Rio Grande Basin Initiative
OUTCOMES

Scientists pull for Bigtooth Maple

NMSU team on track to develop a drought-tolerant maple variety

by Norman Martin

One of the nation's loveliest trees for fall color is the maple, but New Mexico misses out because of an exceedingly dry landscape that prevents the legendary tree from growing well there.

Now, through the Rio Grande Basin Initiative, New Mexico State University (NMSU) scientists report that they're on track to develop a drought-tolerant maple that could one day bring splashes of brilliant reds and yellows to Southwestern yards.

The prospective maple goes by a curious name, Bigtooth, after the somewhat toothy appearance of the tree's leaves.

"We are looking for a tree that will rival eastern sugar maples in fall color but is able to grow with limited water," said Rolston St. Hilaire, assistant professor with NMSU's agronomy and horticulture department.

"We are looking for a tree that will rival eastern sugar maples in fall color, but is able to grow with limited water. The prospect is very appealing."

"The prospect is very appealing," said Curtis Smith, an Albuquerque-based horticulture specialist with NMSU's Cooperative Extension Service. "A lot of people want a maple."

Bigtooth has all the characteristics of a good ornamental tree, St. Hilaire said. It's one of the brightest of the maples. A reengineered, homegrown variety would be a boon to the state's shade and ornamental tree industry.

Rolston St. Hilaire, a horticulturist with New Mexico State University, examines a new drought-tolerant Bigtooth maple tree under development. A new ornamental shade tree with brilliant fall colors could be a boon for Southwestern homeowners and landscapers.

Bigtooth has a jumbo geographic range. It's indigenous to parts of New Mexico, Arizona, Texas, Oklahoma and Utah. However, it isn't widely used in New Mexico's home or commercial landscapes, because the one variety available is difficult to grow.

Attempts to grow the tree from cuttings, a traditional cultivation method, have a success rate of about 1 percent. In addition, the tree only grows well under moist conditions, St. Hilaire said.

Three years ago, NMSU researchers kicked off the Bigtooth project by collecting seed specimens across the Southwest.

*See **Maple** on page 7*

Monitoring water flow and quality

Database and GIS provide timely information for Rio Grande

by Jenna Smith

Technology has hit the Rio Grande, from Elephant Butte Dam, New Mexico, to Fort Quitman, Texas.

Research scientists from Texas A&M University (TAMU), New Mexico State University (NMSU) and Universidad Autónoma de Ciudad Juárez have teamed up with federal and state agencies, irrigation districts, and water organizations from both sides of the border to provide input for the development of a Coordinated Water Resources Database & Geographic Information Systems (GIS) by the Paso del Norte (PDN) Watershed Council.

Leading the research teams are Zhuping Sheng, assistant professor of hydrogeology at the Texas A&M Research and Extension Center in El Paso, and Christopher Brown, assistant professor of geography at NMSU.

Organizations have measured and recorded flow and water quality data for years. Yet, until now, there has been no collaboration among these groups to collect and share this information.

Photo Courtesy of Zhuping Sheng

Ari Michelsen, professor and resident director of the Texas A&M Agricultural Research and Extension Center in El Paso, works with irrigation district staff at the Riverside Canal Heading Gage Station in El Paso.

"We are in the process of creating digital records of historical data, sharing real-time data, providing resources and information through the Coordinated Database Web site, and coordinating water resources measurements and reporting."

"All of these entities have interests in monitoring the river and its canals and drain waters," Sheng said. "They want to effectively collect relevant data to prevent many of the problems we now encounter, such as duplications and inconsistency."

The Rio Grande is the only major source of renewable water in the Paso del Norte region, which includes El Paso, Las Cruces and Ciudad Juárez in Mexico. In order to use the available river supply as effectively as possible, a system for monitoring river and water quality using real-time data is necessary.

The Coordinated Water Resources Database & GIS is designed to collect, synchronize and provide timely online access to flow and water quality data for use by stakeholders, scientists, water agencies and irrigation districts.

Phase I of the project was completed in 2003, and helped to identify sources, locations and parameters of water flow

and quality measurements. At the same time, NMSU developed a Web site with a GIS interface that details the Rio Grande irrigation network, measurement stations and archival water-resources-related data within the Paso del Norte Region.

"We are currently in Phase II of this project," Sheng said. "We are in the process of creating digital records of historical data, sharing real-time data, providing resources and information through the Coordinated Database Web site, and coordinating water resources measurements and reporting."

Creating an easy method for incorporating all the flow and water quality data from a variety of sources and providing access through a Web-based interface will help to better serve the Paso del Norte Region stakeholders in water resources planning and management.

For example, in the past, flash flooding in the region has led to overbank spills and cresting of flood control levees. Integrated, real-time flood tracking using the coordinated system will allow for accurate preventive actions at diversion dams and spillways to ensure containment of floodwaters.

"This up-to-date system of real-time water flow and water quality monitoring is necessary to assure more efficient delivery of specific amounts of water to communities along the river."

Since the completion of Elephant Butte Dam in 1916, little water has been released into the Paso del Norte River region during the non-irrigation season (November through February). Advances in flow monitoring by using real-time technology will help ensure that proper amounts of water are delivered at the prescribed times.

"This up-to-date system of real-time water flow and water quality monitoring is necessary to assure more efficient delivery of specific amounts of water to communities along the river," he said. "By effectively and efficiently monitoring and operating the passage of Rio Grande flows and water quality in our region, we can also maintain water quality within acceptable limits for effective water treatment, especially during low flow periods."

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Several organizations are providing support to develop the PDN Watershed Council's Coordinated Database and GIS. These include El Paso Water Utilities, U.S. Army Corps of Engineers, Rio Grande Basin Initiative, U.S. Bureau of Reclamation, NMSU's Water Resources Research Institute and TAMU.

Learn more at http://www.pdnwc.org.

Student Technician Jamie O. Hincapie confirms the location of the gauge stations using a global positioning system (GPS) receiver.

Photo Courtesy of Zhuping Sheng

Evaluating deficit irrigation

Watermelon quality and lycopene content not affected

by Jenna Smith

The United States produces, on average, 1.77 million tons of watermelons each year.

In Southwest Texas, watermelons constitute a large portion of the vegetable crop as well; however, strict pumping limitations of underground and surface water as well as competition for water use have caused farmers in the region to reevaluate the efficiency of their irrigation systems.

Daniel Leskovar, associate professor of horticulture and principal scientist with the Rio Grande Basin Initiative at the Texas A&M Research and Extension Center in Uvalde, is using evapotranspiration (ET) rate values to evaluate deficit irrigation (0.75 ET and lower) on watermelon crops. ET describes the amount of water removed from soils by soil evaporation and plant transpiration.

Lycopene content was not affected by deficit irrigation. Watermelons contain 60 percent more lycopene—an antioxidant known to reduce the risk of heart attacks and cancer—than tomatoes.

Deficit irrigations of 0.5 and 0.75 ET indicate that plants are only utilizing 50 or 75 percent of the water typically used with full irrigation. When less water is supplied to the plant, the plant must use

Daniel Leskovar, associate professor with the Texas Agricultural Experiment Station, inspects watermelon vines as affected by deficit irrigation rates.

Photo Courtesy of Daniel Leskovar

the available water more efficiently.

Using subsurface drip irrigation systems at three locations—Uvalde, Weslaco and Lubbock—Leskovar determined how decreased water application affected yield, fruit quality and lycopene content of diploid (seeded) and triploid (seedless) watermelons. By examining which cultivar of watermelon adapts more readily to specific environments, watermelons can be grown in their favored environment, increasing survivability and overall fruit quality.

Watermelons require 12 to 22 inches of water for maximum production. The amounts of water applied under deficit irrigation were 6.8 inches (0.5 ET) and 11.7 inches (0.75 ET) compared to 15.5 inches (1.0 ET) for fully watered melons.

"If water pumping restrictions from underground aquifers are further imposed, deficit irrigation will become a reality for vegetable producers. Limited irrigation will directly reduce yield and size, but fruit quality, color and lycopene content will more than likely remain constant in triploid watermelons."

"Trends, in general, across all three locations show that watermelon yields decrease sharply under deficit irrigation scenarios, 0.75 ET and below," he said.

"However, triploids have a 34 percent higher yield and fewer culls than diploids when supplied with deficit water."

Although watermelon yields decreased, deficit irrigation had inverse effects on fruit quality and lycopene content. For example, watermelon firmness increased at 0.5 ET, the lowest deficit water level. Triploid watermelons had higher soluble solids content at the lower irrigation rate as well.

Another important factor to note is that lycopene content was not affected by deficit irrigation. Watermelons contain 60 percent more lycopene—an antioxidant known to reduce the risk of heart attacks and cancer—than tomatoes.

Photo Courtesy of Daniel Leskovar

Watermelons were harvested at 0.5, 0.75 and 1.0 evapotranspiration rates at the Texas A&M University Agricultural Research and Extension Center in Uvalde for analysis of yield, lycopene content and fruit quality.

Lycopene content increased with plant maturity, and ripe and overripe melons had a substantial increase in lycopene at the lower irrigation rates.

"The fact that lycopene content is still high in overripe melons may have practical applications for human use," he said.

"Although overripe fruits are left in the field as wastes, they can be harvested and used to provide an additional source of this beneficial antioxidant."

Understanding that lycopene content is affected more strongly by genetics and plant breeding than environmental conditions will allow for proper cultivars of watermelons to be placed in areas of Texas based solely on their reactions to drought conditions.

"If water pumping restrictions from underground aquifers are further imposed, deficit irrigation will become a reality for vegetable producers," he said. "Limited irrigation will directly reduce yield and size, but fruit quality, color and lycopene content will more likely remain constant in triploid watermelons."

Every drop counts

"The runoff is going to be much better than it has been the last couple of years, but we've still got a big shortfall to make up in terms of our reservoirs."

"The continuing shortages put a premium on available water. We want to help producers use the water they have as efficiently as possible."

Irrigation district maps now available

Maps detailing the 109th Congressional District along the Rio Grande are now available online. The three maps, available in Portable Document Format (pdf), can be downloaded from the Irrigation District Engineering and Assistance (IDEA) Web site, a program of the Irrigation Technology Center (ITC).

Guy Fipps, director of the ITC and agricultural engineer with the Rio Grande Basin Initiative, said, "The maps detail irrigation districts 16, 23, 28, 15 and 27, which span from Southern Elephant Butte Irrigation District north of El Paso to the City of Brownsville. The maps will serve as educational resources for irrigation district managers and personnel throughout the Rio Grande Basin."

The IDEA Web site provides educational services and technical assistance for irrigation districts as well as applied research in GIS-based management systems and rapid assessment methods for prioritized rehabilitation projects based on water saving potential.

http://idea.tamu.edu

State engineer highlights water lecture series

New Mexico's top water official addressed the increasing importance of water resources management at a New Mexico State University (NMSU) lecture series sponsored by the Rio Grande Basin Initiative in Las Cruces.

State Engineer John D'Antonio and Interstate Stream Commission Director Estevan Lopez provided an overview on the state's current drought status.

"Unfortunately, based on the most recent snowmelt runoff estimates, it appears the drought will continue in most areas of the state," said D'Antonio. "The runoff is going to be much better than it has been the last couple of years, but we've still got a big shortfall to make up in terms of our reservoirs."

Lopez discussed implementation of New Mexico's first water plan, which was completed in December 2003.

"Now the work begins," Lopez said. "We hope to make progress on effective management of water during times of drought, installing measuring and metering devices on state streams, and making progress on settling Native American water rights cases."

Workshop emphasizes water management

Irrigation experts and Extension specialists offered new tools for efficiently using water and measuring water use at an agricultural management workshop at New Mexico State University's (NMSU) Leyendecker Plant Science Research Center.

Craig Runyan, water quality specialist with NMSU's Cooperative Extension Service and project coordinator with the Rio Grande Basin Initiative, said the innovative tools—such as portable flumes to calculate water delivery and soil moisture probes to improve cost-efficiency—are especially important under current conditions.

Officials from Elephant Butte Irrigation District announced that New Mexico farmers in the southern part of the state aren't expected to receive much more irrigation water than the 11 inches per acre that they received last year from Elephant Butte and Caballo Reservoirs.

"The continuing shortages put a premium on available water," said Runyan.

"We want to help producers use the water they have as efficiently as possible."

Maple

Continued from page 1

Seeds from 36 locations were then germinated and grown as seedlings. Along the way, researchers invented a new way of coaxing Bigtooth maple seedlings to grow, using a mix of peat and perlite in equal amounts.

"This isn't just for New Mexico. We believe a new maple will be a major addition to the landscaping industry throughout the Southwest."

Next came drought studies, designed to find a Bigtooth maple variety better suited for southern New Mexico's harsh growing conditions. "We've tested them under our dry and hot conditions, and found a few promising candidates," St. Hilaire said.

The best experimental trees are now growing in greenhouses and field plots at NMSU's Fabian Garcia Research Center just west of the main campus. Next, scientists will develop tissue cultures and DNA analysis techniques to customize a variety for dry regions.

"This isn't just for New Mexico," St. Hilaire said. "We believe a new maple will be a major addition to the landscaping industry throughout the Southwest."

Bigtooth maple is normally found as a large shrub or small tree growing on moist canyon sides and mountain sites.

Its height averages about 35 feet with a diameter of nine inches at maturity, but large specimens can reach 50 feet. Bigtooth leaves have the famous maple-shape with three to five lobes.

The maple is one of America's most loved trees, especially in the fall. With variety names like Red Sunset and Autumn Flame, the tree's brilliant colors range from scarlet to golden yellow. Known for its hard, strong wood, maples are often associated with New England, but the United States has 13 native maples, with at least one species native to every state except Hawaii.

Bigtooth maples are closely related to the eastern sugar maple, said St. Hilaire, who has experimented with maples at NMSU and Iowa State University for 10 years. The sap in both can be boiled down to make syrup or sugar. However, Bigtooth, as a smaller tree, isn't an economical syrup producer, he said.

St. Hilaire cautions that a drought-tolerant maple variety won't be available overnight. While several promising specimens have been selected, a new tree for New Mexico is probably more than a decade away. "These are relatively slow-growing trees, not row crops," he said. "It's a long-term effort but one that has tremendous economic potential."

Plus, there's the promise of stunning red and yellow trees sweeping across the landscape each fall for future New Mexicans, he said.

New Mexico State University scientists, who have spent three years collecting colorful Bigtooth maple seeds from across the Southwest, have winnowed promising varieties to half a dozen. Now, those top candidates are being field tested for stress tolerance.

OUTCOMES

Increasing Irrigation Efficiency in the Rio Grande Basin through Research and Education

Through Extension and research efforts, the Texas A&M University System Agriculture Program and the New Mexico State University College of Agriculture and Home Economics are implementing strategies for meeting present and future water demand in the Rio Grande Basin. These strategies expand the efficient use of available water and create new water supplies. This federally funded initiative is administered by the Texas Water Resources Institute and the New Mexico State University Water Task Force with funds from the Cooperative State Research, Education, and Extension Service.

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