gene produces an enzyme called 2,4-D monooxygenase, which will break down the 2,4-D into a non-toxic form. With sophisticated laboratory techniques, this gene has been isolated from bacteria and sucessfully transferred into some plants. It has been demonstrated that tobacco and cotton plants containing the gene are resistant to 2,4-D at a level of 10 times of that applied as a weed killer, while normal plants are sensitive to 1/100 of the commercial level.

Dr. Cheng believes that this genetic engineering technology in tobacco and cotton can be applied to trees. When a tree contains this gene, the tree will degrade the 2,4-D into a non-toxic form. Currently, his lab is working on Siberian elm as a model species with a 2,4-D degradation gene that he obtained from Germany.

There are several steps and tests to develop 2,4-D resistant trees. The lab is currently developing a transformation system to genetically engineer Siberian elm, the most difficult part of

(See 2,4-D on page 5)

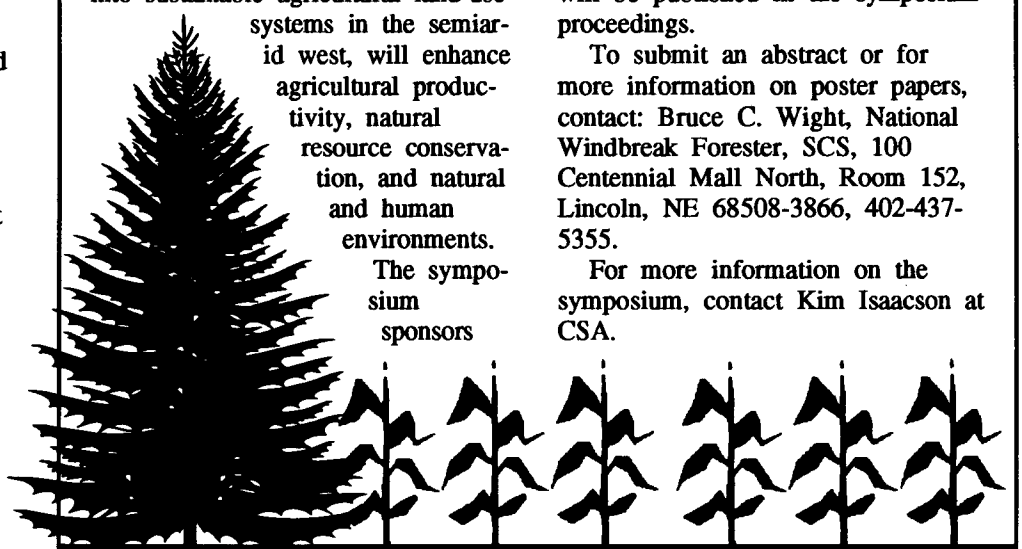
Agroforestry and Sustainable Systems Symposium -- Call for Poster Papers

Agroforestry and Sustainable Systems, a symposium designed for researchers, practitioners, technical specialists, and educators, will be held August 7-10, 1994, in Fort Collins, Colorado. Invited speakers will focus on how trees, integrated into sustainable agricultural land-use systems in the semiarid west, will enhance agricultural productivity, natural resource conservation, and natural and human environments.

The symposium sponsors invite proposals for volunteer poster papers that address the general theme of *Agroforestry and Sustainable Systems.* Proposals must be submitted for approval by April 15, 1994. A one-page summary of poster papers, due June 1, 1994, will be published in the symposium proceedings.

To submit an abstract or for more information on poster papers, contact: Bruce C. Wight, National Windbreak Forester, SCS, 100 Centennial Mall North, Room 152, Lincoln, NE 68508-3866, 402-437-5355.

For more information on the symposium, contact Kim Isaacson at CSA.



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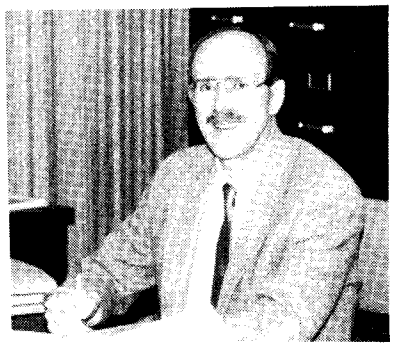


Message From the Manager

A column of important events and programs as reported by CSA Program Manager Bill Rietveld

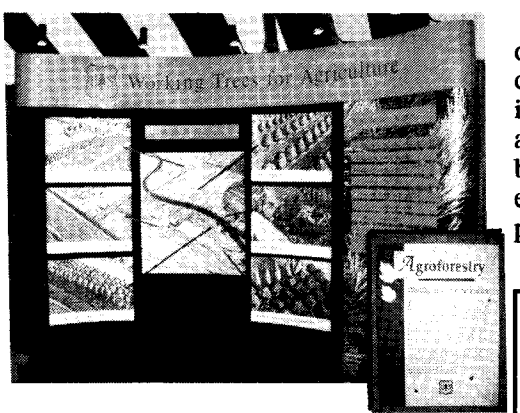
Getting the Word Out

1994 will be a big year for CSA's Technology Transfer and Applications Program. You will be seeing and hearing a lot more about agroforestry in the near future -- thanks to program funding from State & Private Forestry, hard work from the CSA Technology Transfer Team led by Program Leader Jerry Bratton, and strong involvement from many partners and cooperators. New products include: 1) a portable display and leaflet titled *Agroforestry--Working Trees for Agriculture,* which are available to you (see article below); 2) *Agroforestry Notes,* a new application notes series that will debut in 1994; 3) a symposium, *Agroforestry and Sustainable Systems* which will be held August 7-10, 1994 (see article on page 1); 4) a training workshop on Applications of New Conservation Forestry Technologies will be held for Region 2 State Forestry agencies and cooperators; 5) *Green Side Up,* a new training video on conservation tree planting will be available soon; and 6) cooperative agroforestry demonstrations that will continue to be established with additional support from EPA as a new partner.

In addition to these activities, I would also like to mention that a new 32-page booklet called *Conservation Trees for Your Farm, Family, and Future* is available free from the National Arbor Day Foundation. The booklet provides information on 12 conservation forestry practices and their benefits, and it tells where to go for assistance. A new set of conservation trees public service announcements by John Denver was also mailed to every radio station in the United States. This public information and education program is targeted at increasing landowner understanding and use of conservation forestry practices (see article below).

The details on most of these technology transfer and public information and education activities are provided elsewhere in this issue of *IA.* I just wanted to mention them as examples of how we (the Center, together with many partners and cooperators) are fulfilling our commitment to effective technology transfer and strong customer service. Research is important, but it's not enough. Development, applications, demonstrations, and technology transfer to facilitate getting new technologies and information into practice are equally important components of the process. And this is most effectively done through cooperation, partnerships, and strong customer involvement. Let us know if you have any suggestions for future activities.

Working Trees for Agriculture Leaflet and Display



CSA has an 8-foot by 10-foot portable display that is available for your use. It graphically depicts various agroforestry practices and what the benefits are. It is attractive, easy to set up, and a perfect demonstration tool to aid natural resource professionals in informing and educating landowners. Great at fairs, meetings, or the office lobby.

An 8 1/2 by 11 trifold leaflet is also available, either to accompany the display or by itself. It parallels the display, with added depth in explaining the concept of "working trees for agriculture", and the practices and benefits of agroforestry. It is another excellent tool for natural resource professionals.

The display and the leaflet were developed by the Center for Semiarid Agroforestry and the Northeastern Area, State and Private Forestry in a cooperative effort. If you have an event that you would like to schedule the display for or want copies of the leaflet, contact Kim Isaacson at the Center.

New Booklet Available From Arbor Day Foundation

Conservation Trees for Your Farm, Family, and Future, a new 32-page booklet explaining the features and benefits of 12 conservation forestry practices and where to go for assistance is now available from the National Arbor Day Foundation. Public Service announcements by John Denver have also been mailed to radio stations across the Nation.

The booklet along with the PSA's will help educate and encourage all Americans who have a stake in the land to plant and care for conservation trees.

If you would a like copy of this booklet or want more information, contact The National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410, 402-474-5655.

Tree Buffers--Following the Fall of the Conservation Reserve Program

By Dr. A. Louis Licht, Ph.D., P.E.
Associate Research Scientist, Adjunct Assistant Professor
University of Iowa

Dr. Licht's research interests include nonpoint pollution control, solid waste management, and landfill management using plant systems in buffers and caps. His research has focused on the impacts of riparian tree buffers to remove fertilizer and sediment from water leaving farmed fields and in landfill closure and leachate management using planted tree covers.

Dr. Licht is President of Ecolotree, Inc., a company that plants trees for environmental benefits. He also owns a farm that is being planted to stabilize the soils and maintain clean water using these tree-based techniques.

"The needs and opportunities for agroforestry science and practice must be summarized NOW in order to be prepared for the imminent 1995 Farm Bill debate."

--Dr. Louis A. Licht

The Latest National Academy of Sciences Report

In November, 1993, the National Academy of Sciences (NAS) released a report titled *Soil and Water Quality: An Agenda for Agriculture.* The NAS Board on Agriculture, centered the report around this mission: **Humans must improve the environmental performance of agriculture but still profitably grow the renewable raw products so fundamental to prosperity.** In pursuit of this theme, the NAS report lists four objectives that must be simultaneously and holistically implemented:

1) Conserve and enhance soil quality as a fundamental first step to environmental improvement;

2) Increase efficiency and minimize use of pesticides and mineral fertilizers applied to the land;

3) Increase the resistance of farming systems to erosion and runoff (particularly to the heavy rain or snow melt events that do the majority of erosion and damage); and

4) Use more field and riparian buffer zones to reduce delivery of nonpoint pollutants to streams, stabilize stream banks, and grow wildlife habitat.

The ultimate goal is a win-win situation for farm profitability and stability in agricultural ecosystems.

How will this work be financed? It is recommended that crop investment be substantially paid for by harvested value based on commodity markets. Thus the money comes from the private sector, not government subsidies.

When must this program be implemented? Now! Action now stems the negative impacts from agricultural nonpoint pollution, the general malaise in the rural economy (now based on very few over-produced commodities), and the eroding land.

The Conservation Reserve Program Started Land Conversion

The Conservation Reserve Program (CRP) provided a good start in changing agriculture toward the NRC objectives. The 1985 and 1990 Food Security Acts authorized the CRP. The CRP's listed objectives were to:

1) Reduce soil erosion from highly erodible cropland;

2) Protect long-term agricultural productivity;

3) Reduce sediment deposition in streams, ponds, reservoirs, and ditches;

4) Improve runoff water quality by reducing fertilizer and pesticide use;

5) Develop, diversify, and protect wildlife habitat to increase populations;

6) Curb production of surplus annually harvested commodities; and

7) Provide some needed income support for farmers caught in a major recession.

Between 1986 and 1992, farmers enrolled 35.4 million acres of land into CRP 10-year contracts. Farmers converted these reserved acres from erosive, annually tilled crops to perennial plants. The normal CRP crop options were domestic grasses, native prairie plants, wildlife habitat shrubs, and forest trees. Harvesting of feed, seed, human food, or wood products were not permitted during the duration of the 10-year contract.

Farm owners in the upper midwest enrolled 10 million acres (MN-1,900,000 acres; IA-2,100,000 acres; SD-2,100,000 acres; WI-700,000 acres; and ND-3,200,000 acres). The annual rental payment from this 10 million acres amounts to $480,000,000+/-, or an average rent of $48 per acre per year; Iowa has the highest average of $80 per acre per year.

In 1990, the Soil and Water Conservation Society surveyed 2,000 CRP contract holders. The average landowner was 57 years old, had a high school education, owned and operated 323 acres, and produced less than 50 percent of the household income by farming.

Conservation Reserve Program Impacts

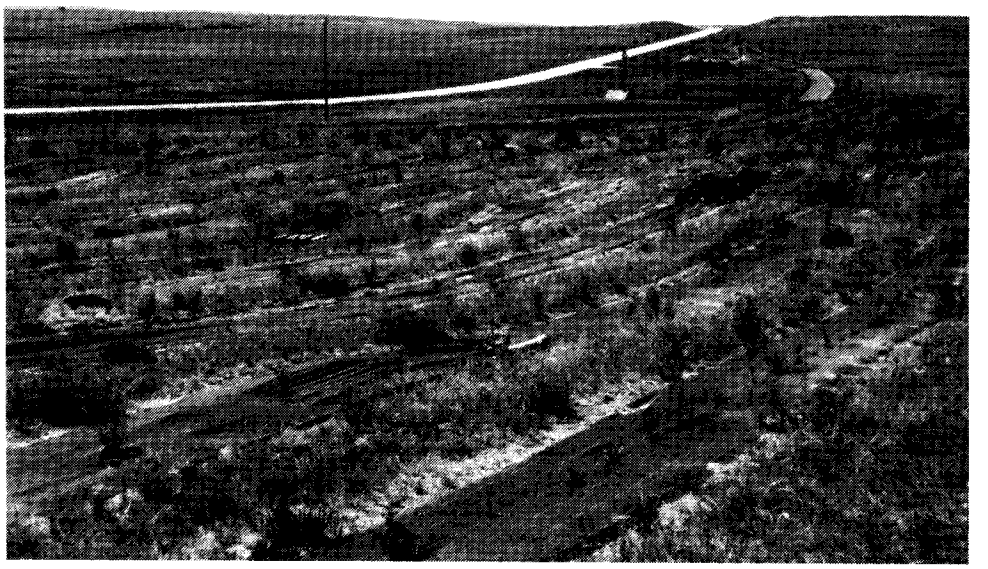
Nationally, over 21,000,000 acres are now planted to domestic grasses, almost 59.3 percent of the total program. There are 8,000,000 acres of native prairie plant species, 2,000,000 acres of wildlife plantings, and fewer than 700,000 acres of filter strips and windbreaks. A disappointing 2,500,000 CRP acres were planted with trees, less than seven percent of the CRP. The USDA offered financial and technical assistance through the USDA-SCS and State Natural Resource Agencies for tree planting, including a five-year CRP contract extention for tree-planted acres. Yet, many farmers remained unconvinced that trees would offer sufficient return and flexability when the contract expired.

Unfortunately, the CRP wasn't condusive for a strong rural farm economy. The value paid to the landowner was usually 30 to 40 percent of the income produced by the annual crop. Though this value may have equalled the profit of farming, it reduced the money that supported the farm-supported businesses in small towns. CRP supported few new farmers, or few new rural industries. Arguably, the CRP supported even more absentee land ownership, took more land out of harvestable crop production, and did not provide long-term stability to the erodible landscape.

Once the 10-year CRP contract has expired, farmers can legally remove any and all of these plantings. A farmer can benefit by replanting the CRP acreage to corn, thereby adding land to a farm's corn base which increases the farm's value for loan collateral. The grasses can be removed simply by the pass of a plow and herbicide application before a corn/soybean crop rotation is reestablished. Is it possible for the land to revert from perennial

(See Buffers on page 5)

11-Row Living Snowfence to Protect Harrison, Nebraska



A living snowfence that stretches 1,700 feet and consists of 2,900 trees and shrubs was established to protect Harrison, Nebraska from severe Great Plains winters.

Editor's note: The Agroforestry Center is working with numerous cooperators throughout the Great Plains to establish demonstrations of needed agroforestry practices under local conditions. This article illustrates the value that the demonstrations will have to the economy, environment, and people.

Harrison, Nebraska, is a hard-working ranch community located on the wind-swept prairies of northern Sioux County where the summers are short and the winters are long. Winters in the Great Plains can be quite severe and this is especially true of Harrison, Nebraska's most northwestern community. Often times, blizzards out of Wyoming will paralyze the community, leaving the town and its citizens snowbound and isolated, due to snow-blocked roads.

However, Harrison has begun to combat it's recurring snow problems. Part of the answer to this problem lies in catching and trapping wind-driven snow before it reaches the community. To accomplish this, an 11-row windbreak ("living snowfence") has been established to protect the north and west half of town.

In the spring of 1992, a livestock fence was constructed to keep cattle from the adjacent summer grazing pasture out. About 2,900 trees and shrubs made up of 20 different species of conifers, hardwoods, and shrubs were planted, and water conservation mulch was laid. Several groups came together to get the 1,700-foot long greenbelt project off the ground. They include the Nebraska Forest Service, Harrison Community Club, Harrison Volunteer Fire Department, Sioux County High School, City of Harrison, Soil Conservation Service, Agricultural Stabilization and Conservation Service, Upper Niobrara White Natural Resources District, Nebraska Department of Roads, Sioux Cooperative Extension Service, Pine Ridge Job Corp, landowner Duane Pullen, and CSA.

According to Doak Nickerson, District and Extension Forester for the Nebraska Panhandle, Harrison is located in a very hostile environment. Its high elevation and short grass prairie landscape, coupled with strong winds from Wyoming, make the wide windbreak a necessity. Once the windbreak has matured, Harrison will not only be able to function during the winter months, but residents will see a reduction in utility bills and energy consumption as well as lower snow removal bills.

To date, the windbreak has seen a 90+ percent overall survival rate. This is due, in part, to all of the precipitation that the Midwest received this spring and summer. Nickerson added that everyone in town knows about the windbreak and is very excited about it. It has already received an A+ from most residents and business people. In fact, the windbreak has received such high marks so far that the planting site is already prepared for the next phase of the project, which will create an "L"-shaped windbreak around town.

Though the project is long term, Nickerson hopes to eventually plant a greenbelt system around the entire community of Harrison for both added protection and landscape beautification. He also plans to use the windbreak for more than just wind and snow protection. For example, local schools hope to get involved by using the belt as an outdoor classroom and laboratory. It will also be used for field tours, for workshops, for media features, and as an example to surrounding communities and landowners of the benefits of windbreaks.

Much of the credit for the success of the Harrison Green Belt project goes to Doak Nickerson. He was instrumental in the planning, coordination, and implementation of the first phase and continues to oversee future progress of Harrison's Greenbelt. Thank you, Doak.

Clear Your Guilty Christmas Memories

If your family was among the 36 million that purchased a real Christmas tree this past year, you can now clear your conscience because the tradition is both environmentally correct and even patriotic. According to the National Christmas Tree Association, 90 percent of all Christmas trees are grown on some 15,000 plantations, many of which are family operations. These tree farms are found in all 50 states and employ 100,000 people full or part time. Artificial trees, on the other hand, are manufactured mostly in Korea, Taiwan, and Hong Kong, and are usually made of non-biodegradable plastics and metals. The association points out that for each real Christmas tree harvested, two or three seedlings are quickly planted in its place. Since young trees in their rapid growth years have a high rate of photosynthesis, just one acre of Christmas trees produces the daily oxygen requirement for 18 people. With approximately one million acres dedicated to Christmas tree production in the United States, this translates to oxygen for 18 million people every day.

Source: Arbor Day, November/December, 1993

(Buffers from page 3)

polycultures that reduce erosion to anually tilled, overproduced carbohydrate and protein commodities? Because of contouring and crop residue management, no-till corn/soybean rotations may leak less than fall moldboard plowing. However, farm managers cannot hope to hold the soil and a sustainable future with annually tilled row crops on highly erodible land, and the population downstream does not want the pollutants in the runoff.

The Challenge of Commercial Products from Perennial Buffers

Assuming annual crops will always be required for food, forage, and industrial feedstocks, a sustainable agriculture can be achieved by including buffers strategically laced across the annually tilled landscape. These buffers will allow the maximum value from the harvested crop and still maintain ecosystem stability. Strategic buffer strips mean placing trees and grasses at the following locations:

Riparian Buffers - ranging from two to 35 meters (six to 120 feet) wide planted next to streams to act as the final sediment, organic pesticide, and fertilizer filter. If 80 percent of all Iowa streams were buffered with four-row poplar buffers, it would require an estimated 600,000 acres of land.

Livestock Manure Buffers - ranging from 10 to 60 meters (33 to 200 feet) wide planted downgradient of confined livestock operations to act as the final manure filter, odor trap, and shelter windbreak.

Field Terrace Buffers - ranging from one to three meters (three to 10 feet) wide planted on the field contour instead of more expensive graded terraces to intercept runoff and to act as a midfield filter that redistributes and slows eroding water and shelters downwind crops. A mile-long, two-row terrace buffer would take 1.2 acres of land.

Water Supply Buffers - surrounding well heads and infiltration galleries that supply water for communities.

Waste Water Buffers - that provide the final filter for removing nutrients (nitrogen and phosphorus) and organic matter before urban waste water finally enters a stream.

Buffers in the 1995 Farm Bill

The 1995 Farm Bill written by Congress defines regulations effecting agricultural commodity subsidies and markets for five years. If subsidies given to erosive annually-tilled crops are removed, and alternative perennial crops can equally compete for the photosynthetic space, then farmers can grow a more stable, less polluting agricultural landscape.

Ultimately, buffered agricultural land puts less pollutant in the water supply, thus reducing the complaints of downstream consumers now facing stricter federal requirements for tap water quality. Ultimately, buffered soils erode slower off the field. Ultimately, trees and grass can build a more diverse habitat which strengthens wildlife populations. Ultimately, a more diverse agricultural harvest leads to more options for new renewable products, adding value to the farm, the rural community, the region, the state, and the nation. New fuels, building materials, industrial raw materials, and recreation opportunities will result; all are essential for the next conventional agriculture.

Modern farmers want all of these benefits, especially if they can add wealth to their farm and stability to their land. It seems almost too simplistic to think that fast growing perennial tree buffers could be a major factor in turning around the fortune's of farming. Exactly right!

The needs and opportunities for agroforestry science and practice must be summarized NOW in order to be prepared for the imminent 1995 Farm Bill debate.

Cowboy Trees

by Jerry Bratton
CSA Technology Transfer Program Leader

Out on my range in the winter, ole boy
we cowboys get frozen and cold.
The wind tears our clothes, the snow stings our eyes
and the freeze numbs our fingers and toes.

Old slim, my best hand, is thin as a rail
and the cold makes his blackened teeth rattle.
Out on the range with just shortgrass to shield
it's so bad he gets froze to his saddle.

The snow gets so deep in the corral and the pens
it fills up my boots on my feet.
The hairs on my chest freeze to my shirt
and my ears get as red as a beet.

I used to think cowboys didn't need trees,
they just took up space from my grass.
But the snow and the wind took their toll on me
I lost beefs, even cowboys in past.

Well that gov'ment man came by one day
and said we could improve our "sitiation."
We could plant windbreak trees in orderly rows
and take away the cold aggravation.

So I planted those trees hopin' they'd work
and believe me I sing a new song.
My cattle are fatter, my wife loves me more
I'm healthier, I'm even strong.

The ole' hoss I ride is really cold backed
when the cold winter winds are a howlin'.
But he settles right down, gives me some slack
'cause of trees we ride in when we're cowin'.

So believe me old' hoss, you'll never regret
plantin' those wind breakin' trees.
If you live in a land where the wind never quits
you'd better get down on your knees
and thank the good Lord for the gift of the tree.
Just hope that he gave you the smart
to plant 'em to break the wind and the cold
and you'll finally be doin' your part!

(2,4-D from page 1)

this entire process. After this system is established, the 2,4-D degradation gene can be introduced into Siberian elm relatively easily. It will take a few more years of testing before they have confirmed 2,4-D resistant Siberian elms.

If Dr. Cheng and his team are successful in developing such Siberian elms, they will be able to answer several very important questions. By comparing 2,4-D resistant and susceptible trees, they can determine how much damage 2,4-D has actually caused to trees. Also, to what extent. The final challenge will be to successfully release a genetically engineered herbicide-resistant tree. Can we utilize these engineered trees to remediate 2,4-D pollution to air and underground water?

Source: The Windbreak Demonstrator, NDSU, July-September, 1993