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annual report + 2014 Summary

NATIONAL PEANUT BOARD / SOUTHEAST PEANUT RESEARCH INITIATIVE

FINAL REPORT for WORK DONE UNDER RESEARCH AGREEMENT APPA-RIA03-PID 415 BID 1317

PROJECT PERIOD:	1 January 2014–30 June 2015
INSTITUTION:	Auburn University
PROJECT TITLE:	Effects of Drought Stress on Symbiotic Nitrogen Fixation in Peanut
RES. AGR. NO.:	APPA-RIA03-PID 415 BID 1317
PROJECT LEADER:	Drs. Yucheng Feng and Charles Chen
EXPIRATION DATE:	30 June 2015
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FINAL REPORT FOR YEAR 1:

Peanut plants form symbiotic relationships with rhizobia, resulting in the fixation atmospheric nitrogen, thus reducing or eliminating the need for nitrogen fertilization. Symbiotic nitrogen fixation is affected by the rhizobial strain involved, the genotype of the host plant, and environmental conditions. Different nitrogen fixation capabilities have been observed in different peanut cultivars. Symbiotic nitrogen fixation is known to be sensitive to soil drying, which tends to occur in sandy soils where peanut is commonly grown. In this three-year project, we will determine the effects of drought stress on nitrogen fixation in various peanut cultivars. Maximizing symbiotic nitrogen fixation during the development of high-yielding peanut cultivars is critical for obtaining high yields without the application of expensive nitrogen fertilizers in peanut production. The objective for Year 1 of the proposed three-year project was to determine the optimal growth stage for measuring nitrogen-fixing activity in peanut.

Materials and Methods

Two peanut cultivars, Tifrunner and Florida-07, were used in the experiment. These cultivars are common parents used to develop the 16 recombinant inbred line (RIL) populations in the peanut breeding community for gene discovery and marker-trait association. Plants were grown in rectangular windowsill planters filled with a mixture of top soil and potting mix. Seeds were inoculated with the peat-based HiStick N/T inoculant. Four replicate plants were sacrificed at 35, 60, 78 and 96 days after planting (DAP). The plants were separated into shoots and roots. Nodulated roots were used to determine nitrogen-fixing activities by the acetylene reduction assay. Gas samples collected from the acetylene reduction assay were analyzed using gas chromatograph (GC). After the acetylene reduction assay, the numbers of the first-order lateral roots were counted. Peanut shoots and roots were then dried at 60°C for 48 hours and weighed to determine the dry mass.

Results

Shoot and root biomass were not significantly different between the two cultivars during the study period (Table 1). Nitrogen-fixing activities as determined by the acetylene reduction assay were the highest at 96 DAP for both cultivars; no significant differences were observed between cultivars. The nodule numbers on individual plants varied greatly. By 60 DAP, Tifrunner had 760 ± 133 nodules while C76-16 had 836 ± 478 nodules. For the last two sampling days, percentages of effective nodules were estimated by observing the color inside 100 randomly selected root nodules on each plant. The proportions of effective nodules (indicated by the red/pink color) were low for both cultivars. Tifrunner had 53% effective nodules at 78 DAP and 25% at 96 DAP, while C76-16 had 10% effective nodules at 78 DAP and 36% at 96 DAP. It is possible that nitrogen fixing activity did not reach the maximum by 96 DAP. In Year 2, we plan to repeat this experiment and extend the sampling period. In addition, we will determine the effect of drought stress on symbiotic nitrogen fixation in various peanut cultivars.

Table 1. Biomass of two peanut cultivars at different stages of plant growth

Growth parameter	Cultivar	Days after planting			
		35	60	78	96
Shoot (g)	Tifrunner	3.59 ± 0.33	12.22 ± 1.64	34.06 ± 5.14	56.18 ± 19.76
	C76-16	5.27 ± 1.28	15.91 ± 7.01	32.37 ± 11.75	62.10 ± 12.15
Root (g)	Tifrunner	0.39 ± 0.14	1.63 ± 0.52	3.64 ± 1.36	4.44 ± 2.04
	C76-16	0.38 ± 0.09	2.10 ± 0.70	2.56 ± 0.72	4.84 ± 1.20
No. of 1st order lateral roots	Tifrunner	16 ± 2	24 ± 8	34 ± 6	43 ± 13
	C76-16	23 ± 2	25 ± 8	30 ± 6	44 ± 9

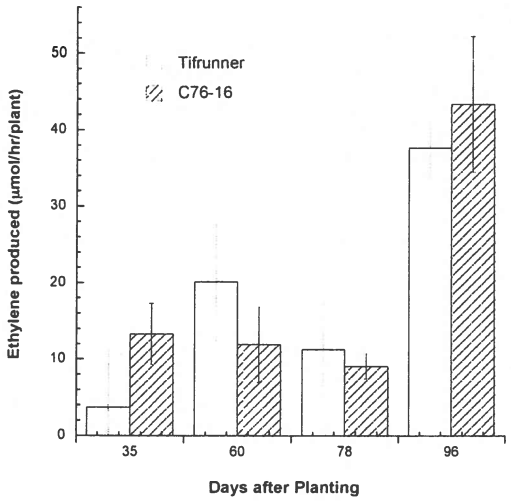

Fig. 1. Nitrogenase activity of two peanut cultivars determined by the acetylene reduction assay