# 2008

# Annual Progress Report

Agricultural Science Center at Tucumcari
6502 Quay Road AM.5
Tucumcari, NM 88401-9661

## NOTICE TO USERS OF THIS REPORT

This report has been prepared as an aid to the Science Center staff in analyzing the results of the various research projects during the past year and for recording data for future reference. This is not a formal Agricultural Experiment Station Report of research results.

Information in this report represents from only one years' research. The reader is cautioned against drawing conclusions or making recommendations as a result of data in this report. In many instances data in this report represents only one of several years' results that will constitute the final formal report. It should be pointed out; however, the staff members have made every effort to check the accuracy of the data presented.

This report was not prepared as a formal release; therefore, none of the data are authorized for release or publication, without the written prior approval of the New Mexico Agricultural Experiment Station.

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Dr. LeRoy Daugherty, Associate Dean and Associate Director
Agricultural Experiment Station

# 2008

# Annual Progress Report
# New Mexico State University
# Agricultural Science Center at Tucumcari
# 6502 Quay Road AM.5
# Tucumcari, NM 88401-9661

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## Leonard Lauriault, Editor

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Rex E. Kirksey
Superintendent and
College Professor

Leonard Lauriault
Forage Agronomist and
College Professor

Larry F. Perkins
Farm Superintendent

Calvin D. Henson
Farm/Ranch Laborer II

Martin Mead
Farm/Ranch Laborer III

Patricia Cooksey
Records Specialist

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**Other Studies**

# Acknowledgements

Several individuals and companies donated products and services to the Agricultural Science Center at Tucumcari during 2008. Appreciation is expressed to the following persons and organizations for their contributions.

Agricultural Science Center Advisory Committee Center

Mr. Donnie Bidegain
Mr. Phillip Box
Mr. Will Cantrell
Mr. Donald Carter
Mr. Paul Estrada, Vice-Chairman
Mr. David Foote
Mr. Herman Lopez
Mr. Franklin McCasland
Mr. Robert Lopez, Chairman
Mr. Clyde Moon
Mr. Jim Norris
Mr. Elmer Schuster
Mr. Pete Tatschl
Mr. Leo Thrasher
Mr. Court Watson

Bayer Environmental Science – Gary Brooks
Memphis, TN ..... Merit 2F Insecticide

Donnie Bidegain
Tucumcari, NM ..... Hay for the Hay Wagon Tour on Field Day

Farm Credit of NM – Cooper Glover
Tucumcari, NM ..... Refreshments for Field Day

Target Seed – Don Miller
Parma, ID ..... Donation to Forage Grass Program

AGRO GUARD
Southwest Border Food Safety & Defense Center ..... Registration for Field Day Program

# Introduction

The New Mexico State University Agricultural Science Center at Tucumcari is located on U.S. Highway 54 three miles northeast of Tucumcari and Interstate 40. The center consists of 464 acres, with 170.9 acres having Arch Hurley Conservancy District water rights. In operation since, 1912, the center is New Mexico State University's oldest off-campus research facility. Home of the annual Tucumcari Bull Test, which helps producers improve their beef herds, the center's mission also includes developing forage and grazing systems for irrigated lands in the western USA and local crop evaluations. Prior to conducting research in irrigated agriculture, the center evaluated dryland cropping systems and trees for windbreak and farmstead plantings The tree research led to the establishment of over 50 species of trees and shrubs on the center grounds, making it an oasis of trees in a sea of native grassland.

## Personnel and Facilities

## Personnel

In March 2008, Martin Mead, Farm Ranch Laborer III, left employment with the University. Calvin Henson, Farm Ranch Laborer II at the center, filled the position when it was advertised in August. Shane Jennings was then hired in September to fill the Farm Ranch Laborer II/Bull Feeder position vacated by Calvin Henson.

A list of temporary employees that were employed at the center, in 2008 is shown below:

| Name | Job Title | Dates of Employment |
|---|---|---|
| McKayle Atwood | Project Aide I | 05/05/2008 – 08/08/2008 |
| Rusty D. Brake | Farm/Ranch Laborer II | 01/01/2008 – 08/13/2008 |
| Alice Johnson | Custodian | 05/29/2008 – 12/31/2008 |
| Carl Jason Henry Latham | Project Aide IV | 01/01/2008 – 05/13/2008 |
| Teri Mitchell-Gallegos | Farm/Ranch Laborer II | 05/29/2008 – 08/31/2008 |
| Jennifer Schallert | Project Aide I | 01/01/2008 – 04/27/2008 |

### Buildings, Grounds, and Facilities

The Horse Barn was re-shingled with 3-tab asphalt shingles in Spring 2008. Development of the Eastern New Mexico Outdoor Arboretum continued as described elsewhere in this Annual Report. A six-inch water line was connected to the pivot irrigation system to supply water for lawn irrigation and in anticipation of installing an automated irrigation system using Legislative Capital Outlay money. This line came due east from the pivot across the roadway, to the north along the road and to the east into the lawn north of the Conference Room. Two risers were installed for continued surface irrigation, one at the end of the line and one in the lawn adjacent to the Superintendent's garage, south of the shop. Concurrently to that installation, a water line was laid from the Conference Room north to meet the 6-inch line and continued in the same ditch to the pivot to provide for livestock watering and other uses with a frost-free hydrant installed at the pivot.

### Irrigation Water

The annual Arch Hurley Conservancy District assessment for 2008 was $10.00 per water right acre and the water delivery charge was $10.00 per acre-foot. The water allotment in 2008 totaled 4 inches with 1 inch allocated in each of March, June, August, and September. Water releases from Conchas Dam in 2008 took place from May 14 to July 11, August 18 to 29, and September 1 to October 14. The center used a total of 56.96 acre-feet of water in 2008 and retained a credit of $160 for pre-paid water.

**Outreach Events, Productivity and Activities**

Staff at the Agricultural Science Center at Tucumcari hosted or participated in a variety of activities in 2008 in addition to the ongoing research programs.

Several College of Agriculture and Home Economics personnel from other locations worked cooperatively with staff at the Tucumcari center in 2008. These individuals included: Sangu Angadi, Jamshid Ashigh, Jane Breen-Pierce, Scott Bundy, Victor Cabrera, Lupe Carrasco, Francisco Contreras-Govea, Tom Dominguez, Manny Encinias, Robert Flynn, Steve Guldan, Steve Loring, Robert Hagevoort, Bernd Leinauer, Steve Loring, Mark Marsalis, Clay Mathis, Mick O'Neill, Tom Place, Naveen Puppala, Ian Ray, Aaron Scott, Sergio Soto-Navarro, Carol Sutherland, Dawn VanLeeuwen, and John Villalba. Individuals from outside the NMSU College of Agriculture and Home Economics, who worked cooperatively with center staff in 2008 were: Art Ariaz (NRCS Tucumcari Field Office), David Bollschweiler (NMSU, OFS Engineering Department), David Dreesen (NRCS Los Lunas Plant Materials Center), Vic Gibeault (University of California, Riverside), Aaron Miller (USDA, APHIS, Abilene, TX), Calvin Trostle (TAMU/TAES, Lubbock), and Greg Walke (NMSU, OFS Facilities Planning and Construction).

**Bull and Heifer Performance Testing**

The 47th Annual Tucumcari Bull Test ended with the Performance Tested Bull and Heifer Sale at the center on March 19, 2008. The 73 bulls completing the test gained an average of 3.90 pounds per day. Four breeds (Angus, Charolais, Hereford, and Maine-Anjou) and nine cooperators were represented in the bull test. The heifer development program that was initiated in conjunction with the bull test in 2004, included 59 heifers representing two breeds (Angus and Charolais). As in 2007, cooperators in the 47th Annual Tucumcari Bull Test were given an opportunity to feed bulls in individual pens, and "unfed, non-performance tested" bulls and heifers were allowed in the sale.

The 48th Annual Tucumcari Bull Test began on October 15, 2007 with the delivery of 122 bulls representing five breeds (Angus, Blonde D'Aquitaine, Charolais, Hereford, and Maine-Anjou) and nine cooperators. There were no heifers. The 2009 Annual Tucumcari Bull Performance Sale will be on March 20. Information on the bull and heifer testing program is available from the NMSU Cooperative Extension Service's "Bull Session" publication, on the Internet at http://cahe.nmsu.edu/beefperformancetest, and from Dr. Manny Encinias. Members of the New Mexico Beef Cattle Performance Association held meetings at the center on November 13 and December 5. 2006 and January 7, February 4, and March 3, 2007 and at the New Mexico Cattlemen's Association meeting in Albuquerque on December 12, 2008.

## Field Day

The center hosted its Annual Field Day on August 7, 2008. Registration began at 5:00 pm. The dinner, catered and served by Del's Restaurant at 5:30 pm, was provided by sponsored by the Southwest Border Food Safety and Defense Center. Rex Kirksey gave the welcome and introduction of guests. Franklin McCasland introduced the guest speaker, Bruce Richardson from the Office of the State Engineer of New Mexico. Two concurrent, but repeated hay wagon tours were offered beginning at 6:45 pm. Presentations on one tour included Beef Cattle Bio-Security (Manny Encinias, PhD, NMSU Extension Livestock Specialist at the Clayton Livestock Research Center), Brush Management (Tom Dominguez, NMSU Quay County Cooperative Extension Service Agent for Agriculture), Sorghum-Legume Intercrops (Sangu Angadi, PhD, NMSU Crop Stress Physiologist, Sultan Begna, PhD, Research Specialist, NMSU Agricultural Science Center at Clovis), and Weed Management (Jamshid Ashigh, PhD, NMSU Extension Weed Specialist, Las Cruces). The other tour was a rolling presentation of the dryland cropping systems project and the ongoing forage research program being conducted under furrow irrigation in the northern plot area led by Leonard Lauriault.

## Other Public Programs

In addition to the Annual Field Day, the center hosted an Earth Day service project for members of Tucumcari High School Class of 2008 on April 22. For this activity, the Seniors cleaned out, planted and mulched the flower bed, re-mulched the boxwood bed, and cleaned out the area planted to golden currant under the juniper tree, all in front of the office, and trimmed back the giant reed south of the Superintendent's residence.

Also in 2008 the center hosted an Alfalfa Scouting School, sponsored by the Quay County Cooperative Extension Service. Mark Muegge, PhD, Extension Entomologist with the Texas Cooperative Extension Service at Fort Stockton, discussed scouting techniques and major insect problems. After a hands-on activity at the alfalfa research plots, Leonard Lauriault gave a brief tour of the ongoing alfalfa research projects.

There were three guided tours of The Eastern New Mexico Outdoor Arboretum and one unguided tour. Garden Clubs of New Mexico, Inc. took a guided tour on October 17, members of the local Girl Scouts of America Daisy and Brownie Troop were guided on October 24, and attendees of the New Mexico Area Conservation Districts Annual Meeting were guided on October 29. On October 30 more attendees of the New Mexico Area Conservation Districts Annual Meeting took an unguided tour using the brochure developed by NMSU University Communications.

## Quay County Cotton Boll Weevil Control District

The Agricultural Science Center at Tucumcari continued to assist the Quay County Cotton Boll Weevil Control District with its activities in 2008 and provided support for the District's boll weevil scouting program. More information about the scouting program is included in an article within this report.

## Advisory Committee

The Advisory Committee to the Agricultural Science Center at Tucumcari met on March 12, 2008. A report on activities in the College of Agriculture and Home Economics was presented by Dr. LeRoy Daugherty, Associate Dean and Associate Director of the Agricultural Experiment Station. The committee's membership roster was updated, ongoing projects were reviewed, and producer concerns and research ideas were discussed.

## Productivity

Refereed Journal Articles

Cabrera, V.E., R. Hagevoort, D. Solis, R.E. Kirksey, and J.A. Diemer. 2008. Economic impact of milk production in the State of New Mexico. J. Dairy Sci. 91:2144-2150. doi:10.3168/jds.2007-0791.

Cabrera. V.E., C.P. Mathis, R.E. Kirksey, and T.T. Baker. 2008. Case Study: Development of a seasonal prediction model for manure excretion by dairy cattle. Prof. Anim. Sci. 24:175-183.

Decker, J.E., P. Luna-Nevarez, A.M. Encinias, R.M. Enns, and M.G. Thomas. (R.E. Kirksey, et al; contributors) 2008. Case study: Scrotal circumference in beef bulls - Prediction of measures at 365 days of age from measures at 240 days of age with data from the Tucumcari Bull Test. Prof. Anim. Sci. 24:488-493.

Lauriault, L.M., R.E. Kirksey, and D.M. VanLeeuwen. 2008. How winter annual forage legumes persist in diverse soil moisture environments. Online. Forage and Grazinglands doi: 10.1094/FG-2008-0619-01-RS.

Marsalis, M.A., L.M. Lauriault, S.H. Jones, and M.J. Renz. 2008. Managing field bindweed in sorghum-wheat-fallow rotations. Online: Crop Manage. doi: 10/1094/CM-2008-0818-01-RS.

Marsalis, M.A., L.M. Lauriault, and D.M. VanLeeuwen. 2008. Selecting small grain forages for the Southern High Plains. Online. Forage and Grazinglands doi: 10.1094/FG-2008-1104-01-RS.

**Abstracts and Proceedings**

Angadi, S.V., M.A. Marsalis, L.M. Lauriault, R.E. Kirksey, and S. Begna. 2008. Short duration alternate crops for the Southern High Plains under limited irrigation. Abstr. CD-ROM. Ann. Mtg. ASA-CSSA-SSSA. Houston, TX. October 5-9, 2008.

Leinauer, B., V. Gibeault, Lauriault, L.M., R. Autio, S. Cockerham, R. Kirksey, and S. Ries. 2008. Establishment and subsequent spring survival of low maintenance turfgrasses in transition zone climates. Proc. Eur. Turfgrass Soc. Conf. 1:113-114 (peer-reviewed).

Lauriault, L.M. 2008. Irrigation and nitrogen effects on teff in the Southern High Plains. Abstr. CD-ROM. W. Soc. Crop Sci. Waimea, HI. June 15-18, 2008.

**Posters and Booths**

Angadi, S.V., M.A. Marsalis, L.M. Lauriault, R.E. Kirksey, and S. Begna. 2008. Short duration alternate crops for the Southern High Plains under limited irrigation. #644-11. Ann. Mtg. ASA-CSSA-SSSA. Houston, TX. October 5-9, 2008.

Kirksey, R.E. 2008. Development of sustainable crop and livestock production systems for land in the Conservation Reserve Program (CRP). Western Region SARE Sub-Regional Conference, Albuquerque, NM. June 10, 2008.

**New Mexico State University Agricultural Experiment Station Publications**

Cabrera, V.E., C.P. Mathis, R.E. Kirksey, and T.T. Baker. 2008. NM-Manure: A seasonal prediction model for manure excretion by dairy cattle in New Mexico. Bull. 797. Online: http://aces.nmsu.edu/pubs/research/livestock_range/bl797,pdf. (Posted: August 2008; Accessed: March 2009; 12pp). New Mexico St. Univ. Agric. Exp. Stn., Las Cruces.

Lauriault, L.M**.** 2008. Climate change effects on New Mexico trees and grasses and alternative energy sources. New Mexico Climate 6:(2):3-4. Online http://aces.nmsu.edu/academics/pes/documents/nl-climate-summer-08.pdf (Posted July 2008; Accessed February 2009; 15 pp). New Mexico St. Univ. Plant and Environmental Sciences Department, Las Cruces.

Lauriault, L.M., R.E. Kirksey, and D.M. VanLeeuwen. 2008. Performance of perennial cool-season forage legumes in diverse soil moisture environments, Southern High Plains, USA. Bull. 796. Online: http://aces.nmsu.edu/pubs/research/agronomy/BL-796.pdf. (Posted: May 2008; Accessed: November 2008; 12 pp). New Mexico St. Univ. Agric. Exp. Stn., Las Cruces.

Lauriault, L.M., I.M. Ray, C.A. Pierce, R.P. Flynn, M.A. Marsalis, M.K. O'Neill, and T. Place. 2008. The 2008 New Mexico alfalfa variety test report. Unnumbered. Online: http://www.aces.nmsu.edu/pubs/variety_trials/ VAR08.pdf. (Posted: December 2008; Accessed: January 2009; 21 pp). New Mexico St. Univ. Agric. Exp. Stn., Las Cruces.

Lauriault, L.M., I.M. Ray, C.A. Pierce, R.P. Flynn, M.A. Marsalis, M.K. O'Neill, and T. Place. 2008. The 2007 New Mexico Alfalfa Variety Test Report. Unnumbered. Online:

http://www.aces.nmsu.edu/pubs/variety_trials/VAR07.pdf. (Posted: January 2008; Accessed: January 2009; 19 pp). New Mexico St. Univ. Agric. Exp. Stn., Las Cruces.

Marsalis, M.A., R.E. Kirksey, R.P. Flynn, M.K. O'Neill, L.M. Lauriault, and M. Place. 2008. New Mexico 2007 corn and sorghum performance tests. Unnumbered. Online: http://www.aces.nmsu.edu/pubs/variety_trials/sorghum07.pdf. (Accessed: January 2009; 70 pp). New Mexico St. Univ. Agric. Exp. Stn., Las Cruces.

**Cooperative Extension Service Publications**

Lauriault, L.M. 2008. An update on recent furrow-irrigated alfalfa research at New Mexico State University's Agricultural Science Center at Tucumcari. Alfalfa Market News, August 27, 2008. New Mexico St. Univ. Cooperative Extension Service, Las Cruces.

Lauriault, L.M. 2008. Roundup Ready alfalfa update #2. Alfalfa Market News, April 22, 2008. New Mexico St. Univ. Cooperative Extension Service, Las Cruces.

**Popular Press**

Kirksey, R.E. 2008. Proper seed selection can pay off. AgSense Column. Clovis News Journal. September 2, 2008.

Olmsted, A. 2008. Arboretum at NMSU's Tucumcari science center is educational walking trail. NMSU Press Release, September 3, 2008. New Mexico St. Univ. Univ. Comm. Mktg. Ser., Las Cruces.

McDowell, K. 2008. (interviewed for) Alfalfa farmers suffer in drought. Farm and Ranch Magazine, Freedom Newspapers. August/September 2008, pp. 10, 11.

Zenk, P. 2008. (interviewed for) Adaptable and appealing. Hay and Forage Grower. Pp 28, January 29, 2008.

**Annual Reports and Other Articles**

Kirksey, R.E. 2008. In: Bean, B., 2007 wheat variety trials conducted in the Texas and New Mexico High Plains. Texas Coop. Ext. Serv. And Texas Agric. Exp. Stn.

Lauriault, L.M. (editor). 2008. The 2007 Annual Progress Report. New Mexico St. Univ. Agric. Exp. Stn., Agric. Sci. Ctr. at Tucumcari.

Lauriault, L.M. 2008. What I learned at several workshops I've been to lately. E-pistle to NMSU Agricultural Experiment Station and Cooperative Extension Service personnel and other selected parties. July 30, 2008.

Lauriault, L.M. 2008. What I learned at the Society for Range Management/American Forage and Grassland Council meeting about biofuels and climate change. E-pistle to NMSU Agricultural Experiment Station and Cooperative Extension Service personnel and other selected parties. April 8, 2008.

Lauriault, L.M. 2008. What I learned about alfalfa at the National Alfalfa Symposium and SRM/AFGC. E-pistle to NMSU Agricultural Experiment Station and Cooperative Extension Service personnel and other selected parties. February 7, 2008.

Lauriault, L.M. 2008. Some thoughts about pastures spurred by presentations at the Society for Range Management/American Forage and Grassland Council meeting. E-pistle to NMSU Agricultural

Experiment Station and Cooperative Extension Service personnel and other selected parties. February 3, 2008.

**Presentations**

Kirksey, R.E. 2008. Development of sustainable crop and livestock production systems for land in the Conservation Reserve Program (CRP). Western Region SARE Sub-Regional Conference, Albuquerque, NM. June 10-11, 2008.

Kirksey, R.E., N. Puppala and S. Angadi. 2008. NMSU Ag Science Center Update. New Mexico Seed Assoc. Clovis, NM. February 8, 2008.

Lauriault, L.M. 2008. Alfalfa variety selection and management as components of IPM. Chaves County CEU Workshop, Chaves County Cooperative Extension Service, Roswell, November 14, 2008.

Lauriault, L.M. 2008. Rolling tour of forage research. Field Day, Agricultural Science Center at Tucumcari, August 7, 2008.

Lauriault, L.M. 2008. Extending fall grazing by interseeding annual forages into sweet corn. Field Day, Sustainable Agriculture Science Center at Alcalde, August 5, 2008.

Lauriault, L.M.. 2008. Research and outreach programs at the Agricultural Science Center at Tucumcari. Rotary Club Luncheon. Tucumcari, July 31, 2008.

Lauriault, L.M. 2008. Recent developments in alfalfa research. Field Day, Agricultural Science Center at Farmington, July 11, 2008.

Lauriault, L.M. 2008. Current alfalfa research. Alfalfa Scouting School. Quay County Cooperative Extension Service and the Agricultural Science Center at Tucumcari, June 20, 2008.

Lauriault, L.M. Irrigation and nitrogen effects on teff in the Southern High Plains. Ann. Mtg. W. Soc. Crop Sci., Waimea, HI, June 16, 2008.

Lauriault, L.M.. 2008. Forage crops. Earth Day celebration for middle and high school students, May 8, 2008.

Lauriault, L.M.. 2008. Alfalfa production. New Mexico Pueblo and Community Agriculture Conference. RAIPAP, Cooperative Extension Service, Agricultural Experiment Station. Santa Fe, April 17, 2008.

Lauriault, L.M.. 2008. Horse pastures. Horses, Hays, and Pastures. Quay County Cooperative Extension Service. Tucumcari, April 4, 2008.

Lauriault, L.M..2008. Irrigated pasture weed control. Toxic Plant Workshop. Grant County Cooperative Extension Service. Silver City, March 27, 2008.

Lauriault, L.M.. 2008. Status of the development of The Eastern New Mexico Outdoor Arboretum. New Mexico Soil and Water Conservation Commission meeting. Tucumcari, March 23, 2008.

Lauriault, L.M.. 2008. Alfalfa variety selection for the middle Pecos Valley. DeBaca County Agriculture Seminar. DeBaca County Cooperative Extension Service. Ft. Sumner, February 28, 2008.

Lauriault, L.M.. 2008. Sainfoin and other alternatives to alfalfa. Southwest Hay Conf. and Trade Show. New Mexico Hay Association. Ruidoso, January 16, 2008.

**Grant Proposals**

**Funded**

Angadi, S., R.E. Kirksey, M.A. Marsalis and S. Begna. 2008. Strip tillage, no-till and stubble management practices for improving water use efficiency. USDA Natural Resources Conservation Service. $74,811.

Guldan, S.G., and L.M. Lauriault. 2008. 2008. Extending the Grazing Season and Integrating Crops and Livestock to Sustain Small Farms and Ranches in the Southern Rockies SARE RFA #07-02, $7381.

Lauriault, L.M. March 2008. May-November 2008. Forage sorghum testing. Various seed companies, $1125.

Lauriault, L.M., I.M. Ray, and R.P. Flynn. April 2008. 2009-2012. Alfalfa variety testing. Various seed companies, $5400.

Marsalis, M., R.E. Kirksey, M. O'Neill, S. Angadi and R. Hagevoort. 2008. Wheat straw as a biofuel feedstock for ethanol production in New Mexico. New Mexico Wheat Growers Assoc., $10,000.

Soto, S., M. Encinias, R. Kirksey, and L.M. Lauriault. 2008. 2008-2009. Supplementation of grazing animals with distillers' dried grains. II: Performance. USDA – ARS, $28,000.

**Pending**

Lauriault, L.M., I.M. Ray, M. O'Neill, and T. Place. December 2008. 2010-2013. Alfalfa variety testing. Various seed companies, $450/entry.

**Not Funded**

Kirksey, R. E. and R. Foster. 2008. Small-scale wind turbine development at the Agricultural Science Center at Clovis. State of New Mexico, Energy, Minerals and Natural Resources Department. $256,939.

Lauriault, L.M., M. Marsalis, S.V. Angadi, S. Ivey, D. Dreesen, A. Ariaz, and D. VanLeeuwen. 2008. Evaluation of perennial warm-season grasses as higher net energy biofuel crops for the Southern High Plains and Rio Grande Basin, NMSU Interdisciplinary Grant, $49,925.

Lauriault, L.M., M. Marsalis, S.V. Angadi, S. Ivey, D. Dreesen, A. Ariaz, D. VanLeeuwen, and F. Contreras-Govea. 2008. Evaluation of perennial warm-season grasses as biofuel crops for the Rio Grande Basin, Southern High Plains, and Pecos Watershed. Rio Grande Basin Initiative, $159,428.

Soto, S., M. Encinias, R. Kirksey, and L.M. Lauriault. 2008. 2008-2009. Supplementation of grazing animals with distillers' dried grains. I: Characteristics of digestion. USDA – ARS, $52,308.

**Memberships**

**Rex Kirksey**

Soil and Water Conservation Society (Regional Representative, New Mexico Chapter)
Research Center Administrators' Society
Association for Arid Lands Studies
Member, Greater Tucumcari Economic Development Corporation

**Leonard Lauriault**

American Society of Agronomy

Crop Science Society of America (Branch Leadership Council)
Western Society of Crop Science (President-elect)
American Forage and Grassland Council (Certified Grassland Professional)
New Mexico Hay Association (Ex-officio Director)

**Meetings and Other Functions Attended**

**Rex Kirksey**

Legislative Appreciation Breakfast, Clovis/Curry County Chamber of Commerce, Clovis
Joint Stockmens' Meeting, Albuquerque, December 12, 2008.
Western Region SARE, IPM Workshop, Las Cruces, December 9, 2008.
Amarillo Farm Show, Amarillo, December 4, 2008.
Vice President Ben Woods and Regent Blake Curtis Tour of Clovis Area, November 18, 2008.
Tom Udall Invited Meeting with Farmers, Ranchers and Dairymen, Clovis, October 27, 2008.
Renewable Energy Transmission Meeting, Tucumcari, October 22, 2008.
Extension Support Council Executive Committee Meeting, Albuquerque, October 13, 2008.
NRCS, Clovis, October 9, 2008.
Clovis Association of Commerce and Industry Legislative Meeting, Clovis, October 8, 2008.
Beef Initiative Outreach Meeting, Fort Sumner, September 24, 2008.
Peanut Field Day. Agricultural Science Center at Clovis. Clovis/Portales. September 22, 2008.
Bovine Tuberculosis Meeting, NM Livestock Board, Tucumcari, September 4, 2008.
Field Day. Agricultural Science Center at Clovis. August 28, 2008.
Dan Alpert (Sen. Jeff Bingaman's Office), Agricultural Science Center at Clovis, August 26, 2008.
Field Day. Agricultural Science Center at Tucumcari. August 7, 2008.
USDA NRCS Conservation Tour, Agricultural Science Center at Clovis, August 6, 2008.
USDA NRCS Local Workgroup Meeting, Clovis, August 4, 2008.
Local Work Group meetings for EQIP. USDA NRCS. Tucumcari. July 25, 2008.
Research Center Administrators Society Meeting, Logan, UT, July 27-31, 2008.
Quay County Agricultural Emergency Preparedness Workshop, Tucumcari, July 1, 2008.
Dairy Fest, Clovis, June 28, 2008
Alfalfa/Forage Pests Scout School, Agricultural Science Center at Tucumcari, June 20, 2008.
GIS in Agricultural Security Training Session, County College, Las Cruces, June 19, 2008.
Western Region SARE Conference, Albuquerque, June 10-11, 2008.
Wheat Field Day, Agricultural Science Center at Clovis, May 28, 2008.
High Plains Dairy Consortium, Education Class Meet and Greet, Clovis, May 19, 2008.
Tucumcari Quay County Chamber of Commerce - Association of Commerce and Industry Luncheon, Tucumcari, May 9, 2008.
NM Peanut Research Board Meeting, Portales, May 2, 2008.
Agriculture and Food Vulnerability Assessment Training Course, Albuquerque, April 28-30, 2008.
NMSU Extension In-Service Training, Las Cruces, April 8-9, 2008.
Horses, Hays, and Pastures. Quay County Cooperative Extension Service. Tucumcari, April 4, 2008.
NM Peanut Research Board Meeting, Portales, March 28, 2008.
Bull and Heifer Sale. New Mexico Beef Cattle Performance Association. Agricultural Science Center at Tucumcari. March 21, 2008.
New Mexico Gran Sorghum Producers Annual MeetingClovis, March 13, 2008.
Advisory Committee meeting. Agricultural Science Center at Tucumcari. March 12, 2008.
Advisory Committee meeting. Agricultural Science Center at Clovis. March 11, 2008.
New Mexico Ag Expo, Portales, February 26, 2008.
NM Seedmens Association tour of Sunland Industries, Portales, February 8, 2008.
Quay County Ag and Home Economics Seminar, January 31, 2008.
Quay County Legislative Appreciation Day, Santa Fe, January 23, 2008.
Clovis Portales Legislative Appreciation Dinner, Santa Fe, January 21, 2008.

New Mexico Beef Cattle Performance Association Meetings, Tucumcari, January 7; February 4; July 1, December 12, 2008.

**Leonard Lauriault**

Canadian River Soil and Water Conservation District monthly meetings when possible. Tucumcari.
Quay County Cooperative Extension Service Advisory Committee meeting. Tucumcari. December 4, 2008.
Chaves County CEU Workshop. Chaves County Cooperative Extensive Service, Roswell. November 13, 2008.
Garden Clubs of New Mexico, Inc., District 3 meeting. Tucumcari. October 17, 2008.
Branch Leadership Luncheon. ASA-CSSA-SSSA. Houston, TX. October 8, 2008.
Annual meeting. ASA-CSSA-SSSA. Houston, TX. October 5-9, 2008.
Peanut Field Day. Agricultural Science Center at Clovis. Clovis/Portales. September 22, 2008.
Directors' meeting. New Mexico Hay Association. Ruidoso. September 12, 2008.
Field Day. Agricultural Science Center at Clovis. August 28, 2008.
Field Day. Agricultural Science Center at Tucumcari. August 7, 2008.
Field Day. Sustainable Agricultural Science Center at Alcalde. August 5, 2008.
Rotary Club Luncheon. Tucumcari. July 31, 2008.
Local Work Group meetings for EQIP. USDA NRCS. Tucumcari. July 25, 2008.
Texoma Pasture Conference. Noble Foundation. Ardmore, OK. July 19, 2008.
Field Day. Agricultural Science Center at Farmington. July 11, 2008.
Annual meeting. Western Society of Crop Science. Waimea, HI. June 15-18, 2008.
Earth Day. USDA NRCS. Tucumcari Outdoor Classroom. May 8, 2008.
New Mexico Pueblo and Community Agriculture Conference. RAIPAP, Cooperative Extension Service, Agricultural Experiment Station. Santa Fe. April 17, 2008.
CRP Haying and Grazing Program public meeting. USDA FSA. Clovis. April 10, 2008.
Horses, Hays, and Pastures. Quay County Cooperative Extension Service. Tucumcari, April 4, 2008.
Toxic Plant Workshop. Grant County Cooperative Extension Service. Silver City. March 27, 2008.
Quarterly meeting, New Mexico Soil and Water Conservation Commission. Tucumcari. March 26, 2008.
Bull and Heifer Sale. New Mexico Beef Cattle Performance Association. Agricultural Science Center at Tucumcari. March 21, 2008.
Advisory Committee meeting. Agricultural Science Center at Tucumcari. March 12, 2008
Advisory Committee meeting. Agricultural Science Center at Clovis. March 11, 2008
DeBaca County Agriculture Seminar. DeBaca County Cooperative Extension Service. Ft. Sumner. February 28, 2008
National Alfalfa Symposium. Kearney, NE. February 4-5, 2008.
Affiliate Council meeting. American Forage and Grassland Council. Louisville, KY. January 30, 2008.
Affiliate Breakfast. American Forage and Grassland Council. Louisville, KY. January 30, 2008.
Professional issues luncheon. American Forage and Grassland Council. Louisville, KY. January 29, 2008.
Joint annual meeting, Society for Range Management and American Forage and Grassland Council. Louisville, KY. January 27-31, 2008.
Directors' meeting. New Mexico Hay Association. Ruidoso. January 18, 2008.
Southwest Hay Conference and Trade Show. New Mexico Hay Association. Ruidoso, January 17-18, 2008.
Pesticide Applicators Workshop. Cooperative Extension Service. Hobbs. January 15, 2008.

**Larry Perkins**

Arch Hurley Conservancy District monthly meetings, Tucumcari
Canadian River Soil and Water Conservation District monthly meetings, Tucumcari
Quay County Cooperative Extension Service Advisory committee meetings, Tucumcari

**Other Activities**

**Rex Kirksey**

Facilitator, Strategic Plan Development, Arch Hurley Conservancy District, Tucumcari, September-November 2008.
On-site Supervisor, PhD Student, Francisco Loya, University of Baja, Mexico.
Grant Application Reviewer, NM Association of Soil and Water Conservation Districts, Water Quality and Conservation Grant Fund, Ruidoso, May 30 and July 18, 2008.
Hosted visit by Rep. Heather Wilson, US Representative, Agricultural Science Center at Clovis, February 5, 2008.
Member, (Appointed) College of Agriculture and Home Economics, Promotion and Tenure Guidelines Committee, 2008.
Member (Elected), College of Agriculture and Home Economics, Promotion and Tenure Committee, 2008.
Member (Appointed), College of Agriculture and Home Economics, Performance Evaluation Committee, 2008.
Manager, Quay County Boll Weevil Control District, scouting program, 2008.

**Leonard Lauriault**

Responded to 18 questions about the bindweed mite and approximately 100 miscellaneous questions from New Mexico residents, including NMSU and NRCS personnel, as well as residents and extension personnel in Colorado, Montana, Texas, Utah, Germany, and Iraq in 2008.
Member, Quay County Cooperative Extension Service Agricultural Advisory Committee.
Guided tours of The Eastern New Mexico Outdoor Arboretum at the Agricultural Science Center at Tucumcari.
Provided information to German authors related to agricultural production in the region for a travel guide.
Provided bindweed mites to Mexican researchers through Senasica.
Assisted Lawrence Velasquez, Santa Rosa High School, with a Science Fair project.
Attended presentation to Tucumcari High School science classes by J. Mexal. The world is exploding with people – how will we feed 6 billion. May 1, 2008.
Advised Guadalupe Soil and Water Conservation District Supervisors regarding equipment purchase and rental agreements.
Acquired USDA APHIS permit to import *Aceria malherbae* bindweed gall mite into Arizona. A similar request to import the mites into California was denied. Mites have been shipped to Ohio and to Colorado. Additionally, arrangements were made to ship mites to Utah from Texas.

**Certifications For All Professional Staff**

Public Pesticide Applicator's License (through December 31, 2009)
NMSU Assurance of Actual Training, IACUC (through October 2010)

# Annual Weather Summary

The first documented weather observations in the Tucumcari area were from a weather station near the Tucumcari Post Office. That station was operational from December 1904 through February 1913. The Agricultural Science Center at Tucumcari began recording daily precipitation in January 1912. Air temperatures were first recorded on May 26 of that year. The weather station at the center has remained in continuous operation since its establishment in 1912. An updated historical summary of weather observations at the Agricultural Science Center at Tucumcari was published as an Agricultural Experiment Station Research Report in early 2003. This report contains summary information relative to weather conditions at the center through 2002. The report is available from the Agricultural Science Center office or online at: www.cahe.nmsu.edu/pubs/research/weather_climate/RR751.pdf .

In addition to the precipitation and weather records, the center has maintained records on wind movement since 1918. Above ground pan evaporation has been measured since 1953. Maximum and minimum soil temperatures, at a four-inch depth, have been recorded since 1977. Maximum and minimum water temperatures in the evaporation pan were first recorded in 1981.

Total precipitation for 2008 was 18.63 inches, 1.63 inches more than the long-term average of 17.00 inches (Table 1). Above average amounts of precipitation were recorded in five months of 2008 (May, June, July, August, and October). The precipitation total for July exceeded the long-term average by over two inches. Record high and low amounts of precipitation, by month, are shown in Table 2. No precipitation records were set in 2008.

The mean maximum temperature for 2008 was 75ºF which exceeded the long-term average by 1ºF (Table 3). Mean monthly maximum temperatures were above normal for the months of January, February, March, April, May, June, July, October, November, and December. Mean minimum temperature for 2008 was 43ºF which is 1ºF lower than the long-term average of 44ºF. Mean monthly minimum temperatures were above normal for the months of February, March, June, November, and December. The mean annual temperature for 2008 was 58ºF which is 1ºF below the long-term average. The lowest recorded temperature in 2008, 6ºF, was recorded on January 17. The highest temperature, 105ºF, was recorded on June 27. Highest and lowest recorded temperatures and mean temperature extremes are shown in Table 4. No record highs or lows were recorded in 2008. The record high of 104ºF in 1998 was tied on June 3.

The last spring temperature of 32ºF in 2008 was recorded on April 27 (Table 5). The first temperature of 32ºF in fall was recorded on October 23. Normal last spring and first fall freeze dates are March 30 and October 9, respectively. The 2008 growing season was 179 days, 10 days shorter than the long-term average of 189 days. The longest and shortest growing seasons on record are 222 and 136 days, which were recorded in 1989 and 1945, respectively.

The last snowfall in spring was recorded on March 7, 2008. The first snowfall in winter 2008 was recorded on December 3. Total snowfall in 2008 was 3.50 inches. The last snowfall in spring has occurred as late as May 18 in 1935 and 1980. The first snowfall in winter has been recorded as early as October 8, in 1970. Summaries of pan evaporation and wind run at the center are shown in Table 6.

Table 1. Summary of monthly precipitation amounts (inches) recorded at the NMSU Agricultural Science Center at Tucumcari, 1905-2008.

| Month | 2008 | 2007 | 2006 | 2005 | 2004 | Average 1905-2008 |
|---|---|---|---|---|---|---|
| January | 0.02 | 0.68 | 0.09 | 1.33 | 0.07 | 0.39 |
| February | 0.03 | 0.18 | tr | 1.10 | 0.59 | 0.49 |
| March | 0.21 | 3.03 | 0.18 | 1.16 | 0.94 | 0.79 |
| April | 0.78 | 0.82 | 0.72 | 2.33 | 3.73 | 1.21 |
| May | 2.50 | 0.81 | 1.14 | 2.35 | 0.29 | 2.10 |
| June | 2.04 | 2.81 | 1.72 | 0.14 | 1.87 | 2.03 |
| July | 5.64 | 0.81 | 3.22 | 2.98 | 2.27 | 2.79 |
| August | 3.61 | 1.25 | 5.10 | 4.46 | 2.75 | 2.91 |
| September | 0.58 | 0.47 | 1.42 | 4.28 | 3.98 | 1.61 |
| October | 2.91 | 0.73 | 1.08 | 0.56 | 2.78 | 1.37 |
| November | 0.09 | 0.24 | 0.14 | tr | 2.27 | 0.70 |
| December | 0.22 | 1.13 | 1.51 | tr | 0.39 | 0.62 |
| Total | 18.63 | 12.96 | 16.32 | 20.69 | 21.93 | 17.00 |

Table 2. Highest and lowest monthly precipitation amounts recorded at the NMSU Agricultural Science Center at Tucumcari, 1905-2008.

| Month | Maximum (inches) | Year | Minimum (inches) | Year |
|---|---|---|---|---|
| January | 1.68 | 1999 | 0.00 | 1967 |
| February | 2.40 | 1912 | 0.00 | 2000 |
| March | 3.69 | 1919 | 0.00 | 1966 |
| April | 4.89 | 1997 | 0.00 | 1996 |
| May | 8.72 | 1921 | 0.00 | 1927 |
| June | 6.39 | 1919 | 0.00 | 1947 |
| July | 11.28 | 1950 | 0.24 | 1987 |
| August | 8.38 | 1933 | 0.12 | 1951 |
| September | 7.23 | 1941 | 0.00 | 1948 |
| October | 7.51 | 1923 | 0.00 | 1975 |
| November | 4.00 | 1905 | 0.00 | 1989 |
| December | 4.27 | 1959 | 0.00 | 1933 |
| April - September Growing Season | 25.70 | 1919 | 4.65 | 1934 |
| Annual | 34.96 | 1941 | 6.13 | 1934 |

Note: Where minimum records are shared by more than one year, only the most recent year is listed.

Table 3. Summary of mean monthly temperatures at the NMSU Agricultural Science Center at Tucumcari, 1905-2008.

| Date | 2008 | 2007 | 2006 | 2005 | 2004 | Average 1905-2008 |
|---|---|---|---|---|---|---|
| | | | Mean Maximum Temperature (°F) | | | |
| January | 53 | 44 | 62 | 56 | 57 | 50 |
| February | 61 | 59 | 61 | 56 | 53 | 56 |
| March | 67 | 69 | 65 | 61 | 68 | 64 |
| April | 75 | 69 | 80 | 71 | 70 | 73 |
| May | 82 | 80 | 87 | 81 | 87 | 81 |
| June | 97 | 90 | 95 | 78 | 93 | 90 |
| July | 95 | 95 | 95 | 78 | 92 | 93 |
| August | 90 | 97 | 89 | 94 | 89 | 92 * |
| September | 84 | 89 | 80 | 87 | 85 | 86 * |
| October | 75 | 81 | 75 | 74 | 73 | 73 ** |
| November | 66 | 66 | 67 | 69 | 56 | 60 ** |
| December | 55 | 52 | 52 | 56 | 55 | 54 * |
| Annual | 75 | 74 | 76 | 74 | 73 | 73 ** |
| | | | Mean Minimum Temperature (°F) | | | |
| January | 23 | 20 | 29 | 31 | 27 | 23 |
| February | 28 | 27 | 25 | 33 | 25 | 26 |
| March | 34 | 38 | 36 | 33 | 40 | 33 |
| April | 40 | 40 | 49 | 42 | 43 | 46 |
| May | 50 | 51 | 55 | 51 | 55 | 52 |
| June | 62 | 58 | 65 | 61 | 60 | 61 |
| July | 64 | 64 | 66 | 65 | 64 | 65 |
| August | 62 | 66 | 64 | 63 | 61 | 63 |
| September | 54 | 59 | 51 | 60 | 58 | 57 |
| October | 43 | 45 | 43 | 46 | 46 | 45 * |
| November | 34 | 33 | 34 | 35 | 34 | 33 * |
| December | 26 | 26 | 25 | 24 | 28 | 25 |
| Annual | 43 | 44 | 45 | 45 | 45 | 44 |
| | | | Mean Temperature (°F) | | | |
| January | 39 | 32 | 45 | 44 | 42 | 37 |
| February | 38 | 43 | 43 | 45 | 39 | 41 |
| March | 44 | 54 | 54 | 54 | 54 | 49 |
| April | 56 | 46 | 56 | 56 | 57 | 59 |
| May | 66 | 71 | 71 | 65 | 77 | 69 |
| June | 79 | 78 | 78 | 77 | 77 | 76 |
| July | 80 | 80 | 78 | 80 | 78 | 80 |
| August | 75 | 75 | 75 | 76 | 75 | 78 * |
| September | 69 | 74 | 65 | 74 | 72 | 70 * |
| October | 59 | 63 | 59 | 60 | 60 | 59 ** |
| November | 50 | 49 | 50 | 52 | 45 | 46 ** |
| December | 40 | 39 | 38 | 40 | 42 | 39 |
| Annual | 58 | 59 | 59 | 60 | 60 | 59 * |

Note: *Indicates 1 year of missing data
**Indicates 2 years of missing data

Table 4. Highest and lowest recorded temperatures (°F) and mean temperatures (°F), by month, at the NMSU Agricultural Science Center at Tucumcari, 1905-2008.

| | Record Extremes (1913-2008) | | | | Mean Extremes (1905-2008) | | | |
|---|---|---|---|---|---|---|---|---|
| | Highest | | Lowest | | Highest | | Lowest | |
| Month | Temp | Year | Temp | Year | Max | Year | Min | Year |
| January | 80 | 1974 | -22 | 1963 | 62 | 2006 | 12 | 1963 |
| February | 83 | 2002 | -16 | 1933 | 67 | 1976 | 17 | 1929 |
| March | 92 | 1989 | -3 | 1948 | 75 | 1974 | 24 | 1965 |
| April | 97 | 1989 | 12 | 1920 | 81 | 1972 | 37 | 1983 |
| May | 103 | 2000 | 25 | 1917 | 90 | 1996 | 46 | 1983 |
| June | 109 | 1990 | 37 | 1919 | 99 | 1990 | 55 | 1983 |
| July | 107 | 1995 | 52 | 1995 | 99 | 2001 | 61 | 1967 |
| August | 108 | 2007 | 49 | 1988 | 98 | 2000 | 57 | 1965 |
| September | 104 | 1995 | 30 | 1970 | 92 | 2000 | 51 | 2006 |
| October | 97 | 2000 | 12 | 1993 | 82 | 1979 | 40 | 1976 |
| November | 90 | 2006 | -2 | 1976 | 71 | 1999 | 26 | 1929 |
| December | 82 | 1980 | -18 | 1918 | 66 | 1980 | 17 | 1983 |
| Annual | | | | | 77 | 1977 | 41 | 1963 |

Note: Where records are shared by more than one year, only the most recent year is listed.

Table 5. Summary of last spring and first fall temperature of 32°F and 28°F and growing season at the NMSU Agricultural Science Center at Tucumcari 1913-2008.

| | 2008 | 2007 | 2006 | 2005 | 2004 | Average 1913-2008 | Record Extremes | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Earliest | Year | Latest | Year |
| 32°F or less | | | | | | | | | | |
| Last in Spring | 27-Apr | 14-Apr | 24-Mar | 2-May | 24-Apr | 30-Mar | 24-Mar | 1943 | 15-May | 1945 |
| First in Fall | 23-Oct | 23-Oct | 27-Oct | 6-Nov | 2-Nov | 9-Oct | 17-Sep | 1965 | 19-Nov | 1989 |
| Growing Season (Days) | 179 | 192 | 217 | 184 | 193 | 189 | 136 | 1945 | 222 | 1989 |
| 28°F or less (Killing Frost) | | | | | | | | | | |
| Last in Spring | 19-Mar | 14-Apr | 24-Mar | 1-Apr | 6-Mar | 20-Mar | 6-Mar | 1935 | 6-May | 1917 |
| First in Fall | 6-Nov | 1-Nov | 31-Oct | 16-Nov | 3-Nov | 23-Oct | 8-Oct | 1970 | 27-Nov | 2001* |
| Number of Killing Frost Free Days | 232 | 201 | 211 | 219 | 242 | 212 | 169 | 1917 | 256 | 2001 |

*Also in 1965 & 1923

Table 6. Summary of pan evaporation (inches) and wind run (average miles per hour) at the NMSU Agricultural Science Center at Tucumcari, 1918-2008.

| | Pan Evaporation | | | | Wind Run | |
|---|---|---|---|---|---|---|
| | 2008 | | 1953 - 2008 | | 2008 | 1918-2008 |
| Month | Total | Daily Average | Monthly Average | Daily Average | Daily Average | Daily Average |
| | ……inches……. | | | | mph | mph |
| April | 12.08 | 0.40 | 10.56 | 0.35 | 4.8 | 5.4 |
| May | 14.58 | 0.47 | 12.27 | 0.40 | 5.5 | 4.8 |
| June | 16.76 | 0.56 | 13.61 | 0.45 | 5.0 | 4.5 |
| July | 11.01 | 0.36 | 13.27 | 0.43 | 3.2 | 3.7 |
| August | 10.41 | 0.34 | 11.57 | 0.37 | 2.4 | 3.3 |
| September | 8.68 | 0.29 | 9.10 | 0.30 | 2.8 | 3.6 |
| | | | - | | | |
| | 73.52 | 0.40 | 70.38 | 0.38 | 3.95 | 4.22 |

# Operational Revenues and Expenditures

The Agricultural Science Center at Tucumcari received $57,912.00 in operational funds in FY 2007-2008 (Table 1). This funding has remained stable for many years. Carry-over funds from the previous year totaled $218,961.00.

The center billed itself $19,546.00 for vehicle and equipment use based on established mileage rates and hourly charges for vehicles, tractors, and other equipment.

The alfalfa variety testing program generated $920.00. The cotton testing program generated $2,375.00, and the sorghum testing program generated $1,125.00.

The center's operational expenditures in fiscal year 2007-2008 totaled $208,989.00 (Table 1). The largest expenditure was Tractor/Vehicle Use in the amount of $19,546.00. Although Tractor/Vehicle Use shows up in the expenditure category of Table 1, it is a revenue source for the Tractor/Vehicle Index (101507). Building Repair/Maintenance Services was the second largest expenditure, which was $16,204.00. New heating and air conditioning, storm windows, and storm doors were installed in the conference building. New slider windows for the basement of the office building were installed (Table 1).

Expenditures for Non-office Supplies totaled $18,556.00 in FY 2007-2008, which was $6,438.00 more than the previous year.

Major purchases were a pre-owned John Deere Model 4045 Windrower, which was $26,500.00, a Twin Diamond Strip-Till Plow which was $12,899.04, a used John Deere Cotton Stripper for $5,585.00, and cattle drinkers which were $4,853.55 (Table 2).

Table 1. NMSU Agricultural Science Center at Tucumcari, Expenditures by Account and Object Code, FY 2007-2008.

| Item | Admin Plan 101226 | Station Sales 101206 | Forage Mgmt. 107977 | Managing Change 101392 | Clayton Pastures 101510 | Tractor/ Vehicle 101507 | Renewal & Replacement 107346 | 2005 Appropriation 109601 | Capital Outlay 109656 | Field Day 902395 | Cotton Boll Weevil 112454 | Irrigation 113455 | Hail Damage 113834 | Outdoor Arboretum 111926 | Cap. Outlay Equipment 111032 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Revenue | | | | | | | | | | | | | | | | |
| Beginning Balance | 39,912 | 19,248 | 9,000 | 9,000 | 2,529 | 26,923 | 10,028 | 55,920 | 4 | 1,352 | 2,000 | 0 | 49,587 | 3,170 | 50,000 | 278,674 |
| Sales/Fees Generated | | 12,038 | | | 10,149 | | | | | 1,475 | | | | | | 23,662 |
| Salaries/Wages Pool | 10,122 | | | | | | | | | | | | | | | 10,122 |
| Vehicle/Tractor Usage | | | | | | 20,606 | | | | | | | | | | 20,606 |
| Transfer of Funds | | | | | | | | | | | | | | | | 0 |
| Budget Expense Pool | | | | | | | | | | | | | | | | 0 |
| TOTAL REVENUES | 50,034 | 31,287 | 9,000 | 9,000 | 12,678 | 47,528 | 10,028 | 55,920 | 4 | 2,827 | 2,000 | 0 | 49,587 | 3,170 | 50,000 | 333,064 |
| EXPENDITURES | | | | | | | | | | | | | | | | |
| Personnel | | | 14 | | | | | | | | | | | | | 14 |
| Temporary Salary | 23,290 | | | | | | | | | | 391 | | | 325 | | 24,005 |
| Fringes | 3,947 | | | | | | | | | | 68 | | | 53 | | 4,069 |
| TRAVEL | 1,065 | 1,005 | 2,845 | 2,794 | | | | 5,338 | | | 626 | | | | | 13,673 |
| SUPPLIES | | | | | | | | | | | | | | | | 0 |
| Local Seminar | 20 | | | | | | | | | | | | | | | 20 |
| Automotive Supplies | 3 | | | | | 279 | | | | | | | | | | 281 |
| Tires & Batteries | | | | | | 2,762 | | | | | | | | | | 2,762 |
| Fuels & Lubricants | 7 | | | 5 | | 9,222 | | | | | | | | | | 9,235 |
| Tractor/Hvy Equip. Supplies | | 130 | | | | 3,805 | | | | | | | | | | 3,935 |
| Office Supplies | 1,945 | | | 187 | | | | 536 | | | | | | | | 2,668 |
| Computer Supplies | 253 | | 21 | 345 | | | | 19 | 4 | | | | | | | 642 |
| Non Office Supplies | 1,323 | 1,327 | 991 | 274 | 6,760 | 80 | | 6,062 | | 95 | 16 | | | 1,630 | | 18,556 |
| Pest Control Supplies | 12 | | | 9 | | | | 120 | | | | | | | | 141 |
| Irrigation Supplies | 129 | | | | | | | 2,707 | | | | | | 50 | | 2,886 |
| Lab Supplies | | | 21 | | | | | | | | | | | | | 21 |
| Cleaning/Janitorial Suppli | 162 | | | | | | | 27 | | | | | | | | 189 |
| Safety Supplies | 543 | | 113 | | | | | 54 | | | | | | | | 710 |
| Feed/Seed/Grain | | 461 | 13 | 160 | | | | 36 | | | | | | | | 670 |
| Herbicide | | 2,231 | 194 | 106 | | | | | | | | | | | | 2,531 |
| Insecticide | 102 | | | | | | | 60 | | | | | | | | 162 |
| Fertilizer | | 1,813 | 541 | 811 | | | | 25 | | | | | | | | 3,190 |
| Business Meals/Food Ite | 569 | | | 29 | | | | 38 | | 1,007 | | | | | | 1,643 |

Table 1. (Continued) Approximate operational revenues and expenditures, by account, Agricultural Science Center at Tucumcari, FY 2007-2008.

| Item | Admin Plan 101226 | Station Sales 101206 | Forage Mgmt. 107977 | Managing Change 101392 | Clayton Pastures 101510 | Tractor/ Vehicle 101507 | Renewal & Replacement 107346 | 2005 Appropriation 109601 | Capital Outlay 109656 | Field Day 902395 | Cotton Boll Weevil 112454 | Irrigation 113455 | Hail Damage 113834 | Outdoor Arboretum 111926 | Cap. Outlay Equipment 111032 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dues/Fees/Taxes | 364 | | | 231 | | | | 1780 | | | | | | 117 | | 2,491 |
| Books/Publications | 30 | | 234 | 56 | | | | 59 | | | | | | 47 | | 426 |
| Furn/Office Equip<=$100 | 52 | 232 | | 1,681 | | | | 555 | | | | | | | | 2,519 |
| Small Tools<=$1000 | 346 | | 25 | 241 | | | | 239 | | 60 | | | | | | 912 |
| Bldg. Repair & Maint Par | 307 | | | | | | | 427 | | | | | 830 | | | 1,563 |
| Electrical Supplies | 33 | | | | | | | | | | | | | | | 33 |
| Plumbing Supplies | 244 | | | | | | | 44 | | | | | | | | 289 |
| Scientific Equipment | | | | | | | | | | | | | | | | 0 |
| Heating/Cooling Supplies | | | | | | | | | | | | | | | | 0 |
| Equip. Repair Parts | 56 | | 3 | | | | | 57 | | | | | | | | 116 |
| Wireless Materials | | | | | | | | | | | | | | | | 0 |
| Veh. Repair/Maint. Parts | | | | | | (8,666) | | | | | | | | | | -8,666 |
| TOTAL SUPPLIES & MATERIALS | 34,802 | 7,198 | 5,014 | 6,929 | 6,760 | 7,482 | 0 | 18,184 | 4 | 1,163 | 1,101 | 0 | 830 | 2,221 | 0 | 91,686 |
| Services | | | | | | | | | | | | | | | | 0 |
| Postage | 455 | 17 | 287 | | | | | 89 | | | | | | | | 849 |
| Telephone | 2,969 | | | | | | | 711 | | | | | | | | 3,680 |
| Cellular Expense | 794 | | | | | | | | | | | | | | | 794 |
| Internet | 240 | | | | | | | | | | | | | | | 240 |
| Printing/Reproduction | (14) | | | | | | | | | 8 | | | | | | -7 |
| Rental | 135 | | | | | | | 1,525 | | | | | | | | 1,660 |
| Repair/Maint. Bldg | 3,842 | | | | | | | 12,362 | | | | | | | | 16,204 |
| Repair/Maint.Equipment | 277 | | | | | 7,502 | | | | | | | | | 1,795 | 9,573 |
| Utilities - Electric | 4,065 | | | | | | | 1,039 | | | | 276 | | | | 5,380 |
| Utilities - Fuel | 591 | | 999 | | | | | 518 | | | | | | | | 2,108 |
| Trash Hauling | 290 | | | | | | | 97 | | | | | | | | 387 |
| Landscaping | 333 | | | | | | | 171 | | | | | | 125 | | 629 |
| Advertising | 256 | | | | | | | | | | | | | | | 256 |
| Magazine Subscriptions | | | | | | | | | | | | | | | | 0 |
| Sales Tax | | | | | | | | 700 | | | | | | | | 700 |
| Prof/Contract Services | 395 | | | | | | | 46 | | | | | | 86 | | 527 |
| Lab Analysis | | 3,283 | 692 | 327 | | | | | | | | | | | | 4,301 |
| Farm/Ranch Services | | 660 | 400 | | | | | | | | | | | | | 1,060 |
| Tractor/Vehicle Usage | 4,268 | 44 | 1,670 | 1,360 | | | | 12,205 | | | | | | | | 19,546 |

Table 1. (Continued) Approximate operational revenues and expenditures, by account, Agricultural Science Center at Tucumcari, FY 2007-2008.

| Item | Admin Plan 101226 | Station Sales 101206 | Forage Mgmt. 107977 | Managing Change 101392 | Clayton Pastures 101510 | Tractor/ Vehicle 101507 | Renewal & Replacement 107346 | 2005 Appropriation 109601 | Capital Outlay 109656 | Field Day 902395 | Cotton Boll Weevil 112454 | Irrigation 113455 | Hail Damage 113834 | Outdoor Arboretum 111926 | Cap. Outlay Equipment 111032 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Irrigation Services | | | | | | | | | | | | | | | | 0 |
| Freight | 4 | 81 | | 71 | | 48 | | | | | | | | 18 | | 222 |
| UPS/FedEx | 49 | 73 | 159 | | | 15 | | | | | | | | | | 296 |
| Computer Software | 444 | 8 | 207 | 260 | | | | | | | | | | | | 919 |
| TOTAL SERVICES | 19,392 | 4,166 | 4,415 | 2,017 | 0 | 7,564 | 0 | 29,463 | 0 | 8 | 0 | 276 | 0 | 230 | 1,795 | 69,326 |
| Equip. & Capital Outlay | | | | | | | | | | | | | | | | |
| Furn/Equip>$1000 | | | | | | | | ($228) | | | | | | | 48,205 | 47,978 |
| TOTAL EQUIP. & CAP. OUTLAY | 0 | 0 | 0 | 0 | 0 | 0 | 0 | ($228) | 0 | 0 | 0 | 0 | 0 | 0 | 48,205 | 47,978 |
| TOTAL EXPENSES | 54,193 | 11,364 | 9,429 | 8,946 | 6,760 | 15,047 | 0 | 47,419 | 4 | 1,170 | 1,101 | 276 | 830 | 2,451 | 50,000 | 208,989 |
| ENDING BALANCE | (4,159) | 19,923 | (429) | 54 | 5,919 | 32,482 | 10,028 | 8,501 | 0 | 1,657 | 899 | (276) | 48,757 | 719 | 0 | 124,075 |

# Summer Irrigation Termination of Alfalfa

**Investigator(s):**

L.M. Lauriault[1], S. Angadi[2], R.E. Kirksey[1], P.L. Cooksey[1], R. Brake[1], C. Henson[1], S. Jennings[1], and L.F. Perkins[1]
[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]New Mexico State University, Agricultural Science Center at Clovis, NM 88101

**Objective(s):**

To evaluate the performance of furrow-irrigated alfalfa subjected to irrigation termination for selected harvests.

**Method(s):**

The test area (Canez fine sandy loam) was conventionally tilled and formed into 36-inch beds for furrow irrigation. Plots, 12 ft (4, 36" furrow beds) x 15 ft, were sown September 21 & 22, 2005 using a grain drill fitted with an alfalfa box set to plant 20 lb inoculated seed/acre. The test, designated 151I, has a split-plot treatment structure in Randomized Complete Block design with 4 replications. In addition to an unirrigated treatment, irrigations beginning in 2007 were applied to the following harvests as whole plot treatments: 1-2-3-4-5-6, 1-2-3-4-5, 1-2-3-5, 1-2-3, 1-2-5, 1-5, 2-3-5, and 2-3. Access tubes for neutron probe soil moisture measurements were installed to a 10-ft depth in all plots of the unirrigated, 1-5, 1-2-5, and 1-2-3-4-5-6 treatments. Subplots included varieties Wilson and New Mexico Common, which had yielded similarly in a variety test sown in 1999 at this location until irrigation was terminated. The entire test area was irrigated with approximately 6 inches of water once prior to each harvest in 2006 to allow complete stand establishment before the application of irrigation termination treatments, which began in 2007. A water meter was used to measure applied water and tailwater was measured through an 1-ft H-flume fitted with a Hobo Water level Logger. These data and an estimate of the surface area irrigated was used to estimate irrigation infiltration amounts for each application. Neutron probe readings were taken prior to the first irrigation and between each harvest and subsequent irrigation throughout the growing season and after the final harvest.

Fertilizer (200 lb/ac 11-52-0) was applied April 16, 2008, and the test was furrow-irrigated according to treatment once prior to cutting except the first because water was not yet available. Irrigations for the second through sixth harvests were applied shortly after the previous harvest. The test received 1 pt/acre of Volunteer plus 1 qt/acre crop oil concentrate on March 15, 2008, for grass control, and a tank mix of Basagran and Volunteer (1 pt/acre of each) and crop oil concentrate (1 qt/acre) on June 6, 2008, for broad spectrum weed control. No insecticides were used. On each harvest date (shown in the table), plots were harvested to 3 inches using a John Deere Model 10 forage chopper. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter (DM)concentration, which was used to convert plot fresh weights to dry matter tons per acre.

**Results:**

Yield data for 2008 were subjected to SAS GLM procedures for tests of significance and means separation. As in 2007, Wilson had greater yields than New Mexico Common only in the first harvest (0.46 vs. 0.32 tons/acre for Wilson and NM Common, respectively, $P < 0.0013$).

Differences in yield also existed among treatments in each but the first harvest (Table 1). First harvest yields were very low likely because irrigation was not applied prior to that harvest. Treatment differences across harvests led to a significant difference in total yield. Contrary to 2007, in which termination of irrigation for more than one harvest reduced total yields compared to the fully irrigated 1-2-3-4-5-6 treatment, the 1-2-3-5 treatment was the only treatment not different from the fully irrigated treatment (Table 1). Based on differences within harvests and total yield, treatments including both the 3rd and 5th harvest appear to be the best options when irrigation water is limited.

**Table 1. Harvest and total dry matter yield of furrow-irrigated alfalfa subjected to varying levels of irrigation termination in 2007 at Tucumcari.**

| | 2008 Harvests [number (date)] | | | | | | 2008 |
|---|---|---|---|---|---|---|---|
| Treatment | 1 (29-May) | 2 (24-Jun) | 3 (24-Jul) | 4 (21-Aug) | 5 (18-Aug) | 6 (29-Oct) | Total |
| 1-2-3 | 0.38 | 0.98 | 2.06* | 0.92 | 0.59 | 0.49 | 5.41[bcd] |
| 1-2-3-4-5 | 0.37 | 0.88 | 2.00* | 1.23 | 0.99* | 0.52 | 5.98[bc] |
| 1-2-3-4-5-6 | 0.47 | 1.24** | 2.19* | 1.54** | 1.09** | 0.87** | 7.40[a] |
| 1-2-3-5 | 0.31 | 1.23* | 2.30** | 1.11 | 0.97* | 0.52 | 6.44[ab] |
| 1-2-5 | 0.33 | 0.96 | 1.91 | 0.80 | 0.90* | 0.50 | 5.40[bcd] |
| 1-5 | 0.38 | 0.69 | 1.81 | 0.74 | 0.84* | 0.53 | 4.99[cd] |
| 2-3 | 0.46 | 0.97 | 1.89 | 0.83 | 0.50 | 0.32 | 4.98[cd] |
| 2-3-5 | 0.41 | 1.04* | 2.22* | 0.98 | 0.95* | 0.34 | 5.95[bc] |
| None | 0.33 | 0.65 | 1.85 | 0.60 | 0.60 | 0.33 | 4.35[d] |
| Mean | 0.38 | 0.94 | 2.00 | 0.95 | 0.83 | 0.50 | 5.61 |
| Prob. > F | 0.3004 | 0.0002 | 0.0093 | 0.0001 | 0.0001 | 0.0013 | 0.0001 |
| LSD, 0.05 | NS | 0.26 | 0.35 | 0.29 | 0.30 | 0.17 | 1.12 |

Treatment numbers indicate which of the six harvests were irrigated.

**Highest numerical value in the column.

*Not significantly different from the highest numerical value in the column based on the 5% LSD.

[abcd]2008 Total yield means followed by the same letter are not significantly different based on the 5% LSD for that column.

# Comparison of the Effect of Seeding Rate on Dry Matter Yield of Alfalfa

**Investigator(s):**

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**Objective(s):**

To evaluate the effect of seeding rate on dry matter yield of alfalfa.

**Method(s):**

The test area (designated 151SR, Canez fine sandy loam) was conventionally tilled and formed into 36-inch beds for furrow irrigation. Plots, 6 ft (2, 36" furrow beds) x 15 ft, were sown September 22, 2005 using a disk-drill fitted with a seed-metering cone at 10, 20, 30 and 40 lb inoculated seed/acre, using the variety RSC 751. Experimental blocking was in two directions having 5 rows and 4 columns. Fertilizer (200 lb/ac 11-52-0) was applied April 16, 2008, and the test was furrow-irrigated once prior to each cutting. Typically the first harvest is in mid-May; however, it was not taken until mid-June because water was not available until mid-May. Irrigations for the second through fifth harvests were applied shortly after the previous harvest. The test received 1 pt/acre of Volunteer plus 1 qt/acre crop oil concentrate on March 15, 2008, for grass control, and a tank mix of Basagran and Volunteer (1 pt/acre of each) and crop oil concentrate (1 qt/acre) on June 6, 2008, for broad spectrum weed control. No insecticides were used. On each harvest date (shown in the table), plots were harvested to 3 inches using a John Deere Model 10 forage chopper. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter (DM) concentration, which was used to convert plot fresh weights to dry matter tons per acre.

**Results:**

Yield data were subjected to SAS GLM procedures for tests of significance. Yields continued to increase compared to previous years, but they were still lower than typically expected at this location. No differences existed between seeding rates for 2008 yields of stands established in 2005 (5.67, 5.20, 5.49, and 4.91 tons/acre for the 10, 20, 30, and 40 lb/acre seeding rates, respectively, $P < 0.7566$).

# Effect of Glyphosate and Tillage on Nitrogen Release from Alfalfa to the Succeeding Crops

**Investigator(s):**

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**Objective(s):**

To evaluate the effect of glyphosate and tillage on nitrogen release from alfalfa to succeeding crops.

**Method(s):**

Two companion trials were used for this project, both of which have four randomized complete blocks with a factorial treatment arrangement comparing tillage and glyphosate. Results from the first test, designated 161T, were reported in The 2007 Annual Report of the Agricultural Science Center at Tucumcari. Both studies were a factorial arrangement of herbicide application (untreated vs. treated with 2.5% glyphosate) and tillage (untilled or tilled) in 4 randomized complete blocks.

The second study was superimposed on the southernmost 8 beds of the 2000 alfalfa/kura clover study (201kc) and was designated 171T. The soil for this study was Quay fine sandy loam in a transition between Canez fine sandy loam Canez fine sandy loam calcareous variant and had received 22 lb/ac N and104 lb/ac P on April 26, 2006. Plots were 12 ft (4, 36-inch beds) x 60 ft. Glyphosate was applied on August 8, 2007, through a backpack sprayer to deliver approximately 10 gpa of 2.5% glyphosate solution with 12 lb ammonium sulfate 100 $gal^{-1}$. Tillage took place on August 23, 2007, after which furrows were pulled through the entire test area with minimal impact on untilled plots. Winter wheat was no-till drilled on September 14, 2007, and the entire test was irrigated uniformly on September 22, October 10, and October 19, 2007. Soil samples were taken to approximately 4 ft deep in 1-ft increments immediately after planting.

On April 1, 2008, when the wheat had jointed, wheat above 2 inches was hand-clipped from a 0.5 sq. yd quadrat placed across the furrow-bed continuum in each plot. On April 21, 2008, when wheat was in the boot stage and alfalfa was 6-8 inches tall and pre-bud, another area was similarly sampled with wheat and alfalfa placed in separate bags. Also on April 21, forage from a second area was collected from the untilled plots and bagged without species separation for nutritive value analysis of the forage mixture. Harvested material was dried at 150$^{o}$F for 48 hr to determine dry matter yield of component species and total forage yield. Prior to sampling on April 1 and 21, SPAD-502 meter readings (Minolta Camera Co., Japan) were taken from an undamaged wheat leaf to estimate differences in leaf N content and the wheat was rated for maturity based on the Zadok scale. The entire area was swathed on April 25 and subsequently baled. A second set of soil samples was collected and a single-cut haygrazer crop was no-till planted on May 21 into existing beds, and irrigated on May 29 and June 27. On August 8, when the haygrazer was approximately 5 ft tall, haygrazer and alfalfa above 3 inches was hand-clipped from a 0.5 sq. yd. quadrat placed across the furrow-bed continuum from an outside bed of the unsprayed, untilled plots with haygrazer and alfalfa placed in separate bags and dried at 150$^{o}$F for 48 hr to determine component yield. Prior to sampling on August 8, SPAD-502 meter readings were taken from an

undamaged haygrazer leaf. On August 11, haygrazer was swathed by plot to 3 inches and harvested using a forage chopper fitted with a pick up header. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter concentration and yield. On August 22 a final set of soil samples was collected from each plot.

Separated wheat, haygrazer, and alfalfa samples were used to calculate the alfalfa proportion of total yield. Separated wheat and haygrazer samples were used to determine yield and nutritive value of the grass species alone. Separated haygrazer yield and nutritive was compared to sprayed and/or tilled harvested haygrazer for grass species yield and nutritive value. Wheat-alfalfa and haygrazer-alfalfa samples were used to determine the nutritive value of forage harvested from those respective systems. All samples, except hand-clipped alfalfa, were ground to pass through a 1-mm screen and delivered to Ward Laboratories (Kearney, NE) for analysis by NIRS for selected nutritive value components. Yield and crude protein concentration were used to estimate N yield. Soil samples are being held for analysis.

Data for the second study were analyzed by SAS PROC MIXED ANOVA to compare spray, tillage, and spray x tillage effects on the grass species. Rep was considered random. An alpha level of $P < 0.05$ was accepted as indicating a significant difference. Least squares means within significant interactions were separated by a protected least significant difference using the PDIFF option.

**Results:**

The glyphosate treatment was not as effective for the second study as it was for the first study. Data and results of statistical analysis for yield and nutritive value of wheat sampled at jointing on April 1 are presented in Table 1. The only difference between spray treatments was for Leaf N and only yield and N yield were different due to tillage treatment. There were no spray x tillage interactions.

For wheat forage measured at boot stage (April 21), there was no difference due to the spray treatment; however, there were differences between tillage treatments for alfalfa percentage, leaf N, and calcium content (Table 2). An increasing number of variables exhibited trends toward significance ($P < 0.10$) for both main effects and spray x tillage interactions.

For haygrazer forage, the spray treatment effect was significant for alfalfa percentage, yield, and crude protein concentration; however, the spray x tillage interaction also was significant (Table 2). Leaf N, alfalfa percentage, yield, N yield, neutral detergent fiber, and all the minerals were significant for tillage treatment. The glyphosate x tillage interaction was significant for alfalfa percentage, yield, crude protein, acid detergent fiber, and net energy for lactation (Table 3). Total N yield from the wheat and haygrazer crops also was affected by tillage treatment (Table 3).

For wheat-alfalfa forage harvested at the wheat boot stage, treatment differences existed only for alfalfa percentage, neutral detergent fiber, and calcium (Table 4). Untreated haygrazer-alfalfa forage contained over 40% alfalfa (Table 5). The difference in alfalfa contribution between this and the untreated wheat-alfalfa forage (Table 4) was likely due to competition by the wheat prior to the onset of active alfalfa growth and the sustained active alfalfa growth throughout the haygrazer growth period. Still the greater presence of alfalfa in the alfalfa-haygrazer forage affected only yield and concentrations of crude protein, phosphorus, and potassium.

**Table 1. The effect of glyphosate application and/or tillage for termination of alfalfa on yield and nutritive value[1] of the subsequent wheat forage measured at jointing at Tucumcari in 2008.**

| Spray | Till | Leaf N SPAD-520 | Maturity Zadok | N yield lb/ac | Yield t/ac | CP % | ADF % | NDF % | $NE_L$ mcal/lb | Ca % | P % | K % | Mg % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | - | 40 | 32 | 25 | 0.45 | 17.43 | 21.3 | 42.6 | 0.8178 | 0.355 | 0.235 | 2.32 | 0.215 |
| 1 | - | 45 | 31 | 29 | 0.53 | 16.81 | 21.6 | 42.7 | 0.8132 | 0.354 | 0.233 | 2.37 | 0.210 |
| Prob. > F | | 0.0223 | 0.6653 | 0.2900 | 0.2372 | 0.2372 | 0.5401 | 0.9426 | 0.5252 | 0.9522 | 0.6506 | 0.1625 | 0.5242 |
| - | 0 | 43 | 32 | 18 | 0.36 | 16.29 | 22.0 | 43.1 | 0.8088 | 0.364 | 0.229 | 2.32 | 0.206 |
| - | 1 | 43 | 31 | 36 | 0.62 | 17.95 | 20.9 | 42.2 | 0.8223 | 0.345 | 0.239 | 2.37 | 0.219 |
| Prob. > F | | 0.9548 | 0.6653 | 0.0004 | 0.0013 | 0.0013 | 0.1180 | 0.2155 | 0.0829 | 0.3791 | 0.0937 | 0.1625 | 0.1320 |
| Spray x Till interaction | | | | | | | | | | | | | |
| Prob. > F | | 0.3752 | 0.6653 | 0.7596 | 0.1979 | 0.3932 | 0.1188 | 0.0604 | 0.1256 | 0.8573 | 0.3732 | 0.3941 | 0.7480 |

[1]CP, ADF, NDF, $NE_L$, Ca, P, K, and, Mg signify crude protein, acid detergent fiber, neutral detergent fiber, net energy for lactation, calcium, phosphorus, potassium and magnesium, respectively.

**Table 2. The effect of glyphosate application and/or tillage for termination of alfalfa on yield and nutritive value of the subsequent alfalfa-free wheat forage measured at boot at Tucumcari in 2008.**

| Spray | Till | Leaf N SPAD-520 | Maturity Zadok | Alfalfa % | N yield lb/ac | Yield t/ac | CP % | ADF % | NDF % | $NE_L$ mcal/lb | Ca % | P % | K % | Mg % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | - | 45 | **52** | 17 | 43 | 1.06 | 13.15 | 23.9 | 46.3 | 0.7844 | 0.295 | 0.205 | 1.97 | 0.193 |
| 1 | - | 44 | 53 | 10 | 50 | 1.25 | 12.51 | 24.1 | 46.3 | 0.7818 | 0.274 | 0.203 | 1.95 | 0.184 |
| Prob. > F | | 0.7737 | 0.1543 | 0.2204 | 0.4206 | 0.3873 | 0.2946 | 0.5951 | 0.8644 | 0.5871 | 0.0925 | 0.4854 | 0.3685 | 0.2328 |
| - | 0 | 41 | 52 | 26 | 39 | 0.95 | 13.05 | 23.8 | 45.9 | 0.7864 | 0.300 | 0.204 | 1.98 | 0.186 |
| - | 1 | 48 | 53 | 0 | 54 | 1.35 | 12.61 | 24.2 | 46.7 | 0.7798 | 0.269 | 0.203 | 1.94 | 0.189 |
| Prob. > F | | 0.0330 | 0.1543 | 0.0007 | 0.0682 | 0.0861 | 0.4646 | 0.2017 | 0.1084 | 0.1798 | 0.0237 | 0.8138 | 0.0587 | 0.6798 |
| Spray x Till interaction | | | | | | | | | | | | | | |
| Prob. > F | | 0.6578 | 0.0574 | 0.2204 | 0.0772 | 0.1357 | 0.8487 | 0.0688 | 0.0924 | 0.0657 | 0.2622 | 0.2561 | 0.3685 | 0.1223 |

[1]CP, ADF, NDF, $NE_L$, Ca, P, K, and, Mg signify crude protein, acid detergent fiber, neutral detergent fiber, net energy for lactation, calcium, phosphorus, potassium and magnesium, respectively.

**Table 3. The effect of glyphosate application and tillage for termination of alfalfa on yield and nutritive value of the subsequent alfalfa-free haygrazer forage measured at boot/heading and after a wheat forage crop had already been grown at Tucumcari in 2008 and total N yield of the wheat and haygrazer crops.**

| Spray | Till | Leaf N SPAD-520 | Alfalfa % | N yield lb/ac | Yield t/ac | CP % | ADF % | NDF % | $NE_L$ mcal/lb | Ca % | P % | K % | Mg % | Total N yield lb/ac |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | - | 34 | 20 | 35 | 2.25 | 5.35 | 39.4 | 60.6 | 0.5874 | 0.250 | 0.198 | 2.35 | 0.275 | 78 |
| 1 | - | 37 | 6 | 41 | 3.26 | 3.89 | 39.6 | 60.7 | 0.5848 | 0.195 | 0.191 | 2.35 | 0.265 | 91 |
| Prob. > F | | 0.3548 | 0.0089 | 0.1804 | 0.0006 | 0.0145 | 0.6288 | 0.7294 | 0.5992 | 0.0501 | 0.2058 | 0.9532 | 0.1649 | 0.1923 |
| - | 0 | 31 | 26 | 32 | 2.35 | 4.89 | 39.2 | 61.2 | 0.5906 | 0.184 | 0.213 | 2.46 | 0.298 | 71 |
| - | 1 | 40 | 0 | 44 | 3.16 | 4.35 | 39.9 | 60.1 | 0.5815 | 0.261 | 0.176 | 2.24 | 0.243 | 99 |
| Prob. > F | | 0.0056 | 0.0002 | 0.0139 | 0.0026 | 0.2959 | 0.0897 | 0.0279 | 0.0899 | 0.0111 | 0.0001 | 0.0227 | 0.0001 | 0.0107 |
| Spray x Till Interaction | | | | | | | | | | | | | | |
| 0 | 0 | - | 40 | - | 1.50 | 6.38 | 38.6 | - | 0.5975 | - | - | - | - | - |
| 0 | 1 | - | 0 | - | 2.99 | 4.33 | 40.2 | - | 0.5773 | - | - | - | - | - |
| 1 | 0 | - | 11 | - | 3.19 | 3.40 | 39.7 | - | 0.5838 | - | - | - | - | - |
| 1 | 1 | - | 0 | - | 3.34 | 4.38 | 39.5 | - | 0.5858 | - | - | - | - | - |
| Prob. > F | | 0.8402 | 0.0089 | 0.8175 | 0.0833 | 0.0123 | 0.0469 | 0.5666 | 0.0465 | 0.2143 | 0.0886 | 0.2935 | 1.0000 | 0.1163 |
| LSD (5%)[2] | | NS | 14 | NS | 0.63 | 1.55 | 1.2 | NS | 0.0153 | NS | NS | NS | NS | NS |

[1]CP, ADF, NDF, $NE_L$, Ca, P, K, and, Mg signify crude protein, acid detergent fiber, neutral detergent fiber, net energy for lactation, calcium, phosphorus, potassium and magnesium, respectively.

[2]Least significant difference at $P < 0.05$. When an LSD value is present, interaction means in that column that differ by more than the LSD value are different.

NS signifies no significant difference at $P < 0.05$.

**Table 4. The effect of glyphosate application and tillage for termination of alfalfa on the subsequent mixed alfalfa-wheat forage measured at wheat boot stage on April 21, 2008 at Tucumcari.**

| Treatment | Alfalfa % | Yield t/ac | CP % | ADF % | NDF % | NEL mcal/lb | CA % | P % | K % | Mg % |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | 34 | 1.02 | 17.2 | 24.1 | 41.9 | 0.7818 | 0.61 | 0.21 | 2.05 | 0.23 |
| Sprayed | 20 | 1.45 | 14.3 | 24.8 | 44.9 | 0.7731 | 0.43 | 0.21 | 2.00 | 0.21 |
| Tilled | 0 | 1.43 | 12.9 | 24.5 | 47.3 | 0.7763 | 0.27 | 0.21 | 1.96 | 0.20 |
| Prob. > F | 0.0231 | 0.2736 | 0.1272 | 0.4110 | 0.0515 | 0.3839 | 0.0438 | 0.9250 | 0.3066 | 0.3838 |
| LSD (5%)[2] | 22 | NS | NS | NS | 4.0 | NS | 0.24 | NS | NS | NS |

[1]CP, ADF, NDF, $NE_L$, Ca, P, K, and, Mg signify crude protein, acid detergent fiber, neutral detergent fiber, net energy for lactation, calcium, phosphorus, potassium and magnesium, respectively.
[2]Least significant difference at P < 0.05. When an LSD value is present, interaction means in that column that differ by more than the LSD value are different.
NS signifies no significant difference at P < 0.05.

**Table 5. The effect of glyphosate application and tillage for termination of alfalfa on the subsequent mixed alfalfa-haygrazer forage measured at wheat boot stage on August 11, 2008 at Tucumcari.**

| Treatment | Alfalfa % | Yield t/ac | CP % | ADF % | NDF % | NEL mcal/lb | CA % | P % | K % | Mg % |
|---|---|---|---|---|---|---|---|---|---|---|
| Control | 40 | 2.12 | 8.13 | 37.8 | 58.0 | 0.5952 | 0.47 | 0.20 | 2.44 | 0.27 |
| Sprayed | 11 | 2.45 | 6.18 | 40.1 | 60.2 | 0.5781 | 0.33 | 0.19 | 2.26 | 0.26 |
| Tilled | 0 | 2.99 | 4.33 | 40.2 | 60.2 | 0.5773 | 0.27 | 0.18 | 2.19 | 0.25 |
| Prob. > F | 0.0035 | 0.0909 | 0.0739 | 0.3391 | 0.3565 | 0.3505 | 0.1976 | 0.0723 | 0.0471 | 0.3657 |
| LSD (5%)[2] | 18 | 0.79 | 3.23 | NS | NS | NS | NS | 0.02 | 0.20 | NS |

[1]CP, ADF, NDF, $NE_L$, Ca, P, K, and, Mg signify crude protein, acid detergent fiber, neutral detergent fiber, net energy for lactation, calcium, phosphorus, potassium and magnesium, respectively.
[2]Least significant difference at P < 0.05. When an LSD value is present, interaction means in that column that differ by more than the LSD value are different.
NS signifies no significant difference at P < 0.05.

# Alfalfa Renovation/Rotation for Re-establishment of Alfalfa

**Investigator(s):**

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**Objective(s):**

To evaluate crop rotation strategies for renovating old alfalfa stands for replanting alfalfa.

**Method(s):**

Two companion trials are being used for this project. The first test (designated 151R) was superimposed on the former 1997 alfalfa fall dormancy/winter irrigation study (171I) and the area to the south that was established in mixed varieties of alfalfa on the same date in 1997. There were three replicates consisting of the north half of 171I, the south half of 171I, and the mixed variety area. Treatments included haygrazer grown in 2005 and 2006, winter wheat grown in 2005-06 followed by haygrazer in 2006, haygrazer grown only in 2006, and continuous alfalfa. These treatment areas were approximately 115 ft x 24 ft (8, 36-inch beds). Tillage for all treatments, including the continuous alfalfa treatment, consisted of moldboard plowing to prepare a conventionally tilled seedbed formed into 36-inch beds for furrow irrigation. Previously plowed plots were disked and re-furrowed for each successive crop. Care was taken during all tillage operations to minimize soil movement although it was realized that large border effects were likely. The test area was irrigated in 2005 and 2006 and alfalfa was harvested from the remaining area as growth permitted. Wheat was harvested for forage at the boot stage in 2006 and haygrazer managed as single-cut system in 2005 and 2006. No yield measurements were taken from any crop during the renovation period.

Alfalfa was reseeded September 18, 2006 with 20 lb/ac AmeriStand 815T RR using a grain drill equipped with an alfalfa box. Plots, 12 ft (4, 36-inch furrow beds) x 15 ft, were defined by spraying 5-ft borders within the larger treatment areas in the harvesting direction. Fertilizer (200 lb/ac 11-52-0) was applied April 16, 2008, and the test was furrow-irrigated once prior to each cutting, except the first and fourth (because irrigation water was not available) applying approximately 6 inches of water with each irrigation. Additionally, the entire test area was treated with Roundup Original Max® (10 gal/ac 2.5% solution with 12 lb ammonium sulfate per 100 gal and surfactant) on March 26. For each of six harvests (dates shown in Table 1), the field was swathed taking care to keep the four center beds of each plot as a swathed unit. The swather was stopped to allow itself to clean out at each border strip. After swathing was complete, the swath within the sprayed borders of each plot was collected and fresh weights measured in the field. A subsample of the collected material from each plot was weighed, dried at 150$^{o}$F for 48 hr, and reweighed to determine dry matter concentration, which was used to convert plot fresh weights to dry matter tons per acre. Equipment cleaning and hay handling guidelines developed by USDA – APHIS for Roundup Ready alfalfa were followed.

The second study, designated 161R, was superimposed on the former 1999 alfalfa variety test (191AVT) study and the northern border and adjacent row of plots of the 1999 alfalfa/kura clover (291kc) test, which were predominantly alfalfa. The soil for this study was Quay fine sandy loam in a transition between Canez fine sandy loam Canez fine sandy loam calcareous variant. Plots are 12 ft (4, 36-inch beds) x 120 ft and there are four replicates. Treatments and time sequence were the same as those described for the test initiated in 2005. Pioneer ‘56S82’ alfalfa was replanted on September 20, 2007 and irrigated on

September 22, October 10, and October 19 to promote establishment. Harvest areas and techniques were similar to those of the 2005 test.

Yield data were analyzed by study using SAS PROC GLM ANOVA to compare rotation treatment effects. Rep was considered random. Treatment means were separated by unprotected least significant difference ($P < 0.10$) using the MEANS/LSD option.

**Results:**

Results of statistical analysis for yield data from the 2005 test (151R) are presented in Table 1. As in 2007, yields were low throughout the growing season and the wheat/haygrazer rotation produced lowest yields.

Results were different for the second study (161R), with the wheat/haygrazer having yields equal to two haygrazer crops and continuous alfalfa yields were among the lowest (Table 2). These varied results are consistent with producer experience and indicate the gamble associated with poor rotation practices and the possibility that using wheat in the rotation is detrimental.

**Table 1. Dry matter yield (tons/acre) of alfalfa replanted in 2006 after various rotation systems at Tucumcari in 2008.**

| | | 2008 Harvests | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Rotation[1]** | **2007 Total** | 29-May | 29-Jun | 24-Jul | 22-Aug | 18-Sep | 30-Oct | **2008 Total** | **2-Yr Total** |
| Cont. Alf. | 2.92$^{ab}$ | 0.73$^{ab}$ | 0.49 | 0.73$^{b}$ | 0.31$^{ab}$ | 0.23 | 0.26$^{a}$ | 2.74$^{ab}$ | 5.66$^{a}$ |
| HG1 | 2.83$^{ab}$ | 0.52$^{b}$ | 0.42 | 0.73$^{b}$ | 0.34$^{ab}$ | 0.24 | 0.11$^{b}$ | 2.36$^{bc}$ | 5.19$^{ab}$ |
| HG2 | 3.73$^{a}$ | 0.78$^{a}$ | 0.47 | 1.00$^{a}$ | 0.42$^{a}$ | 0.29 | 0.27$^{a}$ | 3.23$^{a}$ | 6.96$^{a}$ |
| W/HG | 1.61$^{b}$ | 0.52$^{b}$ | 0.29 | 0.51$^{b}$ | 0.18$^{b}$ | 0.14 | 0.10$^{b}$ | 1.73$^{c}$ | 3.34$^{b}$ |
| Mean | 2.77 | 0.64 | 0.42 | 0.74 | 0.31 | 0.23 | 0.18 | 2.52 | 5.29 |
| P-value | 0.1936 | 0.1771 | 0.3421 | 0.2519 | 0.2551 | 0.3566 | 0.2698 | 0.0793 | 0.1264 |
| LSD, 0.10 | 1.34 | 0.23 | NS | 0.27 | 0.18 | NS | 0.15 | 0.65 | 1.88 |

[1]Cont. Alf., HG1, HG2, and W/HG signify continuous alfalfa plowed approximately one month before alfalfa was replanted, alfalfa plowed in spring 2006 followed by a single-cut haygrazer crop, alfalfa plowed in spring 2005 followed by two single-cut haygrazer crops, alfalfa plowed in summer 2005 followed by a single-cut winter wheat forage crop and a single-cut haygrazer crop.
Data are the means of 3 replicates.
[abc]Means in a column followed by the same letter are not significantly different based on the unprotected 10% LSD.

**Table 2. Dry matter yield (tons/acre) of alfalfa replanted in 2007 after various rotation systems at Tucumcari in 2008.**

| | 2008 Harvests | | | | |
|---|---|---|---|---|---|
| **Rotation[1]** | **29-May** | **24-Jul** | **18-Sep** | **30-Oct** | **2008 Total** |
| Cont. Alf. | 0.28 | 1.16 | 0.44 | 0.3 | 2.19 |
| HG1 | 0.18 | 1.25 | 0.42 | 0.31 | 2.16 |
| HG2 | 0.19 | 1.4 | 0.52 | 0.35 | 2.47 |
| W/HG | 0.21 | 1.39 | 0.53 | 0.29 | 2.42 |
| Mean | 0.64 | 0.74 | 0.23 | 0.18 | 2.52 |
| P-value | 0.1771 | 0.2519 | 0.3566 | 0.2698 | 0.0793 |
| LSD, 0.10 | 0.23 | 0.27 | NS | 0.15 | 0.65 |

[1]Cont. Alf., HG1, HG2, and W/HG signify continuous alfalfa plowed approximately one month before alfalfa was replanted, , alfalfa plowed in spring 2007 followed by a single-cut haygrazer crop, alfalfa plowed in spring 2006 followed by two single-cut haygrazer crops, alfalfa plowed in summer 2006 followed by a single-cut winter wheat forage crop and a single-cut haygrazer crop.
Data are the means of 4 reps.
[abc]Means in a column followed by the same letter are not significantly different based on the unprotected 10% LSD.

# Renovation of Alfalfa Hayfields and Pastures to Maintain a Legume Component for Grass-Legume Pastures

**Investigator(s):**

L.M. Lauriault[1], R.E. Kirksey[1], P.L. Cooksey[1], R. Brake[1], C. Henson[1], and L.F. Perkins[1]
[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

**Objective(s):**

To evaluate a legume rotation strategy to maintain the legume component while renovating old alfalfa hay and pasture stands, converting them to permanent grass-legume pastures.

**Method(s):**

Two companion trials were used for this project the establishment of which are described in The 2006 and 2007 Annual Reports of the Agricultural Science Center at Tucumcari. Winter survival of red clover in the 2006 seeding was not good; consequently, those treatments were reseeded on September 13, 2007, which did not improve those stands in spring 2008. Stands of red clover and tall wheatgrass in the 2007 study were good in spring 2008. On April 16, 2008, 22 lb/ac N and104 lb/ac P was applied. No measurements were taken in 2008 due to labor shortages throughout the growing season. However, each test was irrigated four times (approximately June 2, June 27, August 27, and September 25) and forage removed by swathing (May 19, June 24, July 21, August 18, September 16, and October 15) and baling six times during the season.

**Results:**

Both tests will be maintained for the possibility of making measurements in 2009 and evaluating the effect of each rotation on replanted alfalfa when the red clover in the 2007 seeding begins to decline.

# Evaluation of Pre-plant Incorporated Manure and Phosphorus on Alfalfa

**Investigator(s):**

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**Objective(s):**
To evaluate the effect of preplant incorporated manure and phosphorus or annual phosphorus applications on the long-term performance of alfalfa.

**Method(s):**

The test (designated 171PM) is a split, split plot with manure application (10 tons/acre preplant incorporated or no manure) as the main plot, 300 lb or 100 lb phosphorus ($P_2O_5$)/acre preplant incorporated as the subplot, and phosphorus source (00-46-00 or 11-52-00) as the sub-subplot. A tractor-power rototiller was used to incorporate the manure and fertilizer to approximately 8 inches. The 300 lb phosphorus level represents preplant application of 3 years' anticipated phosphorus requirement and no further phosphorus will be applied during the test period, which is anticipated to be 4 years. The 100-lb level represents the anticipated annual need and will be followed by additional surface broadcast applications. There are 4 randomized complete blocks. Sub-subplots are 10 ft x 15 ft with a chemically fallowed alley at each end to facilitate harvesting. Initial treatment application and establishment techniques are described in The 2007 Annual Report of the Agricultural Science Center at Tucumcari. Irrigations were applied in 2008 at the initiation of regrowth for harvests taken on June 24, July 23, September 15, and October 27; but, not May 19 (yields not measured) or August 20.

On each harvest date, the center 2 beds of each plot were harvested to 3 inches using a John Deere Model 10 forage chopper. Harvesting the two center beds provided a border between adjacent plots and avoided and traffic effect caused by the multiple passes of the fertilizer applications. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter (DM) concentration, which was used to convert plot fresh weights to dry matter tons per acre. These samples also will be stored for nutritive value analysis if that is deemed appropriate. Soil samples (2-inch diameter to 12 inches deep) were collected from each plot after the final harvest. Soil samples were air dried and shipped to Ward Laboratories (Kearney, NE) for routine soil analysis with the Olsen test specified for phosphorus. Subsequent phosphorus applications will be made to the 100 lb treatment during the dormant period, beginning in 2008.

Dry matter yield and soil analysis data were subjected to SAS MIXED procedures for tests of significance and means separation.

**Results:**

Main effect (manure treatment, application schedule, and phosphorus source) means and results of statistical analysis for main effects and interactions are presented in Table 1. June 24 and total yield were increased by preplant applications of 300 lb P/ac and there was a similar ranking in numeric differences for the other harvests.

Table 1. Alfalfa dry matter yield and soil components by main effect at Tucumcari in 2008 and results of statistical analyses for main effects and all interactions.

| | Main Effects | | | | | | | | | Interactions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Manure Treatment (M) | | | Application Schedule (A) | | | Phosphorus Source (S) | | | P-Value | | | |
| Variable | Control | Manure | P-Value | 3 Years | Annual | P-Value | 0-46-0 | 11-52-0 | P-Value | M x A | M x S | A x S | M x A x S |
| 24-Jun, t/a | 1.30 | 1.26 | 0.0633 | 1.34 | 1.21 | 0.0447 | 1.29 | 1.27 | 0.7116 | 0.4976 | 0.1177 | 0.4187 | 0.3322 |
| 23-Jul, t/a | 1.35 | 1.19 | 0.1152 | 1.29 | 1.24 | 0.5128 | 1.30 | 1.23 | 0.3605 | 0.3915 | 0.7408 | 0.9995 | 0.9866 |
| 20-Aug, t/a | 0.89 | 0.94 | 0.5223 | 0.95 | 0.88 | 0.6979 | 0.90 | 0.93 | 0.5150 | 0.1709 | 0.2003 | 0.7919 | 0.7265 |
| 15-Sep, t/a | 0.63 | 0.66 | 0.2233 | 0.66 | 0.63 | 0.2017 | 0.64 | 0.65 | 0.4991 | 0.3388 | 0.5634 | 0.7116 | 0.8439 |
| 27-Oct, t/a | 0.58 | 0.61 | 0.6849 | 0.63 | 0.55 | 0.2548 | 0.60 | 0.59 | 0.8776 | 0.1319 | 0.7661 | 0.0460 | 0.5981 |
| Total yield, t/a | 4.74 | 4.66 | 0.7159 | 4.87 | 4.52 | 0.0424 | 4.73 | 4.67 | 0.7210 | 0.7745 | 0.4769 | 0.2297 | 0.8148 |
| pH | 8.33 | 8.28 | 0.4318 | 8.26 | 8.34 | 0.1303 | 8.28 | 8.32 | 0.5055 | 0.5055 | 0.1303 | 0.6560 | 0.1910 |
| Salts, mmho/cm | 0.19 | 0.22 | 0.0723 | 0.20 | 0.20 | 0.9479 | 0.19 | 0.21 | 0.0706 | 0.2747 | 0.1448 | 0.9479 | 0.8446 |
| OM, LOI % | 0.69 | 0.76 | 0.1996 | 0.73 | 0.71 | 0.4818 | 0.71 | 0.73 | 0.4818 | 0.0169 | 0.4818 | 0.2468 | 0.8135 |
| NO3, ppm | 1.02 | 1.29 | 0.3985 | 1.11 | 1.21 | 0.5373 | 1.14 | 1.18 | 0.8149 | 0.1497 | 0.4386 | 0.8759 | 0.8149 |
| P, ppm | 17 | 26 | 0.1224 | 25 | 18 | 0.0630 | 19 | 24 | 0.1253 | 0.5330 | 0.0726 | 0.4865 | 0.1426 |
| K, ppm | 163 | 237 | 0.0465 | 207 | 193 | 0.3027 | 185 | 214 | 0.0445 | 0.2445 | 0.2592 | 0.8155 | 0.8227 |
| S, ppm | 12 | 18 | 0.0986 | 14 | 15 | 0.6461 | 13 | 17 | 0.0730 | 0.2004 | 0.2801 | 0.2512 | 0.4195 |
| Zn, ppm | 0.36 | 0.63 | 0.0445 | 0.54 | 0.45 | 0.1896 | 0.43 | 0.56 | 0.0596 | 0.0375 | 0.9306 | 0.4714 | 0.0295 |
| Fe, ppm | 2.59 | 2.79 | 0.2413 | 2.69 | 2.68 | 0.8954 | 2.67 | 2.71 | 0.6938 | 0.5135 | 0.8954 | 0.1269 | 0.3001 |
| Mn, ppm | 2.06 | 2.44 | 0.0445 | 2.24 | 2.26 | 0.9114 | 2.16 | 2.34 | 0.1315 | 0.5069 | 0.7388 | 0.3232 | 0.6570 |
| Cu, ppm | 0.24 | 0.28 | 0.0481 | 0.26 | 0.26 | 0.5365 | 0.26 | 0.27 | 0.1102 | 0.0329 | 1.0000 | 0.3075 | 0.1587 |
| Ca, ppm | 2889 | 2851 | 0.6807 | 2885 | 2855 | 0.6672 | 2875 | 2865 | 0.8819 | 0.2443 | 0.9167 | 0.5886 | 0.9768 |
| MG, ppm | 270 | 285 | 0.1580 | 278 | 277 | 0.9707 | 274 | 281 | 0.1706 | 0.4445 | 0.9902 | 0.2538 | 0.4031 |
| Na, ppm | 51 | 54 | 0.4531 | 53 | 52 | 0.5995 | 52 | 53 | 0.6314 | 0.0830 | 0.4531 | 0.3767 | 0.6641 |

There was a significant application schedule x phosphorus source interaction for the October 27 harvest in which applying 300 lb 0-46-0/ac increased yield over 100 lb 0-46-0/ac (Table 2).

**Table 2. The effect of application schedule and phosphorus source on alfalfa yields (t/a) on October 27, 2008 at Tucumcari.**

| | Phosphorus source | |
|---|---|---|
| Application schedule | 0-46-0 | 11-52-0 |
| 3 Years | 0.71[a] | 0.55[ab] |
| Annual | 0.48[b] | 0.62[ab] |

Least squares means followed by the same letter are not significantly different (P < 0.05) based on the interaction LSD of 0.20.

Soil phosphorus (P) was unaffected by any treatment; however, potassium (K), zinc (Zn), and copper (Cu) were all increased by the manure application and several other components demonstrated similar numeric trends (Table 1). Phosphorus source also affected soil potassium, in that, using 11-52-0 increased soil potassium levels (Table 1).

The manure treatment x application schedule interaction was significant (Table 1) for soil organic matter because applying 10 tons/acre of manure increased organic matter levels when 300 lb P/acre was applied preplant incorporated (Table 3).

**Table 3. The effect of application schedule and manure treatment on soil organic matter and copper levels in 2008 at Tucumcari.**

| | Manure treatment | |
|---|---|---|
| Application schedule | Control, 0 t/a | Manure, 10 t/a |
| | Organic matter, % | |
| 3 Years | 0.66[b] | 0.80[a] |
| Annual | 0.71[ab] | 0.71[ab] |
| | Copper, ppm | |
| 3 Years | 0.24[c] | 0.29[a] |
| Annual | 0.25[bc] | 0.27[ab] |

Least squares means within organic matter followed by the same letter are not significantly different (P < 0.05) based on the interaction LSD of 0.10.
Least squares means within copper followed by the same letter are not significantly different (P < 0.05) based on the interaction LSD of 0.03.

The manure treatment effects on Zn and Cu were both moderated by significant manure treatment x application schedule interactions (Table 1). For copper the effect was similar to that of organic matter such that 10 tons/acre of manure increased organic matter levels when 300 lb P/acre was applied preplant incorporated (Table 3). For zinc was further moderated by a significant manure treatment x application schedule x phosphorus source interaction (Table 1) such that soil zinc levels were significantly higher when manure and 300 lb P as 11-52-0/acre was applied than when manure and 300 lb P as 0-46-0/acre was applied (Table 4).

**Table 4. The effect of manure treatment, application schedule, and phosphorus source on soil zinc levels (ppm) in 2008 at Tucumcari.**

| | | Phosphorus source | |
|---|---|---|---|
| Manure treatment | Application schedule | 0-46-0 | 11-52-0 |
| Control, 0 t/a | 3 Years | 0.32[bc] | 0.35[bc] |
| | Annual | 0.27[c] | 0.51[bc] |
| Manure, 10 t/a | 3 Years | 0.59[b] | 0.91[a] |
| | Annual | 0.55[bc] | 0.48[bc] |

Least squares means followed by the same letter are not significantly different ($P < 0.05$) based on the interaction LSD of 0.29.

# Effect of Fall Harvest Management on Alfalfa Fall Dormancy Categories at Tucumcari

**Investigator(s):**

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**Objective(s):**

To evaluate the effect of different fall harvest management regimes on alfalfa fall dormancy categories.

**Method(s):**

The test is designated 171FH. The test is a split plot with harvest management as the whole plot (Table 1) and fall dormancy category as the subplot (54V09 to represent FD 4; 56S82 for FD 6, 58N57 for FD 8, and 59N49 to represent FD 9, all supplied by Pioneer HiBred International). The test area (Canez fine sandy loam) was conventionally tilled and formed into 30-inch beds for furrow irrigation. Plots, 10 ft (4, 30" furrow beds) x 15 ft, were sown September 21, 2007, using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/acre in a Randomized Complete Block design with 4 replications. A chemically fallowed alley was maintained between plots to facilitate harvesting. No fertilizers or pesticides were applied in 2008. The test was furrow-irrigated to field capacity once prior to cuttings in June, July, September, and October.

On each of the first five harvest dates (Table 1), the center two beds of each plot were harvested to 3 inches using a John Deere Model 10 forage chopper. For the sixth and seventh harvests, a self-propelled forage plot harvester equipped with a reciprocating blade and electronic scales was used. Each harvest technique left a 7.5-cm stubble on the bed tops. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150°F for 48 hr to determine dry matter (DM) concentration, which was used to convert plot fresh weights to dry matter tons per acre. Concurrent to harvesting, forage from the border beds on each side of the harvested beds were removed.

**Table 1. Harvest dates by fall harvest management treatment.**

| Treatment | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Control | None[1] | 24 June | 23 July | 20 Aug. | 15 Sep. | 3 Nov. | None |
| 1 | None[1] | 24 June | 23 July | 20 Aug. | 15 Sep. | 15 Oct. | 10 Nov. |
| 2 | None[1] | 24 June | 23 July | 20 Aug. | 15 Sep. | 15 Oct. | 1 Dec.[1] |
| 3 | None[1] | 24 June | 23 July | 20 Aug. | 15 Sep. | 3 Nov. | 1 Dec.[1] |

[1]Yields were not measured due to very short growth.

Harvest (by number) and total annual yield data were subjected to SAS PROC MIXED analysis to test for differences in harvest management and variety and their interaction.

**Results:**

Data for the harvest management and variety effects are presented in Table 2. The 5% alpha level was apparently not sensitive enough because the difference among harvest treatments for total yield is associated with nonsignificant numeric differences in the first three harvests. It is anticipated that the

application of repeated measurements analysis will detect differences across years should they occur. Differences

among varieties were consistent to results of previous studies at Tucumcari as well as typical fall dormancy differences. The harvest treatment x variety interaction was nonsignificant for each harvest and the annual total yield.

**Table 2. Fall harvest management and variety effects at Tucumcari in 2008**

| | 2008 Harvests[1] | | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment (T)[2]** | 2 | 3 | 4 | 5 | 6 | 7 | 2008 Total |
| Control | 0.89 | 1.28 | 0.53 | 0.52 | 0.61 | 0.00 | 3.83[b] |
| 1 | 1.17 | 1.49 | 0.58 | 0.56 | 0.57 | 0.02 | 4.39[a] |
| 2 | 1.21 | 1.48 | 0.68 | 0.52 | 0.54 | 0.00 | 4.43[a] |
| 3 | 1.03 | 1.45 | 0.62 | 0.46 | 0.70 | 0.00 | 4.25[a] |
| P-value | 0.1905 | 0.2196 | 0.1083 | 0.3819 | 0.4251 | 0.0659 | 0.0356 |
| LSD, 0.05 | NS | NS | NS | NS | NS | NS | 0.36 |
| | | | | | | | |
| **Variety (V)** | | | | | | | |
| 54V09 | 1.00 | 1.37 | 0.51 | 0.46 | 0.29[c] | 0.00[b] | 3.63[b] |
| 56S82 | 1.09 | 1.38 | 0.55 | 0.49 | 0.56[b] | 0.00[b] | 4.08[a] |
| 58N57 | 1.08 | 1.40 | 0.64 | 0.54 | 0.68[b] | 0.00[b] | 4.34[a] |
| 59N49 | 1.13 | 1.56 | 0.71 | 0.56 | 0.88[a] | 0.02[a] | 4.86[a] |
| P-value | 0.7053 | 0.5274 | 0.2079 | 0.2410 | 0.0001 | 0.1237 | 0.0468 |
| LSD, 0.05 | NS | NS | NS | NS | 0.13 | 0.02 | 0.83 |
| | | | | | | | |
| T x V P-value | 0.1875 | 0.5671 | 0.6121 | 0.7935 | 0.4524 | 0.0844 | 0.4454 |
| Mean | 1.07 | 1.43 | 0.60 | 0.51 | 0.60 | 0.01 | 4.23 |

[1]Harvest 1 was not taken because irrigation water was not available and yields were deemed to be not measurable.

[2]Control, 1, 2, and 3 signify typical 6-harvest schedule with 6-7 week fall rest, 7 harvests taken every 28-35 days, 7 harvests with a 6- to 7-week rest between the final two, and a 6-harvest schedule with a 6-week rest between the fifth and sixth harvest followed by a seventh harvest 28 days thereafter.

[abc]Means within a column and treatment category followed by the same letter are not significantly different based on the 5% LSD, whether or not protected.

# Evaluation of Selected Herbicides at Varied Rates on Alfalfa and Weed Percentage and Total Annual Yield

**Investigator(s):**

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New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

**Objective(s):**

To evaluate the effects of Prowl $H_20$ and Velpar at various rates on alfalfa and weed stand percentage and forage yield.

**Method(s):**

The test (designated 181H) was laid out with four randomized complete blocks in an area of New Mexico Common alfalfa that had been sown September 22, 2005, using a disk-drill set to plant 20 lb inoculated seed/acre. Prior to planting, the area (Canez fine sandy loam) was conventionally tilled and formed into 36-inch beds for furrow irrigation. Details of management from 2005 through 2007 are similar to those described for an adjacent cowpea aphid resistant germplasm study published in the Annual Reports for those years. Treatments, including Prowl $H_2O$ (1, 2, 3, or 4 qts/ac), Velpar L (1 or 2 pts/ac), or water only were applied on March 19, 2008, through a $CO_2$-pressurized sprayer calibrated to apply 24 gal/ac of spray solution. No other herbicides or insecticides were used.

Fertilizer (200 lb/ac 11-52-0) was applied April 16, 2008, and the test was furrow-irrigated once prior to cutting. Typically the first harvest is in mid-May; however, it was not taken until mid-June because water was not available until mid-May. Irrigations for the second through fifth harvests were applied shortly after the previous harvest. Plots were 6 ft (on 2 beds) with a chemically fallowed alley at each end and chemically fallowed furrows on each side to facilitate harvesting. On each measured harvest date (May 19, June 24, July 24, August 21, September 16, and October 28), each plot was harvested to 3 inches using a John Deere Model 10 forage chopper. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter (DM) concentration, which was used to convert plot fresh weights to dry matter tons per acre. After canopy closure following the June 24 harvest, each plot was rated for stand percentage (ground cover) of alfalfa and annual and perennial weeds.

Percent stand (alfalfa and total, annual, and perennial weeds) and total forage yield data were subjected to SAS PROC GLM procedures for tests of significance and means separation.

**Results:**

The field was initially fairly weed-free and the only difference observed was for alfalfa stand percentage (Table 1). Even this difference is anomalous, likely being due to inherent variation in the field that coincided with the random arrangement of treatments. Hence, it is acknowledged that an alpha level of 0.01 should be used to accept statistical differences. That being stated, and in light of the high P-value for yield, it does appear as though a trend in yield reduction exists as the rate of either herbicide increases. In fact, when only Velpar L treatments are compared to the water only control, there is a stronger trend toward yield reduction (4.50, 4.01, 3.70 tons/ac for the water only control, 1 pt/ac Velpar L, and 2 pt/ac Velpar L, respectively, 5% LSD = 0.72 unprotected at $P < 0.0891$). No such significant effect was observed for Prowl H2O; however, a similar trend was apparent for total yield as the rate increased above water only (Table 1).

**Table 1. The effect of herbicide product and rate on alfalfa and weed stand percentage and total yield in 2008 at Tucumcari.**

| | Stand percentage | | | | Total yield |
|---|---|---|---|---|---|
| | Alfalfa | Total weeds | Annual weeds | Perennial weeds | tons/acre |
| Prowl $H_20$, 1qt | 75.75[bc] | 4.25 | 0.75 | 3.50 | 4.25 |
| Prowl $H_20$, 2qt | 81.25[ab] | 2.00 | 0.50 | 1.50 | 4.37 |
| Prowl $H_20$, 3qt | 82.50[a] | 7.25 | 1.00 | 6.25 | 4.07 |
| Prowl $H_20$, 4qt | 72.50[c] | 2.25 | 0.50 | 1.75 | 4.03 |
| Velpar L, 1pt | 81.25[ab] | 2.50 | 1.50 | 1.00 | 4.01 |
| Velpar L, 2pt | 78.75[abc] | 2.25 | 1.25 | 1.00 | 3.70 |
| Water only (control) | 82.50[a] | 2.25 | 1.00 | 1.25 | 4.50 |
| P-value | 0.0380 | 0.3079 | 0.4911 | 0.2354 | 0.5927 |
| 5% LSD | 6.67 | NS | NS | NS | NS |

[abc]Means within a column followed by the same letter do not differ based on the protected 5% LSD.

# Evaluation of Small Grains for Forage Interseeded into Alfalfa on Seasonal Alfalfa Yield, System Total Forage Yield and Persistence of the Alfalfa

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**Objective(s):**

To evaluate the effect of interseeding small grains in late summer on the long-term performance of alfalfa and system total forage yield.

**Method(s):**

The test (designated 171CSA) was sown into a Canez fine sandy loam soil with 100 lb P/ac pre-plant incorporated. The seedbed was formed into beds on 30-inch centers for furrow irrigation. Pioneer 56S82 alfalfa was sown over the entire test area on September 20, 2007 using a grain drill fitted with a small-seeded legume box. Irrigations were applied after planting to promote germination and establishment. The test area was managed for hay being swathed and baled without yields being measured 3 times in 2008 (June 20, July 16, and 13 August) prior to the initiation of treatments, which included interseeding spring oats, rye, or beardless wheat and control. The test area was irrigated when water became available in late May and after each harvest except the last one. Plots were 10 ft (4 beds x 15 ft) with a chemically fallowed alley at each end to facilitate harvesting and there are 4 randomized complete blocks. Yields were measured as described below on September 15 and October 28. After the September 15 harvest, small grains were no-till drilled (7-inch drill spacing) into the center 7 feet of each plot to be interseeded on September 17, after which the test was irrigated as scheduled.

On each measured harvest date, the center 2 beds (5 feet) of each plot were harvested to 3 inches using a John Deere Model 10 forage chopper. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter (DM) concentration, which was used to convert plot fresh weights to dry matter tons per acre.

Fifth and sixth harvest data were subjected to SAS MIXED procedures for tests of significance and means separation. All reported differences are significant at $P \leq 0.10$.

**Results:**

No differences existed between treatments for the September 15 harvest (0.73, 0.76, 0.69, and 0.65 tons/ac for control, oats, rye, and wheat, respectively, $P \leq 0.4245$). Differences did exist among treatments for the October 28 harvest (0.63, 0.70, 0.50, and 0.55 tons/ac for control, oats, rye, and wheat, respectively, $P \leq 0.0511$, 10% LSD = 0.12). This also led to a difference between treatments for total yield (1.36, 1.46, 1.18, and 1.21 tons/ac for control, oats, rye, and wheat, respectively, $P \leq 0.0598$, 10% LSD = 0.18). Part of these differences is related to numeric differences in the September harvest that may be inherent in the plots randomly selected for rye and wheat. Repeated measurements of yield and alfalfa stand counts will indicate if there is a true treatment effect. All plots had 100% stand of alfalfa at the beginning of the study based on fill of the drilled rows.

# Evaluation of Chemical Qualities of Selected Native and Commonly Grown Introduced Perennial Warm-Season Grasses for Biofuel Feedstock Potential in Eastern New Mexico

**Investigator(s):**

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**Objective(s):**

To evaluate chemical feedstock value of common eastern New Mexico perennial warm-season grasses.

**Method(s):**

Samples (two replicates) were collected post-frost in 2008 as near as possible, and in some cases from the same plant, as samples that were collected in 2007 in Quay County, NM, of selected perennial warm- and cool-season grasses commonly grown in eastern New Mexico (Table 1). Samples were ground to pass through a 1-mm screen and delivered to the lab to be analyzed by NIRS to estimate *in vitro* true digestibility (IVTD) and other traits estimating biofuel potential. Data were analyzed to compare species using SAS PROC MIXED procedures as a completely randomized design with two replicates and two years.

**Results and Discussion:**

There were no year x species interactions. Consequently, data and results of statistical analysis combined across the two years are presented in Table 1. Species are listed alphabetically by common name. Only those species are asterisked that are not different than the species having the most optimum value for a particular variable. Switchgrass (highlighted in Table 1) was included in the top population only for crude protein (CP) concentration and IVTD. High IVTD and low CP and ash are considered desirable for cellulosic feedstock. Several other species were equal to switchgrass in that regard and superior in other variables used for estimating feedstock value (Table 1).

Table 2 lists switchgrass first and indicates all values that were equal or superior to switchgrass for each feedstock quality variable. While switchgrass had been in the top population for two variables (Table 1), several species were not different from switchgrass in at least four of five categories, CP being the one most dissimilar (Table 2). The other Panicum spp. (vine mesquite and Kleingrass) were in this group along with several other species. Among those, giant reed has been added to noxious weed lists in several states and bermudagrass production potential is more dependant on soil nitrogen and water status.

Excessive ash concentrations in plains bristlegrass, showy windmillgrass, sideoats grama, and purple threeawn would tend to lessen the value of these species compared to switchgrass for biofuel feedstock despite their fairly low CP and high IVTD (Table 1).

Big, little, and silver bluestem, Indiangrass, and Johnsongrass all were equal or superior to switchgrass for all five variables (Table 2) and all of those except silver bluestem and Johnsongrass were included in the top population even when switchgrass was not (Table 1).

Table 1. Comparison of perennial warm-season grasses commonly grown in eastern New Mexico for cellulosic feedstock value.

| Common name | Latin name | CP | NDF | NDFD | IVTD | Ash |
|---|---|---|---|---|---|---|
| Alkali sacaton | Sporobolus airoides Torr. | 5.33 | 78.3* | 34.8 | 49.0 | 7.88 |
| Bermudagrass | Cynodon dactylon L. | 4.75 | 72.5 | 46.8* | 61.2* | 9.05 |
| Big bluestem | Andropogon gerardii Vitman | 0.98* | 81.6* | 39.8 | 50.8 | 3.95* |
| Cane bluestem | Bothriochloa barbinodis (Lag.) Herter | 3.85 | 76.9 | 42.8 | 56.0 | 8.13 |
| Eastern gamagrass | Tripsacum dactyloides L. | 5.18 | 74.4 | 38.8 | 54.2 | 7.78 |
| Giant reed | Arundo donax L. | 4.45 | 74.0 | 40.8 | 56.2 | 4.78 |
| Giant sacaton | Sporobolus wrightii Scribn. | 5.70 | 76.6 | 36.0 | 50.9 | 7.73 |
| Giant spike dropseed | Sporobolus contractus Hitchc. or giganteus Nash | 4.40 | 76.3 | 45.0* | 57.9* | 8.75 |
| Indiangrass | Sorghastrum nutans (L.) Nash | 0.75* | 78.3* | 48.3* | 59.4* | 7.03 |
| Johnsongrass | Sorghum halepense (L.) Pers. | 2.18 | 76.3 | 46.3* | 59.1* | 7.95 |
| Kleingrass | Panicum coloratum L. | 2.78 | 75.4 | 43.5 | 57.5* | 6.43 |
| Little bluestem | Schizachyrium scoparium (Michx.) Nash | 1.35* | 79.6* | 44.3 | 55.7 | 5.48* |
| Needle-and-thread | Stipa comata Trin. & Rupr. | 6.08 | 74.8 | 47.3* | 60.5* | 9.53 |
| Plains bristlegrass | Setaria leucopila (Scribn. & Merr.) K. Schum. | 7.83 | 62.9 | 68.5*** | 80.1*** | 15.98 |
| Purple threeawn | Aristida purpurea Nutt. | 4.08 | 74.8 | 46.3* | 59.8* | 10.28 |
| Sand dropseed | Sporobolus cryptandrus Torr. | 5.80 | 74.3 | 46.0* | 59.9* | 7.68 |
| Showy windmillgrass | Chloris virgata Sw. | 5.73 | 73.7 | 46.8* | 60.7* | 10.88 |
| Sideoats grama | Bouteloua curtipendula (Michx.) Torr. | 3.35 | 71.0 | 57.8** | 69.8** | 10.95 |
| Silver bluestem | Bothriochloa laguroides D.C. | 1.58* | 76.9 | 44.3 | 57.1* | 7.20 |
| Switchgrass | Panicum virgatum L. | 0.98* | 75.7 | 43.3 | 56.9* | 6.83 |
| Vine mesquite | Panicum obtusum H.B.K. | 3.08 | 76.7 | 51.8* | 63.0* | 9.18 |
| Weeping lovegrass | Eragrostis curvula (Schrad.) Nees | 3.90 | 78.9* | 38.8 | 51.6 | 3.80* |
| Yellow bluestem | Bothriochloa ischaemum L. | 3.45 | 75.5 | 49.1* | 61.5* | 8.58 |
| | 5% LSD (protected) | 1.43 | 4.0 | 7.3 | 6.5 | 2.62 |

CP, NDF, NDFD, and IVTD signify crude protein, neutral detergent fiber, neutral detergent fiber digestibility, and in vitro true digestibility, respectively, all estimated by near infrared spectroscopy analysis.

Single-asterisked means are not significantly different from the most or next-most optimum value in the column based on the 5% LSD. Double- and triple-asterisked means represent single-species populations that are far superior.

**Table 2. Comparison between switchgrass and other perennial warm-season grasses commonly grown in eastern New Mexico for cellulosic feedstock value.**

| Common name | Latin name | CP | NDF | NDFD | IVTD | Ash |
|---|---|---|---|---|---|---|
| Switchgrass | Panicum virgatum L. | 0.98* | 75.7* | 43.3* | 56.9* | 6.83* |
| Alkali sacaton | Sporobolus airoides Torr. | 5.33 | 78.3* | 34.8 | 49.0 | 7.88* |
| Bermudagrass | Cynodon dactylon L. | 4.75 | 72.5* | 46.8* | 61.2* | 9.05* |
| Big bluestem | Andropogon gerardii Vitman | 0.98* | 81.6** | 39.8* | 50.8* | 3.95** |
| Cane bluestem | Bothriochloa barbinodis (Lag.) Herter | 3.85 | 76.9* | 42.8* | 56.0* | 8.13* |
| Eastern gamagrass | Tripsacum dactyloides L. | 5.18 | 74.4* | 38.8* | 54.2* | 7.78* |
| Giant reed | Arundo donax L. | 4.45 | 74.0* | 40.8* | 56.2* | 4.78* |
| Giant sacaton | Sporobolus wrightii Scribn. | 5.70 | 76.6* | 36.0 | 50.9* | 7.73* |
| Giant spike dropseed | Sporobolus contractus Hitchc. or giganteus Nash | 4.40 | 76.3* | 45.0* | 57.9* | 8.75* |
| Indiangrass | Sorghastrum nutans (L.) Nash | 0.75* | 78.3* | 48.3* | 59.4* | 7.03* |
| Johnsongrass | Sorghum halepense (L.) Pers. | 2.18* | 76.3* | 46.3* | 59.1* | 7.95* |
| Kleingrass | Panicum coloratum L. | 2.78 | 75.4* | 43.5* | 57.5* | 6.43* |
| Little bluestem | Schizachyrium scoparium (Michx.) Nash | 1.35* | 79.6* | 44.3* | 55.7* | 5.48* |
| Needle-and-thread | Stipa comata Trin. & Rupr. | 6.08 | 74.8* | 47.3* | 60.5* | 9.53 |
| Plains bristlegrass | Setaria leucopila (Scribn. & Merr.) K. Schum. | 7.83 | 62.9 | 68.5** | 80.1** | 15.98 |
| Purple threeawn | Aristida purpurea Nutt. | 4.08 | 74.8* | 46.3* | 59.8* | 10.28 |
| Sand dropseed | Sporobolus cryptandrus Torr. | 5.80 | 74.3* | 46.0* | 59.9* | 7.68* |
| Showy windmillgrass | Chloris virgata Sw. | 5.73 | 73.7* | 46.8* | 60.7* | 10.88 |
| Sideoats grama | Bouteloua curtipendula (Michx.) Torr. | 3.35 | 71.0* | 57.8** | 69.8** | 10.95 |
| Silver bluestem | Bothriochloa laguroides D.C. | 1.58* | 76.9* | 44.3* | 57.1* | 7.20* |
| Vine mesquite | Panicum obtusum H.B.K. | 3.08 | 76.7* | 51.8** | 63.0* | 9.18* |
| Weeping lovegrass | Eragrostis curvula (Schrad.) Nees | 3.90 | 78.9* | 38.8* | 51.6* | 3.80** |
| Yellow bluestem | Bothriochloa ischaemum L. | 3.45 | 75.5* | 49.1* | 61.5* | 8.58* |
| | 5% LSD (protected) | 1.43 | 4.0 | 7.3 | 6.5 | 2.62 |

CP, NDF, NDFD, and IVTD signify crude protein, neutral detergent fiber, neutral detergent fiber digestibility, and in vitro true digestibility, respectively, all estimated by near infrared spectroscopy analysis.

Asterisked means are not significantly different from switchgrass based on the 5% LSD for that column. Double-asterisked species were superior to switchgrass for that variable.

Shaded species are not significantly different from or are superior to switchgrass for all five variables.

# Performance of Teff under Different Irrigation and Nitrogen Treatments

**Investigator(s):**

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**Objective(s):**

Evaluate yield and nutritive value of teff in eastern New Mexico.

**Method(s):**

Studies were conducted in 2007 and 2008 in separate fields each year of Canez fine sandy loam soil. Seedbeds were conventionally tilled and formed into beds for furrow irrigation on 36-inch centers in 2007 and 30-inch centers in 2008. In 2007, irrigation regimes, planted as the main plot, initially included all furrows irrigated at planting only (dry) and irrigated at planting and after the first and second harvests (full). A two-row border separated irrigation treatments. During the first harvest, it was realized that a third irrigation effect was measurable using selected pairs of adjacent border rows between irrigation treatments in which one of the beds was irrigated on one side for the equivalent of one-third-row irrigation (limited). Only the full and limited irrigation treatments were planted in 2008 when alternate rows were irrigated for the limited irrigation treatment. Nitrogen treatments each year, as strip subplots applied perpendicularly to the main plots, were 30, 60, or 90 lb N/ac applied preplant incorporated (single 30, single 60, and single 90, respectively), and 30 lb N applied preplant incorporated and after the first two harvests prior to irrigation (split 30, 3x). Each test was a randomized complete block with 4 replicates in 2007 and 3 replicates in 2008.

Plots were planted each year (May 24, 2007 and May 21, 2008) using the small-seeded legume attachment on a standard grain drill (7-inch drill spacing) with the seed tubes removed. In 2007, the drill was set to plant 11 lb timothy/ac and the actual seeding rate was 12.2 lb coated seed/ac. In 2008 5 lb uncoated seed/ac were planted when the drill was set to plant 8 lb timothy/ac. Additional fertilizer (100 lb $P_2O_5$ and 90 lb $K_20$/ac) was applied pre-planting and incorporated, based on soil test recommendations in 2007; but, no non-treatment fertilizers were applied in 2008. After uniform emergence, borders were sprayed with 2.5% glyphosate solution to form 4.67 x 20 ft plots (15 ft in 2008). Irrigations were applied shortly after planting to each entire test and after each of the first two harvests according to treatment. Water was turned off by furrow when the adjacent beds were soaked to their centers.

Standing forage of each entire plot was harvested August 16, September 18, and October 22, 2007 and August 13, September 15, and October 20, 2008 using a John Deere Model 10 forage chopper, leaving 3-inch stubble. Chopped material from individual plots was collected in a garbage can and immediately weighed. Prior to dumping the garbage can, a sample from each plot was placed in a labeled paper bag and sealed in a plastic bag. Immediately after harvesting was complete, samples were weighed, removed from the plastic bag, dried at 150°F for 48 hours, and reweighed to determine harvest moisture and to convert field weights to dry matter yield. No samples were collected for the August 16, 2007 harvest of the limited irrigation treatment; but, yield data was collected and converted to dry matter using the test average dry matter content for that harvest.

Dried samples were ground to pass through a 1-mm screen and submitted to Ward Laboratories (Kearney, NE) for forage nutritive value analysis by NIRS and the single 90 treatment of all irrigation treatments in 2007 was selected for nitrate – N determination by the same laboratory.

Because no samples were collected from the first harvest of the limited irrigation treatment in 2007, the irrigation treatments were analyzed separately for nutritive value components. Additionally, because the

'dry' treatment was not considered economically feasible based on 2007 data, that treatment was not tested in 2008 and the 2007 data was excluded from analysis. Forage dry matter harvest and total yield and selected nutritive value data were analyzed using SAS PROC MIXED procedures to determine where differences existed among nitrogen treatments across years and harvests. Treatment and interaction means were separated by least significant difference using the LSMEANS PDIFF and SLICE options. When a nitrogen treatment x harvest interaction was significant, alpha levels of 10, 5 or 1% were used to accommodate the assumption that no difference should exist between the Single 30 and Split 30, 3x treatments for the first harvest since they had been equally managed prior to that harvest.

**Results and Discussion:**

A combined analysis including both irrigation treatments was possible for dry matter yield across years and harvests. A difference in yield between years (data not shown) was likely due to the non-nitrogen fertilizer application in 2007 in addition to environmental influences. There was no difference between irrigation treatments and no interactions with year or harvest (data not shown). There was a significant ($P < 0.0301$) nitrogen treatment effect in the combined analysis for total yield (2.24, 2.57, 2.71, and 2.91 tons/acre for the single 30, single 60, single 90, and split 30, 3x treatments, respectively, 5% LSD = 0.44).

Nutritive value data by irrigation regime is presented in Table 1. Although not significant, nitrogen treatment yields of the limited irrigation regime had a trend consistent to the full irrigation treatment. While the main effect of nitrogen treatment within the full irrigation regime was not significant for any other variable, the treatment x harvest interaction was significant for all variables except yield and phosphorus. No interactions were significant for the limited irrigation regime, bearing in mind that nutritive value data was available for only two harvests.

Table 1. Nitrogen treatment effects on yield and quality of teff grown in 2007 and 2008 at Tucumcari, by irrigation regime[1].

| Treatment | Crude protein % | Total digestible nutrients % | Phosphorus % | Potassium % | Magnesium % |
|---|---|---|---|---|---|
| Full irrigation | | | | | |
| Single 30 | 15.35 | 65.2 | 0.236 | 1.866 | 0.383 |
| Single 60 | 15.63 | 65.7 | 0.234 | 1.895 | 0.403 |
| Single 90 | 15.43 | 65.4 | 0.236 | 1.896 | 0.380 |
| Split 30, 3x | 15.87 | 65.5 | 0.236 | 1.904 | 0.410 |
| P-value | 0.9312 | 0.9197 | 0.9782 | 0.7365 | 0.5592 |
| LSD[2] | Ns | Ns | Ns | Ns | Ns |
| Limited irrigation | | | | | |
| Single 30 | 15.84[b] | 65.9[ab] | 0.233[ab] | 1.698[b] | 0.405 |
| Single 60 | 14.97[b] | 64.7[b] | 0.227[b] | 1.669[b] | 0.392 |
| Single 90 | 16.24[ab] | 65.7[ab] | 0.236[ab] | 1.722[ab] | 0.420 |
| Split 30, 3x | 17.33[a] | 66.7[a] | 0.242[a] | 1.790[a] | 0.427 |
| P-value | 0.0823 | 0.0491 | 0.0366 | 0.0672 | 0.2948 |
| LSD[2] | 1.35* | 1.6** | 0.010** | 0.075* | Ns |

[1]Full and limited irrigation signify all furrows irrigated at planting and after the first two harvests and all furrows irrigated at planting and one-third (2007) or one half (2008) of furrows irrigated again after the first two harvests, respectively.
Single 30, Single 60, Single 90 and Split 30 signify single preplant applications of 30, 60, or 90 lb N/ac and 30 lb N/ac applied preplant and after each of the first two harvests.
[ab]Means in any column within irrigation regime followed by the same letter are not significantly different based on the LSD.
[2]*,**, and Ns signify alpha levels of 0.10 and 0.05 and not significant, respectively, for the LSD value.
Data are the means of four reps in 2007 and three reps in 2008.

Differences among the nitrogen treatments within the limited irrigation regime for crude protein indicate that crude protein concentration is reduced when less than 90 lb N/ac is supplied during the season. This is consistent with the trend for the full irrigation regime; however, the treatment x harvest interaction for that regime (Table 2) demonstrates that using a single pre-plant application of 90 lb N/ac will reduce crude protein percentage in the first harvest, the reason for which is not currently understood. Additionally, the reduced average crude protein for the single 60 treatment (Table 1) is related to low crude protein in the third harvest, likely due to soil depletion by previous growth. This reduced crude protein in the third harvest of the single 60 treatment did not affect yield as indicated by the absence of a treatment x harvest interaction for yield in either irrigation regime $P < 0.8978$ and $P < 0.8217$ for the full and limited irrigation regimes, respectively; data not shown).

Table 2. The effect (P < 0.0546) of nitrogen treatment and harvest on percentage crude protein content of fully irrigated teff grown in 2007 and 2008 at Tucumcari.

| | Nitrogen Treatment[1] | | | |
|---|---|---|---|---|
| Harvest | Single 30 | Single 60 | Single 90 | Split 30 |
| August | 14.34[c] | 16.15[abc] | 14.32[c] | 15.30[abc] |
| September | 16.45[ab] | 16.00[abc] | 16.85[ab] | 16.22[abc] |
| October | 15.27[abc] | 14.74[bc] | 15.11[abc] | 16.10[abc] |
| 5% LSD | 2.07 | | | |

[1]Single 30, Single 60, Single 90 and Split 30 signify single preplant applications of 30, 60, or 90 lb N/ac and 30 lb N/ac applied preplant and after each of the first two harvests.
[abc]Harvest means in any column or row followed by the same letter are not significantly different based on the 5% LSD.

Total digestible nutrients of teff under limited irrigation responded similarly to crude protein (Table 1). The treatment x harvest interaction within the full irrigation regime for total digestible nutrients indicates a decline or trend toward decline for every treatment, except split 30, 3x (Table 3). Although the decline was minimal, a continuous supply of nitrogen was apparently beneficial to maintaining digestibility across the growing season.

Table 3. The effect (P < 0.0723) of nitrogen treatment and harvest on percentage total digestible nutrient content of fully irrigated teff grown in 2007 and 2008 at Tucumcari.

| | Nitrogen Treatment[1] | | | |
|---|---|---|---|---|
| Harvest | Single 30 | Single 60 | Single 90 | Split 30 |
| August | 65.1[ab] | 66.9[a] | 65.4[ab] | 65.6[ab] |
| September | 65.9[ab] | 66.0[ab] | 65.9[ab] | 65.4[ab] |
| October | 64.6[b] | 64.2[b] | 65.0[b] | 65.6[ab] |
| 5% LSD | 1.9 | | | |

[1]Single 30, Single 60, Single 90 and Split 30 signify single preplant applications of 30, 60, or 90 lb N/ac and 30 lb N/ac applied preplant and after each of the first two harvests.
[ab]Harvest means in any column or row followed by the same letter are not significantly different based on the 5% LSD.

It appears that phosphorus and potassium also are affected by nitrogen treatment similarly to total digestible nutrients (Table 1). The importance of differences among treatment combinations in the treatment x harvest interaction of the full irrigation regime for potassium is not clear (Table 4), except that split applications of nitrogen may reduce the rate of decline compared to the other treatments.

Table 4. The effect (P < 0.0081) of nitrogen treatment and harvest on percentage potassium content of fully irrigated teff grown in 2007 and 2008 at Tucumcari.

| | Nitrogen Treatment[1] | | | |
|---|---|---|---|---|
| Harvest | Single 30 | Single 60 | Single 90 | Split 30 |
| August | 2.067[bc] | 2.259[a] | 2.135[ab] | 2.143[ab] |
| September | 1.920[d] | 1.841[d] | 1.952[cd] | 1.895[d] |
| October | 1.611[e] | 1.587[e] | 1.600[e] | 1.676[e] |
| 5% LSD | 0.125 | | | |

[1]Single 30, Single 60, Single 90 and Split 30 signify single preplant applications of 30, 60, or 90 lb N/ac and 30 lb N/ac applied preplant and after each of the first two harvests.
[abcde]Harvest means in any column or row followed by the same letter are not significantly different based on the 5% LSD.

Although not significant for the main effect of nitrogen treatment for either irrigation regime, trends in magnesium concentration also indicates a benefit to split applications (Table 1) and the treatment x harvest interaction was significant for the full irrigation regime (Table 5). A single pre-plant application of 90 lb N/ac reduced forage magnesium concentrations in the first harvest (Table 5), which is consistent with reduced crude protein concentration for the same treatment – harvest combination previously described (Table 2).

Table 5. The effect (P < 0.0081) of nitrogen treatment and harvest on percentage magnesium content of fully irrigated teff grown in 2007 and 2008 at Tucumcari.

| Harvest | Nitrogen Treatment[1] | | | |
|---|---|---|---|---|
| | Single 30 | Single 60 | Single 90 | Split 30 |
| August | 0.335bc | 0.417ab | 0.330c | 0.418ab |
| September | 0.416ab | 0.415ab | 0.428a | 0.419a |
| October | 0.398abc | 0.378abc | 0.382abc | 0.392abc |
| 1% LSD | 0.084 | | | |

[1]Single 30, Single 60, Single 90 and Split 30 signify single preplant applications of 30, 60, or 90 lb N/ac and 30 lb N/ac applied preplant and after each of the first two harvests.
[abc]Harvest means in any column or row followed by the same letter are not significantly different based on the 1% LSD.

Although differences in $NO_3$ – N existed among irrigation treatments for the single 90 nitrogen treatment (129, 458, and 465 ppm $NO_3$ – N for the dry, limited, and full irrigation treatments, respectively, LSD = 271), no single sample had >705 ppm. Hence, it is not likely that teff will accumulate sufficient nitrates to cause toxicity in livestock.

# Evaluation of Planting Date on Early Growth Rates of Teff

**Investigator(s):**

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[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401

**Objective(s):**

To evaluate the effect of planting date, particularly daylength, on teff growth rate from seeding to first heading.

**Method(s):**

This was a pot study under oscillating sprinkler irrigation. Each pot represented 1 of 4 replicates of 10 planting dates (weekly May 14 to July 16) and 13 sampling dates. Pots were laid out in rows by seeding date in one direction and harvest date, as days after planting (dap) in the other with the four reps of each planting date x harvest date combination in a quad formation. Raw teff seed (0.15 g/pot = 7 lb raw seed/acre) was hand-sown in 6" plastic pots filled with soil collected at the Agricultural Science Center at Tucumcari. A scoop was manufactured by adding a handle to a 22-short shell casing that delivered approximately 0.15 g seed without modifying the shell casing. Urea (60 lb N/ac = 2.45 g/pot, approximated by an ever so slightly rounded ½ teaspoon) also was applied preplant and hand-incorporated into the top 2-4 inches.

Sown pots were watered on Monday, Wednesday (after planting or harvesting), and Friday of each week, pending rain. Clipping to leave ½-inch stubble commenced when sufficient growth was present for the first planting date, which was used to determine the initial growth period for all subsequent planting dates. Clipping continued weekly until 70 dap, which was when the first planting date headed. Samples were dried for 48 hours at 60C and weighed.

The study was analyzed as a completely randomized design using SAS PROC MIXED procedures to determine where differences between planting dates and harvest dap existed. When the F-test was significant ($P < 0.05$), means were separated by protected least significant difference.

**Results and Discussion:**

The first two planting dates (May 14 and 21) had little or no emergence and no data was collected from them. Additionally, growth was not uniform within the next two planting dates; consequently, plants of uniform size were selected for sampling beginning 49 days after planting for the May 28 and June 4 planting dates. Subsequent planting dates had a faster rate of growth and clipping began at 42 dap for them.

As mentioned, germination and establishment was low until mid-June (Table 1). Generally, yield per pot remained low for 42 dap without regard to planting date. Additionally, pot yields were low for all harvest dates for the July 16 planting date. Significant increases in yield did not occur until 56 dap for the June 11 planting or 42 dap for the July 9 planting. Similar results were observed for clump weight (Table 1).

The cause of delayed growth by teff early in the growing season is unknown at this time. This study will be repeated in 2009 with possible slight modification.

**Table 1. The effect of planting date and harvest days after planting on the number of clumps, yield/pot, and weight per clump of teff grown in 6-inch pots at Tucumcari in 2008.**

| | Harvest days after planting | | | |
|---|---|---|---|---|
| Planting date | 42 | 49 | 56 | 63 |
| Clumps per pot, 5% LSD = 2.82 | | | | |
| 28-May | ----- | 1.50$^{gh}$ | 1.50$^{gh}$ | 1.00$^{h}$ |
| 4-Jun | ----- | 3.00$^{efgh}$ | 2.25$^{fgh}$ | 1.75$^{gh}$ |
| 11-Jun | 5.50$^{cde}$ | 4.25$^{defg}$ | 8.50$^{ab}$ | 5.00$^{cdef}$ |
| 18-Jun | 6.75$^{bcd}$ | 6.25$^{bc}$ | 2.25$^{fgh}$ | 10.00$^{a}$ |
| 25-Jun | 4.50$^{c}$ | 7.50$^{ab}$c | 10.00$^{a}$ | 9.00$^{ab}$ |
| 2-Jul | 10.00$^{a}$ | 10.00$^{a}$ | 10.00$^{a}$ | 10.00$^{a}$ |
| 9-Jul | 10.00$^{a}$ | 10.00$^{a}$ | 10.00$^{a}$ | 10.00$^{a}$ |
| 16-Jul | 10.00$^{a}$ | 10.00$^{a}$ | 10.00$^{a}$ | 10.00$^{a}$ |
| Yield, g/pot, 5% LSD = 6.31 | | | | |
| 28-May | ----- | 3.38$^{fg}$ | 1.35$^{fg}$ | 0.56$^{g}$ |
| 4-Jun | ----- | 1.21$^{fg}$ | 0.49$^{g}$ | 0.53$^{g}$ |
| 11-Jun | 2.88$^{fg}$ | 5.17$^{efg}$ | 14.81$^{bc}$ | 19.52$^{abc}$ |
| 18-Jun | 1.81$^{fg}$ | 1.78$^{fg}$ | 4.36$^{fg}$ | 7.37$^{def}$ |
| 25-Jun | 1.26$^{fg}$ | 3.59$^{fg}$ | 11.39$^{cde}$ | 11.44$^{cde}$ |
| 2-Jul | 5.02$^{fg}$ | 6.15$^{efg}$ | 16.90$^{bc}$ | 20.67$^{ab}$ |
| 9-Jul | 6.96$^{def}$ | 20.37$^{ab}$ | 21.82$^{a}$ | 13.15$^{cd}$ |
| 16-Jul | 6.76$^{efg}$ | 4.26$^{fg}$ | 5.07$^{fg}$ | 4.98$^{fg}$ |
| Clump weight, g, 5% LSD = 0.92 | | | | |
| 28-May | ----- | 2.63$^{bc}$ | 0.80$^{efghi}$ | 0.56$^{fghi}$ |
| 4-Jun | ----- | 0.46$^{fghi}$ | 0.24$^{hi}$ | 0.31$^{hi}$ |
| 11-Jun | 0.52$^{fghi}$ | 1.36$^{cdef}$ | 1.75$^{bcd}$ | 3.70$^{a}$ |
| 18-Jun | 0.46$^{fghi}$ | 0.27$^{hi}$ | 2.64$^{b}$ | 0.74$^{fghi}$ |
| 25-Jun | 0.20$^{i}$ | 0.43$^{ghi}$ | 1.14$^{defgh}$ | 1.29$^{cdefg}$ |
| 2-Jul | 0.50$^{fghi}$ | 0.62$^{fghi}$ | 1.69$^{cde}$ | 2.07$^{bc}$ |
| 9-Jul | 0.70$^{fghi}$ | 2.04$^{bdc}$ | 2.18$^{bc}$ | 1.31$^{cdef}$ |
| 16-Jul | 0.68$^{fghi}$ | 0.77$^{fghi}$ | 0.51$^{fghi}$ | 0.50$^{fghi}$ |

$^{abcdefghi}$Means within an interaction followed by the same letter are not significantly different based on the 5% LSD for that interaction.

# Effect of Micronutrient Applications on Forage Cowpeas in Various Soils

**Investigator(s):**

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**Objective(s):**

To evaluate forage yield and nutritive value of forage cowpeas having been treated with a micronutrient solution or not.

**Method(s):**

Cowpea (Iron & Clay) was planted into a conventionally tilled flat seedbed on July 3 using a John Deere flex-planter at a planting rate 8 seeds/meter of row on a 30-inch row spacing (10 lb/ac). Individual plots were 20 x 10 ft (4 30-inch rows) in a Latin Square arrangement with two squares located in each of three soil types (Canez, Quay, and Redona fine sandy loams). On July 31 and August 27 micronutrient solution containing 4 tsp/gal [HiYield Liquid Iron and other micronutrients (Cu, Mn, S, and Zn)] was applied foliarly using a hand-pressurized sprayer to wet the upper surface of the canopy. Prior to application of the micronutrient solution and prior to each harvest (to be described), SPAD-502 meter readings (Minolta Camera Co., Japan) were taken from an undamaged cowpea leaf to estimate differences in leaf N content.

A separate one-meter section of row was hand clipped to ground level on August 20 and September 24 and the plants counted. Harvested material from each plot was dried at 150°F for 48 hours and weighed to determine dry matter yield. Dried samples also were ground to pass through a 1-mm screen and submitted to Ward Laboratories (Kearney, NE) for forage nutritive value analysis by NIRS.

Plant populations, SPAD readings, forage dry matter yield, and selected nutritive value data were analyzed using SAS PROC MIXED procedures to determine where differences among soils and micronutrient treatments existed as well as any interactions. When the F-test was significant ($P < 0.05$), soil means were separated by protected least significant difference.

**Results and Discussion:**

There were no significant interactions between soil type and micronutrient application. Main effect means and results of tests of significance are presented in Table 1. Only SPAD readings on September 24 were different due to the micronutrient applications (Table 1).

Several variables had significant differences due to soil type, many of which (SPAD, crude protein, lignin, fat, and phosphorus) indicated the lower quality of cowpea forage grown in the Quay soil and its intermediate quality when grown in Canez soil compared to the Redona. Generally the Canez soil had the highest crude protein (though not always significant) and the lowest fiber. For plant mineral concentration, Redona was consistently lower in calcium and magnesium.

**Table 1. Cowpea populations, SPAD readings[1], dry matter yield and NIRS-estimated nutritive value components[2] by main effect at Tucumcari in 2008 and results of statistical analyses for main effects.**

| | Main Effects | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Soil Type | | | | | Micronutrient Application | | |
| Variable | Canez | Quay | Redona | P-Value | 5% LSD | Control | Applied | P-Value |
| Plants/m of row, 20-Aug | 8 | 7 | 8 | 0.7505 | NS | 8 | 8 | 0.7318 |
| Plants/m of row, 24-Sep | 7 | 9 | 9 | 0.3149 | NS | 8 | 9 | 0.7758 |
| SPAD, 30-Jul | 40 | 26 | 57 | 0.0709 | 26 | 40 | 42 | 0.3089 |
| SPAD, 20-Aug | 57[a] | 30[b] | 63[a] | 0.0001 | 15 | 48 | 52 | 0.3461 |
| SPAD, 24-Sep | 57[a] | 44[b] | 62[a] | 0.0008 | 12 | 59 | 49 | 0.0035 |
| Yield (g/m of row), 20-Aug | 28[b] | 8[b] | 65[a] | 0.0001 | 31 | 36 | 32 | 0.5896 |
| Yield (g/m of row), 24-Sep | 118[b] | 40[b] | 300[a] | 0.0126 | 118 | 156 | 149 | 0.7031 |
| CP (%), 20-Aug | 27.1[a] | 25.4[b] | 26.8[a] | 0.0023 | 1.4 | 26.3 | 26.6 | 0.4543 |
| CP (%), 24-Sep | 25.4 | 22.9 | 23.7 | 0.0835 | NS | 24.3 | 23.7 | 0.5299 |
| ADF (%), 20-Aug | 13.2[b] | 17.0[a] | 15.4[a] | 0.0001 | 1.9 | 15.6 | 14.7 | 0.0821 |
| ADF (%), 24-Sep | 17.7 | 18.7 | 19.8 | 0.2564 | NS | 18.3 | 19.1 | 0.4575 |
| NDF (%), 20-Aug | 11.4[b] | 15.5[a] | 14.0[a] | 0.0006 | 2.7 | 14.2 | 13.0 | 0.1003 |
| NDF (%), 24-Sep | 16.7 | 17.3 | 19.7 | 0.1355 | NS | 17.4 | 18.5 | 0.3734 |
| NDFD (%), 20-Aug | 54.9 | 51.3 | 58.4 | 0.4726 | NS | 54.9 | 54.8 | 0.9461 |
| NDFD (%), 24-Sep | 61.0 | 47.1 | 64.1 | 0.0674 | NS | 58.4 | 56.4 | 0.3548 |
| Lignin (%), 20-Aug | 3.06[b] | 4.45[a] | 2.98[b] | 0.0102 | 0.68 | 3.51 | 3.48 | 0.8652 |
| Lignin (%), 24-Sep | 3.88 | 4.50 | 3.80 | 0.0787 | NS | 3.95 | 4.11 | 0.5716 |
| Fat (%), 20-Aug | 3.45 | 3.16 | 3.25 | 0.1194 | NS | 3.26 | 3.32 | 0.4045 |
| Fat (%), 24-Sep | 4.00[a] | 3.29[b] | 3.99[a] | 0.0008 | 0.55 | 3.86 | 3.66 | 0.1767 |
| Ca (%), 20-Aug | 3.27[b] | 3.70[a] | 2.80[c] | 0.0191 | 0.46 | 3.20 | 3.32 | 0.1929 |
| Ca (%), 24-Sep | 3.19[a] | 3.51[a] | 2.63[b] | 0.0080 | 0.33 | 3.09 | 3.14 | 0.4491 |
| P (%), 20-Aug | 0.40 | 0.40 | 0.43 | 0.2785 | NS | 0.41 | 0.41 | 0.5973 |
| P (%), 24-Sep | 0.45[a] | 0.36[b] | 0.45[a] | 0.0311 | 0.07 | 0.43 | 0.41 | 0.1798 |
| K (%), 20-Aug | 2.39 | 2.32 | 2.58 | 0.3677 | NS | 2.48 | 2.38 | 0.5078 |
| K (%), 24-Sep | 2.71 | 2.37 | 3.06 | 0.1515 | NS | 2.73 | 2.70 | 0.8532 |
| Mg (%), 20-Aug | 0.64[b] | 0.72[a] | 0.57[c] | 0.0001 | 0.07 | 0.63 | 0.65 | 0.3341 |
| Mg (%), 24-Sep | 0.63[b] | 0.70[a] | 0.54[c] | 0.0140 | 0.07 | 0.62 | 0.62 | 0.9547 |

[1]SPAD meter readings estimate differences in leaf nitrogen content.
[2]CP, ADF, NDF, NDFD, Ca, P, K, and Mg signify crude protein, acid detergent fiber, neutral detergent fiber, neutral detergent fiber digestibility, calcium, phosphorus, potassium, and magnesium, respectively.
P-value gives the probability that the means are not different.
NS not significantly different.
[abc]Soil type means followed by the same letter are not significantly different based on the 5% LSD.

# Performance of Alfalfa Cultivars at Tucumcari in 2008

**Investigator(s):**

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**Objective(s):**

To evaluate the performance of alfalfa varieties submitted by proprietors in the Tucumcari Irrigation Project.

**Method(s):**

Two alfalfa variety tests were ongoing in 2008. One, having been sown in late summer 2005 (designated 151AVT). The test area (Canez fine sandy loam) was conventionally tilled and formed into 36-inch beds for furrow irrigation. Plots, 6 ft (2,36" furrow beds) x 15 ft, were sown September 22, 2005, using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/acre in a Randomized Complete Block design with 4 replications. Fertilizer (200 lb/ac 11-52-0) was applied April 16, 2008. The test received 1 pt/acre of Volunteer plus 1 qt/acre crop oil concentrate on March 15, 2008, for grass control, and a tank mix of Basagran and Volunteer (1 pt/acre of each) and crop oil concentrate (1 qt/acre) on June 6, 2008, for broad spectrum weed control.

The other test was sown on September 21, 2007 (designated 171AVT). Plots, 5 ft (2, 30” furrow beds) x 15 ft, were sown as described above into 4 randomized complete blocks for nearest neighbor analysis. No fertilizer or pesticides were applied in 2008.

Each test was furrow-irrigated once prior to cuttings in June, July, September, and October, applying approximately 6 inches of water with each irrigation. A harvest taken in August had not been irrigated. On each harvest date (shown in the table), plots were harvested to 3 inches using a John Deere Model 10 forage chopper. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter concentration, which was used to convert plot fresh weights to dry matter (DM) tons per acre.

**Results:**

Yield data were subjected to SAS GLM procedures for tests of significance and means separation and are presented in Tables 1 and 2 with varieties arranged by descending total yield. Yields were higher than they had been in previous years, but lower than typically expected at this location.

A report giving results from statewide testing in 2008 and previous years is available from the Agricultural Science Center at Tucumcari, county Cooperative Extension Service offices, and Online at http://cahe.nmsu.edu/pubs/variety_trials/avt08.pdf. This publication also provides more information about alfalfa variety selection. New Mexico alfalfa variety test reports are all available at the new Variety Test Reports website of the New Mexico State University College of Agriculture and Home Economics’ Publications and Videos webpage.

**Table 1. Dry matter yields (tons/acre) of alfalfa varieties sown September 22, 2005, at NMSU's Agricultural Science Center at Tucumcari and furrow-irrigated once for each cutting, except for the one taken on August 21, 2008.**

| Variety | 2006 Total | 2007 Total | 2008 Harvests | | | | | 2008 Total | 3-yr Average |
|---|---|---|---|---|---|---|---|---|---|
| | | | 24-Jun | 24-Jul | 21-Aug | 16-Sep | 28-Oct | | |
| 56S82 | 2.89* | 4.82* | 1.31* | 2.09 | 1.18** | 1.02* | 0.87* | 6.47** | 4.73** |
| RSC751, Lot N536-5A | 3.23* | 4.88* | 1.22* | 2.22 | 0.89 | 0.94 | 0.71 | 5.99* | 4.70* |
| Wilson | 3.37** | 4.67* | 1.10 | 1.99 | 0.96* | 0.96 | 0.95** | 5.96* | 4.67* |
| Tango | 2.89* | 4.75* | 1.23* | 2.30* | 0.82 | 0.88 | 0.78 | 6.02* | 4.56* |
| 55H05 | 3.22* | 4.57* | 1.25* | 2.18 | 0.86 | 0.84 | 0.72 | 5.86* | 4.55* |
| Cimarron VL400 | 3.07* | 4.56* | 1.37** | 2.36* | 0.78 | 0.79 | 0.60 | 5.91* | 4.51* |
| FSG505 | 2.89* | 4.59* | 1.15* | 2.32* | 0.83 | 0.92 | 0.70 | 5.91* | 4.47* |
| NC+605 | 2.63 | 4.59* | 1.20* | 2.28* | 0.91 | 0.98* | 0.76 | 6.14* | 4.45* |
| African Common | 2.62 | 4.24* | 1.09 | 2.12 | 0.97* | 1.12** | 0.93* | 6.23* | 4.36* |
| NM Common | 2.85* | 4.32* | 0.99 | 2.01 | 1.01* | 1.02* | 0.86* | 5.90* | 4.36* |
| DS 204HYB | 2.50 | 4.95** | 1.09 | 2.11 | 0.90 | 0.84 | 0.57 | 5.51 | 4.32* |
| Dona Ana | 2.69 | 4.36* | 1.03 | 2.06 | 0.91 | 1.04* | 0.82* | 5.86* | 4.30* |
| Rebound 5.0 | 2.43 | 4.68* | 1.20* | 2.20 | 0.95* | 0.83 | 0.61 | 5.79* | 4.30* |
| msSunstra-507 | 2.44 | 4.59* | 1.34* | 2.23 | 0.79 | 0.82 | 0.56 | 5.74* | 4.26* |
| Select | 3.05* | 4.06* | 1.13* | 2.27* | 0.70 | 0.70 | 0.59 | 5.40 | 4.17* |
| CW704 | 2.67 | 4.06* | 0.96 | 2.11 | 0.85 | 0.96 | 0.88* | 5.76* | 4.16* |
| Mountaineer 2.0 | 2.84* | 4.16* | 1.14* | 2.20 | 0.69 | 0.75 | 0.62 | 5.41 | 4.14* |
| HybriForce-600 | 2.43 | 4.16* | 1.12* | 2.28* | 0.76 | 0.88 | 0.66 | 5.69 | 4.09* |
| WL 335HQ | 2.55 | 4.17* | 0.97 | 2.51** | 0.65 | 0.72 | 0.58 | 5.43 | 4.05* |
| WL 357HQ | 2.60 | 4.21* | 0.93 | 2.11 | 0.68 | 0.73 | 0.81* | 5.26 | 4.02 |
| Phoenix | 2.50 | 4.19* | 1.12* | 2.14 | 0.70 | 0.75 | 0.61 | 5.32 | 4.00 |
| RSC751, Lot N342-5A | 2.66 | 4.01 | 0.89 | 2.15 | 0.63 | 0.77 | 0.76 | 5.20 | 3.96 |
| DKA50-18 | 2.42 | 4.13* | 0.89 | 2.08 | 0.83 | 0.82 | 0.67 | 5.29 | 3.95 |
| Ruccus | 2.46 | 3.85 | 0.94 | 2.15 | 0.69 | 0.83 | 0.79 | 5.41 | 3.90 |
| 6530 | 2.32 | 3.86 | 1.18* | 2.09 | 0.77 | 0.74 | 0.52 | 5.30 | 3.83 |
| Escalade | 2.42 | 3.89 | 0.97 | 2.10 | 0.57 | 0.78 | 0.76 | 5.18 | 3.83 |
| RSC751-II | 2.52 | 3.61 | 1.03 | 2.14 | 0.66 | 0.80 | 0.65 | 5.29 | 3.81 |
| DKA41-18RR | 2.40 | 3.98 | 0.89 | 1.85 | 0.79 | 0.79 | 0.58 | 4.91 | 3.76 |
| Cutmor | 2.39 | 3.77 | 0.89 | 1.86 | 0.69 | 0.82 | 0.81* | 5.07 | 3.74 |
| 6420 | 2.24 | 3.77 | 1.04 | 2.09 | 0.68 | 0.75 | 0.55 | 5.11 | 3.71 |
| BPR387 | 2.10 | 3.76 | 1.02 | 2.04 | 0.69 | 0.75 | 0.62 | 5.11 | 3.65 |
| Reward II | 2.36 | 3.57 | 0.98 | 2.07 | 0.59 | 0.71 | 0.50 | 4.84 | 3.59 |
| Renograzer | 2.01 | 3.68 | 1.13* | 1.92 | 0.63 | 0.60 | 0.41 | 4.69 | 3.46 |
| Mean | 2.63 | 4.23 | 1.09 | 2.14 | 0.79 | 0.84 | 0.69 | 5.55 | 4.13 |
| LSD (0.05) | 0.62 | 0.93 | 0.27 | 0.26 | 0.26 | 0.16 | 0.15 | 0.78 | 0.70 |
| CV% | 16.84 | 15.73 | 17.92 | 8.81 | 23.39 | 13.93 | 15.27 | 9.98 | 12.02 |

2006 Harvest dates: 13-Jun, 11-Jul, 10-Aug, 13-Sep, and 30-Oct.
2007 Harvest dates: 29-May, 25-Jun, 24-Jul, 21-Aug, 18-Sep, and 29-Oct.
**Highest numerical value in the column.
*Not significantly different from the highest numerical value in the column based on the 5% LSD.
LSD (0.05) stands for the Least Significant Difference at the 5% level. If the difference between two numbers within a column is equal to or greater than the LSD, it is 95% certain that they are different.
NS means that there were no significant differences between the varieties within that column at the 5% level

**Table 2. Dry matter yields (tons/acre) of alfalfa varieties sown September 15, 2007, at NMSU's Agricultural Science Center at Tucumcari and furrow-irrigated once for each cutting, except for the one taken August 21, 2008.**

| | 2008 Harvests | | | | | 2008 |
|---|---|---|---|---|---|---|
| **Variety** | **24-Jun** | **23-Jul** | **20-Aug** | **16-Sep** | **27-Oct** | **Total** |
| Chema 1 | 1.33* | 1.78* | 1.36* | 1.03* | 1.21** | 6.69** |
| NM0307 | 1.67** | 1.85* | 1.32* | 0.85 | 0.96 | 6.64* |
| NM Common | 1.31* | 1.90* | 1.38* | 1.03* | 0.99* | 6.61* |
| NM0313 | 1.41* | 1.90* | 1.25* | 0.93* | 1.05* | 6.54* |
| HybriForce 620 | 1.56* | 2.08* | 1.36* | 0.83 | 0.71 | 6.53* |
| NM0601 | 1.57* | 1.95* | 1.30* | 0.94* | 0.74 | 6.50* |
| 56S82 | 1.49* | 1.78* | 1.45** | 0.82 | 0.96 | 6.49* |
| CW 500 | 1.43* | 2.18** | 1.28* | 0.79 | 0.79 | 6.46* |
| Wilson | 1.67** | 1.65* | 1.34* | 0.90* | 0.87 | 6.42* |
| NM0306 | 1.54* | 1.75* | 1.30* | 0.91* | 0.88 | 6.38* |
| Dona Ana | 1.62* | 1.93* | 1.19* | 0.80 | 0.78 | 6.32* |
| African Common | 1.11* | 1.93* | 1.30* | 1.04** | 0.85 | 6.21* |
| AmeriStand 407TQ | 1.41* | 1.98* | 1.20* | 0.91* | 0.73 | 6.21* |
| A5225 | 1.50* | 1.88* | 0.97* | 0.95* | 0.84 | 6.12* |
| PGI 459 | 1.51* | 1.80* | 1.32* | 0.79 | 0.65 | 6.06* |
| FSG528SF | 1.40* | 1.78* | 1.24* | 0.78 | 0.66 | 5.85* |
| Mean | 1.47 | 1.88 | 1.28 | 0.89 | 0.85 | 6.38 |
| LSD (0.05) | NS | NS | NS | 0.17 | 0.25 | NS |
| CV% | 16.08 | 22.59 | 15.80 | 13.12 | 20.89 | 9.47 |

**Highest numerical value in the column.

*Not significantly different from the highest numerical value in the column based on the 5% LSD. LSD (0.05) stands for the Least Significant Difference at the 5% level. If the difference between two numbers within a column is equal to or greater than the LSD, it is 95% certain that they are different. NS means that there were no significant differences between the varieties within that column at the 5% level.

# Evaluation of Cal/West Seeds Experimental Alfalfa Lines for Resistance to Cowpea Aphids at Tucumcari in 2007

**Investigator(s):**

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**Objective(s):**

To evaluate the performance of experimental alfalfa varieties under pressure from cowpea aphid and when protected by insecticide.

**Method(s):**

The test area (Canez fine sandy loam) was conventionally tilled and formed into 36-inch beds for furrow irrigation. Plots, 6 ft (2, 36" furrow beds) x 15 ft, were sown September 22, 2005, using a disk drill fitted with a seed-metering cone at 20 lb inoculated seed/acre in a Randomized Complete Block design with 4 replications in which spray treatment was the whole plot and variety was the subplot. This study is designated as 151CA.

Fertilizer (200 lb/ac 11-52-0) was applied April 16, 2008, and the test was furrow-irrigated once prior to cutting. Typically the first harvest is in mid-May; however, it was not taken until mid-June because water was not available until mid-May. Irrigations for the second through fifth harvests were applied shortly after the previous harvest. The test received 1 pt/acre of Volunteer plus 1 qt/acre crop oil concentrate on March 15, 2008, for grass control, and a tank mix of Basagran and Volunteer (1 pt/acre of each) and crop oil concentrate (1 qt/acre) on June 6, 2008, for broad spectrum weed control. No insecticides were used. On each harvest date (shown in the table), plots were harvested to 3 inches using a John Deere Model 10 forage chopper. Fresh weights were measured in the field. A sub-sample of the harvested material from each plot was collected, weighed, and dried at 150$^{o}$F for 48 hr to determine dry matter (DM) concentration, which was used to convert plot fresh weights to dry matter tons per acre.

**Results:**

Yield data were subjected to SAS GLM procedures for tests of significance and means separation and are presented in Table 1 with varieties arranged alphabetically. As in previous years, no cowpea aphid infestations occurred so no differences existed between spray treatments. Consequently, only varietal data are reported.

Differences continue to be consistent between varieties across years and for total yield. Also consistent with previous years is the lack of difference in June and July; although, the number of non-signficances during summer declined by one harvest each year such that June through September was not different in 2006 and June through August in 2007. The value of that information is not understood at this time. The test will continue through 2009 to provide the opportunity for cowpea aphids to attack.

**Table 1. Dry matter yields (tons/acre) of Cal/West Seeds experimental alfalfa lines screened for cowpea aphid resistance at NMSU's Agricultural Science Center at Tucumcari and furrow- irrigated once per cutting.**

| | | | 2008 Harvests | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Variety | 2006 Total | 2007 Total | 24-Jun | 24-Jul | 21-Aug | 16-Sep | 28-Oct | 2008 Total | 3-yr Total |
| CW040008 | 2.60* | 4.78 | 1.12* | 2.11* | 0.64 | 0.73 | 0.64* | 5.24* | 12.61 |
| CW040009 | 2.35 | 4.51 | 1.04* | 2.11* | 0.73* | 0.72 | 0.46 | 5.05 | 11.91 |
| CW040080 | 2.92** | 5.51** | 1.07* | 2.10* | 0.79* | 0.80* | 0.65* | 5.41* | 13.83** |
| CW040083 | 2.78* | 5.20* | 1.02* | 2.15** | 0.81* | 0.81* | 0.65* | 5.44* | 13.42* |
| CW30077 | 2.69* | 5.17* | 1.01* | 2.14* | 0.80* | 0.83** | 0.68* | 5.47** | 13.32* |
| CW30083 | 2.67* | 5.34* | 1.07* | 2.08* | 0.83** | 0.77* | 0.63 | 5.38* | 13.39* |
| CW50026 | 2.50 | 5.10* | 1.06* | 1.87* | 0.65 | 0.69 | 0.59 | 4.86 | 12.45 |
| CW55067 | 2.67* | 5.24* | 1.02* | 2.02* | 0.76* | 0.81* | 0.72** | 5.33* | 13.24* |
| CW95026 | 2.80* | 5.25* | 1.13** | 2.11* | 0.72 | 0.80* | 0.66* | 5.42* | 13.47* |
| Mean | 2.66 | 5.12 | 1.06 | 2.08 | 0.75 | 0.77 | 0.63 | 5.29 | 13.07 |
| CV, % | 12.45 | 9.21 | 13.52 | 11.92 | 14.17 | 8.46 | 13.92 | 7.24 | 6.92 |
| Prob. > F | 0.0544 | 0.0076 | 0.2265 | 0.2295 | 0.0142 | 0.0158 | 0.0011 | 0.2720 | 0.0035 |
| LSD, 0.05 | 0.34 | 0.48 | ns | ns | 0.11 | 0.07 | 0.09 | 0.39 | 0.92 |

Means are the average of two spray treatments and four replicates.

# Performance of Furrow-Irrigated Sorghum x Sudangrass Hybrids and Forage Sorghum Cultivars

## Investigator(s):

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### Objective(s):

Evaluate yield and nutritive value of forage sorghum and sorghum x sudangrass hybrids harvested twice under furrow-irrigated conditions.

### Method(s):

A test was planted into a conventionally tilled seedbed formed into beds on 30-inch centers for furrow irrigation. Fertilizer (100 lb/ac N) and Aatrex (2.5 lb/ac) were applied pre-planting and incorporated. Plots were planted May 22, using a drill fitted with a cone seed distributor and drills set on 6-inch centers. The seeding rate was 25 lb seed/ac. Individual plots were 15 x 5 ft, all of which was harvested. Borders of the same size as plots surrounded the test and there was a 5-ft skip between plots. The test was a Randomized Complete Block design with 4 replicates. Irrigations of approximately 6 inches each were applied May 23, June 24, August 26 and September 24. Clarity (0.5 pt/ac) was applied on July 16.

Standing forage was harvested on August 13 and October 21 using a John Deere Model 10 forage chopper, leaving 3-inch stubble. Chopped material from individual plots was collected in a garbage can and immediately weighed. Prior to dumping the garbage can, a sample from each plot was placed in a labeled paper bag and sealed in a plastic bag. Immediately after harvesting was complete these samples were weighed, removed from the plastic bag, dried at 150°F for 48 hours, and reweighed to determine harvest moisture and to convert field weights to dry matter yield.

Dried samples were ground to pass through a 1-mm screen and submitted to the Ward Laboratories (Kearney, NE) for forage nutritive value analysis by near infrared spectroscopy (NIRS) for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), neutral detergent fiber digestibility (NDFD), total digestible nutrients (TDN), net energy for lactation ($NE_L$), relative feed value (RFV), and relative forage quality (RFQ).

Dry and green forage yield, harvest moisture, and nutritive value data were analyzed using SAS PROC GLM procedures to determine where differences between varieties existed. Means were separated by unprotected least significant difference ($P < 0.05$).

### Results and Discussion:

Results of statistical analysis for yield data are presented in Table 1 and results of statistical analysis for nutritive value data are presented in Table 2.

**Table 1. Green and dry matter yield (tons/acre) of sorghum x sudangrass and forage sorghum varieties harvested twice at Tucumcari in 2008.**

| Brand/Company | Hybrid/Variety | | Cutting 1 | | | Cutting 2 | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | | Yield | | Harvest | Yield | | Harvest | Dry |
| Name | Name | Type[1] | Dry | Green | Moisture | Dry | Green | Moisture | Forage |
| | | | t/a | t/a | % | t/a | t/a | % | t/a |
| Richardson Seeds | BundleKing BMR | FS | 1.44 | 5.34 | 73.35 | 0.71 | 2.71 | 72.78 | 2.14 |
| Coffey Forage Seed | Exp2017 | SxS | 1.29 | 5.42 | 76.06 | 1.00 | 3.83 | 73.37 | 2.28 |
| Coffey Forage Seed | Exp2017 DW | SxS | 1.07 | 4.59 | 77.27 | 1.22 | 4.90 | 74.64 | 2.29 |
| Coffey Forage Seed | Exp3017 | SxS | 1.77 | 7.30 | 75.53 | 1.63 | 6.76 | 75.72 | 3.40 |
| Coffey Forage Seed | FSG6810 | FS | 1.25 | 5.80 | 78.66 | 0.82 | 3.24 | 75.32 | 2.07 |
| Eastern Colorado Seeds | HP1010 MS BMR | FS | 1.45 | 5.99 | 75.92 | 1.11 | 4.14 | 73.24 | 2.56 |
| Eastern Colorado Seeds | HP200 BMR | SxS | 1.45 | 5.75 | 74.95 | 1.18 | 4.69 | 74.34 | 2.63 |
| Eastern Colorado Seeds | HP300 BMR PPS | SxS | 1.38 | 4.86 | 72.18 | 1.13 | 4.42 | 74.20 | 2.51 |
| Eastern Colorado Seeds | HP3030 DW BMR | SxS | 1.31 | 5.30 | 76.04 | 1.48 | 5.46 | 72.42 | 2.79 |
| Eastern Colorado Seeds | HP95 BMR | FS | 1.83 | 8.07 | 77.43 | 1.32 | 5.06 | 73.91 | 3.15 |
| Richardson Seeds | Pacesetter BMR | FS | 1.36 | 5.48 | 75.31 | 0.91 | 3.51 | 73.96 | 2.27 |
| Richardson Seeds | Pacesetter | SxS | 1.39 | 5.60 | 75.50 | 0.73 | 2.81 | 74.30 | 2.12 |
| Seed, Inc. | RibbonGraze | SxS | 1.48 | 5.90 | 74.69 | 0.73 | 2.85 | 74.31 | 2.22 |
| Richardson Seeds | Silo700D | FS | 1.52 | 6.33 | 75.83 | 1.35 | 4.94 | 72.04 | 2.87 |
| Sorghum Partners | Sordan Headless | SxS | 0.88 | 3.65 | 75.41 | 1.58 | 5.73 | 71.76 | 2.46 |
| Sorghum Partners | Sordan79 | SxS | 1.30 | 4.89 | 73.56 | 1.10 | 4.15 | 72.89 | 2.40 |
| Richardson Seeds | Sweeter'N Honey BMR | SxS | 1.99 | 7.34 | 72.93 | 0.84 | 3.07 | 72.61 | 2.82 |
| Richardson Seeds | Sweeter'N Honey II | SxS | 1.61 | 6.30 | 74.77 | 1.49 | 5.65 | 73.24 | 3.10 |
| Curtis and Curtis | TripleGainer | SxS | 1.34 | 5.43 | 75.60 | 0.98 | 3.67 | 71.87 | 2.32 |
| Curtis and Curtis | WonderGraze | SxS | 1.42 | 5.52 | 74.42 | 1.30 | 5.10 | 73.31 | 2.72 |
| | | Trial Mean | 1.42 | 5.74 | 75.27 | 1.13 | 4.33 | 73.51 | 2.55 |
| | | LSD | 0.65 | 2.18 | 3.51 | 0.78 | 3.07 | 3.13 | 0.94 |
| | | LSD P > | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | | CV | 32.15 | 26.61 | 3.27 | 48.10 | 49.61 | 2.98 | 25.66 |
| | | F Test | 0.3991 | 0.2347 | 0.0669 | 0.3819 | 0.4115 | 0.3665 | 0.4849 |

[1]Type: FS and SxS indicate Forage Sorghum and Sorghum x Sudangrass hybrid, respectively.

**Table 2. Nutritive value of sorghum x sudangrass and forage sorghum varieties harvested twice at Tucumcari in 2008.**

| Hybrid/Variety | Cutting 1 | | | | | | | | | Cutting 2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | CP | ADF | NDF | NDFD | Ash | TDN | $NE_l$ | RFV | RFQ | CP | ADF | NDF | NDFD | Ash | TDN | $NE_l$ | RFV | RFQ |
| | % | % | % | % | % | % | Mcal/lb | --- | --- | % | % | % | % | % | % | Mcal/lb | --- | --- |
| BundleKing BMR | 9.60 | 39.00 | 63.60 | 55.25 | 10.30 | 58.10 | 0.5924 | 86 | 101 | 8.00 | 39.0 | 59.4 | 63.0 | 10.7 | 58.1 | 0.5922 | 92 | 112 |
| Exp2017 | 10.40 | 37.60 | 61.30 | 59.00 | 11.20 | 59.70 | 0.6104 | 91 | 107 | 8.00 | 39.8 | 60.3 | 62.5 | 11.1 | 57.2 | 0.5818 | 89 | 108 |
| Exp2017 DW | 9.50 | 37.80 | 60.10 | 56.00 | 10.90 | 59.40 | 0.6074 | 92 | 105 | 7.60 | 39.9 | 60.8 | 60.5 | 10.2 | 57.1 | 0.5811 | 89 | 106 |
| Exp3017 | 10.20 | 37.90 | 60.80 | 60.00 | 11.30 | 59.30 | 0.6061 | 91 | 109 | 8.70 | 39.1 | 60.0 | 61.3 | 10.7 | 58.0 | 0.5916 | 91 | 110 |
| FSG6810 | 9.20 | 38.60 | 61.20 | 60.00 | 10.90 | 58.50 | 0.5972 | 89 | 107 | 8.00 | 38.8 | 59.2 | 60.3 | 10.8 | 58.3 | 0.5949 | 93 | 109 |
| HP1010 MS BMR | 9.60 | 38.00 | 61.80 | 56.25 | 10.10 | 59.30 | 0.6056 | 90 | 105 | 7.80 | 40.3 | 60.2 | 60.3 | 10.9 | 56.6 | 0.5758 | 89 | 105 |
| HP200 BMR | 8.90 | 39.60 | 62.30 | 55.75 | 11.10 | 57.40 | 0.5846 | 87 | 99 | 8.00 | 39.6 | 60.4 | 61.0 | 10.7 | 57.4 | 0.5845 | 90 | 107 |
| HP300 BMR PPS | 9.30 | 38.20 | 61.20 | 58.00 | 10.60 | 59.00 | 0.6028 | 90 | 106 | 7.40 | 38.8 | 59.4 | 63.5 | 10.8 | 58.3 | 0.5945 | 92 | 110 |
| HP3030 DW BMR | 9.80 | 37.90 | 62.00 | 55.25 | 10.50 | 59.40 | 0.6066 | 89 | 101 | 8.00 | 40.4 | 60.5 | 62.0 | 11.5 | 56.5 | 0.5745 | 89 | 104 |
| HP95 BMR | 10.40 | 37.40 | 61.40 | 57.50 | 10.50 | 59.90 | 0.6124 | 91 | 109 | 8.00 | 38.7 | 59.8 | 60.3 | 10.2 | 58.5 | 0.5964 | 92 | 111 |
| Pacesetter BMR | 10.00 | 38.30 | 61.30 | 57.00 | 11.50 | 58.90 | 0.6010 | 90 | 103 | 8.20 | 39.4 | 60.0 | 59.3 | 10.6 | 57.6 | 0.5874 | 90 | 107 |
| Pacesetter | 8.90 | 38.00 | 61.40 | 56.00 | 9.70 | 59.30 | 0.6053 | 90 | 106 | 7.40 | 39.9 | 60.2 | 64.5 | 11.5 | 57.1 | 0.5816 | 90 | 108 |
| RibbonGraze | 8.80 | 39.40 | 62.40 | 55.25 | 10.90 | 57.70 | 0.5877 | 87 | 98 | 8.20 | 39.7 | 60.3 | 62.0 | 11.0 | 57.2 | 0.5827 | 90 | 109 |
| Silo700D | 9.10 | 38.60 | 61.20 | 59.75 | 10.70 | 58.60 | 0.5972 | 90 | 108 | 8.40 | 39.8 | 61.0 | 59.8 | 11.4 | 57.2 | 0.5818 | 88 | 103 |
| Sordan Headless | 9.30 | 39.20 | 62.60 | 57.50 | 11.30 | 57.90 | 0.5899 | 87 | 101 | 6.40 | 41.0 | 60.9 | 60.8 | 12.6 | 55.8 | 0.5663 | 87 | 94 |
| Sordan79 | 10.00 | 38.80 | 61.90 | 60.00 | 12.80 | 58.40 | 0.5951 | 88 | 102 | 7.70 | 38.9 | 59.1 | 64.0 | 10.9 | 58.2 | 0.5934 | 93 | 112 |
| Sweeter'N Honey BMR | 10.80 | 38.4 | 62.6 | 56.0 | 10.5 | 58.8 | 0.6006 | 88 | 103 | 8.50 | 39.2 | 59.2 | 60.5 | 10.8 | 57.9 | 0.5900 | 92 | 110 |
| Sweeter'N Honey II | 11.00 | 37.9 | 61.8 | 54.8 | 10.3 | 59.5 | 0.6071 | 90 | 105 | 8.90 | 39.8 | 59.8 | 60.8 | 11.4 | 57.2 | 0.5826 | 90 | 107 |
| TripleGainer | 9.00 | 37.8 | 60.4 | 55.8 | 10.4 | 59.5 | 0.6083 | 92 | 105 | 7.10 | 40.5 | 60.8 | 60.5 | 10.7 | 56.4 | 0.5735 | 88 | 103 |
| WonderGraze | 9.30 | 39.2 | 62.4 | 56.0 | 10.7 | 58.0 | 0.5906 | 87 | 100 | 8.10 | 39.0 | 60.2 | 61.8 | 10.8 | 58.1 | 0.5928 | 91 | 109 |
| Trial Mean | 9.64 | 38.40 | 61.70 | 57.10 | 10.80 | 58.80 | 0.6004 | 89 | 104 | 7.90 | 39.6 | 60.1 | 61.5 | 11.0 | 57.4 | 0.5850 | 90 | 107 |
| LSD | 1.53 | 1.2 | 2.1 | 4.3 | 1.4 | 1.4 | 0.0156 | 4 | 8 | 1.48 | 1.9 | 1.6 | 4.7 | 2.4 | 2.2 | 0.0247 | 4 | 10 |
| LSD P > | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| CV | 11.08 | 2.24 | 2.37 | 5.27 | 9.30 | 1.67 | 1.82 | 3.35 | 5.47 | 13.14 | 3.44 | 1.87 | 5.38 | 15.57 | 2.70 | 2.95 | 3.27 | 6.34 |
| F Test | 0.1847 | 0.0170 | 0.2428 | 0.2528 | 0.4600 | 0.0159 | 0.0154 | 0.1845 | 0.0820 | 0.4822 | 0.4168 | 0.1498 | 0.6814 | 0.9806 | 0.4150 | 0.4157 | 0.1794 | 0.0852 |

CP, ADF, NDF, NDFD, TDN, NEL, RFV, and RFQ signify crude protein, acid detergent fiber, neutral detergent fiber, neutral detergent fiber digestibility, total digestible nutrients, net energy for lactation, relative feed quality, and relative forage quality, respectively.

# Evaluation of Lorsban for Reducing Bird Damage to Grain Sorghum When Applied for Grasshopper Control

**Investigator(s):**

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**Objective(s):**

Evaluate Lorsban insecticide as an option to reduce bird damage to grain sorghum to address a question posed by the Advisory Committee of the Agricultural Science Center at Tucumcari.

**Method(s):**

This test, a repeat of a similar study in 2007, was planted into a conventionally tilled seedbed formed into beds on 36-inch centers for furrow irrigation. Fertilizer (100 lb/ac N) and Aatrex (2.5 lb/ac) were applied pre-planting and incorporated. Plots were planted May 22 with NC+ variety 7B51, using a John Deere flex-planter at a seeding rate of 8 lb/ac with one planted row in the center of each bed. Individual plots were 15 x 12 ft, of which the center two rows were to be harvested. There was a 5-ft skip between plots. Bird control treatments included (1) untreated control, (2) 1 pt/ac Lorsban applied on August 27 and September 25, and (3) plots protected by bird netting that draped nearly to the ground around the plot. Irrigations of approximately 6 inches each were applied May 23 and July 27. Clarity (0.5 pt/ac) was applied on July 16. Border areas surrounding the test at least 12 feet wide were treated as occasionally with a blood meal solution to reduce predation by deer.

Immediately prior to harvesting, rows to be harvested were rated for pest (deer and birds) damage, and unfilled grain, as a combined percentage of head-fill, and stand percentage. The center two rows were hand harvested and threshed with an Allis-Chalmers Model 66 All Crop B series harvester on November 19. Combine-run grain weights were recorded and an aliquot was measured for volume and weighed to determine test weight (lb/bu). The aliquot was then dried for 72 hours at 65ºC and reweighed to calculate % moisture. Grain yields (lb/ac) were adjusted to 14% moisture.
Head-fill, test weight, and adjusted grain yield data were analyzed using SAS PROC MIXED procedures to determine where differences among treatments existed. When the F-test was significant ($P < 0.15$, due to the nature of the data), means were separated by protected least significant difference. An alpha level of $P \leq 0.05$ was required to show differences.

**Results and Discussion:**

Results of statistical analysis are presented in Table 1. Due to sporadic stands and obvious deer predation that likely occurred overnight between removal of the netting and harvest, plots with <60% stand or <70% head-fill were deleted from the analysis. Still yields were considerably lower than in 2007, even in the netted plots, which likely reduced the possibility of detecting differences. This study will be repeated in 2009 and possibly 2010 to include a sprayed, netted treatment.

**Table 1. Effects of selected bird damage prevention techniques on grain sorghum yield and other variables.**

| Treatment | Head fill, % | Test wt., lb/bu | Grain yield, lb/ac |
|---|---|---|---|
| Control | 81 | 59 | 810 |
| Lorsban | 85 | 60 | 1371 |
| Netted | 88 | 60 | 1267 |

# Bindweed Mite Research and Educational Projects and Distributions in New Mexico and Elsewhere

**Investigator(s):**

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[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]New Mexico State University, Extension Plant Sciences Department, Las Cruces, NM 88003

**Objective(s):**

The purpose of this project is to educate agricultural and non-agricultural sectors about using the *Aceria malherbae* gall mite for control of field bindweed (*Convolvulus arvensis*) and to distribute it throughout New Mexico. Work continues to determine the limits of the mite's adaptation in semiarid environments and management schemes to enhance bindweed control through a combination of biological, chemical and cultural practices.

**Research projects**

A project is in the planning stages to evaluate the interaction between selected herbicides and the mite on weed control and the effects on the mites in collaboration with Jamshid Ashigh, NMSU Extension Weed Specialist.

Results from a previous research project off-station were published as a journal article:

Marsalis, M.A., L.M. Lauriault, S.T. Jones, and M.J. Renz. 2008. Managing field bindweed in sorghum-wheat-fallow rotations. Online. Crop Management doi: 10.1094/CM-2008-0818-01-RS.

**Distribution**

In 2008, 18 individuals from throughout New Mexico contacted the Agricultural Science Center inquiring about the mites. Many were referred to providers in closer proximity; but, mites were delivered from the Agricultural Science Center to 8 of those.

A more general permit to import mites into Arizona was applied for and acquired. Mites were shipped to Native Seeds in Patagonia, AZ in early May. Other out-of-state inquiries about the mite came from Colorado (3), Utah (1), and Montana (1). The requests from Colorado and Utah were referred to the Colorado Department of Agriculture and USDA-APHIS in those states, respectively.

# The Eastern New Mexico Outdoor Arboretum

**Investigator(s):**

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[1]New Mexico State University, Agricultural Science Center at Tucumcari, NM 88401
[2]Owner/operator of Bruce's New Life Tree Farm and trained forester, Tucumcari, NM 88401

**Objective(s):**

To replace trees at the New Mexico State University Agricultural Science Center at Tucumcari that have died during recent drought; to evaluate new species, in anticipation of demonstrating greater variety in the number of tree and shrub species shown to be adapted to eastern New Mexico for windbreak, ornamental, and farmstead plantings; to develop an arboretum as an educational exhibit for 4-H, FFA and other groups; and to encourage public use of the arboretum for aesthetic pleasure.

**Funding:**

Continued activity related to this project in 2008 was largely funded by the initial grant of $10,242 by the New Mexico Soil and Water Conservation Commission. Those funds were expended in 2008. New funding may be sought in 2009.

**Changes in 2008:**

Development of the irrigation system and initial plantings are described in The 2007 Annual Report of the Agricultural Science Center at Tucumcari along with a copy of the brochure.

The irrigation system was expanded in 2008 to include existing lilac and honeysuckle bushes that had been planted as part of the USDA lilac-honeysuckle phenological study to estimate the onset of spring that were already part of the arboretum and to plant another tree across the driveway from the superintendent's residence.

New plantings in 2008 included a boxelder across the driveway from the superintendent's residence. A large specimen was chosen to challenge the bur oak that had been planted in 2007. Also planted was a crape myrtle south of the office and a chestnut oak west of the pecan in the arboretum, southwest of the office. The crape myrtle perished due to transplant shock. It was replaced with a wavy leaf oak, which has a shrubby growth habit similar to other specimens in the lawn south of the office. A new crape myrtle will be planted in a more protected area. The silky dogwood was moved from the north lab yard to the shrub area south of the office because it had that growth habit. It was replaced in the north lab yard with a chinquapin oak.

During winter 2007-2008, the valve for one irrigation zone had stuck open, which led to overwatering and the demise of the eastern redbud specimen. No other trees in that zone were adversely affected. This tree was replaced late in 2008. In another incident during spring 2008, the irrigation controller was likely struck by lightning and ceased to function leading to the death of the flowering dogwood and one of the yews that had previously suffered from drought. Both of these specimens will be replaced when

replacements are found. It is anticipated that additional trees and shrubs will be planted as specimen species are selected and acquired, based on availability of funds.

**Other activities in 2008:**

An update about the arboretum was presented to the New Mexico Soil and Water Conservation Commission at their quarterly meeting in Tucumcari on March 26. Copies of the brochure were distributed and appreciation was expressed for their funding support. They also expressed appreciation for the project.

University Communications prepared a press release regarding the arboretum that was made public on September 3.

There were three guided tours in 2008 and one unguided tour. On October 17 Garden Clubs, Inc., District 3 were led on a guided tour as part of their semi-annual meeting. The Neighborhood 55 Girl Scout Daisy and Brownie Troop took a guided tour on October 24. And on October 29, the New Mexico Area Conservation Districts included a guided tour as part of their annual meeting. Several of their attendees who could not participate in the guided tour took an unguided, but partially observed tour on October 30. Feedback from that group indicated that unguided tours were definitely feasible with no difficulty following the map in the brochure. The only suggestion for improvement given was to indicate which species were native. That will be done the next time the brochure is updated, which should be during winter 200-2009.

# Variation in Precipitation During the Growing Season at the Agricultural Science Center at Tucumcari

**Investigators**

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**Objective(s):**

To evaluate variation in precipitation at multiple locations at the Agricultural Science Center at Tucumcari.

**Method(s):**

Precipitation was measured at three locations distributed throughout the Agricultural Science Center property (Figure 1). Location 1 was the National Weather Service station. Location 2 was just east of the northern plot area, where most of the small plot research has been conducted and Location 3 was at the western end of that plot area. Precipitation was collected and measured using 8-inch US Weather Bureau Non-Recording Rain and Snow Gages.

Precipitation events were measured daily at approximately 8 am at Location 1. At the other locations it was measured Monday through Friday at approximately 8 am or as soon after precipitation had ended and roads were passable. It was always measured at approximately 8 am on Monday. Consequently, weekly total precipitation for each location was tallied as of Monday morning. Data were collected from April 1until October 27.

Weekly and season total precipitation data from each location were averaged and a standard deviation was generated to illustrate variation between the locations and differences in variation across locations within weeks and for the season total. The standard deviation also was divided by the weekly or total average and converted to a percent (100*standard deviation/mean, percentage of variation) as a method to comparing standard deviations associated with low or high precipitation weeks.

**Results and Discussion:**

Weekly and season total precipitation for April through October 2008 and their statistics (mean and standard deviation) are presented in Table 1. Weekly total precipitation ranged from 0.00 inches across all locations for several weeks to 3.11 inches at location 1 during the week preceding August 18. As in 2007, precipitation gradients were not consistent within weeks or for the growing season total (Figure 1, Table 1). Excluding weeks with no precipitation, weekly variation between locations ranged from 0.000 inches to 0.645 inches.

The percentage of variation (100*standard deviation/mean) continues to be equal for season mean weekly precipitation and for season total precipitation indicating the value of using this statistic to compare the standard deviations of large and small means (Table 1). The standard deviation as a percent of the mean for specific weeks ranged from 4 to 173%, the latter value being due to a light event at location 1 that was not measurable elsewhere (Table 1).


Figure 1. Locations of precipitation gages at the Agricultural Science Center at Tucumcari in 2006 (1 inch = ~¼ mile).

Table 1. Precipitation (inches) at three locations at the Agricultural Science Center at Tucumcari from April through October 2008 and associated statistics[1].

| | | Location | | | | | Std. Dev/Mean |
|---|---|---|---|---|---|---|---|
| Year | Date Week Ended | 1 | 2 | 3 | Mean | Std. Dev. | % |
| 2008 | 7-Apr | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 14-Apr | 0.36 | 0.40 | 0.36 | 0.37 | 0.023 | 6 |
| 2008 | 21-Apr | 0.30 | 0.33 | 0.34 | 0.32 | 0.021 | 6 |
| 2008 | 28-Apr | 0.03 | 0.05 | 0.04 | 0.04 | 0.010 | 25 |
| 2008 | 5-May | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 12-May | 0.47 | 0.42 | 0.38 | 0.42 | 0.045 | 11 |
| 2008 | 19-May | 0.77 | 0.70 | 0.69 | 0.72 | 0.044 | 6 |
| 2008 | 26-May | 0.40 | 0.27 | 0.25 | 0.31 | 0.079 | 26 |
| 2008 | 2-Jun | 0.83 | 1.47 | 2.12 | 1.47 | 0.645 | 44 |
| 2008 | 9-Jun | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 16-Jun | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 23-Jun | 0.35 | 0.29 | 0.28 | 0.31 | 0.038 | 12 |
| 2008 | 30-Jun | 1.69 | 1.73 | 1.89 | 1.77 | 0.106 | 6 |
| 2008 | 7-Jul | 0.28 | 0.18 | 0.32 | 0.26 | 0.072 | 28 |
| 2008 | 14-Jul | 4.14 | 3.81 | 4.27 | 4.07 | 0.237 | 6 |
| 2008 | 21-Jul | 1.09 | 1.63 | 1.75 | 1.49 | 0.352 | 24 |
| 2008 | 28-Jul | 0.01 | 0.00 | 0.00 | 0.00 | 0.006 | 173 |
| 2008 | 4-Aug | 0.14 | 0.13 | 0.16 | 0.14 | 0.015 | 11 |
| 2008 | 11-Aug | 0.38 | 0.31 | 0.17 | 0.29 | 0.107 | 37 |
| 2008 | 18-Aug | 3.11 | 2.44 | 2.55 | 2.70 | 0.359 | 13 |
| 2008 | 25-Aug | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 1-Sep | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 8-Sep | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 15-Sep | 0.18 | 0.15 | 0.15 | 0.16 | 0.017 | 11 |
| 2008 | 22-Sep | 0.40 | 0.30 | 0.27 | 0.32 | 0.068 | 21 |
| 2008 | 29-Sep | 0.00 | 0.00 | 0.00 | . | . | . |
| 2008 | 6-Oct | 0.18 | 0.20 | 0.20 | 0.19 | 0.012 | 6 |
| 2008 | 13-Oct | 1.06 | 0.80 | 0.70 | 0.85 | 0.186 | 22 |
| 2008 | 20-Oct | 0.21 | 0.17 | 0.31 | 0.23 | 0.072 | 31 |
| 2008 | 27-Oct | 0.62 | 0.58 | 0.52 | 0.57 | 0.050 | 9 |
| 2008 | Average | 0.57 | 0.55 | 0.59 | 0.57 | 0.023 | 4 |
| 2008 | Total | 17.00 | 16.36 | 17.72 | 17.03 | 0.680 | 4 |

[1]Mean, Std. Dev., and Std. Dev./Mean signify the average, standard deviation (a measure of variation between components of the mean), and the Std. Dev. divided by the mean expressed as a percent (percentage of variation) as a method of comparing standard deviations derived within weeks.

Locations 1, 2, and 3 are located at the National Weather Service weather station, just to the east of the northern plot area, and at the western edge of the northern plot area, respectively (Figure 1).