USDA National Agroforestry Center

Inside Agroforestry

Spring 2003

Windbreaks are by far the most common agroforestry practice in the U.S. But, as you will read in this issue, windbreaks are utilized in many uncommon ways.

Windbreaks transform South Carolina county

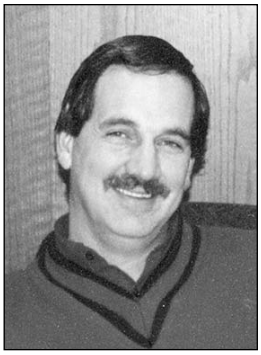
Bruce Wight
NAC NRCS Agroforester
Lincoln, Nebraska

Clouds of dust and blowing soil are usually associated with the Great Plains Dust Bowl of the 1930's and not the coastal plain of South Carolina. However, the mid-1960's saw significant dust storms on the sandy soils in Marlboro County in northeastern South Carolina. "In the past, this area was considered a garden spot with above average land values and cotton growers who won production contests. But, homeowners started complaining about the 'dust and grit' in their houses and damage to their paint from sandblasting," according to 'Bunny' Anderson, District Conservationist (retired) with the Natural Resources Conservation Service (NRCS). The blowing soil was also damaging the cotton crop.

This map, circa 1967, details the Hebron Community-wide windbreak plan. Approximately 55 landowners set pine windbreaks to protect 3500 acres.

see **SOUTH CAROLINA** on page 7

Inside



NAC Director's Corner

A commentary on the status of agroforestry by NAC Director, Dr. Greg Ruark

Windbreak applications are widespread and varied

In the United States, windbreaks have been recognized for their ability to help control soil erosion since the Dust Bowl days of the 1930s. Today, windbreaks are still commonly planted and maintained on agricultural lands in the Central and Great Plains. What is less obvious is how widespread their application has become nationally. This issue of *Inside Agroforestry* highlights some of these examples. In the Southeast, windbreaks are being used in a coordinated fashion in one county to control wind erosion of sandy soils and protect crops and homes from being sandblasted. In the Northwest, "living snowfences" are being used to keep roads, communities, and farmyards free of drifting snow. In the Northeast, many types of specialty forest products are being grown in association with windbreak plantings. In Puerto Rico, windbreaks have been shown to improve pollination efforts by honey bees that would otherwise struggle against strong winds. In Hawaii, most agricultural crops need protection from the prevailing trade winds that constantly challenge the islands. Although windbreaks frequently provide multiple benefits, there are situations, like native grasslands, where tree planting may not be appropriate. Consequently, we asked a grassland ecologist to discuss situations when tree planting needs to be carefully thought out and, in fact, may not always be a good thing.

"Idaho has been averaging approximately 265,000 feet (50 miles) of windbreak annually."

Growing training program, growing windbreaks

Dan Ogle
NRCS Plant Materials Specialist
Boise, Idaho

Idaho has an aggressive technology transfer program including training (commonly one-day sessions) and the development of technical information to ensure proper planning and installation of windbreak systems.

According to the NRCS reporting system (PRMS) in the past three years, Idaho has been averaging approximately 265,000 feet (50 miles) of windbreak annually.

Most windbreaks being installed in Idaho involve cost-share under the continuous signup of the Conservation Reserve Program. Other cost sharing opportunities are also utilized through the EQIP and WHIP programs.

These windbreaks primarily are installed for the following purposes:

- Field protection
- Farmstead and Feedlot protection
- Screens (Primarily for dairies - system also installed for odor control)
- Living snowfences (Primarily for roadway protection)

One notable living snowfence is being installed along Interstate 84 east of Burley, Idaho in the spring of 2003. This new 2.1-mile living snowfence is replacing the living snowfence windbreak installed years earlier to protect this highway from blowing snow in the winter and blowing dust during spring periods.

Here, a living snowfence *(lower left corner of photo)* keeps snow from drifting over the primary access highway to a community, which increases driving safety and lowers snow removal costs. Living snowfences can also be designed to distribute snow evenly across a field, increasing available spring soil moisture.

Why not to plant trees

Dr. David Wedin
Associate Professor of Natural Resources
University of Nebraska - Lincoln

To many people, tree planting is an inherently good activity. In a speech given in 1900, the famous Nebraska botanist Charles Bessey said, "We have to preach the crusade of filling up this state with trees, and to do that we must plant trees, and plant trees, and plant trees". Why should we plant trees? A common answer is "Why not?! It's the right thing to do". As a grassland ecologist, I will play the role of scrooge and skeptic. Here are some reasons not to plant trees:

Unintended microclimate impacts. You may have the bitter cold days of January in mind when designing a windbreak for a livestock operation, but the increased heat load of still air and high humidity on livestock in a feedlot surrounded by trees in August may be more costly than winter cold. Know prevailing wind directions. Do they differ by season? Other unintended consequences of overly dense or poorly placed plantings may include early frosts, deep snowbanks, wet spring soils, etc.

Riparian messes. Once mature, trees along stream banks may fall into streams, disrupting water flow and creating maintenance headaches. It may be better to plant shrubs along streams, with trees set far enough back from the bank to prevent problems.

Evapotranspiration. There are well-documented cases in semi-arid regions (for example, Australia and South Africa) where extensive plantings of aggressive exotic tree species have significantly decreased local and regional water tables. In the American Southwest, the expansion of tamarisk along streams has led to decreased stream flow. These cases generally involve intentional or unintentional afforestation, where the land cover of an entire landscape has been altered in an increasingly water-scarce world. Will the types of practices used in agroforestry, such as riparian forest buffers, have a hidden "cost" in terms of lost water on some sites?

Soil impoverishment. A recent soils textbook has a chapter entitled "how forests attack soils". It is well documented that conifers, pines in particular, can alter soil properties compared to grasslands and deciduous woodlands. Responses can include decreased soil organic matter, decreased pH, and the leaching of base cations such as calcium. Most of the "trees are bad for soils" examples come from afforestation with conifers. Are these cases relevant to agroforestry plantings, which are usually very limited in size? Should soil health issues be addressed when planning agroforestry practices?

Destroyed grassland habitat. Many agroforestry practices create woody edges in otherwise open landscapes, and, as a result, change how wildlife use that landscape. In an intensively farmed and wildlife-impoverished landscape, the increase in "edge" wildlife species, such as cottontail rabbits and deer, associated with windbreaks are seen as positive. However, edge wildlife species also include infamous nest predators including foxes, raccoons, skunks, opossums, jays and crows. One group of wildlife that does not appear to benefit from agroforestry practices is obligate grassland species, particularly birds, but also mammals and insects, that require large intact blocks of open habitat. As one who is passionate about protecting grassland biodiversity, do I object to all agroforestry practices? No. It depends on landscape context. Here in Southeast Nebraska there are only a few areas remaining where large blocks of open grassland exist (>640 acres). The area has largely been converted to human habitat: row crop agriculture and urban development. Tree planting and agroforestry practices in these situations should probably be tailored primarily to economic and aesthetic needs.

Invasive trees and shrubs. An Oklahoma study estimates that over 9 million acres have been taken over by expanding juniper species. In other cases, non-native shrubs such as multiflora rose, buckthorn and various honeysuckles have expanded into native woodlands and choked out the native understory. If these species are used in an agroforestry project, their invasive nature will cause them to spread and cause problems elsewhere on the landscape.

Loss of open landscapes. I have discussed the need to maintain open landscapes in particular regions where native grassland biodiversity is threatened. On the other hand, an "open" landscape may be desirable on aesthetic and cultural grounds. The introduction of conifer plantations into the vast, heather-covered moors of Scotland, northern England and Wales is frowned upon by many as breaking up historically and culturally important vistas. Do similar historically open landscapes exist in the US (for example, Civil War battlefields). Is this even a priority in our young, ever-changing American landscape?

* * *

Perhaps, I have reinforced a point already emphasized many times. Any agroforestry project should incorporate a well thought-out plan that takes into consideration both negative, as well as positive, consequences. Is the project cost-effective? Will it have the desired outcomes for the landowner? Could the project have significant negative hydrologic or soils impacts? Will it use appropriate plant materials and not aggravate problems with invasive plants? Will it enhance the natural biodiversity of the area, or might it, in some situations, further threaten imperiled plant, animal or insect species that require open habitats? And finally, will the project be detrimental to the surrounding landscape either economically or aesthetically? If those questions can be addressed for a tree-skeptic like me, it's probably a great project.

Honey bees:

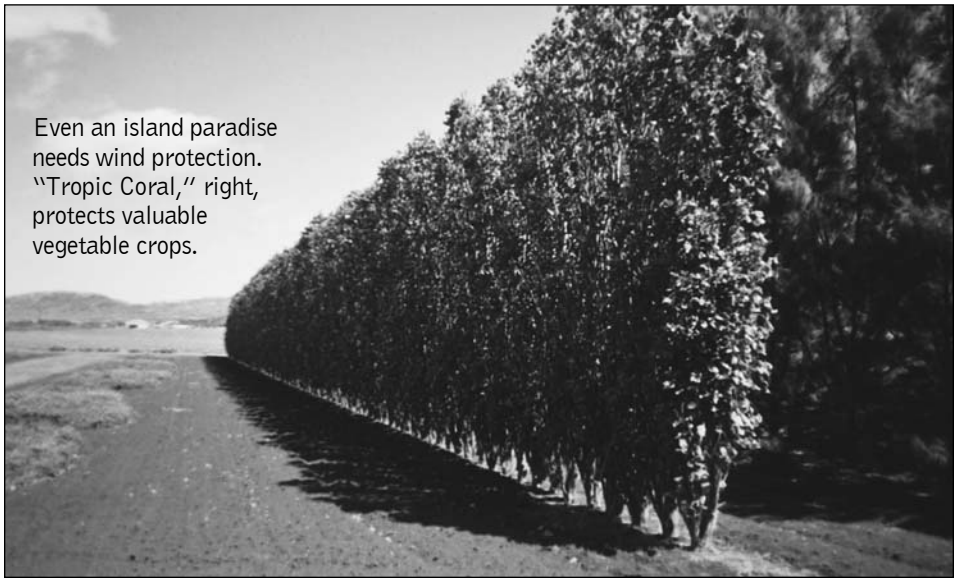
Wind speed affects pollination

Daniel G. Pesante, Ph.D.
College of Agriculture
University of Puerto Rico

Honey bees reduce flight activity when they encounter wind speeds of 9-12 miles per hour and stop flying at wind speeds of 27 mph and above. When high wind conditions coincide with the flowering of a particular crop which requires the incorporation of honey bees for pollination, a significant reduction in seed, fruit or vegetable set may result, especially when high wind conditions persist. This is principally the result of a reduction or cessation in foraging events. High winds not only inhibit or reduce flight activity but have the potential of reducing pollen grain viability due to desiccation, further reducing pollination effectiveness.

Proper selection and placement of wind barrier type in or around a given crop will significantly reduce wind speed and eddy formation allowing honey bees to better forage and pollinate. Wind barriers may help extend the foraging effort per unit time by allowing honey bees to forage for more time in favorable field conditions. Wind barriers in combination with adequate irrigation practices will increase humidity conditions below and around the plant. Depending on plant size and type of growth this may create a favorable micro-climate conducive to prolonging pollen grain viability, which in turn further increases the probabilities of adequate seed, fruit or vegetable set and growth.

Editor's note: Keep an eye out for Dr. Pesante's new book on bees, wind and wind barriers. The book is in final revision and will be released in Spanish.



Even an island paradise needs wind protection. "Tropic Coral," right, protects valuable vegetable crops.

Hawaiian windbreaks

Bob Joy
NRCS Plant Materials Specialist
Hoolehua, Hawaii

Hawaii is located in the high tropics where the trade winds blow 250 days or more each year. These winds are from the northeast and average 8 to 20 miles per hour with occasional gusts of over 40 miles per hour. Storm winds may blow from other directions at any season, but most often in the winter. Gusts from these winds may reach 80 miles per hour, causing considerable damage to agricultural crops.

The need for windbreaks has increased in recent years with the conversion of many acres of agricultural land from sugar cane and pineapple to vegetable and hybrid corn seed crops. Sugar cane and pineapple can be produced successfully without windbreaks but most other crops cannot. Other crops grown in Hawaii that benefit from windbreaks include ornamentals, coffee, bananas, papayas, macadamia nuts, various tree fruits and high value hardwoods. Windbreaks are also planted to protect livestock, farmsteads and urban areas.

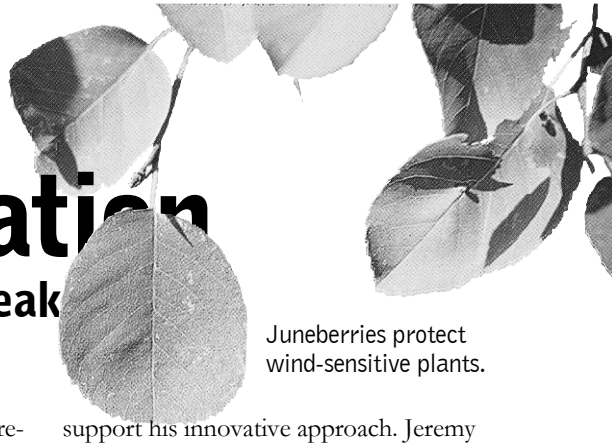
In the past, farmers planted ironwoods (Casuarina spp.), eucalypts (Eucalyptus spp.), Cook and Norfolk Island pines (Araucaria spp.) and other tall trees. While these are still planted mainly on property and boundary lines as primary windbreaks, the current trend favors species with a more compact, upright growth habit that takes up less space and grow rapidly for in-field windbreaks. Some farmers, especially vegetable growers, are planting only in-field windbreaks.

"Tropic Coral" tall erythrina (Erythrina variegata) is a rapidly growing, columnar, leguminous tree that can reach a height of 40 feet in approximately four years from an unrooted cutting. It is popular with farmers and it is basically a low elevation tree. It does well from sea level to 1,000 feet but grows best below 500 feet. The sterile hybrids of sorghum-sudangrass and forage sorghum (Sorghum spp.) are widely used as in-field windbreaks. They grow 6 to 7 feet tall in about two months and are adapted from sea level to approximately 3,000 feet. If cut back to a height of 12 inches each year, fertilized and irrigated, as needed, they will last for about three years. They can be replanted as often as needed.

Windbreak needs expressed by growers, extension agents, and others include trees with a growth habit similar to Tropic Coral that will grow at higher elevations. Crops are grown up to approximately 4,000 feet in Hawaii. There is also increasing interest in native species if they are wind tolerant, easily established, and reasonably fast growing native plants can be found. Other growers, especially those with small farms, prefer windbreaks that have multiple uses. Examples of these are neem (Azadirachta indica) which contains the natural insecticide azadirachtin and "Santa Catarina Prata" dwarf Brazilian banana (Musa balbisiana) that produces a commercial quality dessert banana.

Productive conservation

Growing specialty forest products in windbreak



Juneberries protect wind-sensitive plants.

Bruce Wight
NAC NRCS Agroforester
Lincoln, Nebraska

"I have extreme difficulty, especially in spring and fall, with row covers, plastic mulches, signs and other mobile objects being blown around by the wind. I've also noticed damage to young vegetable plants from the wind," stated Jeremy Barker-Plotkin. Due to these problems, Jeremy began exploring different alternatives to reduce the wind impacts, and he settled on applying a multi-purpose windbreak. "With this project, I hoped to find some species that provided some economic, amenity, or other types of benefits besides merely providing shelter from the wind," added Barker-Plotkin.

Jeremy Barker-Plotkin's Simple Gifts Farm is an eleven-acre parcel of land he rents from the New England Small Farm Institute (NESFI) located in central Massachusetts. He raises mixed vegetables and has been certified organic by the Northeast Organic Farmer's Association since 2000. The long, skinny 10-acre vegetable field is oriented from west-northwest to east-southeast and is about 1000 feet long. The problem wind comes primarily from the west. Jeremy planted the windbreak along the windward edge of the field, using a three-row design along the short side of the field and two-row design parallel to the long side. The windbreak site was prepared in 2000 and the trees and shrubs planted in 2001.

> **"The hybrid poplars did grow astonishingly quickly – they are at least 15 feet tall by the end of the first season."**

The outside row is composed of several shrub species to form a dense screen to block the low-level wind. The shrubs were selected for interesting fruit, low maintenance, and minimal pest pressure. "The fruit fall into two categories: potential for commercial harvest or for 'grazing' or recreational harvest which adds a site amenity for visitors, but which does not offer direct commercial benefit," commented Barker-Plotkin. The shrubs included juneberry, Manchurian apricot, bush cherry, American plum, currants, josta berries, hazelberts, and basket willow for potential commercial use. Elderberry and edible honeysuckle were also added specifically for "grazing" value.

The second row is comprised of tall trees to provide greater field protection. This is also a mixed-species row that combines quick growth for protection and long-term product potential. Hybrid poplars were used for quick protection while black walnut, pawpaw, persimmon, and mulberry will provide a potential commercial products.

Barker-Plotkin has chosen shrubs that create a dense windbreak, create income producing fruit, and keep visitors coming back. Seen here are American plum, juneberry, and currants. *Photographs courtesy USDA NRCS. Additional information on productive conservation and agroforestry can be found in publications at* www.unl.edu/nac.pubs.html/#other

The trees were planted on a ten-foot spacing with two hybrid poplars for every one slower-growing tree. "The hybrid poplars did grow astonishingly quickly – they are at least 15 feet tall by the end of the first season," said Jeremy.

The third row on the short side of the field is an orchard row. This row included Asian pear trees at a 15-foot spacing with four gooseberries planted between the pears. According to Jeremy, this row will add some higher value fruit trees as well as provide some additional wind protection.

Since Jeremy wanted to try a different approach with his windbreak design, he applied to the Sustainable Agriculture Research and Education (SARE) producer grant program and was awarded a grant to support his innovative approach. Jeremy received technical support and input for the project from Eric Toensmeier and Kathy Ruhf of NESFI, Lisa Krall, USDA Natural Resources Conservation Service, and the USDA National Agroforestry Center. The grant requires him to document the project and provide the results both to SARE and his peers in the area. To date he has documented his costs to establish the windbreak, but it is too early to determine the economic value since the trees and shrubs have not started bearing fruit. Jeremy commented, "Establishment costs of a windbreak planting can vary widely depending on the intended side benefits of the windbreak planting. Hybrid poplars can provide a very economical windbreak at pennies per foot. Adding diversity, value, and longevity to a tree row with walnuts, pawpaws, and persimmons still keeps the total cost under a dollar per foot."

To share his multi-purpose windbreak approach to others, Jeremy hosted two farm tours in 2002 including the Northeast Organic Farming Association's (NOFA) Summer Conference and part of the University of Massachusetts Extension Twilight Tour series. He hopes to have the NOFA tour each season.

"The hope is that if the windbreak can provide enough economic value to offset the cost of planting, then wind protection is free or at least cheaper than otherwise," concluded Barker-Plotkin.

Planning to planting

Washington State interagency living snowfence project

Gary Kuhn
NAC NRCS Agroforester
Spokane, Washington

April 1, 2003 was a great day for conservation tree planting in the state of Washington. The first interagency living snowfence was planted adjacent to state highway 25, about 14 miles north of Davenport, WA. The two 850-foot twin row Rocky Mountain juniper plantings will prevent snowdrifts along this section of a highly traveled highway. This was a cooperative project between the USDA National Agroforestry Center (NAC), NRCS, Lincoln County Conservation District, and landowner, Bill Reinbold.

This interagency project began in January 2002, with an information/education meeting coordinated by NAC, NRCS and Washington State University (WSU) Extension. In attendance were also personnel from Conservation Districts, Washington State Department of Transportation (WDOT), and Washington State Department of Fish and Wildlife (WDFW). From this meeting an interagency working group was formed to develop a plan of work.

Photos show the various steps in site preparation, planting, and fabric mulch installation.

The plan of work included every detail from identifying snowdrift locations on state highways of Lincoln, County, to planting and follow-up public education.

One site was selected due to its high visibility and most importantly, because of a cooperative landowner/farmer, Bill Reinbold. The living snowfence is located in his cropland, 150 feet windward of the highway. Bill participated throughout the project, using his equipment for site preparation, and provided valuable assistance during the day of planting.

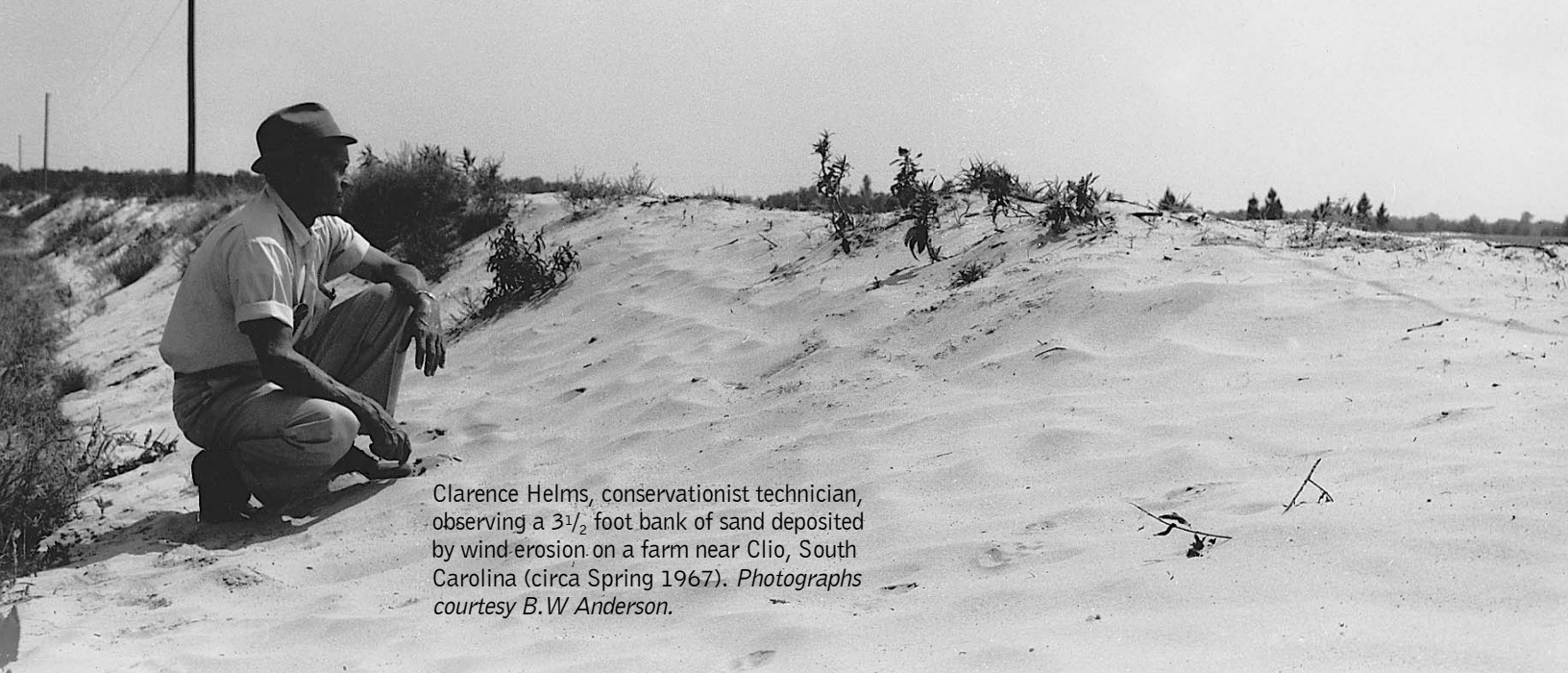
> **"This effort could not have been done without interagency cooperation and commitment."**

WDFW provided the tractor, tree planter, and fabric mulch machine and individuals from NRCS, WDOT, NAC, WSU Extension and Lincoln County Conservation District participated in planting the trees and installing the fabric mulch. The Pullman, WA NRCS Plant Material Center manager helped prepare the planting site and seeded a low growing bunch grass between the twin row sets, which are about 35 feet apart. Superior juniper seedlings were grown in 20 cubic inch containers by the University of Idaho Forest Research Nursery. The site is in a 16-inch precipitation zone and the juniper will grow well without supplemental water due to good site preparation and the use of fabric mulch for moisture conservation. The living snowfence should be fully functional in catching and holding snow within 5-7 years.

This "planning to planting" effort could not have been done without interagency cooperation and commitment.

The NRCS Davenport field office staff did an excellent job of keeping the plan of work on schedule. Another key effort involved public information professionals during the entire "planning to planting" process. Regional TV stations and local/regional newspapers were there to cover the planting. In 2-3 years public information signs will be located near the living snowfence to inform passing motorists.

In a few years, WSU Extension will feature this living snowfence at a regional living snowfence workshop, to educate interagency personnel and landowners on living snowfence benefits, planning, design, and establishment.



Clarence Helms, conservationist technician, observing a 3 1/2 foot bank of sand deposited by wind erosion on a farm near Clio, South Carolina (circa Spring 1967). *Photographs courtesy B.W Anderson.*

South Carolina
continued from page one

Anderson and local soil conservation leaders decided to initiate a community-wide effort to address this resource problem. About 55 farmers were identified in a 3500-acre area in central Marlboro County. They started by holding a chicken supper at a local community church and inviting farmers from the area. One of the local landowners chaired the meeting following the supper to discuss the soil erosion concerns. The soil conservation staff had a large map of the area posted on the wall and discussed how windbreaks could be used to help reduce some of the blowing soil. The soil loss was estimated at four to seven tons per acre per year. One landowner in the neighborhood had planted a windbreak about fifteen years earlier, and it was used an example. Several people in the audience commented that they weren't going to "chase" their soil anymore.

The meeting was followed by extensive local publicity including articles in the newspaper and on the radio. Since the project stood to benefit the entire community, many people helped the conservationists promote the program. For example, a local storeowner was an aggressive salesman for the project and "talked it up" to many of his customers. The county road department promoted the project to help reduce the sediment in the road ditches. They also liked the side benefit of keeping the farmers from actually farming into the road right-of-way. The farmers also helped sell the idea to their neighbors.

Windbreaks were planted mostly along the field edges and property lines. The initial design consisted of four rows of primarily loblolly pine and some longleaf pine. By changing the plant spacing and adding shrubs, the original design was gradually modified to one and two-row designs. Over the next twenty years, the local soil conservationists worked with the NRCS Plant Materials Center in Americus, Georgia to try different plant species such as cherry laurel, privet, crabapple, and other species to add greater diversity.

When planting began, local timber companies provided tree seedlings and planting equipment. The cooperation from these companies was instrumental in the success of the project especially for situations where the landowners could not afford the seedlings or did not have the necessary equipment. Often the windbreaks were planted in strips of rye to help protect the young seedlings. Rye strips were also used as wind strips between the tree windbreaks to help reduce the blowing soil until the trees had a chance to grow.

As the planting progressed, the publicity continued with pictures of each farmer with their newly planted windbreak published in the local paper. The big wall map used at that first church supper remained posted at the church for several years to follow the progress of the windbreak plantings. Of the 55 farmers identified in the beginning, only four did not initially sign on to the project, but after some more encouragement from their neighbors, they eventually joined too.

> **"Landowners weren't going to 'chase' their soil anymore."**

Almost 40 years later, this South Carolina community windbreak network is still going strong. A couple of windbreaks have been removed due to changes in farm operations like the addition of irrigation. Conservation cover crops like winter pea and conservation tillage have been added to the conservation tool kit, but the windbreaks still stand as the backbone. In addition to less soil erosion and crop damage, the wildlife have benefited, too. By adding some additional shrub and herbaceous cover next to the windbreaks at the field edges, quail habitat has improved as well as deer, rabbits and dove. Local residents have also commented that the windbreaks have "beautified the county." Bunny Anderson commented, "The key to the success of this project was how the community worked together so neighbors' efforts benefited each other."

What was planted:

Species: Primarily loblolly pine, and some long leaf pine
Configuration: Started out using a four-row design, then adjusted to one- and two-row design by changing the plant spacing and adding shrubs underneath.

Problems encountered:

Weed control; insects; disease

Benefits:

Improved crops; less erosion and dust, more wildlife; enhanced aesthetics

Upcoming Events

June 7-8, 2003
Income Opportunities from Field and Forest. Rural Action Forestry. Ohio. Contact: Cynthia Brunty, *cynthiab@ruralaction.org*, or *www.ruralaction.org.*

June 17-19, 2003
Fourth Annual 1890 University Faculty Training Workshop in Agroforestry: Community Applications. Alabama A&M University, Normal, AL.

June 22-25, 2003
Eighth North American Agroforestry Conference. Corvallis, OR. Contact: Steve Sharrow, *Steven.H.Sharrow@orst.edu,* or *www.missouri.edu/~afta/8thconference.htm*

July 26-30, 2003
Soil and Water Conservation Society's 58th Annual Conference. Spokane, WA. Contact: Nancy Herselius, (515) 289-2331 extension 17, *nancyh@swcs.org*

September 21-28, 2003
XII World Forestry Congress. Quebec City, Quebec. Contact: Jean-Louis Kérouac, Phone: (418) 694-2424, Fax: (418) 694-9922, *sec-gen@wfc2003.org*, or *www.wfc2003.org*

June 27-July 2, 2004
1st World Congress of Agroforestry. Orlando, FL. Contact: P.K. Nair, (352) 846-0880, *pknair@ufl.edu*, or *www.conference.ifas.ufl.edu/wca/*

Inside Agroforestry is published quarterly by the USDA National Agroforestry Center.
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Mission

NRCS Natural Resources Conservation Service

RMRS Rocky Mountain Research Station

The USDA National Agroforestry Center (NAC) is a partnership of the Forest Service, Research & Development (Rocky Mountain Research Station) and State & Private Forestry and the Natural Resources Conservation Service. NAC's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land-use systems. To accomplish its mission, NAC interacts with a national network of partners and cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.

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Inside Agroforestry | Spring 2003