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2011 Southeastern Peanut Research Initiative
Final Report

Title: Influence of harvest date and maturity profile on peanut seed germination and vigor

Investigators: Jason Ferrell, Univ. of Florida; jferrell@ufl.edu; 352-392-7512.

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Over the past 20 years, enhanced efforts have been made to develop peanut cultivars that are resistant to tomato spotted wilt virus, leaf spot, and other diseases. The resulting cultivars possess a striking level of resistance to these diseases while also showing excellent yield potential. Many of these cultivars were developed from PI 203396, an early peanut introduction, including C99-R, DP-1, Georgia Green, Georgia-01R, and more recently Georgia-06G). Although these cultivars share many impressive agronomic characteristics, some share the commonly reported problem of poor germination and emergence after planting, most notably DP-1, Georgia-01R, and Georgia-06G (to lesser extent). Due to this flaw, many promising cultivars have been discarded before having the opportunity to positively impact southeastern peanut production.

The reason (or reasons) for poor germination and emergence are not fully understood. Recent research has shown that these cultivars have specific storage and handling requirements. But this fact alone doesn't fully explain the field level inconsistency that is commonly observed. Calcium is known to cause poor germination and many controlled experiments have demonstrated the link between calcium deficiency and poor pod development. However, the link between soil test calcium and pod available calcium has not been demonstrated successfully, leading some to believe that calcium is not the single factor effecting germination either. Another theory is that the cultivars under question are not allowed to fully mature in the field prior to harvest. The more problematic cultivars such as DP-1 and Georgia-01R are known to be late-maturing, as much as 3 to 4 weeks later than the industry standard Georgia Green. Late plantings, poor weather, and general mis-management could lead to premature digging of these cultivars. High yields and good grades are misleading as to the actual maturity of the resulting seed of these late maturing cultivars. Lack of full maturity often does not impact baseline germination, but seedling vigor may be greatly compromised.

Pod blasting and color profiling peanut maturity has been widely accepted across the southeast to target optimum harvest timing. This process is scientifically sound and provides volumes of data with regard to peanut physiology. However, the assumption of this procedure is that all peanuts mature at the same rate and in the same way. The profile board was developed using 'Florunner' and seems to match the maturity status of mid-maturing cultivars (Georgia Green) very well. The profile board does not as accurately predict the best digging date of later-maturing cultivars due to the less determinant growth habit. This could lead seed producers to dig too early, thereby compromising seed quality.

Therefore, experiments were conducted to determine the relationship between harvest date and pod color, yield, grade, and seedling vigor.

Materials and Methods

Three peanut cultivars (Georgia-06G, York, and Georgia Green) were planted the last week of April in Gainesville, FL. All plots were managed according to standard fungicide and fertility practices and maintained weed free throughout the season. Then starting at 120 days after planting, peanuts were harvested at 7 day intervals from through 155 days. With each harvest, 5-10 plants were randomly selected for maturity profiling. Pods were blasted with a pressure washer and laid on the profile board according to color class. The traditional color board allows, and suggests, that black pods can be moved from one class to another to ensure that the slope relative to "days to digging" will be achieved. For these experiments, no pods were moved and "days to digging" was determined by the last category containing 3 or more pods. Additionally, all pods from each class were counted and a ratio of brown/black pods, relative to all pods, was determined. This was done to determine if this method, which is simpler and faster than the board methods, would be indicative to optimum yield and grade.

Each plot was harvested for yield determination and samples dried to 9% moisture. A sample was collected (approx. 3 lbs) for official grade determination. In addition, a sample of pods was collected, shelled, and approx. one lb of medium-sized seed were tested for seed quality (germination and vigor). Seed quality was determined using a vigor index model. Fifty seeds were imbibed in a shallow tray of water for 24 hours, then incubated between moist sheets of filter paper at 29C for 72 hours. The seeds were removed from the incubator and radical length was measured in mm. The various lengths were then summed and multiplied by the percent germination. The higher the vigor index, the more likely a seed will germinate and emerge in a field setting. All experiments were conducted with 6 replications to minimize inherent variability.

Results

2010

GA 06G is considered a mid-maturity cultivar, which was not necessarily validated in Table 1. Yield from 06G reached the numerical maximum yield at 148 d, however, this was not significantly greater than yields obtained at 134 d. The color profile board ranged between 12 d (at 134 d after planting) to 5 d (at 155 d after planting). No significant differences were detected for GA 06G yield or crop value, regardless of digging time. This was surprising, but a large degree of variability was observed between reps for this cultivar. We knew that variability can be problematic in peanuts, thus we employed 6 replications to mitigate these effects. Regardless, since yield did not vary with respect to digging time, it doesn't appear that the color profile board was either inhibitory or beneficial.

GaGreen, also a mid-maturity cultivar, followed a more typical pattern of yield and value with respect to digging date. The highest yields were observed at 134 d after planting, which then dropped off precipitously at 155 d. Peanuts dug at 120 or 155 d had lower yields than those dug at 134 d. But it should be noted that the profile board did not accurately predict the highest yield. At 134 d, the profile board suggested waiting an additional 9 days until digging. Additional digging times were accomplished near this prediction of 144 d, but found no statistical reduction in yield or crop value over the 134 d timing. Although the profile board did not predict the optimum digging date, it was not inhibitory to overall crop value or yield.

For both GaGreen and GA 06G, the % brown/black pods (relative to total pods) provides an interesting contrast to the profile board. Two separate individuals will often place the same set of pods in different columns as it can be difficult to agree on the degree of "blackness" on a given pod. However, agreement that a pod is brown, black, or other is easier to settle upon. For both of these cultivars, a brown/black ratio of 60-73% coincided with the highest levels of yield. It is possible that this simple technique, which is likely more reliable and rapid than the traditional profile board, is a simple and powerful alternative.

York, which is considered a late-maturity cultivar, had the greatest yield response relative to digging date. This was expected since it is the latest maturing entry in this test. The profile board predicted the proper digging date fairly well with 3 d occurring at both 148 and 155 days. Surprisingly, the brown/black ratio never reached 60%, even at the latest digging date. Considering that yield consistently increased with each week, and that this is a late cultivar, it is questioned if optimum yield was obtained with York. If additional dates were included and the brown/black ratio of >60% was achieved, it is unknown how yield would have been affected. But regardless of digging date, TSMK was surprisingly low.

One of the key questions for this project was how digging date affected seed germination and quality. It has been our hypothesis that the poor emergence characteristics from some cultivars is potentially due to early harvest dates when the peanut kernels are not totally mature. Although germination may be high, the immature kernel may not have sufficient vigor to emerge consistently. From these data, digging date did not impact seed quality (Table 3).

2011

As in 2010, Ga06G reached optimum (numerical) yield, grade, and crop value at 148 days after planting (Table 2). However, few significant differences were observed until 155 days when yield and value decreased precipitously. This was due to late-season disease infestation. Across all cultivars, an unidentified foliar disease that did not respond to the fungicide program increased in severity until 155 days when most all plots were defoliated. Based on the vine condition at this time, few conclusions can be drawn from this last harvest timing. Regardless, the profile board accurately predicted the highest yield and grade value for Ga06G.

A similar trend was observed for Ga Green. Though the maximum yield was observed at 127 days, few differences were observed between 120 and 148 days. Due to the variability of this data set, it is difficult to see a particular trend to better understand the impact of harvest timing on crop yield and total value.

York, a late-season cultivar, performed as expected with yield and crop increasing until 148 days. Again, few differences were observed in yield or crop value, but the profile board did adequately predict optimum harvest timing.

Though no statistical differences were observed in 2010, seed vigor followed a bell-curve in 2011 (Table 3). Surprisingly, optimum seed vigor occurred near 134 days for all cultivars, then declined quickly after 141 days. Our original theory for this project was that poor seedling emergence in Ga06G and York was primarily due to harvest operations occurring too early when seed were not fully mature. However, these data indicate that optimum seed quality and optimum crop value do not necessarily coincide. Across all cultivars, maximum value occurred near 148 days while peak seed quality was near 134 days. The reason for this observation is not currently evident. Since no trend in seed quality was observed in 2010 and the 2011 data do not match the current understanding of physiological maturity in peanut, additional research will be necessary to fully validate or reject these data.

Conclusions

Though the impact of harvest timing on seed quality was not evident, at least three conclusions can be drawn from these data.

1. The profile board does adequately predict optimum harvest timing of these three cultivars. Though this method was validated on a now defunct cultivar (Florunner), the color profile process is still relevant for currently grown cultivars.
2. A brown/black pod ratio of 60-70% is also an effective indicator of crop maturity. This method is much less labor intensive and provides a sound basis for a general determination of harvest timing.
3. If no objective criteria (profile board or pod color ratios) are used to determine maturity, delaying harvest is not inhibitory. If harvest timing is based on calendar days after planting, delaying harvest is better than harvesting too early. A delayed harvest may not improve lb/A yield, but a trend of increasing grade was

consistently observed.   Since yield does not decline and grade does improve, it may be more profitable to dig later than one would normally consider “optimum” for a mid-maturity cultivar.

Table 1. Relationship between peanut harvest time, projected time of harvest and peanut yield/grade for peanuts grown in 2010.

	harvest (days)	projected days until dig[a]	% brown/black	Yield[b]	TSMK	Value $/A[c]
GA06G	120	14	43	4163 a	74.7	637 a
	127	17	40	4301 a	74.5	649 a
	134	12	55	4916 a	75.7	742 a
	141	8	58	4900 a	76.3	895 a
	148	3	64	5238 a	77.5	979 a
	155	5	65	5161 a	77.7	803 a
Ga Green	120	7	51	4800 b	75.7	878 b
	127	7	60	4992 ab	76.1	769 ab
	134	9	63	5338 a	77.2	991 a
	141	4	69	5184 ab	76.2	950 ab
	148	4	73	4928 ab	77.8	927ab
	155	5	75	3648 c	76.2	437 c
York	120	10	36	3226 e	68.3	539 b
	127	14	41	3725 d	70.3	637 b
	134	8	47	4211 c	70	799 a
	141	9	49	4672 b	71.3	802 a
	148	3	55	4506 bc	71.5	783 a
	155	3	54	5466 a	69.5	914 a

[a]Projected days to harvest as determined by the color profile board.
[b]Yield values, within a particular cultivar, are not statistically different if they share a common letter. Lettering was determined using Fisher's Protected LSD (P = 0.05).
[c]Crop value as calculated by USDA metric considering a market price of $355/ton. Yield, production cost, and all grade factors were used to determine this value.

Table 2. Relationship between peanut harvest time, projected time of harvest and peanut yield/grade for peanuts grown in 2011.

	harvest (days)	projected days until dig[a]	% brown/black	Yield[b]	TSMK	Value $/A[c]
GA06G	120	11	41	4184 ab	73 b	760 bc
	127	15	51	3684 b	73.3 b	682 c
	134	11	64	4152 ab	75.6 ab	794 ab
	141	6	72	4073 ab	74.1 b	768 ab
	148	3	80	4393 a	78.8 a	865 a
	155*	6	72	2496 c	74.5 b	538 d
Ga Green	120	11	39	3239 ab	71.7 a	590 ab
	127	12	50	3561 a	73.5 a	660 a
	134	7	62	3113 ab	73.5 a	573 b
	141	4	73	2880 b	73 a	533 b
	148	3	68	3111 ab	74 a	582 ab
	155*	3	59	512 c	66.5 b	92 c
York	120	13	33	2650 a	62.8 c	426 bc
	127	14	48	2721 a	68.4 b	470 ab
	134	8	55	2564 ab	68.8 b	441 b
	141	7	68	2304 ab	68.8 b	400 bc
	148	4	64	2906 a	72.6 a	521 a
	155*	5	70	2048 b	68.5 b	362 c

[a]Projected days to harvest as determined by the color profile board.
[b]Yield values, within a particular cultivar, are not statistically different if they share a common letter. Lettering was determined using Fisher's Protected LSD (P = 0.05).

[c]Crop value as calculated by USDA metric considering a market price of $355/ton. Yield, production cost, and all grade factors were used to determine this value.
*An unidentified foliar disease greatly impacted the harvest at 155 days. Due to the plants being nearly defoliated by this point, the 155 day data should not be viewed as authoritative.

Table 3. Influence of harvest timing on seed vigor.

	harvest (days)	projected days until dig[a]	Vigor Index	
			2010	2011
GA06G	120	11	480	415 b
	127	15	616	639 a
	134	11	634	556 ab
	141	6	498	381 bc
	148	3	586	190 cd
	155	6	745	129 d
			NS	
Ga Green	120	11	769	514 b
	127	12	921	457 bc
	134	7	645	716 a
	141	4	713	719 a
	148	3	980	291 c
	155	3	1045	482 bc
			NS	
York	120	13	703	420 b
	127	14	772	606 a
	134	8	588	525 ab
	141	7	589	414ab
	148	4	784	206 c
	155	5	575	209 c
			NS	