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ARTICLE

Initial Investigation into a Peanut Shelling Characteristic Called Leathery Hull

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ABSTRACT

In 2013, peanut industry stakeholders reported that shelling plant throughput was reduced when shelling peanuts grown in a specific region of the Florida panhandle compared to peanuts grown elsewhere in their supply chains. As a result, samples were collected from suspect fields in Florida, a commercial field in southwest Georgia, and research plots from the National Peanut Research Laboratory (NPRL). Shelling tests showed that the peanuts from the Florida panhandle area shelled at an average rate of 46 kg/h compared to 91 kg/h for the research plot samples and confirmed the observation of stakeholders. Tissue analysis of the hulls also indicated that NPRL samples had much higher levels of iron (Fe) and lower levels of phosphorous (P) than those from Florida. In 2015, experiments using a 2 x 2 factorial experimental design with a high and low soil pH and high and low soil P were conducted in rainout shelters. Shelling analysis revealed no statistically significant differences in shelling rates. However, the samples from plots with low P had numerically higher shelling rates than those from the plots with high P. Results from 2014 and 2015, while somewhat inconclusive, presented enough evidence to warrant further research into the possible cause and potential for this "leathery hull" phenomenon.

INTRODUCTION

The process to deliver peanuts to the consumer has three distinct segments, all with the goal of delivering what the customer wants with the highest quality possible at the lowest cost using the most economical and environmentally sustainable means possible. The peanut grower has the role of growing and harvesting farmers' stock peanuts. Immediately after harvest, the grower delivers the farmers' stock peanuts to the peanut shellers. The shellers have the responsibility of maintaining the quality and quantity of peanuts delivered by the grower, removing the foreign material, and removing the hull or shells. After the hulls are removed, the shelled kernels are sorted by size, and damaged kernels removed by electronic color sorters. The sized and sorted kernels are packaged in 20-t lots of shelled peanuts. The goal of the shelling process is to produce the 20-t lots that meet size and quality specifications, including aflatoxin limits outlined by government regulations and manufacturer specifications in one pass through the shelling plant with no re-processing (Davidson *et al.*, 1982). The third processing segment of the peanut industry is the manufacturer who purchases the 20-t lots of shelled peanuts and turns them into products like peanut butter, candy bars, or ingredients for the consumer.

Modern shelling plants are marvels of machinery that use physical properties like density, size, and shape to process farmers' stock peanuts at flowrates up to 30-40 t per hour (tph). Most shelling plants use similar equipment to operate in the range of 30 tph (L.M. Carter, Jr., *pers. communication*, February 9, 2026). Shelling plants are extraordinarily effective

in the removal of foreign material. Foreign material is measured as percent of gross weight of the farmers' stock at intake (USDA 2019) and generally reported as no foreign material in the milled peanuts (USDA 2023). Many manufacturers specify foreign material limits in milled peanuts as a piece count.

After cleaning, the peanuts are processed through multiple stages of shelling machines to separate the kernel from inside the hull. Each sheller stage consists of a rotating open cylinder with bars on its outer perimeter that rotates inside a concaved slotted grate (Figure 1). The rotating bars pinch the inshell peanut in the space between the leading edge of the rotating bar and the edge of the slot in the grate breaking the hull. The kernels and hulls fall through the slot in the grate into a vertical airstream where the hulls are aspirated into a duct system and the peanut kernels fall onto a sizing screen. Inshell peanuts smaller than the slot in the grate will fall through the grate intact, get separated by size and density, and recirculated to a second stage sheller with a smaller slot. The process is repeated through a total of four to five stages with progressively smaller shelling grates (Davidson *et al.,* 1982). If the grate in the lead, or first stage, sheller is sized properly, 75 – 85 % of the peanuts are shelled in the first stage.

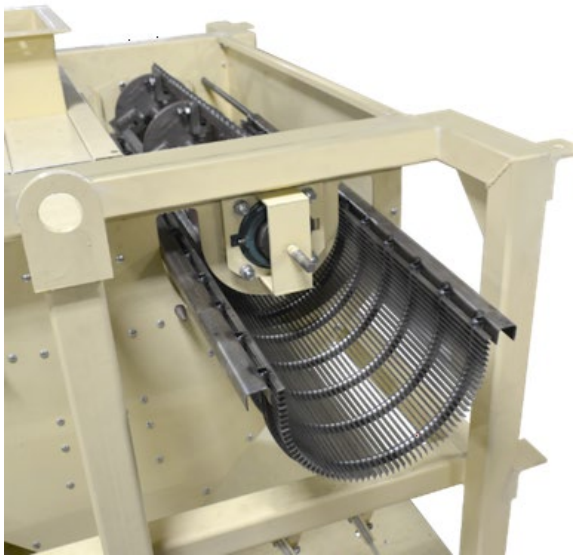

Figure 1. Cutaway of the single stage of a typical peanut sheller (image used by permission of LMC Mfg., Donalsonville, GA)

Improper selection of shelling grate sizes can lead to reduced shelling rates. If the grate size for the lead sheller is too large, fewer peanuts will be shelled causing a higher volume of peanuts going to the second stage and reduce throughput of the second stage. If the shelling grate in the lead or first stage is too small, peanuts will remain in the first stage for a longer period leading to increased split and broken kernels. A procedure for optimal grate selection is outlined in the procedures for shelling evaluations for the Uniform Peanut Performance Tests (USDA, ARS 2008).

In 2013, the authors received reports that shellers were receiving peanuts from a specific region of the Florida panhandle with a characteristic they labeled as "leathery hull" because of reduced shelling plant throughput (American Peanut Shellers Association, *personal communication*, April 2013). They stated that in addition to reduced throughput, outturns of splits increased dramatically, and the discarded hulls appeared to be much finer in particle size than those shelled from other production areas. When shelling characteristics of peanuts from different sources are significantly different, it requires that those peanuts remain segregated from peanuts from other sources to maintain maximum processing efficiency. Reduced throughput slows down the process and may impact the ability of the individual sheller to fulfill contracts for milled peanuts in a timely fashion. An increase in the amount of splits produced in the shelling process typically reduces the outturns of whole kernels requiring more total tons to be shelled to meet demand of specific whole-kernel lots. Extension personnel offered that the soils in the area where the reduced shelling throughput peanuts were grown were known to have a lower pH and a higher natural level of phosphorus (P). There was also a prevalence of the nematode-tolerant cultivar, Tifguard (Holbrook, *et al.,* 2008), grown in the area due to the presence of nematodes.

The objective of this research was twofold. The first objective was to determine the magnitude of the shelling rate reduction due to "leathery hull". The second objective was to determine the agronomic conditions and peanut hull chemistry that results in "leathery hull.".

MATERIALS AND METHODS

2014 Field Grown Peanuts

Sample Collection.

Reports of reduced shelling rates and excessive breakage during shelling were reported by shellers, from peanuts grown in two locations, one in the Florida panhandle and a commercial field near Plains, Georgia. To determine the validity of the claims of reduced shelling rates for peanut grown in the Florida region, ten (10) producer peanut fields were selected in 2014 within a 20-km radius of Jasper, FL (30° 29' 21.49" N, 83° 6' 22.22" W). Three soil samples were collected from each field after peanuts had been planted and emerged. Each sample was retrieved using a 15-cm probe to collect approximately 100 cm^3 from multiple locations in the field. The soil was mixed then placed in the soil sample bag. Basic soil chemistry including pH, phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), and manganese (Mn) was analyzed (Univ. of Georgia, Soil, Plant, and Water Laboratory, Athens, GA).

Exact planting dates were not provided by growers for the Florida fields but were estimated to be between April 10 and May 01, 2014. Cultivars planted were provided for only two of the ten Florida fields. One was planted to Georgia-06G (Branch 2007) and the other was Tifguard (Holbrook *et al.*, 2008), while the others were unknown. The field identified near Plains, Georgia was confirmed to have been planted to Tifguard. Peanuts (Georgia-06G and Georgia-09B) grown at the National Peanut Research Laboratory research farm located in Shellman, Georgia were considered to be the control. Peanuts were grown and harvested according to conventional practice.

Peanuts were marketed and graded according to normal practice.

Nine samples from five of the ten previously-selected Florida fields, seven samples from the single commercial Georgia field, and six samples from the NPRL research plots as the control were obtained. The cultivar of the samples collected from the Florida farms could not be verified. The Georgia field samples were verified as Tifguard by the grower. Three of the NPRL samples were Georgia-06G and three were Georgia09B (Branch 2010). NPRL samples were collected while harvesting excess from research plots produced by the National Peanut Research Laboratory near Dawson, GA (31° 43' 58.15" N, 84° 23' 43.19" W).

Sample Analysis.

Samples were shelled following the procedure outlined for evaluating peanut samples in the Uniform Peanut Performance Tests (USDA, ARS 2017). Samples were cleaned separating loose shelled kernels (LSK) and foreign material (FM) from the cleaned, inshell pods.

Samples were shelled using a small-scale rotary sheller described by Davidson, *et al.* (1981) designed to closely mimic the commercial shelling process when shelling small samples. Each sample was shelled using three stages with successively smaller slots in the shelling grates. The slot width for first stage shelling grate for each sample was determined by hand-shelling 200 g of the largest of pods from the pod diameter distribution determination. The kernels from the largest pods were then sized over a series of slotted screens. The first stage shelling grate size was the width of the screen slot that the largest kernels would ride on the screen plus .08 mm (2/64 inch). The second stage was 1.2 mm (3/64 inch) smaller than the first stage grate. The grate in the third and final stage had a 6.4 mm (16/64 inch) slot. For instance, if the largest kernel rode a screen with a 10.3-mm (26/64-in) width slot, the width of the 1st, 2nd, and 3rd-stage shelling grates would be 11.1-mm (28/64), 9.9-mm (25/64-in), 6.4-mm (16/64-in), respectively.

The weight of the peanut pods remaining after taking the 200-g sizing subsample was recorded and placed in the hopper of the sheller feeding the first stage. The sheller motor was started and allowed to reach full speed before opening the gate allowing the peanuts to enter the shelling chamber. The time required for all peanuts to pass through the first stage was recorded. The unshelled peanuts were hand-sorted from the material that passed through the first stage and weighed. The unshelled peanuts were then fed into the second sheller stage and the time required for the peanuts to pass through the sheller was recorded. The unshelled peanuts from the second stage were hand-sorted from the shelled peanuts, weighed, and then processed through the third stage. The shelling time for the third stage was not recorded because the volume of unshelled peanuts was less than 10% of the original sample and did not adequately fill the sheller for a valid time.

The shelling rate was calculated for both the first and second stages of shelling by dividing the initial mass of peanuts (kg) placed in the sheller stage hopper by the time (h) required for the material to completely pass through the sheller stage. Overall shelling rate was calculated by dividing the initial weight of the sample by the total time required for the sample to pass through both sheller stages.

Subsamples of hulls (200 g) and kernels (500 g) were collected from each shelling sample for elemental analysis.

2015 Rainout Shelter Grown Peanuts

Preliminary analysis of the 2014 samples indicated that the Florida soils had a lower pH and higher P content than the NPRL soils and that the shelling rates for the two origins were different. Based on these preliminary observations, research was initiated using two of the rainout shelters at the USDA-ARS National Peanut Research Laboratory in Dawson, GA to replicate the phenomenon. The rainout shelters have been described in previous publications (Blankenship *et al.*, 1980, Blankenship *et al.*, 1983). Since the rainout shelters are used continuously to grow peanuts for research, it is customary for researchers to periodically remove and replace the top 46-cm of soil in the shelters. In the spring of 2015, the top 46 cm of soil were removed from the two rainout shelters and replaced with top soil (Troup Series, Loamy, kaolinitic, thermic Grossarenic Kandiudults) from a nearby farm (31°49'31.26"N, 84°33'12.42"W) with a 5.5 pH. Dolomitic lime (14.5 kg) was incorporated into the soil of one shelter to raise the soil pH from 5.5 to approximately 6.5. An 8-10-10 fertilizer was applied to the front or back half of each of the plots to raise the phosphorus levels to approximately 112 kg/ha (Figure 2). This layout resulted in a 2 x 2 factorial design with Hi/Lo pH and Hi/Lo P treatments.

Pre-planting soil tests (Table 1) confirmed that the pH of one rainout shelter was 5.8 (LO) and the other was 6.9 (HI). The lime applied to raise the soil pH also increased Ca above that in the LO pH plot. Soil tests confirmed that the P in the HI P plots were approximately 4 times that in the LO P plots. Statistical comparisons of the soil chemistry were not performed because a single soil sample for each of the treatments was taken and evaluated.

Tifguard (Holbrook *et al.* 2008) was hand-planted on 29 May 2015 at a rate of 19.6 seed/m in rows spaced 91 cm apart. Each row was terminated 30 cm from each end of the shelter, with a 60-cm gap in the middle of the shelter to serve as a buffer between the front and back half (Hi/Lo P) of each shelter plot. Phorate insecticide/nematicide was applied in-furrow at the recommended rate. Pre-emergence herbicides were applied and incorporated using a 13-cm irrigation. Fungicides were applied according to recommended practice and irrigation was applied throughout the season as recommended by Irrigator Pro (Butts, *et al.*, 2020; USDA, ARS, 2025). Plants were dug by hand and inverted on 23 Oct 2015, allowed to dry for 3 days, then harvested using a small plot thresher (Kingaroy Engineering Works, Kingaroy, QLD, Australia) on 26 Oct 2015. Each row was harvested separately and considered a single repetition for the experimental treatments. The center row of each plot was considered excess and not considered in the study. Harvested samples were dried to safe storage levels using ambient air in sample dryers described by Butts *et al.* (2002). After drying, samples were stored in mesh bags at ambient conditions and allowed to equilibrate to approximately 6% kernel moisture content. Samples were cleaned and shelled as previously described recording shelling outturns and shelling times.

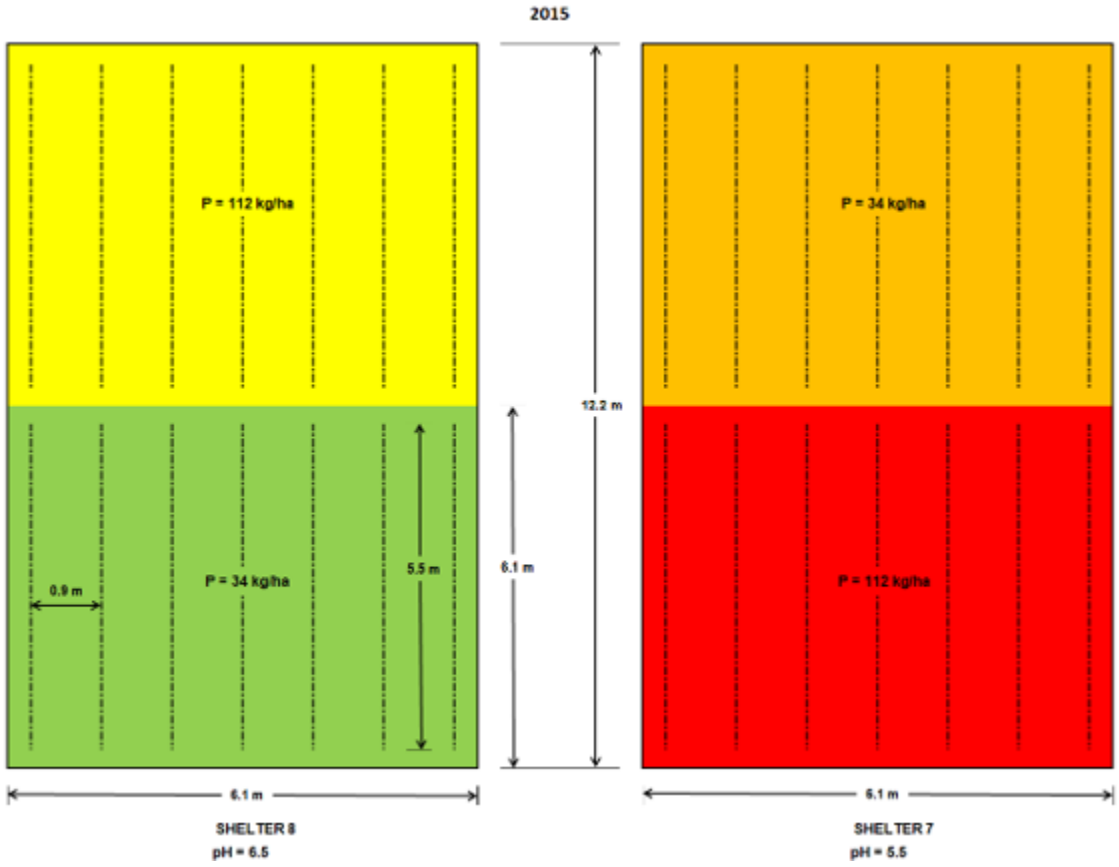

Figure 2. 2015 rainout shelter plot layout for leathery hull peanuts with varying soil pH (pH = 5.5 and 6.5) and phoshorus (P = 38 and 112 kg/ha)

Table 1. Pre-plant soil test results compared to the experimental plan.

Treatment	Soil pH	Soil P	Soil Chemistry			
			pH	P	Ca	Fe
				---------- kg/ha----------		
1	LO	HI	5.8	119	510	30
2	LO	LO	5.8	34	443	24
3	HI	LO	6.9	30	759	17
4	HI	HI	6.9	133	979	19

Statistical Analysis

Soil chemistry, shelling rates (kgh), and hull chemistry means were compared by location using Tukey pairwise comparisons (SAS Institute, 2020) for the 2014 field samples. The mean shelling rates for the 2014 NPRL field samples were compared by cultivar, since two known cultivars were harvested at the same location. Tukey pairwise comparisons were used to determine significant differences due to treatment in the 2015 small plot experiments.

RESULTS AND DISCUSSION

2014 Field-Grown Peanuts

Soil analyses from the ten commercial fields are presented in Table 2. Soil series classifications for these soils were obtained from the Web Soil Survey (USDA NRCS, 2026) based on the latitude/longitude of each field (Table 2). All sampled soils were well-drained sands. The NPRL field soil was a Red Bay loamy sand (fine-loamy, kaolinitic, thermic Rhodic

Kandiudults). The average soil pH of the Florida fields was 6.2 which is at the lower end of the target range of 6.2-6.5 for peanut production in Florida (Sidhu *et al.,* 2026) but within the 6.0-6.5 range recommended in Georgia (UGA Extension 2024). All elements tested were within the recommended ranges to avoid deficiencies or toxicity (UGA Extension 2024). P and Ca levels in the sampled fields were,respectively, 4.5 and 2.3 times the recommendend minimum. The NPRL field had a soil pH of 6.7, slightly above the recommended range for peanut production in Georgia. Primary elements were within the recommended range for peanut production. The mean P in the Florida field soils was approximately 2.6 times that of the NPRL soil, but NPRL soil had approximately 2.5 times K than the Florida soils. Ca levels in both soils were well above the recommended minimum for good peanut production.

Table 2. Analysis of soil samples from selected fields in the Florida panhandle and research plots at the National Peanut Research Laboratory prior to harvest of the 2014 peanut crop.

				Soil Analysis[b]						
Location	Field ID[a]		Soil Series	pH	P	K	Ca	Mg	Zn	Mn
					---------- kg/ha ----------					
FL	1	*	Valdosta Sand	5.9	238	130	835	58	6	15
FL	2		Blanton-Bonneau complex	6.7	274	96	1640	96	4	14
FL	3		Alpin Sand	5.7	109	81	3959	86	3	25
FL	4		Alpin Sand	6.3	60	47	974	43	1	22
FL	5	*	Blanton Sand	6.7	190	154	2228	282	5	20
FL	6		Valdosta Sand	6.1	257	84	835	56	5	12
FL	7	*	Valdosta Sand	6.2	283	222	1373	451	4	25
FL	8	*	Foxworth Sand	5.9	96	43	969	80	1	13
FL	9	*	Alpin Sand	6.5	129	59	1230	110	7	16
FL	10		Alpin Sand	5.4	92	114	420	41	5	17
FL	Mean	All		6.1	154	102	1290	116	4	15
		Sampled		6.2	167a	53b	1184a	175a	4b	15b
NPRL	13	*	Red Bay loamy sand	6.7	63b	133a	842a	130a	3a	53a
Recommended[c]				6.0-6.5	34	67	560	67	2-9	7

[a] Peanut samples obtained from fields with Field ID followed by *.

[b] Values represent the mean of three samples.

[c] UGA Extension, 2024, minimum recommendations for all elements except Zn. Zn recommended range to avoid toxicity depending on pH.

The shelling rates in the first and second stages of shelling as well as the combined shelling rate are shown in Table 3. Since cultivar was not repeated across locations, variation due to cultivar could not be determined separately from the NPRL location. Therefore, a Location pairwise comparison was conducted. Analysis showed that there was no difference in shelling rates due to cultivar at the NPRL location, and a pooled result is shown in Table 3. Tifguard was included as a cultivar in the 2007 Uniform Peanut Performance Test (UPPT) as advanced breeding line C724-19-15 (USDA, ARS 2008)(USDA, ARS 2008). The UPPT shelling data showed that Tifguard samples from nine different locations in the US shelled at a significantly higher rate than the standard check cultivar, Florunner, and three other University of Georgia advanced breeding lines. Therefore, it was concluded that differences observed in shelling rates were not likely to be due to cultivar and the data were pooled by location. The pooled analysis was essentially the same as the Location comparisons and showed that the Florida samples had an average shelling rate of 46 kg/h; about half that of the NPRL samples (91 kg/h). The field samples from Georgia shelled at a rate (65 kg/h) that was about two-thirds of the NPRL samples. These results tended to confirm the reports of reduced shelling plant throughput.

Table 3. Shelling data for samples collected during the 2014 harvest in commercial peanut fields and research plots.

Field ID	Location[x]	Rep	Cultivar	Shelling Rate		
				Stage 1	Stage 2	Average
				---------- kg/h----------		
FL-01	FL	1	Unknown	57.86	17.58	38.42
FL-01	FL	2	Unknown	88.14	29.10	58.76
FL-01	FL	3	Unknown	77.00	18.81	46.41
FL-05	FL	1	Unknown	66.53	23.96	32.02
FL-07	FL	2	Unknown	92.59	33.95	42.34
FL-07	FL	3	Unknown	71.93	33.36	44.87
FL-08	FL	1	Unknown	92.60	36.74	45.95
FL-08	FL	2	Unknown	74.15	34.10	49.43
FL-09	FL	1	Unknown	77.11	23.20	50.95
GA-11	GA	1	Tifguard	88.30	17.66	56.33
GA-11	GA	2	Tifguard	107.46	42.06	70.18
GA-11	GA	3	Tifguard	95.67	19.61	61.29
GA-11	GA	4	Tifguard	85.57	16.79	54.04
GA-11	GA	5	Tifguard	125.39	31.07	84.31
GA-11	GA	6	Tifguard	112.79	57.38	85.63
GA-11	GA	7	Tifguard	68.34	21.71	41.67
GA-12	NPRL	1	GA-06G	142.76	32.91	93.81
GA-12	NPRL	2	GA-06G	139.01	25.92	83.79
GA-12	NPRL	3	GA-06G	151.84	55.76	90.65
GA-12	NPRL	1	GA-09B	152.83	63.52	97.03
GA-12	NPRL	2	GA-09B	148.25	56.28	92.66
GA-12	NPRL	3	GA-09B	152.74	46.75	89.46
Means[yz]						
	FL		Unknown	77.5 C	27.9 B	45.5 C
	GA		Tifguard	97.7 B	29.5 AB	64.8 B
	NPRL		GA-06G	144.5 a	38.2 A	89.4 a
			GA-09B	151.3 a	55.5 a	93.1 a
			Pooled	147.9 A	46.9 A	91.2 A

[x] FL=Florida commercial field; GA = Georgia commercial field; NPRL = National Peanut Research Laboratory field plots.
[y] NPRL means in the same column followed by the same different lower case letter are not significantly different due to cultivar using a Tukey pairwise comparison , α = 0.05.
[z] Means by location in the same column followed by a different upper case letter are significantly different using a Tukey pairwise comparison , α = 0.05.

Results of the tissue analysis for the hulls from the shelled samples by field are shown in Table 4. Tissue analysis was reported in Table 4 for fields FL-05 and FL-09, but were not included in the means separation since there was only one sample from each of these fields. There were significant differences in most elements in the hull samples when compared on a field-by-field basis (Table 4). Generally, the mean concentrations of most elements in the hulls from Florida fields were grouped together and the two fields in Georgia (GA-11 and PL-12) were generally grouped together. The hull Fe content ranged from 184 ppm from FL-08 to 1621 ppm for the PL-12 samples. However, statistically, there were no differences in hull Fe content by field.

Table 4. Tissue analysis of hulls for samples collected from individual fields during the 2014 peanut harvest for leathery hull.

		Field ID						
Element	Units	FL-01 (n=3)	FL-05 (n=1)a	FL-07 (n=2)	FL-08 (n=2)	FL-09 (n=1)[a]	GA-11 (n=7)	PL-12 (n=6)
N	%	0.81 bc[b]	0.81	1.27 a	1.10 ab	0.95	0.79 bc	0.61 c
P	%	0.06 ab	0.06	0.10 a	0.08 ab	0.06	0.05 b	0.04 b
K	%	0.64 ab	0.73	0.91 a	0.78 ab	0.60	0.57 b	0.53 b
Mg	%	0.09 ab	0.10	0.13 a	0.11 ab	0.10	0.07 b	0.08 b
Ca	%	0.38 ab	0.52	0.53 a	0.38 ab	0.48	0.27 b	0.32 b
S	%	0.12 bc	0.13	0.21 a	0.16 ab	0.12	0.10 bc	0.08 c
B	ppm	17 ab	23	25 a	20 ab	22	15 b	16 b
Zn	ppm	11 a	30	26 a	18 a	47	26 a	14 a
Mn	ppm	49 a	86	42 a	48 a	72	84 a	141 a
Fe	ppm	252 a	347	284 a	184 a	210	866 a	1621 a
Cu	ppm	6 ab	4	4 b	6 ab	8	8 a	7 ab

[a] Not included in means separation due to only one replicate.

[b] Means in the same row followed by the same lower case letter are not significantly different using a Tukey's pairwise comparison, α=0.05.

Table 5. Tissue analysis of peanut hulls for samples collected during 2014 peanut harvest for leathery hull pooled by sample origin (location).

		Location[x]		
Nutrient	Units	FL	GA	NPRL
N	%	0.99 a	0.79 b	0.61 c
P	%	0.07 a	0.05 b	0.04 b
K	%	0.74 a	0.57 b	0.53 b
Mg	%	0.10 a	0.07 b	0.08 b
Ca	%	0.44 a	0.27 b	0.32 b
S	%	0.15 a	0.10 b	0.08 c
B	ppm	21 a	15 b	16 b
Zn	ppm	22 b	26 a	14 b
Mn	ppm	54 a	84 b	141 b
Fe	ppm	250 a	866 b	1621 b
Cu	ppm	5 a	8 b	7 b

[x] Means in the same row followed by the same lower case letter are not significantly different using a Tukey pairwise comparison, α = 0.05

When tissue analyses were grouped by location, FL, GA, and NPRL, there were significant differences in element concentration due to location (Table 5). Except for Zn, hulls from the Florida samples had significantly higher or lower concentration of elements than the Georgia field and NPRL plot samples. Samples from GA and NPRL were not significantly different from each other except in the case of hull N concentrations. Hull N for the NPRL samples averaged 0.61% compared to 0.79% for the GA samples. Separations in elemental concentrations by location were similar to the separations in shelling rate by location. For example, hull N, P, K, Mg, Ca, B, Mn, and Fe from the FL fields were different than those from the GA and NPRL locations. Shelling rate (Table 3) tended to increase from NPRL to GA to FL locations. While numerical trends in hull tissue analysis and shelling rates due to location could be observed, there were no statistically significant relationships observed.

The element with a very pronounced numerical and statistical difference was hull Fe content. NPRL peanut samples had an Fe content of 1621 ppm compared to 250 ppm in the Florida samples (Table 5).

2015 Rainout Shelter Grown Peanuts

There were no statistically significant differences in the shelling rates due to combined treatments of pH or P (Table 6) in these tests conducted in the rainout shelters. However, in the LO pH soil, the 1st stage and average shelling rate for peanuts grown in the LO P soil was approximately 6% higher than those grown in the HI P soil. There was a 25% numerical difference in the 2nd stage shelling rate. Similarly, in the HI pH soil, the average shelling rate of peanuts grown in the LO P soil was approximately 6% higher than those grown in the HI P soil.

Table 6. Comparison shelling rates for peanuts produced with HI/LO soil pH and HI/LO soil P in the rainout shelters at the National Peanut Research Laboratory in 2015.

			Shelling Rate[x]		
Treatment	Soil pH	Soil P	Stage 1	Stage 2	Average
			---------- kg/h ----------		
1	LO	HI	87.1	18.7	43.3
2	LO	LO	92.9	23.4	46.3
3	HI	LO	96.9	23.7	45.7
4	HI	HI	86.9	20.7	42.9

[x] Means in the same column were not significantly different using Tukey's HSD pairwise comparison, $\alpha = 0.05$.

SUMMARY AND CONCLUSIONS

Commercial peanut shellers reported that shelling plant throughput decreased considerably when they were shelling farmers' stock peanuts from a specific region in the panhandle of Florida. During the harvest of the 2014 peanut crop, samples were obtained at the buying point from several fields in this specific growing region, from a single grower's field in Georgia, and from research plots. Testing confirmed that peanuts grown in the targeted region in the Florida panhandle had reduced shelling rate as reported by commercial peanut shellers. In 2015, tests were conducted in rainout shelter plots to replicate the agronomic conditions that resulted in the reduced shelling rate. The rainout shelters mimicked soil characteristics suspected to have resulted in reduced shelling rate in the target region, however there was no strong statistical evidence to verify the correlation between suspected soil conditions and reduced shelling rates. These results and additional conversations with sheller stakeholders indicated a need for additional research to identify the cause and determine possible agronomic solutions to "leathery hull".

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