MINNESOTA Science
Agricultural Experiment Station
UNIVERSITY OF MINNESOTA
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Climatology Research Has Practical Applications

A hand-held depth monitor shows thawed ground down to two feet deep on April 1. Undergrouund, thermocouples at the St. Paul campus Climatological Observatory monitor "earth temperature" and frost depth down to 42 feet. This is the only U.S. site deep enough to have a record free from seasonal variations

Our climate history is more than just the historical high and low temperatures reported each evening on television news. It's information that guides building codes, road surface research, and installations of underground cables, pipelines and storage tanks. And our records in Minnesota are some of the best.

"Minnesota probably has the longest, high quality temperature record in North America, going back to 1819 at Fort Snelling," says experiment station researcher Donald Baker. "Older stations out east have been affected by population growth and urbanization along the coast."

Minnesota records, together with around-the-state reports from networks of observers, are complemented by 30 years of comprehensive data from the St. Paul campus Climatological Observatory.

"We also measure 'earth temperature,'" Baker says, taking soil temperature readings down to 42 feet underground. This 30 year measurement series—unique in the U.S.—has found that at about 40 feet deep the earth's temperature no longer varies with our planet's seasons. This record contributes important information to designs for underground installations. Changes to this depth record may also provide accurate warnings of global warming.

The National Weather Service often erroneously receives credit for this kind of climate and weather information. Says Baker, "almost all climatology research is done within university communities."

"The Weather Service's specialty is public safety, aviation and interstate commerce," says Mark Seeley, an extension agricultural climatologist. "They're concerned with the upper atmosphere," adds Baker.

Climate research is based on records originally gathered for military and agricultural uses. Weather information in Minnesota was first recorded by the army, from 1819 to 1890. The U.S. Weather Bureau, organized under USDA in 1891,

Climatology *continues on page 2*

Solar Radiation and 'Shallow Air' Observed

"Our station and the extension network also monitor solar radiation," says climotologist Donald Baker. That's the amount of energy reaching the earth's surface. Researchers use the data to model effects of crop residues—how surface roughness, wetness, and darkness affects soil temperature. Urban construction material selection also stands to benefit from this work.

The St. Paul campus is also the only place in Minnesota that records 'shallow' air temperatures at, near and just below the earth's surface. It is compared to a worldwide standard measured five feet above ground.

Unfortunately, the temperature at five feet is different than that encountered at ground level by young corn, tomatoes or freshly poured concrete.

MINNESOTA Science

Diet and Disease Links Closer to Discovery

Have you ever wondered how your body keeps on performing, day-after-day, despite an intestinal nightmare of food fueling it—bacon, eggs and coffee breakfast; french fries and burger lunch; pizza, pop and potato chips dinner? The body digests and absorbs it all, good and bad, and precisely distributes essential nutrients to all cells in the body.

"Multiple regulatory responses help the body maintain homeostasis, or internal stability," says nutrition researcher Linda Brady, "even involving cellular genetic material, DNA."

"Multiple loops allow the body to adapt to everything thrown at it," Brady says. She is studying the 'loops'—molecular paths—that allow cells to use carbohydrates, lipids and proteins for energy, regardless of what food they come from.

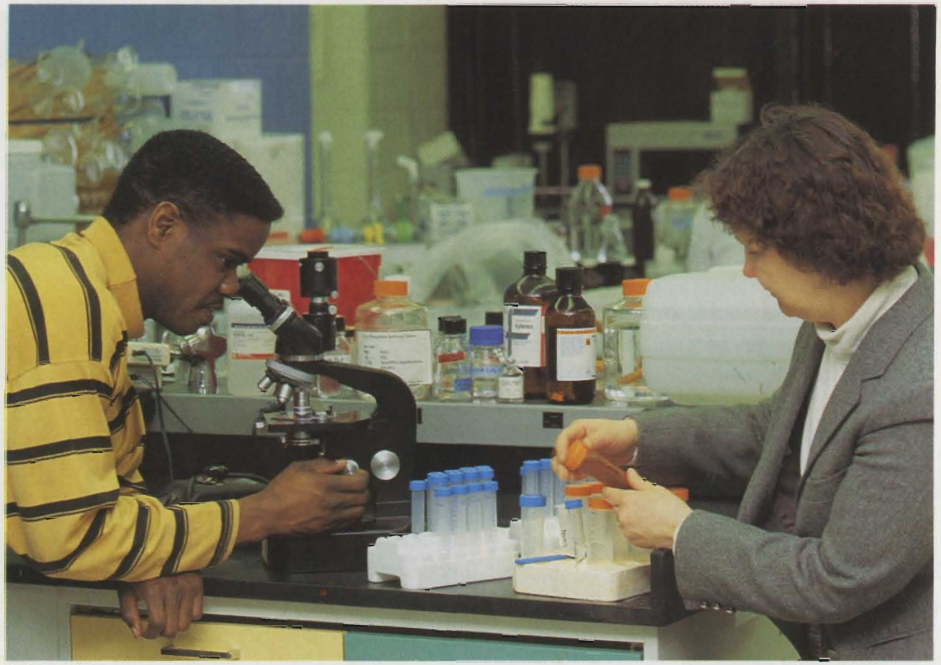
There can be major health consequences when these cellular functions don't proceed normally. These can include problems like diabetes and cancer.

Brady's research focuses on a regulatory protein, 4EBP, which triggers the loop controlling whether fat is used for energy or storage.

Brady says some DNA is very responsive to diet. Various liver enzymes are made within minutes after eating. "We are trying to learn what turns on specific DNA in response to diet," she says.

"Originally we were concerned with how the body maintains homeostasis and balance," Brady says. "Some of the mechanisms can become defective and lead to chronic diseases such as cancer."

Nutrition research is currently focusing on very basic levels of metabolism, says Brady. "We find that nuclear binding proteins regulate DNA expression, and that diet affects those proteins. We have finally come to look at what makes a normal gene product, or what goes awry and produces an abnormal product."



Nutrition scientist Linda Brady and graduate research assistant Fred Young investigate how nutrients regulate gene expression. Their research seeks to improve our understanding of links between diet and diseases such as cancer and diabetes.

"Nutrition research is closely related to other types of medical research," she says. "To rationally prescribe a diet to a patient or to decrease risk of chronic disease, you have to know the effect of the diet on cells in the body."

"Diet is only one of many environmental factors—radiation, temperature, drugs, stress, etc.—that can affect gene expression. But it is one that people have control over. The point is to identify a disease process as it begins, when diet may have a beneficial impact on the disease."

Investigations of this type require teamwork beyond one laboratory. She says experiment station nutrition researchers and food scientists are examining diet from many perspectives.

For instance, nutritionist Dan Gallaher is studying how dietary fiber is ultimately used by bacteria in the colon, and how it contributes to colon function. And microbiologist Frank Busta says, "We're investigating how beneficial microorganisms in specific diets affect the microbe populations in the colon, and their role in colon cancer."

Aid Available to Forestry Professionals

Many factors affect tree growth, and forestry professionals can often suggest ways for forest owners to improve tree growth on their land. Unfortunately, environmental factors such as climate and soil type can't be altered.

A "site index" helps in choosing tree species and management practices to encourage fast, productive tree growth. An index expresses the relationship between a tree's age and height.

A 50 foot tall, 50 year old tree has an index of 50. "Any element in the environment that affects height growth will likewise affect site index," says forest soil scientist Donald Prettyman.

"A site index reflects both genetic factors and an integrated response of trees to an environment," says Prettyman. A site index is often used to estimate the quality of a site with respect to timber production. The indexes for different tree species can vary substantially on any given site.

Besides genetic variations within species, tree growth on any site can be affected by a species' individual responses to soil type, availability of nutrients to roots at various depths, local geographically influenced climate affects, etc.

Indexes and the value of "indicator species"—using a known species to predict growth performance of another with

Broccoli Taking Off as New Crop

Broccoli Taking Off as New Crop

Minnesota production of cole crops such as cauliflower and broccoli has been refined and demonstrated by researchers at the Northwest Experiment Station, Crookston. Commercial broccoli production, helped by this work, has increased significantly since 1990.

"Why broccoli?" asks Gary McVey, horticulture researcher at the Northwest Experiment Station, Crookston. "Because broccoli prefers cool nights and moderate daytime temperatures, which northern Minnesota provides," he answers.

Varietal trials at the station, begun in 1990, have helped commercial growers expand production, "from half acre fields in 1989 to fields 30 to 60 acres for 1993," McVey says.

"Six hundred boxes, or about 12,000 pounds per acre, are good yields in California and are normally attained or exceeded here," McVey says. He and agronomist Larry Smith worked with about a dozen commercial varieties.

McVey recommends that Minnesota growers favor extended harvests by staggering plantings—every four to five days—if labor is available. Combined with early maturing varieties, that could allow producers to harvest from mid-July into September. Broccoli withstands temperatures to near 22 degrees.

Vegetable crops are labor and capital intensive, he says. "Costs range from $1,500 to $3,500 per acre, with yields of 8,000 to 30,000 pounds per acre. Large outlays are required at harvest time for labor, cartons, ice and shipping."

Marketing is a major challenge to Minnesota's fledgling industry. So far, all sales have been as fresh produce. "Developing a national marketing plan is key to establishing a large scale vegetable scheme in northern Minnesota," McVey says.

A trial to be run with this year's crop will look at producing broccoli with low chemical inputs. The low residue product will have potential use for the baby food market.

The research, supported by Northwest Minnesota Initiative Fund and the Agricultural Utilization Research Institute, is also looking at the potential of other cole crops, such as cauliflower and cabbage.

—David Hansen

"Together we form a unique team found almost nowhere else in the country," Brady says. "We want to know what kind of diet will prevent—or reduce the risk of—certain diseases." Millions of people stand to benefit from what they find out.

Brady's research is funded by the National Institutes of Health. Prior work was supported by the American Diabetes Association, American Heart Association and USDA. The Minnesota and South Dakota Dairy Foods Research Center helps fund Gallaher and Busta's work.

—David Hansen

similar requirements—are discussed by Prettyman in a new publication, *Forest Soils-Climate-Site Index Relationships for Minnesota*. He recommends the publication to owners and managers of forest within Minnesota, and to forestry management professionals and educators.

The publication is available for $1.50 by mail from the Distribution Center, 20 Coffey Hall, University of Minnesota, 1420 Eckles Ave., St. Paul, MN 55108-6064 (Minnesota residents add $.10 sales tax per copy ordered). Request publication AD-MR-6062-D. Make checks payable to the University of Minnesota.

—Larry Etkin

Climatology *continued from page 1*

took over and continued the measurements until 1972, when the federal climatologist positions were eliminated, says Baker.

The University of Minnesota and the Minnesota Department of Natural Resources filled the gap. State climatologist Jim Zandlo, employed by the DNR, is officed next to Baker on the university's St. Paul campus.

Degree Data Has Many Uses

Earth temperature information has many local uses, in addition to global climate studies. It's used to:

- develop frost depth recommendations for building codes;
- design or predict energy savings for underground buildings;
- predict frequency of freeze-thaw cycles (*Creator of road potholes!*);
- recommend stable depths for underground fuel storage tanks;
- determine placement of underground electrical and fiber optic cables;
- forecast when soil temperatures are optimal for applying NO_3 fertilizer.

The data is used in every season. "During the winter we issue a weekly snow depth map, for recreational users and wildlife managers," Zandlo says. DNR foresters receive moisture information during the fire season. And with a lakes hydrologist, he has developed a computer model to predict fluctuations in water levels. His office also manages the 170 years of data, now mostly digitized.

Current information comes from more than 1,000 volunteer observers, and from public sources. "For some types of information: soil moisture, solar radiation, and evaporation, the only place to get it is the branch experiment stations," Zandlo notes.

"The university and experiment station deserve credit for recognizing that climatology is an important and ongoing study," says Baker. "You're never really done. Five or 25 years is not long enough to measure climate.

"Climate is dynamic. It's constantly changing. A climate forecast considers many more factors than a five day meteorological forecast: heat stored in oceans, surface covered by snow and ice, increase in greenhouse gasses, and population growth and the changes people cause."

—Dave Hansen

MINNESOTA Science

IN PRINT

Southern Station Reports 1992 Research

The annual report on research activities of staff at the Southern Experiment Station, Waseca, is available. Its 240 pages include selected summaries of agronomy research on corn and soybeans; horticultural studies of sweet corn, peas and onions; soil science studies; and animal research on dairy and Holstein beef, and on swine.

Copies are available for $6 from the Southern Experiment Station, Highway 14 West, Waseca, MN 56093-1926.

More Turkey Eggs: Poultry Gold to Producers

Getting their hens to lay more eggs could add millions of dollars to Minnesota's turkey industry. Experiment station animal scientist Mohamed El Halawani is on the verge of controlling two factors inhibiting it.

El Halawani has developed a vaccine to control broodiness, and a lighting program to cause earlier egg laying. Both techniques should reduce production costs.

A broody turkey spends relatively more time sitting on a nest than producing eggs. A broody hen could lay up to 10

Experiment Station Faces Opportunities and Challenges

In a time when the University of Minnesota is being called on to clarify its research role in improving quality of life for our state's citizens, Michael Martin begins work as a new assistant director for the Minnesota Agricultural Experiment Station. He also serves as associate dean for research in the College of Agriculture. Martin holds a degree in agricultural economics from the University of Minnesota.

"We're involved in long term strategic planning to establish a framework for how we will set research priorities for the next five to 10 years," Martin says. He says those research goals need to be very clear, both to experiment station scientists and to the people of Minnesota whom they serve.

Opportunities and challenges face the university, he says. "We cannot be all things to all people, and that means making some hard decisions, deciding where our comparative advantage is, or can be, and pursuing it.

"One challenge is helping our traditional constituents understand that we are not abandoning them, but striking out in the direction society wants us to go."

At the same time, Martin says the university must do what it can to help people in Minnesota's urban areas understand the importance of our traditional emphasis. Research in agriculture and forestry is essential for the continued viability of those segments of the state's economy and for the well-being of all Minnesotans, he says. "Ours is a natural resource based state," Martin says. "I guarantee, that if the rural areas of Minnesota do not prosper, the effect will be felt in the urban areas as well."

Experiment station assistant director Michael Martin (right) and Gary Lemme, superintendent of the West Central Experiment Station. Martin says urban Minnesotans should recognize the importance of traditional agricultural research, just as rural residents need to accept the shift of significant research resources toward urban concerns.

And as new constituencies emerge, Martin says the experiment station will seek funding for its research from supporters that it has never fully cultivated or even interacted with before—foundations and private industry.

Martin says that, in the future, experiment station scientists will do more research that creates jobs in value-added agriculture as well as in areas that address the needs of urban interests.

—Sam Brungardt

New "Norm" Released for Wheat Growers

Meet Norm, a new semidwarf, hard red spring wheat variety released by the Experiment Station and the USDA's Agricultural Research Service.

Video Mentoring Is New Educational Tool

Everyday use of computerized videophones may be a futuristic dream for most of us, but University of Minnesota

percent fewer eggs.

A genetic correlation exists between the heavier weights producers breed for and poor reproductive performance. Broody hens must be physically moved off their nests. "Costs of handling broody hens are high since they require individual handling," El Halawani says.

The hormone prolactin is linked with broody hens. He's developed a vaccine neutralizing the hormone by immunizing hens against it.

El Halawani's new lighting program starts with 14 hours of daily light. Every week the light is cut by one-half hour per day, until reaching six hours. Then lighting is gradually increased.

Hens exposed to this "step down, step up" lighting program begin laying eggs three weeks earlier than normal.

Turkey eggs—at 60 cents each—certainly aren't worth their weight in gold. But with more than five million turkey hens in the U.S., increasing each turkey's average egg production by only five eggs adds up to more than $15 million. Minnesota's turkey industry adds $1.6 billion annually to the state's economy. With 44 to 46 million birds produced annually, Minnesota ranks second among states in turkeys raised.

—Jack Sperbeck

University wheat breeder Robert Busch says, "Norm is the most stable variety I've tested. Unlike other varieties, it has high yields in the north and the south." In southern Minnesota tests at Morris, Lamberton, Waseca, and St. Paul, yields over four years averaged higher than almost all other varieties.

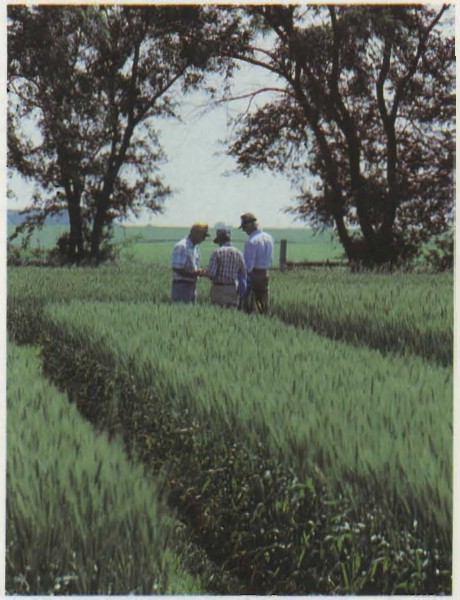
Norm heads a couple of days earlier than Vance, a premium University of Minnesota release. Since it is semidwarf and stiff strawed, it is less likely to "lodge", to fall over, than taller or weaker-strawed varieties. Lodged wheat makes harvesting all the grain difficult.

Norm resists leaf and stem rust and tolerates common leaf spotting diseases. It is moderately susceptible to loose smut and susceptible to Fusarium head blight.

Test weight (grain weight per bushel), important because farmers are paid less for wheat that weighs too little, is well above acceptable minimums.

Norm also has good characteristics for end uses, in terms of protein content and baking quality.

—Sam Brungardt



A test plot of "Norm" wheat, grown at the West Central Experiment Station, Morris.

students in a unique mentoring project are using such a computer/phone/videocamera combination to do some good old-fashioned educating.

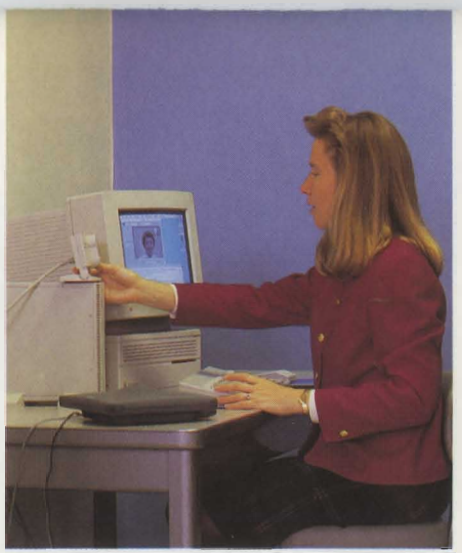
Teaching is just one possible application for this new technology. U.S. businesses and individuals will eventually become enthusiastic users of the technology, according to rhetoric professor Ann Hill Duin.

It may be some time before many U.S. homes have telecommunicating multimedia workstations, but there is a near precedent. France already has its Minitel computer phone system in widespread use. It lacks a video component, but does let private citizens access many different sets of information.

Duin expects to eventually see multimedia technology used extensively. She says it can electronically extend the university across Minnesota, linking the St. Paul campus to Crookston, for example. And multimedia kiosks, much like today's telephone booths, may eventually let students or alumni simultaneously see, talk and exchange computer files with professors and each other. Students may also eventually be able to electronically access taped course lectures.

Her speculations about future applications stem from an experimental, one-on-one multimedia mentoring project. Since January, university students have been electronically mentoring students at Totino-Grace High School in Fridley, face-to-face via computers and telephone lines enhanced to provide video conferencing. It has proved valuable to both the mentors and mentored, says Duin.

During the winter quarter, 25 university students in a world environment and food production course mentored 27 Totino-Grace students. They used the system to help learn how to go about making decisions in complicated environmental case studies. One involved deciding what to do with high lead content compost, an ethical dilemma that bore the catchy title "Heavy Metal Veggies."



Researcher Ann Hill Duin uses computer and video technology to allow interactive communication, teaching and information sharing between geographically separated sites.

The Totino-Grace students researched aspects of the case. The university students coached them, made suggestions on their writing about the case, and in some cases used the video screen as a "show and tell" to help younger students understand the effects of lead on the root systems of several vegetables.

Duin is keenly aware of the educational needs of both sets of students involved in the project. She is a former elementary and secondary school teacher.

It can electronically extend the university across Minnesota.

Our mentors learned more about their subjects by mentoring, Duin says.

Totino-Grace students and teachers

Video *continues on back cover*

MINNESOTA Science

'Autumn Spire' Maple Available, Ideal for Small Spaces

A new upright growing maple is now available from local nurseries and garden centers. Minnesota Agricultural Experiment Station horticultural researcher Harold Pellet says 'Autumn Spire' maple "is particularly useful as a small specimen or shade tree where space is limited, such as small residential lots or near townhomes, apartment complexes, or schools."

Unlike most maples, which have wide crowns, 'Autumn Spire' has a broad-columnar growth habit. It was developed from the seed of a tree found growing wild near the North Central Experiment Station, Grand Rapids. This new maple variety is registered as *Acer rubrum* 'Autumn Spire' with the U.S. Patent Office.

In addition to its unique branching characteristics, the tree produces no seeds or fruits. It also develops fall coloration before most other maple cultivars. "Spectacular fall color, exceptional cold hardiness, and a seedless habit, make 'Autumn Spire' a valuable new ornamental tree for northern climates," Pellet says. Like other maples,'Autumn Spire' should be grown in full sun in moist, well-drained, slightly acidic soils.

—David Hansen

'Autumn Spire' maple.

International Effort to Improve Landscape Plants Begins Here

More than 60 universities, botanical gardens and arboreta are working together to breed hardier landscape plants for northern climates. Initiated by experiment station horticultural scientist Harold Pellett in 1990, the effort already involves researchers from the U.S., Canada, Denmark, Estonia, Finland, Lithuania, Norway, Russia and Sweden.

" 'Hardy' includes cold tolerance, and tolerance to drought, heat, poorly drained soils, poor soil fertility, and resistance to insects and disease," says Pellett.

The Center for Development of Hardy Landscape Plants encourages development of plants better adapted to environmental and biological stresses. "More tolerant plants would enable us to be less dependent on pesticides," Pellett says, "and would result in greater success of landscape plants helping to improve our environment."

The major emphasis is plant breeding, but collection of promising plant materials often must happen first. An upcoming trip to northern China's Heilongjiang province, by representatives of several arboretums, will be seeking plant material from an extreme climate area closed to outsiders since the early 1900s.

Preservation and evaluation of potentially useful species is also part of the center's role.

The Center's 60 worldwide research sites, "allow us to evaluate and select plants in many different growing conditions," Pellett says.

Plant breeding efforts often start with initial crosses made between stress tolerant plants and outstanding ornamental plants with limited stress tolerance. At least two generations of crosses are usually needed to find individual plants that combine hardiness and aesthetic appeal.

Minnesota's project to breed cold hardier roses is just one example of an international effort to develop plants better adapted to environmental and biological stresses.

Second generation seedlings are distributed to institutions throughout the world, for selection trials seeking individual plants well adapted to the various regions. "Outstanding plants are selected for further propagation and eventual release to the public," says Pellett.

Projects funded for the U.S. include one by the U.S. Forest Service seeking

Forage Mining Can Reduce Ground Water Nitrate

Livestock produce a lot of manure. They also produce a challenge for its disposal. The challenge is managing land on which it's applied, to prevent ground water pollution from the manure's nitrates

nitrate from the land in the form of a forage that can be recycled as high-quality livestock feed. That's a good way for producers to reduce their feed and fertilizer costs."

He says their continuing research

with a hay crop than with any of the grain crops," he observes.

But plan to apply only agronomically sound amounts of manure to cropland, warns Russelle. "With tight economic conditions on the farm and with increas-

Nitrate polluted drinking water poses a real danger to human and animal health. At the West Central Experiment Station, Morris, USDA soil scientist Michael Russelle and experiment station soil scientist Sam Evans are studying how perennial legumes and grasses could remove nitrates from the subsoil.

"You can get away with applying manure to cropland at high rates as long as you manage the land correctly," Russelle says. "You have to grow crops that will mine the nitrates from the manure before they can be leached down into the ground water."

The research plots were part of a manure rate study from 1972 until 1976. As much as 64 tons per acre of manure had been applied to the plots annually.

Corn grown on these plots until the late 1980s depleted accumulated nitrogen from the top four feet. But, 1989 soil tests revealed more than 2,000 pounds of nitrogen per acre between the four and ten foot depths. Deeply rooted crops were needed to take up those nitrates before they reached ground water.

In 1990, the plots were planted to four deep-rooting crops: Agate alfalfa; Ineffective Agate (an alfalfa unable to "fix" much atmospheric nitrogen); Palaton reed canarygrass, a cool-season grass; and Forestburg switchgrass, a warm-season grass. The four crops yielded varying amounts of forage while mining substantial amounts of the deep nitrogen.

Russelle estimates that Ineffective Agate removed as much as 350 pounds of nitrogen per acre; reed canarygrass, 220 pounds; and switchgrass, 135 pounds. Soil samples are still being analyzed to determine how much nitrogen was removed by Agate.

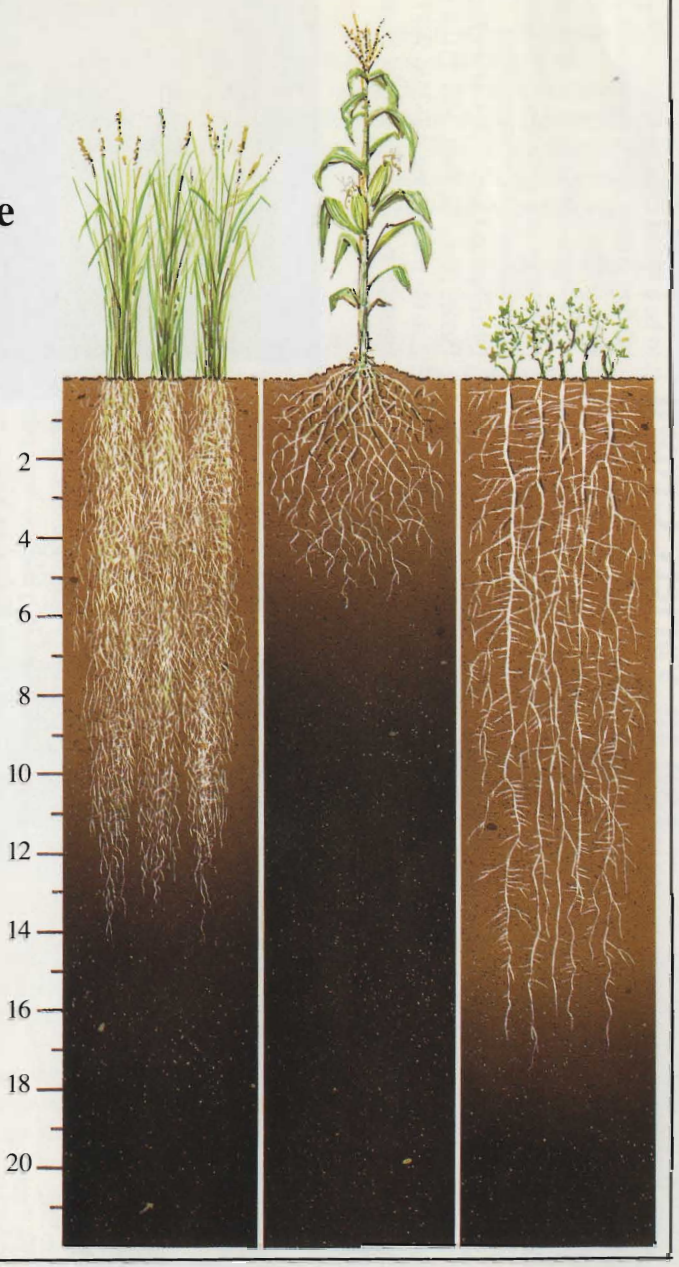
Alfalfa may be especially valuable for recovering subsoil nitrate. "Alfalfa roots grow down at a rate of about six feet per year. After three years, the roots will have grown 15 to 18 feet into the soil," says Russelle. "If you cut the alfalfa at the right time, you can remove quite a bit of

shows that farmers can apply manure to cropland without endangering the ground water so long as they exploit the ability of different crops to recover nitrates. "You can usually remove a lot more nitrogen

ing awareness about how bad management practices can damage our environment, it makes good sense to use manure wisely."

—Sam Brungardt

Deeply Rooted Perennials Can Retrieve Nitrates from Soil Depths



Soil scientists are studying the use of deep rooted perennial crops (switchgrass-left, alfalfa-right) to recover subsoil nitrates that are beyond the reach of annual crops such as corn (center). Nitrates that reach ground water may contaminate drinking water.

Some alfalfa varieties can remove up to 350 pounds of nitrogen per year from each acre.

The amount of plant material visible above ground does not indicate how much activity and root growth there is below. Alfalfa roots grow about six feet per year and can recover nitrates from deep beneath the surface.

Illustration by Dan Wiemer

better techniques for screening drought tolerant trees. Another project is looking for small statured, stress tolerant trees. Funded by a collaborative of electric utility companies, its goal is reducing maintenance costs and improving the appearance of trees under power lines.

The center is also working with maples, trying to learn more about what species will successfully interbreed. "Hybridization of maples is difficult. It's hard to collect much pollen and the nature of flowering differs considerably between species," Pellett says. "We learn how to handle each species as we progress."

—David Hansen

Young Steer Calves Do Better on Waxy Corn

Is there any advantage to feeding the new high yield waxy corns to steer calves? It appears it can, in some cases, according to animal scientists Lee Johnston and Pete Anderson.

Nearly two decades ago, other researchers reported that yearling steers gained weight faster when fed waxy corn, but last year's trial at the West Central Experiment Station, Morris, found otherwise. It found that waxy corn has no effect on either growth or carcass traits.

Nearly all the starch in waxy corn is amylopectin, which may be more easily digested than the amylose that makes up about 25 percent of the starch in normal feed corn. So the reasoning goes that steers fed waxy corn should grow more efficently than steers fed normal dent corn diets.

So, who's right? Can waxy corn improve feedlot efficiency? In some cases it can, say Johnston and Anderson.

They tested the question on large-framed steer calves. In a 40-day study, they showed that waxy corn diets may improve feedlot performance only during the initial phase of the feeding period.

—Sam Brungardt

Video *continued from page 3*

benefited extensively, says Totino-Grace Principal Richard Paul. "Writing has improved and students take ownership and pride in their work. They like writing for a real audience. It gives their work more meaning." He says mentoring via telecommunications has also "expanded the walls of the school."

The multimedia program is the only one in the world known to be currently using videophone technology. It illustrates two potent educational principles, says Duin. "Those who teach, learn," she says. "Also, successful programs need to be simple but powerful and this one is."

Duin does her research for the Minnesota Agricultural Experiment Station. Support and equipment for the program comes from various sources, including U S WEST Communications.

Duin hopes to link multimedia system with one at the University of Sweden, for an international test.

—Anne Gillespie Lewis

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New Barley Stands Tall In Variety Crowd

The barley variety Stander has been released by the Minnesota Agricultural Experiment Station. Its name comes from its superior ability to resist "lodging" and stand upright through harvest.

Stander is agronomically superior to the widely planted Robust and Excel varieties also developed in Minnesota. It was developed by plant breeder Donald Rasmusson and plant pathologist Roy Wilcoxson. Certified seed will be available for general production by barley growers in 1994.

The new variety was tested at experiment stations in Minnesota, cooperating states in the region, the ARS-USDA Cereal Research Unit at Madison, Wis., and industry laboratories.

Stander is a six-rowed, smooth-awned spring barley that should be "non-itchy" like Robust. Its yield has been consistently higher than Robust in 32 Minnesota trials conducted since 1988. Its malting quality is similar, if not superior, to industry standard Morex.

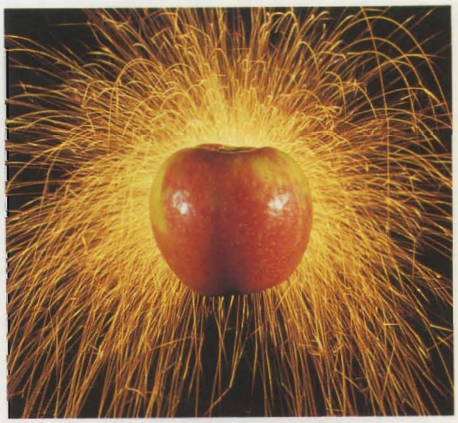
—Jack Sperbeck

IN PRINT

"Explosively Crisp" Honeycrisp™ Apple Poster Available

Newly available is a full color poster with crop cultivation and management information for the University of Minnesota's Honeycrisp apple tree. This "explosively crisp" apple seems destined to be a world class product—consistently beating quality apple varieties in university taste tests.

Copies of this 11 x 17 inch poster/publication are available from county extension offices or through the Distribution Center, 20 Coffey Hall, 1420 Eckles Ave., St. Paul, MN 55108-6064. Ask for publication AD-MR-5877. Cost per copy is $.50 (plus tax for Minnesota addresses).



'Explosively crisp' Honeycrisp™ apple

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