Quantifying Seed Membrane Leakage and Water Potential to Predict Peanut Seed Quality and Maturity

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Introduction

- **Rationale:** The ultimate goal of seed vigor test is to provide a reliable identification of physiological potential for seed lots. Therefore, in-season physiological characteristics should be evaluated as important as assessing seed vigor early in development.
- **Hypothesis:** Germination tests have been widely used for testing seed vigor but may not always be reliable. Thus, there is a need to develop and assess additional seed tests that may indicate crop field performance more reliably. Membrane electrolyte leakage has a significant relationship with field physiological traits for corn (*Zea mays* L.) and/or soybean (*Glycine max* L.) and may be appropriate for predicting seed quality in other species as well.
- **Objectives:** The objective of this study was to examine the efficacy of a standard germination test combined with the assessments of seed membrane leakage in peanut (*Arachis hypogaea* L.) for predicting the overall field performance of seed.

Materials and Methods

Pre-planting experiment

- **Standard germination test:** 50 seeds per cultivar with 4 reps; cultivars were divided into four germination potential (GP) levels: FloRun 107 (excellent GP), TUFRun 511 and Georgia06-G (good GP), C99-R (fair GP), York and DP-1 (poor GP).

- **Water Potential (WP) and Electrical conductivity (EC) test:** 10 seeds for each cultivar with 4 reps. WP test first and followed by the EC test.

In-season experiment

- **Location:** Plant Science Research and Education Unit in Citra, FL, USA.
- **Plot layout:** randomized complete block design (RCBD) with 4 reps. Six rows per plot with 15 feet by 3 feet (length by width) per row.
- **Measures:**
  1) Daily emergence: visually counted the 3rd and 4th rows (the yield rows) from 5 to16 days after planting (DAP).
  2) Leaf area index (LAI): 10 days interval after 40 DAP (the 2nd and 3rd rows).

  3) Chlorophyll fluorescence (OJIP) : 20 days interval after 40 DAP (2 hours before sunrise; leaf on the second node position of a plant in 2nd row).

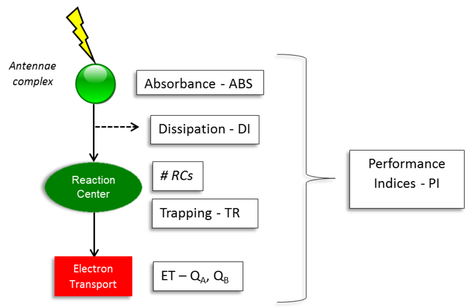

Figure 1. Simplified light reaction process

Results

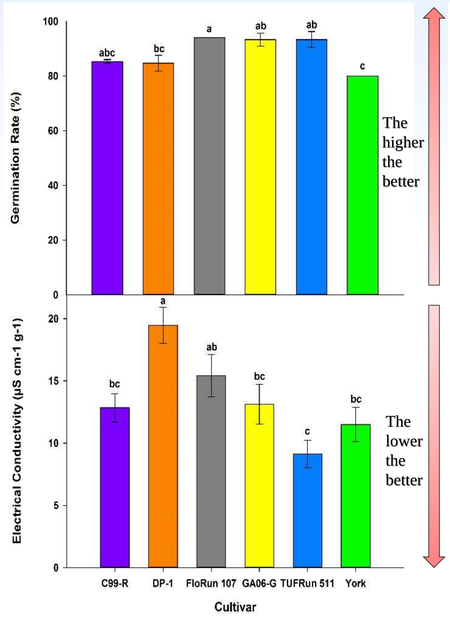

Figure 2. Results for standard germination and electrical conductivity test. Data shown as the mean ± SE, different letter in each column mean significant differences at α=0.05 level (t-test).

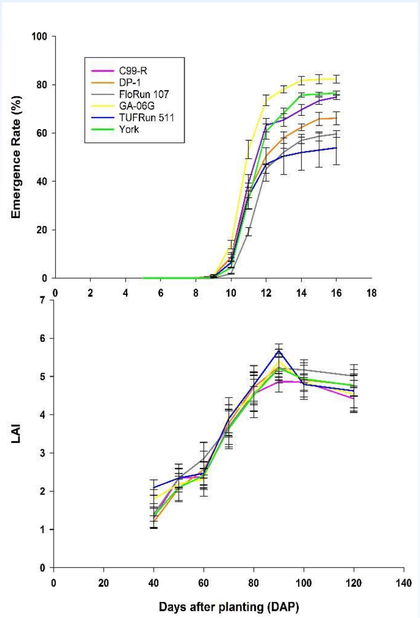

Figure 3. Results for field emergence and LAI. Data are presented as the mean ± SE.

List of OJIP Parameters:

ABS/CS – Absorbance per cross section **DIo/CS – Dissipation per cross section**

RC/CSm – Reaction centers per cross section **JOTR/CS – Trapping per cross section**

JOET2/CS – Electron transport per cross section **PITCSm – Performance Index per cross section**

Table 1. Genotypic differences of OJIP parameters of interest at 80 DAP.

Cultivar	Parameters					
	ABS/CS	DIo/CS	RC/CSm	JOTR/CS	JOET2/CS	PITCSm
C99-R	716.50 ab	125.63 a	500.89 a	590.88 ab	450.97 a	7831.86 ab
DP-1	687.00 ab	138.63 a	425.93 ab	548.38 ab	394.66 a	3822.28 b
FloRun 107	654.13 b	126.63 a	412.81 b	527.50 b	382.94 a	4030.79 b
GA06-G	696.88 ab	123.00 a	459.06 ab	573.88 ab	444.81 a	6530.16 ab
TUFRun 511	733.63 a	129.38 a	490.69 a	604.25 a	460.64 a	10489.66 a
York	684.63 ab	129.25 a	455.63 ab	555.38 ab	414.33 a	5296.43 ab

Note: different letters in each column mean significant differences at α=0.05 level (student t-test).

Discussion

- York has relatively higher seed vigor while DP-1 and FloRun 107 had lower seed vigor compared with germination (as shown in Figure 2).
- Surprisingly, TUFRun 511 has low EC, but also low emergence at 16 DAP (Figure 3). GA06-G and DP-1 had higher emergence rates than expected based on EC test.
- EC and yield (data not shown) were correlated ($p<0.01$) for C99-R; RC/CSm and yield were correlated ($P<0.05$) for TUFRun 511. No correlation was observed between water potential and any field parameters.
- No differences in LAI among cultivars (Figure 3).
- Difference were observed among cultivars for Dio/RC, JOET2/CS, PITABS, PITCSm($P< 0.1$) and PIABS ($P<0.05$) at 80 DAP. This indicates that TUFRun 511 had improved light reaction components in comparison to DP-1 and FloRun 107.
- Root data is being processed.

Conclusions

- ✓ Both seed vigor tests were not correlated to field emergence, canopy development and yield among cultivars which implies that the reliability of both tests may not be adequate for peanut.
- ✓ No close correlation was observed between field emergence and final yield in this study indicating that the effect of seed vigor on yield is not only through seedling emergence (Finch-Savage et al., 2015), and that other physiological functions, such as the light reaction of photosynthesis, should be taken into account as well .

References

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- Finch-Savage, William E., and George W. Bassel. "Seed vigour and crop establishment: extending performance beyond adaptation." Journal of experimental botany 67.3 (2015): 567-591.
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