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Report–National Peanut Board

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Title: Impact of Temperature on the Growth, Production, and Quality of Peanuts.

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Problem and Need: The northwest Texas peanut growing region experiences generally cooler temperatures than do other U.S. growing areas, although rivaled by Oklahoma and the Virginia-North Carolina region. Our unusual temperatures are a result of both altitude and latitude. Elevation for the region ranges from 2,000 to 4,000 feet with latitude ranging from 32°45' to just over 34°. In comparison, the elevation at Pearsall in the South Texas peanut growing region is 650 feet at latitude of 25°. Heat unit accumulation averaged over several years during the May 15 to October 15 growing season is 3,200 in western Gaines County, compared to 4,500 or more in South Texas. There are both advantages and disadvantages to our cooler climate. We tend to focus on disadvantages, because the vast majority of U.S. peanuts are grown under markedly warmer conditions. Cooler temperatures in the spring slow germination, emergence, and early season growth. Cooler temperatures in the fall may slow maturation or cause freeze damage in the worst case. Cool temperatures are an advantage when they prevent the development of aflatoxin, when they reduce dark respiration that uses up carbohydrates fixed during the daytime hours, or when they slow the progression through phenological stages allowing time for accumulation of nutrients to be deposited in the peanut seed. Despite our overall cooler climate, the region's high altitude and clear skies produce significantly warm daytime temperatures and radiant heating during the summer and extremely hot daytime temperatures during some growing seasons.

Some of our past research has been related to temperature. We have compared peanut heat unit accumulation patterns at several sites in northwest Texas and observed variation from 87% to 110% of the base value from western Gaines County. Spanish and Valencia peanuts generally performed well, but runner peanuts were sometimes less mature than we would have preferred at the coldest sites. A comparison of daily minimum and maximum temperatures arranged by days after planting has allowed us a degree of comparison between excellent and less productive crop seasons. Warmer early season temperatures have generally been associated with larger plant size, while the most recent season (1996) with the highest yields combined warm early season with moderate temperatures during pod filling period of July through mid-September.

We have observed regional effects on fatty acid profiles of seed storage fat that were probably related to temperature during seed development. When average oleic/linoleic acid (O/L) ratios for nine germplasm lines were compared, we found that the Brazos County O/L ratios were 90% and Gaines County O/L ratios were 68% of those from Frio County-grown peanuts.

We have also observed differences in germination at cold temperatures that were related to storage fat chemistry. High oleic peanut breeding lines tested by Brett Jungman for his Master of Science research germinated more slowly under cool temperatures than did those of middle or low O/L ratios. Discrepancies from the trend of less germination-cold-tolerance as O/L ratios increased from low to high were related to the ratio of unsaturated/saturated fatty acids. This type of information would be useful in selection of breeding lines for cooler growing regions and for recommendations of seeding rates and planting times specific to planting time-soil temperature combinations.

Peanut seed vigor relationships using germination data and radical length measurements at 72 hours after imbibition have been used as a vigor index by Dr. Darold Ketring, USDA-ARS, Stillwater, OK (retired). Some commercial peanut seed companies use cool-temperature germination tests as a means of rating seed quality. In cottonseed, a combination of germination data at both high and low temperatures has been used in a seed vigor index.

Although we have made valuable observations on temperature effects on peanut growth, development, and production in the field, our progress had been hampered by not having access to growth chambers that would allow testing under controlled temperature conditions. Now that the controlled-temperature chamber has been installed, we are able to expand experimentation on the effects of cool temperatures on early plant growth, as well as other temperature effects. Particular emphasis is being placed on germination, emergence, and early vegetative growth.

Observations during the 2001 growing season led us to widen our focus to study varietal interactions with warm temperatures as well as cool temperatures; we began to suspect that changes in variety played an important role in response to irrigation application method observed in the 2000-2001 seasons compared to the 1995-1999 seasons. Temperature and relative humidity measurements in the peanut plant canopy should help us quantify conditions associated with these varietal interactions, if they are indeed important. These measurements should also help in determining climatic effects on peanut flavor and quality in the West Texas growing region.

Progress to date: Our focus during much of the last year was on measurement of temperatures and related conditions in the field at Western Peanut Growers Research Farm (WPGRF) near Denver City, Texas. In an attempt to understand varietal interactions with moisture and temperature conditions, we grew FlavorRunner 58 (the dominant variety in West Texas in 2000-2001), Tamrun 96, and Florunner peanuts under six irrigation schemes at WPGRF and under two irrigation schemes at the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) near Lamesa, Texas. At WPGRF, these schemes included three irrigation strategies after stand establishment: (1) Low-Energy Precision Application (LEPA), using drag tubes and socks; (2) Low Elevation Spray Application (LESA) using two applicator types--low drift spray and wobbler-type nozzles; and (3) LEPA-LESA-LEPA, in which LEPA was used until early-July, LESA (low drift spray) was used during the bulk of the pod-development period, and LEPA resumed late in the season if leaf damage previously associated with long-term LESA developed. In all methods, irrigation amounts were applied to approximate 75% ET replacement, with additional 50% and 100% ET levels using LEPA. At AG-CARES, we used only LEPA and LEPA-LESA-LEPA at one irrigation rate.

While I will not belabor the points in this report, because detailed irrigation results will be presented in another report by Dana Porter and Mike Schubert, Table 1 shows yield and grade responses to some of the irrigation treatments at WPGRF. While there was not effect of irrigation method on grade, there is a trend toward Florunner reacting more positively toward LEPA irrigation than FlavorRunner 458 and Tamrun 96.

Table 1. Mean harvested yields from Peanut Yield Mapping System data and Grades, WPGRF 2002.

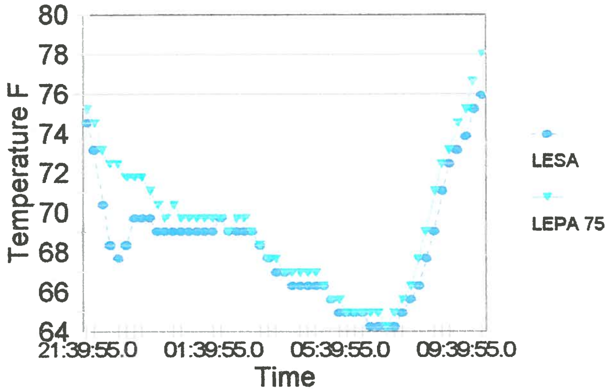
Irrigation Method	**LESA**	**Wobbler**	**LEPA**	**LEPA-LESA- LEPA**
PYMS Yield (lb/ac)				
Florunner	4,271 b	3,996 a	4,547 b	4,397 b
Tamrun 96	4,131 a	4,181 a	4,214 a	4,569 b
FlavorRunner 458	4,057 a	4,298 b	4,255 b	4,319 b
Grade				
Florunner	78.7 a	79.5 a	79.5 a	78.7 a
Tamrun 96	78.4 a	79.2 a	77.2 a	78.2 a
FlavorRunner 458	79.5 a	79.7 a	78.9 a	79.1 a

** Note: values in each row followed by the same letter are not significantly different at 0.05 probability.*

To determine differences in the effect of irrigation practices on the microclimate around the peanut plants, we set up temperature-relative humidity sensors in the canopies of several of the irrigation treatments. Because the three varieties studied were all runner peanuts with similar morphology and because the equipment is too expensive to purchase three times the number, we measured only in the FlavorRunner 458 in LESA, LEPA-LESA-LEPA, LEPA 75% ET, and LEPA 50% ET. We also had a recording rain gauge positioned near the LEPA temperature/RH sensors; data from this instrument allowed us to pinpoint when the irrigation system reached this point in the field so we could find the canopy temperature/RH data that corresponds to the hours following the irrigation. The graphs below illustrate the temperatures in the canopies following late night, mid-day, and early morning irrigation by LESA and LEPA 75. The LESA irrigation reduced the temperature in the plant canopy for a few hours following water application compared to the LEPA application of the same quantity of water at the nozzle or drag hose.

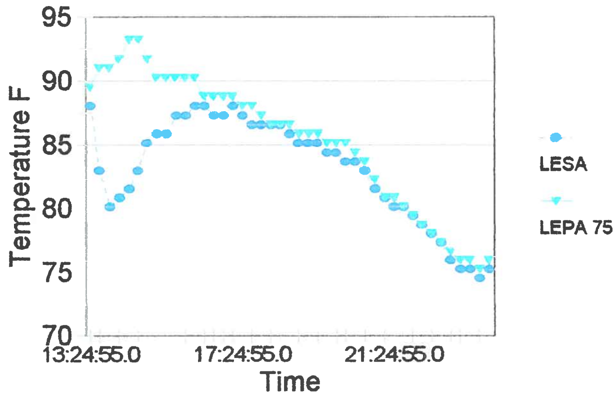
Temperature In Canopy

July 21, 2002 11:40 p.m.



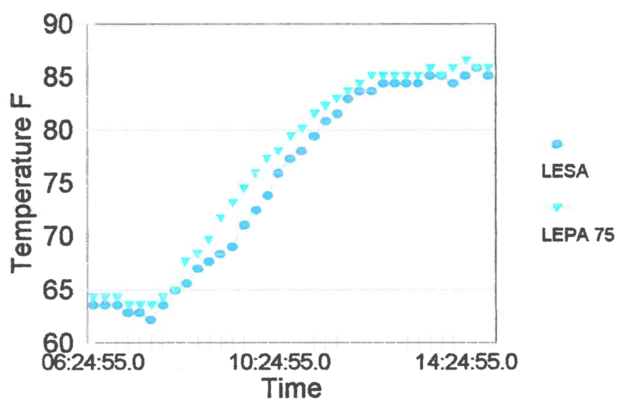
Temperature In Canopy

July 31, 2002 1:24 p.m.



Temperature In Canopy

August 4, 2002 6:24 a.m.



We have much more temperature and relative humidity data, as well as weekly plant mapping data for all variety/irrigation method combinations at WPGRF and AG-CARES. Although the National Peanut Board decided to not extend this grant, we will seek support from other sources to continue this important work.

We have resumed testing germination response to temperature in the growth chamber using peanut cultivars and breeding lines with a range of O/L values this winter. We are also comparing samples of several peanut cultivars and breeding lines that vary in O/L values because of whether each was grown in South Texas or West Texas. At this time, it appears that higher O/L values, whether inherent or induced by the climate in which the peanut seed were grown, are often associated with some reduction in ability to germinate as quickly under cool conditions that simulate soil temperatures of 60 F. Likewise, we will seek support from other sources to continue this critical research.