Gas exchange, yield and seed quality of peanut in response to decreasing soil moisture

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- Peanut (*Arachis hypogaea* L.) is mainly grown under rainfed conditions and lack of precipitation may significantly impact yield and quality. The Virginia peanut type, predominantly grown in the Virginia-Carolina (VC) region, may require ample water and carbon for filling its large seeds. The VC region is classified as sub-humid; however, recurrent droughts during June, July, and August have often been reported.

- <u>The objective</u> was to assess how soil moisture affects carbon assimilation, yield and quality, and the level of tolerance among the currently grown cultivars, which is essential for the development of more drought tolerant peanut cultivars for this region.

- <u>Materials and methods</u> consisted in evaluation of 13 cultivars and lines in replicated 1.6 m^2 plots under 3 rainout shelters at Holland, VA, in 2013 and 2014. Soil moisture was maintained for each shelter at 0.17, 0.14, and 0.08 m^3m^{-3} water content at 30 cm depth by irrigation; representing a well-watered, moderate, and severe drought. Soil type was Eunola.
- ANOVA and Tukey HSD were used in GLM procedure of SYSTAT 12.

- Figure 1. Peanut plots exposed to well-watered (left) and severe drought (right) water regimes.

<u>Results</u> showed that carbon assimilation rate decreased linearly with the decrease of soil water (Fig. 2; Table 1). GP-NC WS 17 (tested as experimental line SPT 06-07) and line N05006 maintained higher carbon fixation rate under drought stress than others.

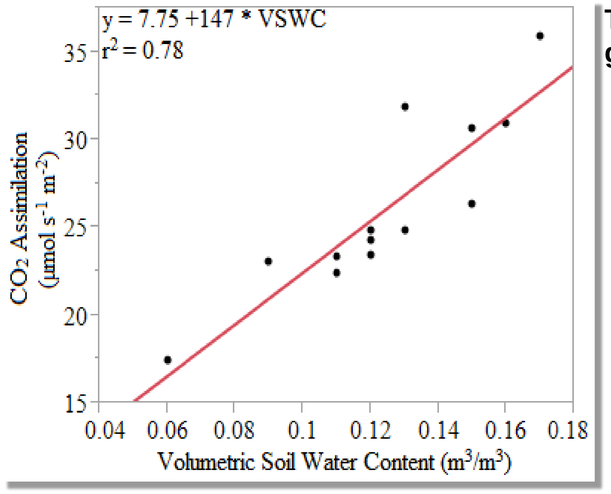

Figure 2. The rate of carbon assimilation reduction with the soil water decrease for six peanut genotypes.

Table 1. Carbon assimilation rate (µmol m^{-2} s^{-1}) of six peanut genotypes grown under three water regimes.

	2013			2014		
	Well Watered	Moderate Stress	Drought Stress	Well Watered	Moderate Stress	Drought Stress
GA 06G	-	-	-	28.0 A	27.1 A	26.5 A
N04074FCT	25.7 AB	23.1 A	19.7 BC	26.9 A	25.2 A	22.2 A
N05006	26.4 AB	19.9 B	20.5 B	26.3 A	27.0 A	26.2 A
Phillips	26.9 A	23.9 A	20.2 BC	27.1 A	26.3 A	23.1 A
GP-NC WS 17 (SPT06-07)	27.1 A	24.0 A	23.4 A	28.4 A	27.8 A	26.4 A
Wynne	23.4 A	19.4 B	17.3 C	25.2 A	26.1 A	23.5 A
Mean	**25.7 a**	**21.6 b**	**20.3 c**	**27 a**	**26.6 a**	**24.7 b**

Decreasing soil moisture reduced pod yield and color, and seed quality but magnitude varied with year and genotype (Tables 2 & 3); no G × Y under drought was noted.

Table 2. Pod yield, the extra-large kernels (ELK), sound mature kernels (SMK), damaged kernels (DK), crop value, pod color (Hunter L score), and the ratio of oleic to linoleic fatty acid (O/L ratio) averaged for 13 peanut genotypes. Drought columns show absolute values and the reduction (in red) or increase (in green) from the well-watered water regime.

Trait	Year	Well Watered	Moderate Drought		Severe Drought	
Yield kg ha^{-1}	2013	5063	3429	32%	1907	63%
	2014	6580	6062	8%	3427	48%
ELK %	2013	36	28	22%	26	28%
	2014	51	50	2%	35	32%
SMK %	2013	62	56	10%	43	31%
	2014	71	74	0%	65	8%
DK %	2013	3.5	5.0	43%	8.3	240%
	2014	0.6	1.1	83%	4.8	800%
Value $ ha^{-1}	2013	302	175	42%	68	77%
	2014	456	402	12%	173	62%
Hunter L score	2013	34	30	12%	26	24%
	2014	42	42	0%	38	10%
O/L ratio	2013	16	-	-	12	25%
	2014	11	-	-	8.7	21%

Table 3. Pod yield of eleven peanut genotypes under three water regimes averaged over two years.

	Severe Drought	Moderate Drought	Well Watered
	kg ha^{-1}		
N05006††	3892 A†	5319 A	6334 A
GP-NC WS 17	3579 AB	5629 A	5968 A
Sugg	3224 AB	4643 A	5319 A
GA06G	3114 AB	5046 A	5599 A
Florida07	3041 AB	4650 A	6509 A
NO8082ol	2682 AB	5104 A	6306 A
Phillips	2503 AB	5329 A	6533 A
N04074FCT	2242 AB	4300 A	5218 A
Bailey	1825 AB	5117 A	6357 A
Wynne	1389 B	3908 A	5457 A
Spain	1328 B	3764 A	5066 A
Mean	**2620 c**	**4801 b**	**5879 a**

† Based on Tukey HSD at $p < 0.05$.
†† Two genotypes were excluded because they were tested only in one year each, either 2013 or 2014.

GP-NC WS17 and N05006 had least yield, quality, and carbon fixation reduction when soil moisture was decreased <u>concluding</u> that mechanisms allowing for high rate of leaf carbon fixation under drought should be considered for the peanut improvement for the VC region.

VA Peanut Board, National Peanut Board, and VA Crop Improvement are kindly <u>acknowledged</u> for providing financial support for this work.

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