400
VA-50
1211
2013

Report to Project 449000

Project Title: "Comparison of Virginia and Runner-Type Peanut Cultivars for Yield Potential and Grading Factors under Optimum and Limited Irrigation"

Funding Year: 1/1/2013-12/31/2013

Principal Investigators:
Dr. Maria Balota, Assistant Professor (mbalota@vt.edu)
Daljit Singh, Graduate Research Assistant (singhdj@vt.edu)
Jacqueline Hawkins, Graduate Research Assistant

Cooperating Personnel: Doug Redd, Frank Bryant

Total Funds Requested: $6,600

Locations:
Tidewater Agric. Res. & Ext. Ctr., 6321 Holland Rd., Suffolk, VA

Project Summary: Water deficit, i.e., rainfall amounts and distribution, is the most common abiotic stress that limits peanut (*Arachis hypogea* L.) production in Virginia-Carolina (VC) region. Severe drought events are not common in the VC region, but even in good "rainy" years short drought episodes may have negative effects on peanut yield and quality. Indeed, our previous results suggest that in good "rainy" years such as in 2011 yield can be 0 to 10% less in rainfed versus irrigated plots, depending on the peanut cultivar. Daljit Singh, M.S. student is now preparing his Thesis using this information. Under historically moist conditions, over 90% of the current peanut farming is rainfed in the VC area. In previous projects funded by the National Peanut Board, we attempted to improve peanut tolerance to short drought episodes by application of soil and foliar anti-stressors (AS) as a quick fix. Unfortunately, this approach does not seem practical because high amounts of AS are needed to induce tolerance in plants necessitating high costs of application. It appears that the only option to increase peanut production under rainfed cropping systems and in dry years is by using peanut cultivars more tolerant to drought. At this time, we do not know which the most draught tolerant virginia-type cultivars are.

Earlier research suggested that runners could be more drought tolerant than the virginia-type peanuts. They can germinate and grow with less soil moisture and requires less amounts of calcium than the virginias because of less foliage and smaller kernels (Pallas *et al.*, 1977; Gaines *et al.*, 1991; Zharare *et al.*, 2009); soil moisture is important for proper calcium uptake. However, most of the new available runners have big kernels, similar to the virginia-type cultivars. Therefore their drought tolerance advantage over virginia-type needs to be revisited.

Recognizing the need for research in this area, my program secured funding to build the infrastructure to allow the work. Four rain exclusion shelters that control rainfall and irrigation were constructed at Tidewater AREC in 2011 and 2012. An automated irrigation system that allows application of precise amounts of water to the plots is under the shelters. In this proposal we plan to use the rain exclusion shelters system to control soil moisture when comparing runner and virginia-type cultivars for their response to different soil moisture regimes ranging from well

watered to permanent wilting of the plants. The work will be performed by a new graduate student, Jacqueline Hawkins, as part of her M.S. program.

Objectives

Based on research from 2009 through 2012, we clearly saw that peanut yield and quality can be affected by short drought episodes early in the season even in "rainy" years such as 2011 (Table 1). We also determined that cultivars respond differently to moisture stress and some are less affected than others. The objective of this research was to identify peanut cultivars and breeding lines with tolerance to water deficit stress.

Table 1. Effect of Irrigation on CHAMPS Peanut in 2011.

Treatment	% LSK	% FM	% Fancy	% Water	% ELK	% SS	% OK	% DK	% SMK	% Total Meat	Support Price $/cwt	Yield[1] lb/A	Value $/A
Irrigated plots	0.7	1.2	88a[2]	8.7	44a	0.5	2.3	1.7	68a	72a	17.91a	4151a	744a
Rainfed plots	0.5	1.3	85b	8.8	39b	0.6	2.8	1.9	64b	70b	17.01b	3631b	618b

[1] All yields are net, adjusted to 7% standard moisture and foreign material is deducted.

[2] Means sharing the same letter(s) are not statistically different, at P=0.05 based on the Fisher's protected LSD test.

Materials and Methods

Experimental plots of four runner and eight virginia-type peanut were planted in small plots (2- 5 ft. rows on 36" centers under three rain exclusion shelters at the Tidewater AREC (Fig. 1). Each shelter received different amounts of irrigation starting at growth stage R3 (beginning pod) (65 days after planting) to mimic a well watered, intermediate, and drought water regimes. The well watered received from early July to mid-September a total of to 7 in, intermediate water 3.5 in, and drought 1.4 in. Irrigation was applied on 7/25, 8/8/, 8/19, 8/27, and 9/05 with 1.35 each time for the well watered and 0.7 for the intermediate drought regimes, and on 8/8 with 1.4 in for the severe drought regime. Plots were planted on May 17 in a randomized complete block design with three replications for each water regime.

Figure 1. Three rain exclusion shelters at the Tidewater Agricultural Research and Extension Center in Suffolk, VA, accommodating peanut irrigation research.

Physiological measurements to evaluate plant drought tolerance were made throughout growing season. At physiological maturity on Oct. 9, plots were dug and yield was determined; grading characteristics are to be determined.

Results

Drought plots showed clear signs of stress throughout the growing season (Fig. 2). Soil moisture was monitored under each rain shelter and the volumetric water content was calculated as 0.15 m^3 m^{-3} for the well water, 0.06 for intermediate drought, and 0.02 for the severe drought water regimes.

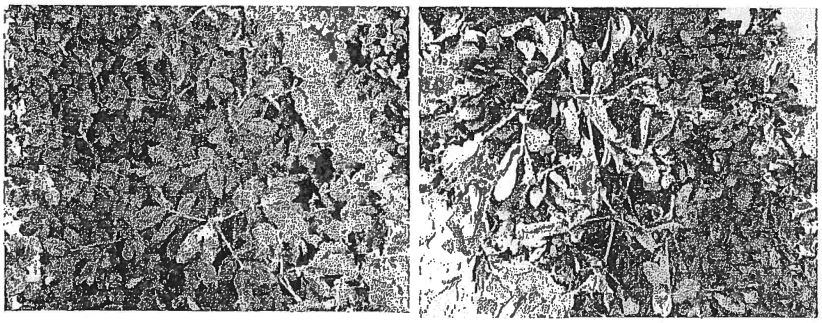

Figure 2. Peanut vines under well watered (left) and drought (right) water regimes.

Average yields of all genotypes were 5,907 lb/A under well water, 4,036 lb/A for the intermediate drought - 68% of the well watered plots – and 2,281 lb/A for the severe drought – only 39% of the well watered plots. Pod yields by genotype and water regime is presented in Table 1.

Our data showed that for each inch less water received during July 10 – Sep 15 peanut yield was reduced with 648 lb/A. Bailey, GA 09B, and Phillips were tolerant to moderate drought but not severe drought; N05006, HST06-07, and Sugg were tolerant to moderate and severe droughts; N04074FCT, Spain, and Wynne appeared to be the most drought sensitive. Variety data was in agreement with previous field and lab studies, but conformation of these results will have to be provided by further research in the next years.

Table 1. Pod yield of 12 cultivars and breeding lines under three water regimes under the rain exclusion shelters.

	2013 Pod Yields (lb/A)		
Variety	**Well-watered**	**Intermediate**	**Drought**
Bailey	7374 a[1]	5444 a	1608 cd
Sugg	5761 b-f	3841 bc	2534 a-c
Spain	5162 d-f	3445 cd	1634 cd
Phillips	6433 a-d	4585 ab	1988 b-d
SPT06-07	6146 a-e	5620 a	3107 ab
N04074FCT	4653 ef	3242 cd	2108 b-d
N05006	7125 ab	4585 ab	3529 a
HTS 02-05	4523 f	2909 cd	2738 a-c
GA 09B	5569 c-f	4960 a	2633 a-c
N08081ol (Wynne)	5954 a-f	2774 d	952 d
No8082ol	5376 c-f	3201 cd	2035 b-d
Florida 07	6812 a-c	3825 b-d	2503 a-c
Mean	**5907**	**4036**	**2281**
LSD $_{0.05}$[2]	**1494**	**1054**	**1342**

[1] Means sharing the same letter(s) are not statistically different.
[2] Fisher's least significant difference (LSD) at P = 0.05.