Assessment of Genetic Diversity Changes in U.S. Runner-type peanut cultivars
Released between 1943 and 2009 Using Simple Sequence Repeat (SSR) Markers.

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The objective of this study was to assess allelic diversity changes among 59 peanut (Arachis hypogaea L.) cultivars of the runner market-type released between 1943 and 2009 using simple sequence repeat (SSR) markers. Thirty four SSR primer pairs amplified a total of 154 alleles. The mean number of alleles per locus was 4.5, ranging from two to ten. The informational worth of each marker was evaluated by calculating the polymorphic information content (PIC) for each locus. PIC values ranged from 0.05 to 0.76, with an average of 0.37. Changes in the average genetic diversity were analyzed with respect to breeding periods, breeding programs, and breeding cycles. Our results indicated that (i) at the gene level, allelic diversity has increased significantly through decades of breeding, (ii) at the population level, genetic diversity was at its lowest during the pre-1980s time period and gradually increased in each subsequent decade, and (iii) most of the observed SSR variation occurred within, rather than among, time periods. Visual representation of the principal coordinate analysis clearly demonstrated increases in the variation present in each subsequent breeding decade, reaching its maximum in the 2000s. Therefore, it appears that runner-type peanut breeders have been successful at developing improved peanut cultivars while increasing levels of diversity in the last three decades of breeding.
Oleic acid (C18:1), a monounsaturated, omega-9 fatty acid is an important agronomic trait in peanut cultivars because it provides increased shelf life, improved flavor, enhanced fatty acid composition, and a beneficial effect on human health. Consequently, an emphasis has been placed on breeding peanuts with high levels of oleic acid and low levels of linoleic acid (C18:2), a polyunsaturated, omega-6 fatty acid. In an attempt to increase genetic diversity, specifically disease resistance of high oleic acid lines, crosses between lines containing high oleic to linoleic ratios (high O/L), wild species, and cultivated botanical varieties (Arachis hypogaea ssp. hypogaea var. hirsuta or peruviana) were prepared. The main bottleneck of breeding research is rapid detection of the trait(s) of interest. Therefore, genotyping assays were developed to detect wild type and mutant alleles in both ahFAD2A and ahFAD2B, which are known to affect oleic acid (C18:1) and linoleic acid (C18:2) levels. Total fatty acid composition and the ahFAD2 genotypes were determined in the parents and the progeny of four crosses, as well as, some selected peanut germplasm. The O/L ratio varied from 0.85 to 30.30 in the four crosses evaluated. The oleic acid trait segregated in a digenic (15:1) or a monogenic (3:1) manner dependent on the genotype of the parents used in the cross. Statistical analysis demonstrated that oleic acid was negatively correlated with linoleic and palmitic acid (C16:0), but positively correlated with two long chain fatty acids, gadoleic (C20:1) and lignoceric acid (C24:0). Combining the fatty acid profiles determined by gas chromatography with each individual’s genotype provides valuable insight on the effect of each genotype on the oleic acid and correlated fatty acid content in peanut seeds.
First Insight into Population Structure and Linkage Disequilibrium in Peanut, and
Association Mapping of Drought Tolerance-Related Traits in the US Peanut Minicore Collection.

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Ninety-six genotypes comprising 92 accessions of the US peanut minicore collection, diploid progenitors A. duranensis (AA) and A. ipaënsis (BB), and a component line of the cultivar Florunner and the synthetic amphidiploid accession TxAG-6 were investigated with 392 SSR marker bands amplified with 32 highly-polymorphic SSR markers. Both distance and model-based (Bayesian) cluster analysis revealed the presence of structured diversity. UPGMA analysis divided the population into four subgroups, two major subgroups representing subspecies fastigiata and hypogaea, a third containing mixed individuals, and the last containing diploid progenitors and TxAG-6. Similarly, model-based clustering identified four subgroups - fastigiata and hypogaea subspecies, a third consisting of diploid progenitors and TxAG-6, and a fourth being mixed. At the significance threshold of $p \leq 0.01$, marker loci pairs with distance $< 50 \text{cM}$, beyond $50 \text{cM}$, and unlinked were found in strong LD. Linkage disequilibrium stretched to a longer distance within the fastigiata subspecies, in accord with LD extending to great distances in self pollinated crops. Minicore accessions were screened for six drought tolerance-associated traits namely, SPAD chlorophyll, canopy temperature, flower count, leaf closure, plant height and width, in two environments, over two growing seasons (2007 and 2008). Unified mixed linear model (MLM) analysis incorporating population structure and kinship identified several SSR loci associated with drought tolerant traits. The current findings imply LD mapping could be an excellent tool to exploit the natural variation present in cultivated peanut.
Development and Characterization of Two Peanut RIL Mapping Populations.

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An appropriate mapping population, suitable marker system, and the software for analyses of data are the critical elements for genetic linkage map construction and quantitative trait loci (QTLs) identification. We have developed two RIL mapping populations that derived from the crosses of ‘Tifrunner’ x ‘GT-C20’ and ‘SunOleic 97R’ x ‘NC94022’. The parents used in the crosses possess very divergent traits either in agronomic phenotypes or disease resistance. The progenies of a total of 248 F2:7 lines for ‘Tifrunner’ x ‘GT-C20’ and 352 F2:7 lines for ‘SunOleic 97R’ x ‘NC94022’ have been assessed under field conditions for descriptive traits on plant, pods, and seeds and TSWV resistance in two growing seasons. Two hundred sixty nine and 173 SSR polymorphic markers also have been used to assess these two populations, respectively. The descriptive statistics for agronomic traits and resistance to diseases were computed considering the maximum, the mean and the minimum values, the standard deviation, the coefficient of variation, and the distribution of frequency. Cluster analysis and estimation of genetic distances among and within populations were conducted with SSR marker data. The repeatability coefficient was calculated to estimate the accuracy of the phenotypic measurements through the methods variance analysis, principal components analysis, and structure analysis. Our results showed that the two progenies segregated for resistance to TSWV and other traits, thus illustrating the usefulness of genetic linkage map construction and QTLs identification.
The genus *Arachis* (Fabaceae) is comprised of 80 species restricted to South America. The existing monograph divided the genus into nine sections and provides an intuitive assessment of evolutionary relationships, but a comprehensive phylogenetic analysis of the genus is lacking.

To test the current systematic treatment of the genus, we reconstructed a phylogeny for *Arachis* using nuclear ITS and plastid trnT-trnF sequences from a total of 48 species representing all nine sections. ITS cloning of the allotetraploid species of section *Arachis* indicated the presence of A and B genome alleles and chimeric sequences. Our study also showed species from section *Extranervosae* as the first emerging lineage in the genus, followed by sections *Triseminatae* and *Caulorrhizae*, and two terminal major lineages, which we refer to as erectoides and arachis. Species in the arachis lineage formed two major clades, arachis I that includes the B and D genomes species and the aneuploids, and arachis II that includes the A genome species. Our results substantiated the sectional treatment of *Caulorrhizae* and *Triseminatae*, but demonstrated that five sections (*Arachis*, Erectoides, Procumbentes, and Trierectoides) are not monophyletic. A detailed study of the genus *Arachis* with denser taxon sampling, additional genomic regions, plus information from morphology and cytogenetics is needed for a comprehensive assessment of its systematics.
Despite the availability of several thousand simple sequence repeat (SSR) primer pairs for cultivated peanut, exceedingly low rates of polymorphism constrain the number of useful markers. To address this deficiency we have mined DNA sequences from the ends of bacterial artificial chromosome (BAC) clones for additional novel SSRs. 4,448 BAC end sequences of A. hypogaea Tifrunner were obtained from 3784 BAC clones that were selected based on hybridization to peanut NBS-LRR disease resistance genes; these sequences yielded 142 new SSRs (RGH-SSRs) that met our criteria for SSR content and length. These same A. hypogaea BAC clones were fingerprinted to produce physical map contigs of regions of the peanut genome containing disease resistance gene homologs. In addition, we sequenced 25,000 randomly selected BAC clones of A. duranensis, resulting in 41,856 end sequences and 1392 SSRs that met criteria for length and content. A total of 1152 functional primer pairs were analyzed for polymorphism across a panel of eight parental genotypes of four populations. The polymorphic SSR markers were used to construct a high density of genetic linkage map.
Developing a High-Density Molecular Map of the A-Genome Species A. duranensis.

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Although markers have been mapped into linkage groups of both wild and cultivated peanut since the early 1990’s, the maps have been extremely low density. This is in large part because identifying highly polymorphic parents has been problematic, the cultivated peanut has two genomes (A and B), and the species is polyploid which results in many gene duplications. To overcome difficulties associated with molecular polymorphism, Expressed Sequence Tag libraries were created to facilitate identifying Simple Sequence Repeats (SSR) and Single Nucleotide Polymorphism (SNP) markers in peanut. Further, to circumvent problems associated with the allotetraploid A. hypogaea, the progenitor species A. duranensis was used for genetic mapping experiments with the goal of utilizing the data for fine-mapping in the cultivated species. The objectives of this research were to first identify a large number of SSRs and SNPs in peanut and then to map polymorphic markers into linkage groups. Two A. duranensis accessions PI 475887 and Grif. 15039 were used for this study. Normalized cDNA was produced from leaf and root tissues of both accessions from which 22,356 and 21,487 long-read ESTs from leaves and roots, respectively, were produced for PI 475887 using the Sanger technology. Short-read ESTs also were produced from leaves (212,938 and 296,242 for PI 475887 and Grif. 15039, respectively) and roots (266,575 and 235,245 for PI 475887 and Grif. 15039, respectively). In addition, 2,134 SSR markers developed from an A. hypogaea EST database were evaluated for polymorphism in the two diploid accessions. A total of 2,319 markers were mapped into 10 linkage groups, including 971 SSRs, 221 single-stranded DNA conformation polymorphism (SSCP) markers, and 1,127 SNPs. This represents the first high-density map for a peanut species. The linkages identified in this study will be an invaluable resource for sorting the A and B genomes and linkage relationships in the cultivated species.

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A genetic linkage map is critical for identifying the QTL (quantitative trait loci) underlying targeted traits. Over the last few years, progress has been made in marker development from multiple sources enabling the expansion of quality resources needed for genotyping applications in cultivated x cultivated populations. The most recently published intra-specific maps were constructed from the crosses of cultivated peanuts (Varshney et al. 2009; Hong et al. 2010), in which only 135 and 175 simple sequence repeat (SSR) markers were sparsely populated in 22 linkage groups, respectively, representing the 20 chromosomes of A. hypogaea. A high resolution linkage map with sufficient markers will increase the chances of QTL identification. Two intra-specific F2:7-RIL (recombinant inbred line) populations of 248 and 352 lines derived by single seed descent from crosses between ‘Tifrunner’ × GT-C20 and ‘SunOleic 97R’ × NC94022’ have been developed and used in this study. The primary phenotype evaluation conducted in 2009 (F2:5) has demonstrated that a significant divergence among RILs of both populations was obvious. The populations are suitable for linkage map construction and QTL analysis. We have collected 4,574 SSR markers and screened for polymorphisms in the parents. Of these SSRs, 269 and 173 markers were polymorphic in these two populations, respectively, and used for the genetic map constructions. The constructed linkage genetic map for S population has 20 linkage groups (LG) with 186 mapped loci (173 SSRs and 13 with two loci). In 2009, we conducted field evaluation of F2:5 lines for disease resistance to TSWV with two replications. From our preliminary result, one QTL for TSWV resistance has been identified. The identified QTL may explain 40% phenotypic variation. The seeds for these populations have been advanced to next generation (F2:7) and more field phenotypes will be conducted in 2010 for confirming this major QTL. This map will be compared with the genetic map from T population. Furthermore, an integrated map will be constructed from these two populations with more markers to better cover the peanut genome.
Northampton County, North Carolina has always been a traditional peanut growing county. In 1989 Northampton Farmers planted 26,278 acres of peanut across the entire county. The peanut production infrastructure was in place to handle a peanut farmer’s crop literally just down the road. Today peanut production is still part of the agricultural industry in Northampton County but many adjustments have taken place. Several growers have sold their peanut equipment and have replaced peanuts with more cotton and soybeans. Peanut acres have deceased down to an average of 4500 acres over the last 5 years. Gone are the days of growing quota peanuts. The growers who remain are carefully looking at production cost and available resources before making a decision on signing a peanut contract.
Tillage Systems with Peanut in Halifax County, North Carolina: An Historical Perspective.


Twenty years ago approximately 25,000 acres of peanut were produced in Halifax county North Carolina exclusively in conventional tillage systems. A significant portion of fields where peanut were produced are considered at high risk for water erosion. Declines in soil productivity and crop yield due to intensive conventional tillage practices led to development of regulations subsequently leading to implementation of soil conservation practices to address erosion issues on many fields in the county. Several peanut growers began experimenting with no-till production but experienced little success. However, one grower began using strip till as an alternative to both conventional and reduced tillage and over the course of the past 20 years this practice has proven to be very successful. Advantages often expressed by growers implementing strip tillage include soil moisture conservation, reduced erosion, less disease and insect problems, and improved soil productivity and higher yield of peanut and other crops. Today, approximately 50% of the 5100 acres of peanut are planted using some form of reduced tillage. These systems range from strip tillage into stubble from the previous crop to a single disking operation in the fall and establishment of a small grain cover crop followed by spring strip tillage at planting.
Over the past 4 or 5 years, the peanut cultivar Georgia O2-C has become one of Southeast Georgia’s most consistent yielding peanut cultivars. During this time, county agents and farmers from the area observed that this cultivar tends to hold on to peanuts even after perceived maturation, and to add yield and grade after significant cold stress. To test this hypothesis, a study was designed to quantify peanut maturity, yield, and grade over an extended harvest period through the onset of cold stress.

On May 13 2009, Georgia 02-C peanut was planted at the Southeast Georgia Research and Education Center in Midville, Georgia. Harvest dates were arranged in a randomized block design with 4 replications. A hull scrape maturity test was conducted on Sept. 10th at 120 days after planting (DAP) to project the first digging date which was September 30th at 140 DAP. Hull scrape maturity tests (4 reps) were conducted weekly through November, and pod-stem breakdown and pod losses were observed. Seven harvests for yield and grade were conducted from Sept. 30th until Nov. 21st. Weekly harvests were planned, but impossible due to heavy rain.

In the 2009 trial, the highest yield (5328 lbs/a) was observed on October 27th at 167 DAP. This was 8 days later than the first near-freezing cold spell (35° F), although 13 of the prior 20 days since Sept. 29th had nighttime temperatures less than 60° F. Peanut grade as indicated by total sound mature kernels reached a maximum of 77% on Oct. 21st, approximately 1 week before maximum yield and remained level throughout the other digging dates.

Detailed data from hull scrape maturity profiles showing pod movement through and into maturity groups was recorded. Maximum yield corresponded with 37%, 68%, and 76% when harvestable pods were grouped as black; brown plus black; and orange plus brown plus black, respectively. Pod stems remained strong and little pod-stem breakdown was evident through the date of maximum yield, even though black pods were observed in hull scrape profiles for the preceding 5 weeks. This data suggests that pod stems for Georgia O2-C may have more resistance to maturity breakdown compared to previous observation in other varieties, and may be partially responsible for the longer time between planting and harvesting and the greater flexibility in timeliness of digging.
Severity of soil borne diseases in peanuts in the form of Limb Rot (Rhizoctonia solani), CBR (Cylindrocladium Black Rot) and Southern Stem Rot (white mold, Sclerotium rolfsii) were estimated for peanut plots in Randolph County and how these diseases affected yield, grade, and dollar value per acre. UGA research has shown the potential for increases of 1000 -1500 lbs/A when spraying fungicides at nighttime when the leaves are folded compared to daytime sprays when leaves are fully expanded. The premise is that “relaxed” peanut canopy allows better spray penetration and efficacy during nighttime applications. The plot used in Randolph County had a two year peanut rotation with a history of disease including aerial rhizoctonia and Southern Stem Rot. Six total plots were evaluated with three replications of Georgia-06G peanuts for night and daytime fungicide applications. All practices were the same in the plots with the exception of the soil borne fungicide application times. Year one was an Abound program with only two Abound sprays (22 oz. /A) applied at night. In 2009 a tebuconazole program with Folicur (7.2 oz. /A) and Toledo (7.2 oz. /A) with generic chlorothalonil – Chloronil (1pt. /A) applied in a four block night spray program was used. Spray times were between 5:00 – 6:00 A.M. in order to utilize the moisture from dew. In 2009, yields were still high for the nighttime program at 494 lbs/A more for the daytime program. The two year average is 804 lbs/A. Disease ratings revealed white mold as the only soil borne disease of note. Nighttime plots showed a 20% reduction in white mold. Early and late leaf spot were also heavy with defoliation ranges from 40 – 75%. There was no statistical difference in leaf spot control between the plots.
Deer and Hog Mega Fence on Peanuts.


Deer and hogs and other wildlife are doing extensive damage to our crops and especially peanuts. Results from a survey conducted in 2008 resulted in 10% or a $16 million loss to our crops just in Southwest Al. Some fields were totally abandoned. The costs of wildlife fence are prohibitive to most Alabama growers. However, a less expensive cost efficient fence, the deer and hog mega fence was constructed and tested in 2009 and again in 2010. A three strand high tinsel electric fence is constructed around a field. Three feet out from this fence is a one strand high tinsel electric fence. The idea of the two separate fences is to disorientate the deer and hogs. Once the fence is constructed it is plugged in immediately with a high mega charger. It is utmost important that the charger have a high joule output (8 or 12 joule). This fence is cost efficient and proved 99.9% effective in controlling wildlife in 2009. Further research is being conducted on even less expensive fencing and in other areas and crops in Alabama.
Field experiments were conducted to evaluate eight fungicide systems for control of leaf spot, white mold, and rhizoctonia pod rot during the 2009 growing season. The systems that were evaluated included a four block Folicur program (sprays 3 - 6) with Headline (spray 1) & Bravo (spray 7); Tilt Bravo (sprays 1 & 2) + Abound (sprays 3 & 5), with Bravo (sprays 4, 6 & 7); Provost @ 8 oz per acre (sprays 3, 4, 5 & 6) with Bravo (sprays 1, 2 & 7); Provost @ 10.7 oz per acre (sprays 3, 4, 5 & 6) with Bravo (sprays 1, 2 & 7); Elast (sprays 1, 2, 3, 4, 5, 6) with Folicur (sprays 3, 4, 5 & 6) and Bravo (spray 7); Evito (sprays 3 & 5) with Tilt Bravo (sprays 1 & 2) and Bravo (sprays 4, 6 & 7); Abound (sprays 3 & 5) with Provost (sprays 4 & 6) with Tilt Bravo (sprays 1 & 2) and Bravo (spray 7); Bravo (sprays 1, 2, 3, 4, 5, 6, & 7). Treatments were applied according to manufactures recommendation. Disease control ratings were taken from each plot. Disease control ratings for leaf spot showed some statistical differences while rhizoctonia ratings were not statistically different. Yields were statistically different across treatments.
Peanut Tolerance and Weed Control Following Fomesafen Applied at Different Rates and Timings in Texas.

Fomesafen (Reflex) is a herbicide that has effectively controlled broadleaf weeds and woollyleaf bursage [Ambrosia grayi (A. Nels.) Shinners] in cotton (Gossypium hirsutum L.). In Texas, Reflex was recently labeled for use in cotton west of I-35 as a fall or spring preplant use only, but a recent 24C will allow applications up to 14 days before planting and use postemergence-directed. There is currently no label for use in peanut and the minimum rotational interval before planting peanut is 10 months. The objective of this research was to examine peanut tolerance to Reflex 2SL applied at 0, 0.19, 0.25, 0.38, and 0.50 lb ai/A (0, 12, 16, 24, and 32 oz/A) preemergence (PRE), at ground-crack (AC), and early postemergence (EPOST, 21 days after planting). This study was conducted under weed-free conditions at Lamesa, TX in 2008 (Flavorunner 458) and 2009 (Tamrun OL02) and under weedy conditions at Yoakum in 2009 (Tamrun OL02). In 2008 at Lamesa, Reflex applied PRE at 12 to 32 oz/A caused up to 59% peanut injury 47 days after application (DAA). More injury was observed as Reflex rate increased. Late-season (Sep 26) injury was still apparent following PRE applications. Reflex applied AC or EPOST caused up to 50 and 54% injury, respectively. More injury was observed as the Reflex rate increased and injury was still apparent late-season. Peanut yield was reduced following Reflex applied PRE at all rates, AC at 24 and 32 oz/A, and EPOST at 16, 24, and 32 oz/A relative to the non-treated control (5196 lb/A). In 2009 at Lamesa, Reflex applied PRE at 16 to 32 oz/A caused 6 to 15% peanut injury 21 DAA, 6 to 23% injury 35 DAA, and 8 to 46% injury mid-season (July 2). As in 2008, injury increased as Reflex rate increased. Late-season (Sep 25) injury up to 44% was still apparent following PRE applications. Reflex applied AC or EPOST caused up to 36 and 15% injury, respectively. More injury was observed as the Reflex rate increased and injury following 16 to 32 oz/A treatments was still apparent late-season. Peanut yield was reduced following Reflex applied PRE at 16 to 32 oz/A rates; AC at 12, 16, and 32 oz/A; and EPOST at 24 oz/A. In 2009 at Yoakum, peanut injury 34 days after planting (DAP) with Reflex applied PRE ranged from 8 to 23% while Reflex injury from AC applications ranged from 22 to 38%. No injury from Reflex applied EPOST was noted at the 34 DAP rating since this was only 12 days after application. When evaluated 76 DAP, peanut injury with Reflex applied PRE, AC, or EPOST ranged from 17 to 53% and increased as the rate of Reflex increased. Results from this study suggest that Flavorunner 458 (2008) and Tamrun OL02 (2009) are very susceptible to Reflex applied PRE, AC, and early postemergence at rates from 12 to 32 oz/A. Although Reflex provided good to excellent control of certain broadleaf weeds, peanut injury with PRE, AC, or EPOST applications was unacceptable. Future label changes that would allow Reflex use in peanut seem unlikely based on this data collected on the Texas High Plains (Flavorunner 458 and Tamrun OL02), south Texas (OL02 and previously in OL01 and OL07), Georgia (Georgia Green), and Florida (SunOleic 97R).
Influence of Tillage, Herbicide Programs and Cropping Systems on the Management of Bengal Dayflower.

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Weed management programs in conventional vs. strip-tillage peanut were evaluated for effectiveness in controlling Bengal dayflower in 2008 and 2009. Strip-tillage increased Bengal dayflower infestation by 21 and 17% over conventional-tillage in both 2008 and 2009 respectively. Conventional tillage also had slightly higher but non-significant peanut yield in both years. Ten peanut herbicide programs were evaluated in each tillage system. In 2008 only Dual Magnum + Gramoxone Inteon + Induce at cracking (AC) followed by Dual Magnum + Cadre + Induce postemergence (POST) and Dual Magnum + Gramoxone Inteon + Basagran AC followed by Pursuit + Induce POST provided acceptable Bengal dayflower management (>74% control). In 2009 all herbicide programs, except the low input program of Gramoxone Inteon + Induce AC, provided at least 78% Bengal dayflower control. Herbicide programs that included Strongarm, Cadre, or Pursuit in a POST application had 92% or greater weed control. In 2008 all herbicide programs improved peanut yield over the untreated while in 2009 only programs with a POST application of Strongarm or Cadre improved peanut yield over the untreated.

In another study peanuts and cotton were planted in conventional or strip-tillage under high, medium, low or no herbicide input programs in 2008 and 2009 to evaluate influence on Bengal dayflower density and control. In 2008 Bengal dayflower control was the greatest in conventional tillage for both crops. However, in 2009, no differences were detected between tillage treatments or between cropping systems. In both years all herbicide programs improved control over the untreated, but in 2008 only the medium and high input programs maintained acceptable control (>80%). In both years weed counts were taken during the mid- and late-season. Only the high input herbicide programs significantly reduced the total number of Bengal dayflower plants compared to the untreated control in both years. No significant differences in yield were detected between the herbicide programs in peanuts or cotton in 2008. In 2009 the high and the medium herbicide programs improved yield in peanut over the untreated, but no differences between programs were detected in cotton.
Weed Management in Narrow- vs. Wide-Row Peanut.

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Research was conducted in Florida during 2005 through 2008 to evaluate weed management systems in narrow (38 cm)- and wide (76 cm)-row peanut. Benghal dayflower control increased when peanut row spacing was narrowed. Paraquat + bentazon early-postemergence (EPOST) followed by (fb) imazapic or imazethapyr mid-postemergence (MPOST) or chlorimuron late-postemergence (LPOST) controlled Benghal dayflower at least 90%. Imazapic EPOST with or without 2,4-DB MPOST controlled Benghal dayflower 98 to 100%. Diclosulam or flumioxazin preemergence (PRE) fb paraquat + bentazon EPOST fb 2,4-DB MPOST or either PRE herbicide fb 2,4-DB MPOST did not increase Benghal dayflower control compared with imazapic-containing treatments. Browntop millet control was 98 to 100% for treatments with imazapic or imazethapyr EPOST and control was greater in narrow-row compared to wide-row peanut. All herbicide treatments controlled pitted morningglory at least 90% and peanut row spacing did not influence control. Only treatments with imazapic EPOST as a component controlled sicklepod at least 90%. No difference between peanut row spacing was observed for sicklepod control. In general, peanut planted in narrow-rows yielded greater than wide-row peanut. Few differences in peanut yield were observed among herbicide treatments, but all treatments resulted in yields greater than the nontreated control. Data indicates that seeding peanut in narrow-rows will improve control of Benghal dayflower and browntop millet and will increase peanut yield compared to wide-row peanut.
Cultural weed control is the basis on which an integrated system of weed management in organic peanut is based. The cultural practices evaluated for weed control were row patterns and seeding rates, integrated with cultivation intensity. Results showed that peanut seeded in wide rows (two rows, 91 cm apart), at a density of 20 seed/m, and cultivated weekly for at least 6-wk was the most effective regime evaluated. Weeds were not effectively controlled in peanut seeded in twin rows (two pairs of rows, each pair 46 cm apart with each row in the pair 17 cm apart) at a density of 10 seed/m. However, when peanut in twin-row patterns were seeded at 20 seed/m, weeds were controlled by intense cultivation with a tine weeder. These results suggest that in-row plant spacing is critical for successful weed control with cultivation and independent of row pattern. Peanut seeded at 20 seed/m improved crop competition with weeds and greatly facilitated overall weed control with cultivation. It was noted that cultivation needed to be initiated before weed emergence, which coincided with peanut emergence (‘cracking’). Weeds already emerged were not consistently controlled with the tine weeder, regardless of the duration or frequency of cultivation. These basic concepts were also proven to be effective in transition to organic production in plantings of millet and southern pea.
Because peanut is considered to be a minor crop by many outside the southern U.S., research and development for potential new herbicides is limited. Therefore, the objectives of this research were to evaluate the use of Reflex (fomesafen), Sharpen (saflufenacil), and Spartan (sulfentrazone), for weed control in peanut and to compare these herbicides to current standards such as Strongarm (diclosulam) and Valor (flumioxazin). Replicated, small-plot, field trials were conducted in 2009 at two locations in Georgia (Tifton, Plains). Preemergence (PRE) applications of the following treatments were evaluated: Strongarm 84WG at 0.45 oz/A; Valor SX 51WG at 3 oz/A; Strongarm at 0.23 oz/A + Valor @ 1.5 oz/A; Spartan 4F @ 4, 5, 6, and 8 oz/A; Reflex 2SL at 12 and 16 oz/A; and Sharpen 2.85SC at 1 and 2 oz/A. All treatments also included Prowl H20 3.8ASC at 34 oz/A (PRE) and Cadre 2AS at 4 oz/A + Agrioil at 1% v/v (POST). In Tifton, both rates of Reflex and Sharpen at 2 oz/A caused significant peanut stunting that was observable as late as 55 days after treatment. In Plains, the greatest amount of peanut injury (leaf burn) observed was from Spartan at 6 and 8 oz/A. At both locations, all PRE treatments provided ≥ 92% control of Palmer amaranth (Amaranthus palmeri). In Tifton, annual morningglory (Ipomoea spp.) control was ≥ 98% with all PRE treatments except Reflex (75%), Sharpen at 1 oz/A (85%), and Spartan at 4 and 5 oz/A (83-88%). In Plains, Florida beggarweed (Desmodium tortuosum) control was ≥ 91% with all PRE treatments except Reflex (36-57%). Peanut yields were significantly reduced by both rates of Reflex and Sharpen, and Spartan at 8 oz/A at the Tifton location. Yield data was not collected at the Plains location due to excessive moisture conditions at harvest.
Peanut is an important legume crop in southern Mexico where 85% of the crop is grown during the rainy season. However, average pod yield of the rainy season crop is poor (1300 kg ha⁻¹) because unimproved landrace cultivars are grown by the peasants. Improved cultivars are needed. In 2002 the best Mexican peanut cultivars, selected during 1994-2000, were crossed at the North Carolina State University peanut breeding program, among themselves and with other improved peanut lines including Perry. Breeding populations were received in Mexico in 2003, and evaluated on campus from 2004 to 2006. Spreading and bunch growth habits were observed. In 2007 through 2009 two different trials were conducted in different localities of the states of Morelos and Puebla. In this paper some results are reported from experiments conducted during 2009 in Cuauchichinola, Morelos, Mexico. Data were obtained from small plots of 2.64 m². Although additional yield components were recorded, only peanut pod yield and 100-seed weight are presented. Of 14 lines with bunch growth habits, 1-06Ch, 4-06Ch, 8-06Ch, and 10-06Ch ranked in the group with the highest pod yields. Line 4-06Ch had the greatest yield (2127 kg ha⁻¹), but those of the other three lines exceeded the national average yield indicated above. Criollo de Ocozocuautla, a landrace control in the trial, had the greatest 100-seed weight (80.8 g). Among lines with spreading growth habit, line 6-06Ch ranked first in pod yield (3174 kg ha⁻¹) while 14-06Ch ranked last (1487 kg ha⁻¹). Line 6-06Ch had a 100-seed weight of 71.4 g, intermediate to the extremes for the improved lines set by 20-06Ch (61.2 g) and 19-06Ch (80.2 g). Pod yield in 6-06Ch was more correlated with mature pod number than to seed size.
Immunoglobulin E (IgE) antibodies from sera of peanut-allergic individuals are known to bind specifically to major peanut allergens, Ara h 1 and Ara h 2. The objective of this study was to determine the efficiency of magnetic beads (Dynabeads) attached with IgE antibodies in the removal of major peanut allergens from peanut extracts. Anti-human IgE antibodies were attached to magnetic beads by incubating Protein G-Dynabeads with goat anti-human IgE antibodies. The resultant anti-IgE-beads were incubated, respectively, with two sera (containing IgE antibodies) of peanut-allergic individuals. This process produced the IgE-Dynabeads which were further incubated with a peanut extract containing major peanut allergens. Allergens that bound to the IgE-beads were retrieved, using 0.1 M glycine hydrochloride, pH 2.5. The retrieved allergens and beads-treated extracts were analyzed by SDS-PAGE and Western blots. Results showed that the majority of major peanut allergens remained in the treated extract, and only small amounts of the allergens, especially Ara h 1, bound to the beads. It was concluded that while the IgE-Dynabeads bound major peanut allergens, the system was not efficient enough to remove peanut allergens to produce a less allergenic peanut extract. Further optimization of the IgE-bead system is needed.
Expansion of a Direct Shoot Organogenesis System in Peanut to include U.S. Varieties.

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The most successful method for producing transgenic peanut is particle bombardment of somatic embryos. One of the major disadvantages of this approach is the time required to produce mature plants (8-12 months). An alternative to lengthy bombardment and regeneration protocols is Agrobacterium-mediated transformation employing direct shoot organogenesis. This strategy allows for mature, transgenic plants to be obtained quickly (3 - 4 months). Peanut cultivars, ‘Florida-07’ (Runner), ‘Georgia Green’ (Runner), ‘Georgia Brown’ (Spanish), ‘New Mexico-A’ (Valencia), and ‘VC2’ (Virginia), were selected to represent all four market types. Two types of cotyledonary explants were examined, those that previously had an attached embryo-axis upon cotyledon separation (explant A) and those that were embryo-axis-free upon separation (explant B). Explants were placed on shoot induction medium (MS salts, B5 vitamins, 3% sucrose, 0.8% agar, 10 µM 2,4-D, pH 5.8) with N6-benzyladenine (BA) concentrations ranging from 10 µM - 80 µM for Florida-07, Georgia Green, and VC2, 10 µM - 320 µM for Georgia Brown, and 10 µM - 640 µM for New Mexico-A. Following a four-week culture period, explants were visually rated based on a scale of 1 to 4, where 1 = slight greening, no growth; 2 = greening, callus-like growth, no adventitious bud formation; 3 = greening, adventitious bud formation; and 4 = greening, adventitious bud formation, small plantlet development. A difference in shoot induction was observed for the cotyledon explants examined (Pr > |t| = <0.0001). Explant A had greater shoot induction with a visual rating of 1.75, while explant B had a rating of 1.64 (Pr > |t| = <0.0001). Additionally, cultivars responded to the culture conditions differently (cultivar * BA interaction). Georgia Green on 40 µM BA producing the most shoot buds (31.2%) and the highest visual rating (2.22), followed by VC2 on 10 µM BA (17.3%, 1.84), New Mexico-A on 640 µM BA (15.9%, 1.84), Georgia Brown on 80 µM BA (9.1%, 1.73), and Florida-07 on 40 µM BA (5.6%, 1.82). Of the tested varieties, Georgia Green, New Mexico-A and VC2 appear to be the best suited for future transformation experiments based on their shoot bud production.
Relative Interference of Eight Palmer Amaranth Populations with Peanut and Other Crops.

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Palmer amaranth (Amaranthus palmeri) has become difficult to control in southern row crops due to development of resistant biotypes that are no longer controlled by acetolactate synthase-inhibiting herbicides and/or glyphosate. This weed is extremely competitive and can cause complete crop failure in some instances. Previous research suggests that biotypes or populations of individual weed species can interfere with crop yield differently. It is suspected that differences in crop response to populations of Palmer amaranth may exist, and determining the relative difference in interference by glyphosate-resistant (GR) populations and glyphosate-susceptible (GS) populations is of interest. The objective of this research was to compare early season interference of corn (Zea mays), cotton (Gossypium hirsutum), peanut (Arachis hypogaea), snap bean (Phaseolus vulgaris), and soybean (Glycine max) growth by eight Palmer amaranth populations collected from Georgia and North Carolina.

Seeds from eight Palmer amaranth populations and corn, cotton, peanut, soybean, and snap bean were planted in 15 cm round plastic pots containing commercial soil medium in two parallel rows 2.5 cm apart. Approximately 6 crops seeds and 25 Palmer amaranth seeds were planted in each pot and eventually thinned to one crop and one Palmer amaranth plant per pot. The experimental design was a randomized complete block with ten replications and the experiment was conducted twice. Height of the Palmer amaranth and crop plants was determined every 5 days beginning one wk after pots were thinned to one Palmer amaranth and one crop plant per pot up to 40 days after emergence (DAE). At 40 DAE, Palmer amaranth and crop plants were severed at the soil surface and fresh and dry weights determined. Corn leaf tips and number of nodes per soybean plant were also recorded at harvest. Data for plant height and weight were subjected to analysis of variance for a six levels of crop (no crop, corn, cotton, peanut, snap bean, soybean) by nine levels of Palmer amaranth population (no Palmer amaranth and eight populations from North Carolina and Georgia) factorial treatment arrangement. Means of significant main effects and interactions were separated using Fisher’s Protect LSD test at p < 0.05.

The interaction of crop by population was not significant for crop height and fresh weight or Palmer amaranth height. However, this interaction was significant for Palmer amaranth fresh weight. Main effect of crop was significant for all parameters while the main effect of population was significant for crop fresh weight (but not crop height) and Palmer amaranth height and population. Lack of an interaction of crop by Palmer amaranth population for crop fresh weight suggests that interference from Palmer amaranth populations is similar for corn, cotton, peanut, soybean, and snap bean. In contrast, the interaction of crop by population was significant for Palmer amaranth fresh weight suggesting that Palmer amaranth growth was affected differently depending on crop. This interaction was most likely caused by the wide range of competitive ability of the crops used in this experiment and the relative uniformity of Palmer amaranth populations. In absence of a crop, Palmer amaranth fresh weight varied among populations. Corn and snap bean were the most competitive crops with Palmer amaranth resulting in relatively low Palmer amaranth weight across all populations. A range of differences in Palmer amaranth weight was noted when comparing populations with cotton, soybean, and peanut. These crops are less competitive than corn and snap bean most likely allowing differential growth of Palmer amaranth populations. This difference in competitiveness was noted for Palmer amaranth height where cotton, soybean, and peanut reduced height by 40 DAE by approximately 17% while presence of corn and snap bean reduced height by approximately 50%. Results from this experiment indicate that interactions among crops by Palmer populations can occur with respect to early season interference with growth of both crops and weeds. However, the effect of these Palmer amaranth populations on crop growth did not vary with respect to crop selection.

One important question of interested is whether there is a fitness penalty for glyphosate resistance in GR weed populations compared with GS populations. While results from this
Peanut Response to Simulated Drift Rates of Dicamba, Glufosinate, and 2,4-D.

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Development and utilization of dicamba, glufosinate, and 2,4-D resistant crop cultivars potentially will have a significant influence on weed control in the southern United States. However, off-site movement to adjacent non-tolerant crops is a concern in many areas of eastern North Carolina, especially where peanut and tobacco are produced. Cotton, peanut, soybean, tobacco, and many vegetable crops not resistant to these herbicides are often grown in close proximity to one another, and practitioners will need to consider potential adverse effects on these crops. Research was initiated in 2009 to determine response of these crops to simulated drift rates of dicamba, glufosinate, and 2,4-D when applied at two locations for each crop in early June to crops planted in early to mid May (cotton, peanut, soybean) or when tobacco was transplanted in April. The highest rate of these respective herbicides was 0.125 lb ai/acre, 0.27 lb ai/acre, and 0.24 lb ai/acre. Herbicides were applied at four additional rates going as low as 0.000488 lb/acre (dicamba), 0.017 lb/acre (glufosinate), and 0.00093 lb/acre (2,4-D). Peanut yield was reduced by only the highest rate of either glufosinate or 2,4-D. Dicamba at 0.125 lb/acre reduced pod yield at one location while rates of 0.125 and 0.03125 lb/acre reduced yield at a second location. Although not reported here, yield of cotton, soybean, and tobacco generally were affected more than yield of peanut. Results from these experiments will be used to emphasize the need for diligence in application of these herbicides in close proximity to adjacent crops that are susceptible as well as the need to clean sprayers completely before spraying sensitive crops.

Additionally, these data will be used to correlate visual injury with yield loss when these herbicides damage susceptible crops.
Reduced tillage peanut (Arachis hypogaea L.) production continues to gain interest in North Carolina. Informal surveys at county production meetings revealed that 10% (1998), 23% (2005), and 41% (2009) of growers produced peanut on a portion of their acreage in reduced tillage.

Research with Virginia market type peanut has been conducted since 1997 to develop recommendations for reduced tillage systems. When pooled over 53 experiments from 1997-2009, pod yield was 3.1% higher (133 lbs/acre) in conventional tillage compared with reduced tillage. However, in a number of these trials yield in reduced tillage was equal to or greater than yield in conventional tillage. Yield in conventional tillage was higher in 28 of 53 trials (53%) compared with reduced tillage which was higher in 47% of trials. Yield often favored conventional tillage when major differences were noted between tillage systems. The range of difference between tillage systems was 15% lower in conventional tillage compared to reduced tillage to 28% higher in conventional tillage compared with reduced tillage. These data indicate that strip tillage is increasingly a viable option for peanut growers in North Carolina. However, defining soils that are more conducive to reduced tillage production continues to be important, and research continues in an effort to assist in making recommendations to producers on implementation of reduced tillage systems for peanut.
Growth and Yield of Valencia, Spanish, Virginia and Runner Market Type Peanuts in Various Row Spacings.

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Currently, the majority of peanuts grown in New Mexico and West Texas are planted in single rows on beds 36 to 40 inches apart. In 2006-2008, several field studies were conducted with Valencia peanuts comparing single row, twin row, and diamond planting patterns in various populations. The basic conclusion of this research was that twin row and diamond planting patterns were at times superior to single row planting. It was also observed that increasing the seeding rate of Valencia peanuts could improve yield at an economically sustainable level. In 2009, we decided to start new experiments that include all four peanut market types in single row, twin row, and diamond planting patterns at the recommended six seed per foot of row. Because of the range of maturity in these market types, an early and a late harvest was made in an attempt to show the interaction of market type and planting pattern yield potential over time. In 2009, the diamond planting pattern had overall poor emergence which drastically affected the yield. The single row and twin row plots emerged with good uniformity. Yield for ‘Valencia C’ ranged between 2,500 and 3,830 lb/A when harvested early and 4,270 and 4,590 lb/A at the late harvest. Grade for ‘Valencia C’ improved between 4 and 6 points between harvest timings. When harvested early in twin rows, ‘Tamnut OL06’ had 27% better yield than single rows or diamond planting. Early harvest grade also improved for Spanish when planted in twin rows by 2 points. The late harvest yield for ‘Tamnut OL06’ ranged between 4,560 and 5,030 lb/A with grades of 72 and 73. Although not significant, the Virginia variety ‘Gregory’ showed potential for a yield advantage when harvested late in twin rows over single rows and diamond planting with 18% higher yield. This was the highest yield in the experiment. The yield range for early harvested ‘Gregory’ was 3,220 and 4,170 lb/A and 5,020 to 6,010 lb/A for late harvest. Virginia grade improved 4 to 6 points between early and late harvest. The runner market type ‘Flavor Runner 458’ had better yield in single rows compared to diamond planting when harvested early. Twin row runners harvested early produced 4,200 lb/A which was similar to single row and diamond planting patterns. The late harvested runners ranged between 5,200 and 5,790 lb/A for all planting patterns with grades 4 to 7 points better than early harvested runners. This experiment will be repeated in 2010.
Leaf area index (LAI) and ground cover (GC) are important parameters as they are directly related to light interception, plant growth, and yield. However, determination of LAI and GC are often tedious processes and, for LAI require destructive sampling. Hence, remote sensing can be a tool for determining LAI and GC non-destructively. Numerous spectral-based models are available in the literature for estimating LAI. Many of these spectral-based models depend on the empirical relationships between LAI and vegetation indices, which sometimes make them site- and sensor-specific. We have conducted a study in a peanut field in Brownfield, TX, to develop a procedure based on the Perpendicular Vegetation Index (PVI) to estimate GC and LAI. Aerial images were collected three times during the growing season using the Texas Tech Airborne Multispectral Remote Sensing System (TTAMRSS) at an altitude of approximately 3000 m. As the first step, vegetation cover is estimated from the ratio of the PVI for an image pixel to the PVI of full vegetation canopy (100% ground cover). In the second step, vegetation cover is converted to LAI using a model relating GC to LAI. The major advantages of using PVI compared to other indices such as Normalized Difference Vegetation Index (NDVI) is that this method does not rely on empirical relationships.
Utility of Flumioxazin in Texas Peanut.

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Flumioxazin (Valor SX) was registered for use in peanut in 2001. Valor SX may be applied prior to planting or preemergence (within 48 hours after planting and prior to peanut emergence). In 2008 and 2009, several studies were conducted in grower fields across the Texas Southern High Plains to evaluate peanut response to Valor SX in large plot replicated trials. In 7 studies over 2 years, Valor SX at 2 oz/A did not reduce peanut yield relative to the non-treated control. In 11 of 12 studies over 2 years, Valor SX at 3 oz/A did not cause a peanut yield reduction; however, in one of four experiments in Dawson County, yield loss in Flavorunner 458 following Valor SX at 3 oz/A was observed. Although peanut injury has been observed in other states, in the High Plains when rates exceeded labeled recommendations, and at one location (following Valor SX at 3 oz/A) in these studies, this herbicide is a valuable option for peanut growers with minimal risks and will provide effective early-season weed control for four to six weeks. Studies were initiated in 2009 and 2010 to determine peanut response to Valor SX at 0, 2, and 3 oz/A and Gramoxone Inteon at 0, 8, and 16 oz/A applied alone and in tank mixture applied preemergence (PRE) or at ground crack (AC). In 2009, peanut stand ranged from 9.2 to 10.8 plants per 3 feet of row and no treatment caused a reduction in stand relative to the non-treated control (9.7 plants/3 feet). Only Valor SX applied AC at 2 and 3 oz/A injured peanut, but this injury was no greater than 5%. Yield from Valor-treated plots ranged from 3424 to 3608 lb/A, and were not reduced relative to the non-treated control (3297 lb/A). Results from this study suggest that Valor SX alone or in tank mix with Gramoxone Inteon is a safe herbicide option to peanut producers in our region. The current Valor SX label states that applications must be made within 48 hours of planting. There is a risk of peanut injury if Valor SX applications are delayed and peanuts are emerging.
Peanut wild relatives contain useful alleles and can be potentially used as a secondary gene pool for improving cultivated peanuts. The variability of oil content and fatty acid composition in these peanut wild relatives were not well assessed. Sixty accessions representing 40 species within Arachis genus covering different genomes (A, B, and D) with different chromosome numbers (18 – 40) and ploidy levels (2x – 4x) were selected from the USDA peanut germplasm collection and evaluated for their oil content and fatty acid composition with nuclear magnetic resonance (NMR) and gas chromatography (GC). Significant variability of oil content and fatty acid composition has been identified among these peanut wild relatives. The information obtained in this study would be useful for further screening peanut wild relatives and introgression of wild species alleles into cultivated peanut in breeding programs.
Helping Producers Adjust to Management of Large-Seeded Runner-Type Peanut Cultivars.

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Five of the more recent runner-type peanut (Arachis hypogaea L.) cultivar releases in the southeast have a seed size that is significantly larger than ‘Georgia Green’. The large-seeded cultivars include ‘Georgia-06G’, ‘Florida-07’, ‘Tifguard’, ‘Georgia-07W’, and ‘AP-4’. The seed count per pound for these cultivars ranges from approximately 600 to 650, compared to 800-850 seed per pound for Georgia Green. This difference in seed size has resulted in some challenges for producers. When sown at the recommended six seed per row-foot rate, the larger seed size cultivars require approximately 30 pounds per acre more seed than Georgia Green. The typical range of seeding rate between Georgia Green and the large-seeded cultivars is 105 to 135 pounds or more per acre. At a seed cost of $0.75 per pound, the cost differential between the two seed sizes is approximately $22.50 per acre more to plant the large-seeded cultivars. Trials were established at three locations in 2008 and 2009 in Georgia to determine if the large-seeded cultivars could be planted at reduced rates in order to lower seed cost per acre without reducing yield potential. Data from the trials indicated no difference in yield (p<0.05) for large-seeded cultivars planted at 5.2 seed per row-foot compared to 6 seed per row-foot. The results indicate a cost savings in seed. Another challenge is the calcium requirement for large-seeded runner cultivars. Trials were established in 2009 to determine the “pegging zone” threshold for large-seeded cultivars. Preliminary data indicates the large-seeded cultivars will require a higher “pegging zone” calcium level. The exact level has yet to be determined.
In 2009, ten commercial runner peanut cultivars were evaluated for their reaction to insect pests and to late early and late leaf spot, rust, stem rot (SR), and Tomato spotted wilt virus (TSWV) at the Wiregrass Research and Extension Center (WREC) in Headland, AL and the Gulf Coast Research and Extension Center (GCREC) in Fairhope, AL. Recommendations of the Alabama Cooperative Extension System for tillage, fertility, weed, and nematode control were followed. Soil insecticide sub-plot treatments included Temik 15G at 6.5 lb/A, Thimet 20G at 4 lb/A, and a non-insecticide treated control. A high input fungicide program for the control of leaf spot diseases and SR was followed. A RCB with six replications was used. Plots consisted of four 30-ft rows spaced 36 to 38-in apart. Incidence of TSWV was assessed at three different dates during the growing season. Leaf spot was rated using the Florida 1-10 leaf spot scoring system and rust was rated using the ICRISAT 1-9 rust rating scale. Hit counts for SR were taken immediately after plot inversion (hit equaled < 1 foot of consecutive diseased plants per row). Yields are reported at + 10% moisture. Late leaf spot was the dominant foliar disease at both locations however rust pressure was high at the GCREC due to late season rains. At the WREC, the soil insecticides Temik 15G and Thimet 20G significantly reduced TSWV incidence on five and seven of the cultivars, respectively. Neither soil insecticide Temik 15G and Thimet 20G significantly reduced TSWV incidence on Florida 07 or Georgia 06G. While Thimet 20G reduced SR incidence compared with Temik 15G, leaf spot ratings and yield for the soil insecticide treated and the non-treated peanuts was similar. Low disease ratings were not always associated with the highest yields. With the exception of Georgia Green, TSWV incidence had no impact on yield. Georgia 07W and McCloud, which were two of the higher yielding cultivars, had the highest leaf spot ratings. At the GCREC, the soil insecticides Temik 15G and Thimet 20G reduced the incidence of TSWV and increased yield when compared with the nontreated control. Significant reductions in rust severity obtained with Thimet 20G were not reflected in higher pod yields. Low leaf spot, rust and SR ratings for York and Georgia 02C translated into higher yields. Yields for AP-4, Florida 07, Georgia 06G, Georgia Greener, and Tifguard were similar to those reported for the current industry standard Georgia Green.
Seminole County Extension responds to need for farmers, agribusiness and general public to have timely tips and educational information. New era of electronic communication brings need for timely agricultural information through email and the internet. Agricultural awareness for community leaders and the general public is important as decisions are made by these folks who need to be more informed and up to date about what is going on in agriculture. New generation of farmers want information electronically available.

The agent developed “Seminole Crop E News” electronic newsletter to disseminate breaking news concerning agriculture. He developed an email list of farmers, agribusiness folks, and local community leaders and is continually expanding it. This newsletter contains many photos of crops, insects, disease problems and farm activities. It includes hot topics of concern to growers and excerpts from scientist’s newsletters and links to websites and downloads of timely interest.

“Seminole Crop E News” has been well received by farmers and others on the over 200 person email list that receives the newsletters. Newsletters are placed on our UGA Seminole County Extension website (http://www.ugaextension.com/seminole/) and can also be accessed on other websites such as sowegalive.com, Agfax.com, and WTVY.com.
A long-term seed storage environment is important in maintaining good seed viability for commercial seed production operations. This study was conducted to determine what type of storage condition best plays a role in certain cultivars having better seed viability than others. During 2008, we harvested about 90 early, medium, and late maturing cultivars from two yield tests and placed them in two different locations for a year. The first location was in a cold storage unit of a temperature range of 45-50 degrees Fahrenheit all the time, while the second location was in a warehouse bin with temperatures fluctuating with the outside weather through the year. During 2009, we tested the cultivars three different times with a rag-doll germination test, a water conductivity test, and a soil germination test, only once at the end. The tests were performed three months apart from each other, first in March, second in July, and finally in December. Seed germination with the rag-doll tests showed little to no correlation between test one and two in the cold unit and warehouse storage. (P = ?) However, there seemed to be a significant difference on the second and third rag-doll test between the two storage environments. (P = ?). Water conductivity tests showed very little correlation between test one and two in the cold unit and warehouse storage. (P = ?). But, there were bigger differences between the second and third test between the two storage environments (P = ?), showing some of the peanut cultivar seeds deteriorating by the third test, with a higher leachate reading than they had on the second test.
Effect of Herbicide and Fungicide Tank-mixes on Disease and Weed Control in Peanut.

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Postemergence weed control and foliar and/or soilborne disease control are major concerns for peanut growers across the state. Requests from peanut growers about the possibility of mixing postemergence herbicides with a foliar fungicide seem to increase every year because of the need to reduce field operations in order to reduce fuel costs. Therefore, field studies were conducted in south, central, and west Texas from 2007 through 2009 to determine the effects of various tank-mix combinations of postemergence herbicides (acifluorfen, clethodim, sethoxydim, imazapic, imazethapyr, lactofen, and 2,4-DB) with three commonly used peanut fungicides (prothioconazole + tebuconazole, pyraclostrobin, tebuconazole, fluazinam, and boscalid) on annual grass and broadleaf weed control as well as foliar and soil-borne disease control.

Weed control. Broadleaf signalgrass [Brachiaria platyphylla (Griseb.) Nash], Texas millet [Urochloa texana (Buckl.) R. Webster] and southern crabgrass [Digitaria ciliaris (Retz.) Koel] control was not reduced (at least 87%) when clethodim or sethoxydim were tank-mixed with any of the fungicides compared with clethodim or sethoxydim applied alone. In west Texas, the combination of 2,4-DB and prothioconazole + tebuconazole did result in antagonism in one year with only 30% Palmer amaranth (Amaranthus palmeri L.) control. In south Texas, lactofen, imazapic, or 2,4-DB alone or in combination with any of the fungicides did not result in reduced control of Palmer amaranth. However, either acifluorfen or imazethapyr plus pyraclostrobin and imazethapyr plus pyraclostrobin resulted in reduced Palmer amaranth control from either of the herbicides alone. Lactofen, acifluorfen, imazapic, and 2,4-DB alone or in combination with fungicides provided at least 97% control of smellmelon (Cucumis melo L. var. Dudaim Naud). Imazethapyr alone controlled smellmelon only 79% while imazethapyr in combination with any of the fungicides provided at least 90% control. All herbicides alone or in combination with prothioconazole + tebuconazole, pyraclostrobin, or tebuconazole controlled pitted morningglory at least 90% with the exception of lactofen plus pyraclostrobin which resulted in 79% control.

Disease control. Early leafspot (Cercospora arachidicola S. Hori) was the predominant species at all locations in both years. When fungicides were applied in combination with broadleaf herbicides at Lamesa none of the fungicide-herbicide combinations resulted in greater leafspot control than the respective fungicide alone. At Yoakum, all fungicide-herbicide combinations resulted in less leafspot than the untreated check in 2008 and 2009; however, in 2009, reduced leafspot efficacy was noted with pyraclostrobin + imazapic and tebuconazole + clethodim, acifluorfen, or imazapic compared with pyraclostrobin or tebuconazole alone. Southern blight (Sclerotium rolfsii Sacc.) pressure was only present at the Yoakum location and was considered light. When fungicides were applied in combination with herbicides, all fungicide-herbicide combinations, with the exception of pyraclostrobin plus 2,4-DB, produced no more southern blight disease than the respective fungicide alone. No effects on Sclerotinia blight (Sclerotinia minor Jagger) control were noted when clethodim or sethoxydim were applied in combination with boscalid or fluazinam.

Peanut Injury. When broadleaf herbicides were evaluated, lactofen and acifluorfen resulted in peanut injury and the addition of prothioconazole + tebuconazole pyraclostrobin, or tebuconazole did not enhance crop injury. No injury was observed following imazapic, imazethapyr, or 2,4-DB alone but enhanced peanut injury was observed when pyraclostrobin was added to imazapic, imazethapyr, or 2,4-DB; when tebuconazole was added to 2,4-DB or imazapic; and when prothioconazole + tebuconazole was added to imazapic, imazethapyr or 2,4-DB depending on location and year. When grass herbicides were evaluated, no peanut injury was noted in south Texas while in the High Plains, clethodim plus either tebuconazole or prothioconazole + tebuconazole and sethoxydim in combination with any of the fungicides resulted in increased peanut injury when compared with the untreated check.
Thrips Management in Peanut: Evaluation of New Insecticides and Peanut Varieties.

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In 2009, five thrips management experiments were conducted in peanut, four in Suffolk, VA and one in North Carolina. Two evaluated experimental seed treatments (Cruiser 70WS, A17460, A17461, A17462) and compared them to standards (Thimet 20G and Temik 15G). One evaluated different rates of DPX-HGW86 20SC applied as a liquid in-furrow and compared them to the same standards. A fourth evaluated foliar broadcast insecticides (Orthene 97, Radiant SC, Karate Z, Ecotec, and Requiem 25EC). The fifth evaluated virginia-type peanut varieties/lines (‘VT 003069’, ‘VT 003194’, ‘VT 004152’, ‘VT 024077’, ‘VT 024051’, ‘VT 9506083-3’, and ‘Bailey’) for susceptibility to thrips.

In the seed treatment tests, there were significant differences in plant injury caused by thrips feeding on all four sample dates, with all treatments except those with fungicide alone performing better than the non-treated check. Plants in treatments with in-furrow applications of Thimet 20G or Temik 15G had the least injury, but seed treatments that included insecticides were very close, and often were not significantly different. Results were similar with numbers of thrips. On most sample dates, seed treatments that included insecticides and the in-furrow insecticide treatments had the fewest thrips. This was especially apparent on 9 Jun when the immature population peaked at 120 per 10 leaflet sample in the non-treated check. On that date all insecticide treatments (seed and in-furrow) were equally effective at reducing immature populations. Late-season Tomato spotted wilt incidence (hits per 80 row ft) included a high of 12.8 in the numbered compound ‘A17461’, 10.8 in the non-treated check, and a low of 2.8 in the Thimet treatment. Pod yield data followed these trends with the lowest yields in the non-treated checks, ranging from 5,040 to 5,293 lb/acre. Yields with the other treatments were much higher and ranged from 5,589 to 6,165 lb/acre. The highest yields were achieved with the in-furrow treatments (Thimet 20G, Temik 15G) and the seed treatments with Cruiser 70WS and the numbered compound ‘A17460’. These ranged from 5,831 to 6,165 lb/acre.

In the DPX-HGW86 20SC liquid in-furrow test, all treatments had significantly less plant injury relative to the non-treated check on all four sample dates. The DPX-HGW86 20SC treatments held well until the 9 Jun rating, then provided less control compared with the in-furrow treatments with Thimet 20G and Temik 15G. There were differences between treatments for adult tobacco thrips populations on 27 May and 2 Jun but not on later sample dates. At the adult peak (2 Jun), only Temik 15G treated plots had significantly fewer thrips than the non-treated check. All treatments had significantly fewer immature tobacco thrips than the non-treated check on 2 and 9 Jun, with no differences between treatments on these dates. Treatments significantly reduced Tomato spotted wilt incidence on 28 Sep relative to the non-treated check, with differences between treatments. Yields were statistically the same among treatments and resulted in an average increase of 603 lb/acre compared with the non-treated check.

In the foliar broadcast insecticide test, there were significant differences in plant injury on all four sample dates, with Requiem 25EC not differing from the non-treated check on any date. Karate Z and a tank mix of Ecotec + Karate Z were also not different from the check on the dates when thrips injury was the most severe. The treatments that provided the best control and had the least injury were tank mixes of Ecotec + Radiant SC and Ecotec + Orthene 97. Five of nine treatments had yields that were not different from the check including Requiem 25EC, Karate Z, Ecotec + Karate Z (2 rates), and the low rate of Ecotec + Radiant SC. The highest yields were obtained with tank mixes of Ecotec (high and low rates) + Orthene 97, Ecotec (high rate) + Radiant SC, and Orthene 97 alone.
In the Virginia-type variety/lines test, there were significant differences in plant injury on two of four sample dates, with VT 9506083-3 and Bailey having the most injury. Number of adult thrips differed significantly on one of four sample dates (2 Jun), also the “peak” date for adults, with a range of 8.8 (VT 003069 and VT 024077) to 20.5 (VT 024051) adult thrips per 10 terminal leaflets. Numbers of immature thrips were not significantly different on any sample date, with a range of 52.3 to 108.5 thrips per 10 terminal leaflets on the peak date of 9 Jun. Late-season evaluation of Tomato spotted wilt indicated significant differences between treatments, with Bailey having the fewest hits (7.5/80 row ft), and VT 004152 and VT 024077 having the
Traditionally, peanut cultivar development has been dominated by conventional breeding methods, which have greatly increased yield and will continue to play an important role in peanut genetic improvement. Applications of MAS (marker-assisted selection) in plant breeding have been shown to increase significantly the rate of genetic gain when compared to conventional breeding. The cost of genotyping and throughput are still a concern in marker-assisted selection in peanut breeding. The objective of this study is to introduce a simple, low-cost, and high-throughput protocol for genotyping in peanuts. The developed system was based on polyacrylamide gel to separate PCR amplified DNA fragments and silver stain to visualize the bands. In this system, one electrophoresis unit (cost less than $200) can hold two vertical 52-sample slab gels, and the cost of the unit is less than $200. The electrophoresis runs about 1 hr and 40 min at 180 V for a 9% polyacrylamide gel or 1 hr and 20 min at 160 V for a 6% polyacrylamide gel. The silver stain takes 30 min. After stained, the gels can be placed on the light-box for genotyping score and the gel image can be photographed using digital camera. The cost per gel is estimated at $0.54 and the cost for silver stain is estimated at $0.37. Therefore, the total cost could be as low as $0.018 per data point, excluding PCR reaction and DNA extraction cost. This system has been successfully used in our peanut genetic mapping, and could generate over 1,000 data points by one person a day.
Application of the CSM–CROPGRO–Peanut Model in Assisting with the Performance Evaluation of Peanut Lines at the Early Stage of Yield Testing.

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The success in deriving the cultivar coefficients from a reduced set of field data allows the use of crop models in assisting with performance evaluation of crop breeding lines at the early testing stage. At this stage, the lines are normally tested in only a few environments, and selection decisions are based on these limited tests. The model can provide simulated yield of the tested peanut genotypes for a wide range of environments and in multiple years. These simulated yield data can help plant breeders make decisions on line selection more accurately and effectively. However, the actual practice of this application so far has not been evaluated with real data. The objective of this study was to evaluate the application of the Cropping System Model (CSM)–CROPGRO–Peanut in assisting with performance evaluation of peanut breeding lines at the early testing stage. Two sets of peanut lines in the preliminary yield trial (PYT) stage, referred to as Set I and Set II, were yield tested at Khon Kaen University for three environments during 2004–2005. Separate experiments for these lines were also simultaneously conducted for two seasons to obtain reduced data sets for determining the cultivar coefficients that are needed for the CSM–CROPGRO–Peanut model. The model was then used to simulate pod yield of the test lines for the same three environments in which they were actually tested in the PYTs. In addition, the model was used to simulate pod yield for 130 locations that covered all major peanut production areas in Thailand for 30 years for a total of 3,900 unique environments in order to extend the range of the environments of the PYTs. Three selection scenarios were employed based on genotypic ranking by observed yield from the PYTs, by simulated yield for 3,900 environments, and by both observed and simulated yields. The results showed that model simulation picked up more genotype x environment (G x E) interaction in extending the range of the test environments from 3 to 3,900. Among the top 50% highest yielding lines in Sets I and II, actual PYTs and model simulations were found to identify the same four out of nine lines in Set I and nine out of 12 lines in Set II. The results from the model simulations also indicated that some lines with high yield potential could have been eliminated in the early stage of yield evaluation if selection was based on only observed yield from the PYT. Likewise, some lines with high observed yield could have also been eliminated if selection was based on only simulated yield. It was concluded that using both simulated yield based on the CSM-CROPGRO-Peanut model and observed yield from actual PYT as the basis for selection will ensure that these lines will not be eliminated, and will make line selection at the early evaluation stage more effective.
Variability of Total Oil Content in Peanut Across the State of Texas.

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The state of Texas has three major growing regions; South, Central, and West, with a history of peanut production. The Texas AgriLIFE peanut breeding program conducts a replicated advanced yield trial at multiple locations within each of these regions annually. We routinely sample high oleic varieties from each of these environments across multiple years and locations and we have found that it is common for oleic/linoleic fatty acid ratios in the West Texas environment to be as much as 10 points lower than ratios from the South and Central, Texas environments. We initiated a study using entries from our advanced line test to determine if there was an inter-regional and or intra-regional effect on total oil content variability between and within the entries. The hypothesis of the study was that we would see differences in total oil content between the three regions based on the differences we have detected with O/L ratios. The study was comprised of five cultivars used as checks in our yield tests and five of our breeding lines for a total of ten entries. Three replications of each entry were tested for two South Texas, two West Texas, and two Central Texas locations. All of the samples were tested with a Nuclear Magnetic Resonance (NMR) machine which was used as a non-destructive test to determine the total oil content of a sample. Random samples of 70g sound mature kernels (SMK) were shelled from each replication of each entry and then three 20g subsamples from each of the 70g samples were tested using the NMR. Samples were harvested from the 2008 and 2009 growing seasons. Initial results indicate that unlike the O/L ratios, there were no significant regional differences due to locations for total oil content. Peanut maturity was the greatest contributing factor to the differences detected in the total oil content of the genotypes in this study.
A field experiment was conducted to evaluate herbicide and application timing on cutleaf groundcherry population, biomass, seed production, and peanut yield. Treatments included: 1) a non-treated control; 2) hand pruning; 3) diclosulam applied preemergence (PRE) at 0.027 kg ai/ha alone; 4) paraquat applied at cracking postemergence (POST) at 0.14 kg ai/ha followed by bentazon at 0.56 kg ai/ha alone or mixed with 5) 2,4-DB at 0.22 kg ae/ha; 6) acifluorfen at 0.28 kg ai/ha; 7) imazapic at 0.07 kg ai/ha; or 8) chlorimuron ethyl at 0.00875 kg ai/ha. Hand pruning and POST herbicides were applied at four weekly intervals beginning June 23rd. Diclosulam applied PRE provided season-long cutleaf groundcherry control; imazapic applied at the two earliest POST timing also provided excellent control. Use of basagran alone or mixed with chlorimuron ethyl, or hand pruning increased cutleaf groundcherry biomass and subsequent seed production compared to the non-treated control in almost all comparisons. Peanut yield reflected cutleaf groundcherry control. Utilizing herbicides that injure but do not control cutleaf groundcherry may increase seed production.
Peanut root distribution patterns are not well understood and have not been studied extensively. There is a lack of information on the classification of root distribution patterns for many peanut genotypes under mid-season drought, which could be useful for peanut drought breeding programs. The goal of this study was to determine the root distribution pattern of 40 peanut genotypes under mid-season drought. The experiment was conducted in 2007 on the research farm of Khon Kaen University, Thailand. All plots were well-irrigated, except during the period from 50 to 83 days after planting when water was withheld, corresponding to a mid-season drought. Root samples were obtained using the auger method on the most water-stressed date at the end of the drought period. The samples were collected at two positions, including at the center between two plants in the row and between row positions. The soil was sampled to a depth of 90 cm and was separated into three layers, including upper (0 to 30 cm), middle (30 to 60 cm) and deeper (60 to 90 cm) soil layers. Root length density (RLD) was analyzed with the Winrhizo program. For each peanut genotype the relative contribution to each layer was calculated and defined as %RLD. Then, the forty peanut genotypes were categorized as either high and low %RLD depending on the mean of %RLD in each layer for the three soil layers. The range for the high %RLD genotypes for the upper layer was 67.3-56.1%, whereas the range for the low %RLD genotypes was 54.9-39.1%. For the middle layer, the range of the high %RLD genotypes was 33.4-27.2%, while the range for the low %RLD was 27.0-17.8%. For the lower layer, the range for the high %RLD genotypes was 28.7-17.4%, while the range for the low %RLD genotypes was 17.0-5.6%. The 40 peanut genotypes were then categorized into six combinative groups, based on the high and low %RLD for each of the three layers. The relationship between %RLD in the lower layer (60 to 90 cm) and yield was determined and found to be positive, indicating that %RLD in the lower layer is an important trait that affects pod yield and top dry weight under mid-season drought conditions.
Simple Sequence Repeat Marker Variability Among Arachis Species.

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Developing species-specific DNA markers is desirable for both maintaining germplasm purity and identifying interspecific peanut hybrids. The objective of this study was to identify species-specific Simple Sequence Repeat (SSR) markers in Arachis species. Cultivar NC-V 11 and 64 accessions of 42 wild Arachis species, representing all sections of the genus except Trierectoides, were analyzed with 55 SSR primer pairs. Either one or two plants per accession were evaluated, but very low levels of polymorphism were observed within accessions. The 55 primer pairs generated 948 SSR marker bands among all the 42 species. Between 17 (A. pusilla) and 134 (A. correntina) SSR marker bands were observed for an individual species, most of which also were observed in other species of the genus. However, from one to 12 unique bands were identified in 30 species that allowed positive identification of entries. A few species, for example A. duranensis, were highly variable and accessions within the taxa could be separated. The diploid and tetraploid species of section Rhizomatosae were highly divergent and A. burkartii is an unlikely progenitor of the tetraploids. Species within sections Caulorhizeae and Triseminatae had two and six common banding patterns, respectively, each of which was unique from other species. One common marker was observed between two species in section Heterantheae, but the band also occurred in sections Arachis and Rhizomatosae. A common marker was observed among the five species in section Erectoides, but it was also found in sections Extrarnosae, Procumbense, and Rhizomatosae. Finally, seven common markers were observed among the three Procumbentes species, six of which were found in species of one to several other sections. This study identified many unique banding patterns within species of the genus Arachis that will be useful for preserving the wild Arachis genetic resources and for identifying interspecific peanut hybrids.
Early maturing peanut cultivars are a necessity in Virginia-Carolina and west Texas, regions that have short growing seasons with cool night temperatures at season’s end. However, breeding early cultivars is difficult because peanut maturity involves complex biochemical processes that are influenced by many genes and the environment. Furthermore, current methods for maturity assessment are laborious and relatively subjective. Molecular markers provide a powerful tool to improve the efficiency of breeding methods when using Marker Assisted Selection (MAS). Among these markers, Simple Sequence Repeats (SSRs) are highly polymorphic even among the highly conserved elite US cultivated peanut genomes. Establishment of associations between specific genomic regions and early maturing phenotypes, and subsequent implementation of MAS could provide an efficient and objective assessment method of maturity. In the present study, two populations of recombinant inbred lines (RILs) were developed from the crosses of a high-oleic backcross derivative of Chico, a very early maturing Spanish-type cultivar, by PI 313949 and PI 365550, two Bolivian PIs with pronounced late maturity. A total of 200 and 191 polymorphic markers for the Chico / PI 313949 and Chico / PI 365550 populations, respectively, were identified from a set of 426 SSR markers that had been previously found to be variable among other cultivated peanuts. These markers were used to genotype the populations and to create two linkage maps. Subsequently, genotypic and phenotypic data were analyzed, in order to identify QTL associated with early maturity.
For over 30 years University of Florida’s peanut breeding program has made it a priority to develop and deploy leaf spot resistant peanut cultivars. Utilization of leaf spot resistant peanut cultivars would lessen environmental impact of repeated fungicide applications while reducing production costs. Leaf spot resistant peanut lines have been developed but suffer from poor seed quality and delayed maturity. Poor seed germination may be tied to low seed calcium concentration and low antioxidant capacity. This project will determine if antioxidant capacity and seed calcium levels are related to germination and seedling emergence in breeding populations diverse for those traits. In addition to classical breeding, we will utilize a transgenic approach to develop novel germplasm with the potential for leaf spot resistance and normal relative maturity. The focus of this project, using classical and transgenic approaches, is to develop a commercially viable peanut cultivar with acceptable seed germination quality, normal maturity, and resistance to leaf spot.

Knowledge of careers in plant breeding is lacking in secondary schools. Our project seeks to educate a key demographic group (middle and high school students) about the importance of plant breeding in agriculture and about careers in plant breeding. By improving students’ scientific literacy and exposing them to potential careers in plant breeding, we anticipate more students will be motivated towards this career path. A 4-H Youth Development curriculum will be developed to introduce plant breeding and career/educational opportunities in plant breeding and related fields. We will provide a pedagogically sound set of educational and career exploration experiences to students. This includes exposure to plant breeding research, career information and examination of the contributions of famous plant breeders. This integrated research and education project is supported by a grant from the National Institute of Food and Agriculture under the Agriculture and Food Research Initiative, Plant Breeding and Education Program of 2009.
Peanut seed have approximately 50% oil which is primarily composed of fatty acids (FA). The three main FAs are palmitic (16:0), oleic (18:1) and linoleic (18.2), which constitute about 90% of the oil. Oleic and linoleic are unsaturated and more desirable from a health standpoint. Oleic is much more stable than linoleic, which oxidizes 10 times faster producing off flavors and unhealthy byproducts. High oleic gives longer shelf-life and is most desirable from several health aspects. High oleic peanuts have oil chemistry essentially the same as olive oil. The first high oleic (80±% oleic) peanut (HOP) cultivar was SunOleic 95R, released by UF in 1995. Numerous HOPs have been released since 1995 by UF, UGA, TAES, AgraTech, and NC State in the US, as well as programs in Australia, Argentina, South Africa, and possibly others. Early releases in the US were very susceptible to Tomato Spotted Wilt Virus, which delayed production in the SE USA. There is currently significant production of HOPs in the SW (Texas, OK) and the SE (GA, FL, AL). Almost all of the SW acreage is in HOPs. Cultivars currently in production in the SE are FL-07, Ga-02C, AgraTech 215, Fla. Fancy, and McCloud. SW production includes Flavor runner 485, TAES---------- and AgraTech 215. HOPs available to growers and the industry include runner, Virginia, and Spanish market-types. Australian production and marketing has moved totally to HOPs, noting the shelf-life and health advantages. The US has been slow to market HOPs to the consumer and inform consumers of the benefits. Many other crops are currently producing or developing high oleic cultivars (sunflower, canola, soybean, oats, corn, etc.).
Germins and germin-like proteins (GLPs) play diversified roles in plant development and basic defense. In this study, 36 EST-clones encoding GLPs were identified. Sequence similarity analysis demonstrated that the peanut genome possessed multi-gene family encoding at least 8 GLPs, named AhGLP1 to AhGLP8. Out of the 8 AhGLPs, three (AhGLP1 AhGLP2 and AhGLP3) were identified in 14, 10 and 7 EST clones, respectively, whereas the remaining ones were identified in a single clone. The length of the deduced amino acid residues of AhGLPs is ranged from 208 to 223 with exceptions of AhGLP6 and AhGLP8, which was incomplete at carboxyl terminus. All the AhGLPs contained a possible N-terminal signal peptide with a range of 17-24 residues in length excluding AhGLP7, which was predicted to contain a non-cleavable amino-terminal sequence. Phylogenetic analysis showed that these AhGLPs were classified into three subfamilies (subfamily 1, 2 and 3). All AhGLPs shared the conserved structural motifs that other known GLPs have. Southern blot analysis revealed that AhGLP1 and AhGLP2 likely have at least four copies in the allotetraploid peanut genome. The recombinant mature AhGLP1 and AhGLP2 proteins were successfully expressed in E. coli. The purified recombinant AhGLP2 protein shows the superoxide dismutase activity in enzymatic assay. However, attempts to demonstrate oxalate oxidase (OXOX) activity for AhGLP2 protein have failed. The superoxide dismutase (SOD) activity related to AhGLP2 was stable up to 70°C and resistant to high concentration of hydrogen peroxide, which revealed that AhGLP SOD might be a manganese-containing SOD. Moreover, AhGLP2 was capable of providing protection in E. coli against oxidative damage attributable to free radicals caused by the herbicide paraquat, suggesting that AhGLP associated with SOD activity will likely protect peanut from reactive oxygen metabolites. In summary, the results provide the insight information into the diverse nature of the peanut GLP family and suggest that some of AhGLPs might play an important role in plant defense responding to environmental abiotic or biotic stress.
Research was conducted to evaluate seven planted peanut varieties. Farmers continue to look for successful peanut varieties comparable to Georgia Green as well as the best value. A large portion of peanut acreage planted is dry land and this test provided valuable information. The field selected for this study was planted using conventional tillage methods and was dry land. Varieties that were assessed included: Georgia Green, Georgia Greener, Georgia O2C, Georgia O6G, Florida O7, Georgia O7W, and Tifgard. The planting date was May 19, 2009, and the digging date was determined based on maturity sampling. The experimental design was a randomized complete block. Each of the five replications contained seven plots. The trial was planted with John Deere air planter. Each of the four single row plots was planted on 36 inch row centers with similar row lengths across the trial. The plot lengths were measured using GPS. Stand counts were taken after emergence. Each plot was rated for leaf spot, white mold, and tomato spotted wilt virus (TSWV). These diseases did not significantly impact yield or grade. Yield was determined on each plot. Each variety was graded.
Evaluating Florida-07 for Leaf Spot Tolerance.

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Florida-07, a peanut cultivar recently released by the University of Florida, displays classic symptoms of leaf spot susceptibility, having numerous lesions and heavy defoliation. However, it has been observed to produces good yields even with severe symptoms of leaf spot. Therefore, our hypothesis is that Florida-07 possesses tolerance to leaf spot. To test this hypothesis, Florida-07 was compared to a known leaf spot susceptible cultivar, AP-3, and a known resistant, York. Experiments were conducted in Gainesville, FL in 2008 and Marianna, FL in 2008-2009 seasons. For all years and locations, late leaf spot (Cercosporidium personatum (Berk and M. A. Curtis) Deighton) appeared to be the predominant foliar pathogen. The experimental design was a randomized complete block with a split-plot treatment arrangement and three replications. The cultivars were assigned to the sub-plots and fungicide treatment (full-season vs. no spray) was assigned to the main plots. Data collected included area under the disease progress (AUDPC) curve for visual leaf spot rating (Florida 1-10 scale), lesion/leaf percentage, lesion density, and average lesion area. Following harvest, pod yield and seed grade were determined. In regard to visual rating, lesion/leaf percentage, and lesion density, the rate of disease progression (AUDPC) was the same in sprayed and non-sprayed York, sprayed AP-3, and sprayed Florida-07. Disease progression was also observed to be the same in non-sprayed AP-3 and non-sprayed Florida-07, but at a rate significantly faster than the aforementioned cultivar*treatments. Regardless of cultivar*treatment, lesion growth occurred at the same rate. Based on these data, we conclude that Florida-07 and AP-3 possess the same degree of susceptibility to late leaf spot disease. The impact of leaf spot on pod yield of Florida-07 was similar to its impact on pod yield of AP-3 in two out of three tests, but in the third test, leaf spot impacted pod yield of Florida-07 (968 lbs/A loss) less than it did AP-3 (1778 lbs/A loss) (p>t=0.0524). On average, however, yield loss (sprayed minus non-sprayed) of AP-3 (1440 lbs/A) was not different than that of Florida-07 (1026 lbs/A). Therefore, we can also conclude that in some environments, Florida-07 may provide a degree of tolerance to late leaf spot disease that AP-3 does not possess. However, on average, these results suggest that Florida-07 does not possess significant tolerance to leaf spot.
Co-application of herbicides, fungicides, insecticides, plant growth regulators, micronutrients, or adjuvants can broaden the spectrum of pest control and increase efficiency of pest management practices in peanut (Arachis hypogaea L.). Research was conducted in 2008 and 2009 to determine interactions of five way mixtures applied for control of weeds, diseases and insects and to improve row definition in peanut. The herbicides clethodim, lactofen, imazapic, imazethapyr, sethoxydim, and 2,4-DB were evaluated in separate experiments when applied alone or in combination with three fungicide treatments (no fungicide, chlorothalonil plus tebuconazole, or pyraclostrobin), two insecticide treatments (no insecticide or lambda-cyhalothrin), three micronutrient treatments (no micronutrient, boron, or manganese), and two adjuvant/conditioning agent treatments (nonionic surfactant or Class Act for imazapic, no adjuvant or Class Act for 2,4-DB, crop oil concentrate or Class Act for clethodim and lactofen). Canopy defoliation of peanut caused by early leaf spot (Cercospora arachidicola) and late leaf spot (Cercosporidium personatum) was evaluated during 2008 and 2009. Pyraclostrobin and chlorothalonil plus tebuconazole (2008) or chlorothalonil and tebuconazole plus prothioconazole (2009) were applied alone or in combination with two insecticide treatments (no insecticide or lambda-cyhalothrin), three micronutrient treatments (no micronutrient, boron, or manganese), and three herbicide treatments (no herbicide, clethodim plus crop oil concentrate, or 2,4-DB). Two additional sprays of each pyraclostrobin followed by chlorothalonil were applied in both years on half of each plot. Experiments were also conducted to compare corn earworm [Helicoverpa zea (Boddie)] and fall armyworm [Spodoptera frugiperda (J.E. Smith)] control with two insecticide treatments (lambda-cyhalothrin and fenapropathrin) applied alone or with three herbicide treatments (no herbicide, clethodim plus crop oil concentrate, or 2,4-DB), two fungicide treatments (no fungicide or pyraclostrobin), and three micronutrient treatments (no micronutrients, boron, or manganese). One experiment was conducted during 2009 with the insecticide acephate for thrips (Franklinella spp.) control in combination with three non-residual herbicide treatments (no herbicide, paraquat, or bentazon), four residual herbicide treatments (no herbicide, S-metolachlor, dimethenamid-P, or alachlor) for thrips control in peanut. Experiments were also conducted to compare efficacy of prohexadione calcium in improving the row definition and visibility when applied alone or in combination with two insecticide treatments (no insecticide or lambda-cyhalothrin), two fungicide treatments (no fungicide or pyraclostrobin), and three micronutrient treatments (no micronutrients, boron, or manganese). A portion of the prohexadione-treated plots received one additional spray of prohexadione calcium. Prohexadione calcium was applied with crop oil concentrate and nitrogen solution. Weed control was affected in several instances by adjuvant/conditioning agent, micronutrients, and fungicides while insecticide had the least observable influence of herbicide efficacy. However, no clear trend was observed within or across herbicide comparisons. Canopy defoliation was lower when fungicides were applied three times compared to a single fungicide application regardless of the agrochemical combination. The micronutrients boron and manganese negatively affected fungicide efficacy in some but not all experiments. When interactions were observed among fungicide combinations, in most cases the percent canopy defoliation differences among treatments were minor. Populations of fall armyworm and corn earworm were low and therefore no conclusion about the role of co-application could be drawn from these experiments. However, there was no increase in crop phytotoxicity when insecticides were applied with other agrochemicals. Damage from tobacco thrips feeding did not differ appreciably when acephate was applied alone or with other agrochemicals. However, peanut was damaged more by some combinations of herbicides, especially when tobacco thrips damage was high in cases where acephate was not included. Prohexadione calcium improved row visibility, especially when applied sequentially. Applying prohexadione calcium with other agrochemicals did not negatively affect ability of prohexadione calcium to improve row visibility. Sequential applications of prohexadione calcium were more effective than single applications in improving row visibility regardless of the agrochemical combination. Collectively, results from experiments with up to five-way mixtures used for weed, disease, or insect control.
Sod-based production systems have been successful in some regions of the southeastern and mid-Atlantic region of the United States as an alternative to conventional tillage systems. Research was conducted in North Carolina to compare corn, cotton, peanut, and soybean yield when these crops were strip tilled following four years of tall fescue versus four years of either corn or cotton grown in no till or strip till systems. Cotton yield was higher following tall fescue at all locations compared with yield following agronomic crops. Yield of corn was lower following tall fescue compared with agronomic crops while peanut and soybean were not affected by previous cropping history. Additional treatments in peanut included conventional tillage following both cropping systems, and pod yield was lower at all locations when peanut was strip tilled into either tall fescue or residue from corn or cotton compared with conventional tillage systems. No major differences in soil bulk density or porosity were noted when comparing tall fescue or agronomic crops. Populations of soil parasitic nematodes were often lower in peanut following tall fescue compared with agronomic crops. These experiments indicate that sod-based systems may be an effective alternative to reduced tillage systems, especially for cotton. However, benefits were not observed for peanut or soybean and corn was negatively affected by tall fescue sod.
Evaluation of Pesticide Efficacy in Situations where Spray Application is Delayed.

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Weather events, equipment failure, and other unforeseen events can prevent the timely application of spray solutions. Although pesticides are often left in the spray tank for numerous days, there is little information available to growers concerning the effects of delayed applications on efficacy. The objective of this research was to determine the influence of delayed spray application on efficacy of pesticides commonly applied to peanut. Research was conducted in North Carolina during 2009 to determine the influence of delayed applications on efficacy of peanut fungicides, herbicides, insecticides, and prohexadione calcium. Treatments included four timings of mixing prior to application: mixing the day of the application (0 day), and mixing 3, 6, and 9 days prior to application. Pesticides were stored in plastic bottles in the dark at room temperature. Pesticide solutions were agitated thoroughly immediately prior to application. Four trials were conducted with the Sclerotinia blight (Sclerotinia minor) fungicides boscalid and fluazinam. Two trials were conducted with fungicides that control early leaf spot (Cercospora arachidicola) and late leaf spot (Cercosporidium personatum) including chlorothalonil, pyraclostrobin, tebuconazole, and prothioconazole plus tebuconazole. One trial was conducted with acephate for early season tobacco thrips (Frankliniella fusca) control. In separate experiments, corn earworm (Heliothis zea) insecticides included fenpropathrin, indoxacarb, and lambda-cyhalothrin, each evaluated in one experiment. Three trials were conducted with the preemergence herbicides diclosulam, dimethenamid, flumioxazin, imazethapyr, pendimethalin, and S-metolachlor. In separate experiments, postemergence herbicides included dicamba, glufosinate, glyphosate, imazethapyr, lactofen, and paraquat. Two trials were conducted with the plant growth regulator prohexadione calcium. Pesticides were applied at the manufacturer’s suggested use rate in municipal water at pH 6.5. Visual estimates of percent weed control, canopy defoliation (caused by early and late leaf spot), plant condition rating (percentage of the canopy expressing disease), damage from thrips feeding, and row visibility were used as indicators of agrichemical efficacy as influenced by the time elapsed between mixing and application. Efficacy of chlorothalonil, pyraclostrobin, tebuconazole, and prothioconazole plus tebuconazole, and boscalid was not affected by delayed applications. However, in 1 of 4 trials fluazinam mixed three days prior to application controlled Sclerotinia blight better than the 0, 6, and 9 day mixes. When considering thrips and corn earworm insecticides, delayed application of spray solutions did not affect efficacy of acephate, fenpropathrin, indoxacarb, and lambda-cyhalothrin. Preemergence and postemergence herbicides diclosulam, dimethenamid, flumioxazin, imazethapyr, pendimethalin, and S-metolachlor were not affected by delayed applications. However, efficacy of lactofen and paraquat were affected by delayed applications although differences were sporadic. In the plant growth regulator study, prohexadione calcium efficacy was not influenced by delayed spray applications. While these data suggest that growers should be aware of possible inconsistent pest control with certain pesticides that sit in the spray tank for extended periods of time, additional research is needed to clearly define the scope of this potential issue.
Effect of Soil Calcium Levels on Peanut Fruit and Seed Development.

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Calcium is an essential plant nutrient that plays a significant role in peanut seed development. Previous studies have examined the effect of calcium on peanut seed development at the end of the growing season. However, the stage at which developing seeds are most affected by a lack of calcium remains unclear. Therefore, the effect of calcium on peanut seed development of two runner varieties, C99R and Georgia Green, was studied under field conditions with low calcium soils. To attain sufficient calcium levels in half of the test plots, gypsum was applied at 30 and 60 days after planting. Underground developing fruits were sampled throughout the growing season from random one meter rows. Data were collected on pod length, seed and pod stage, fruit development, number of segments and number of seeds on each individual fruit sampled. The seeds and pods from four developmental stages also were analyzed for calcium concentration. Pod length was not affected by calcium levels. However, calcium deficiency resulted in fewer two segmented pods (P = 0.04), fewer fruit with two seeds (P = 0.04) and more immature and aborted seeds (P = 0.001). Although results were similar for both varieties, the effect of calcium on C99R fruit and seed development was greater than for Georgia Green. Pods had twice the calcium concentration of seeds irrespective of genotype and treatment. While gypsum application increased the concentration in both pod (2.46 mg/g) and seed (1.01 mg/g), in low calcium soils the concentration was 1.59 mg/g in pod (P < 0.001) and 0.73 mg/g in seed (P < 0.0001). Georgia Green had higher calcium concentrations in both tissues compared to C99R.

In addition to being a plant nutrient, calcium also serves as a secondary messenger, coupling physiological responses to environmental and developmental signals. Likewise, protein kinases are important in numerous signal transduction pathways that influence developmental processes. Several lines of evidence reiterate the important role for calcium and calcium dependent protein kinases (CDPKs) during seed development. Therefore, CDPK expression was explored as a candidate sensor during peanut seed development. Quantitative RT-PCR and Western blot analyses showed expression of CDPK during immature stages of seed development in both pod, as well as seed tissues. However, in contrast to pods, seeds showed higher CDPK transcript and protein levels under calcium deficient conditions. Immunolocalization data showed decoration of immunoreactive CDPK primarily in the outer most cell layers of the pericarp and around vascular bundles linked by lateral connections in developing pods, as well as the single vascular trace which supplies nutrients to the developing ovule.
Cultivation Duration and Frequency Effects on Two Peanut Cultivars Under Organic Management.

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Weed management is a significantly limiting factor in developing commercial organic peanut (Arachis hypogaea L.) production in the southeastern U.S. However, previous research indicates that cultivation can be an effective method of weed control and subsequent yield improvement in organic peanut systems. The objective of this study was to assess the effects of various frequencies and durations of cultivation with a flexible tine (“flex-tine”) cultivator on peanuts grown under organic management. Two cultivars (‘Georganic’ and ‘Tifguard’) were planted in Tifton, GA in 2008 and 2009. Flex-tine cultivations were initiated 7-10 days after planting and were conducted at two frequencies (weekly or twice weekly) for three durations (3 wks, 4 wks, or 5 wks). All cultivated plots received cultivation with flat sweeps at least once and were hand weeded during the growing season. An uncultivated, unweeded control treatment was also included for comparison. Yields varied among cultivated treatments (3523 kg ha-1 to 4335 kg ha-1 in 2008 and 3418 kg ha-1 to 3698 kg ha-1 in 2009) but differences were not significant (p < 0.05). However, all cultivated treatments displayed significantly higher yields (p < 0.05) than the uncultivated controls both years (1139 kg ha-1 in 2008 and 2215 kg ha-1 in 2009). Final plant stand was also greater in all cultivated treatments (3.6 plants ft-1 to 4 plants ft-1) than in the uncultivated treatment (1.8 plants ft-1) in 2008 (p < 0.05). In 2009, the once weekly/4 wks, twice weekly/4 wks, and once weekly/5 wks treatments resulted in significantly higher plant stands than the uncultivated treatment (2.4 plants ft-1) at p < 0.05. There were no significant differences in hand weeding times among treatments (p < 0.05). These results indicate that a combination of flex-tine cultivation, flat sweep cultivation, and hand weeding can significantly improve yield potential of peanuts grown in an organic management scenario.
A metabolic engineering approach will be used to improve the nutritional content of peanut kernels. Folate, also known as vitamin B9, is an essential vitamin that must be obtained from dietary sources because humans lack the enzymes to make folate de novo. Deficiency in folate is correlated with cancer, cardiovascular disease, anemia, and most notably neural tube birth defects such as spina bifida. A folate biofortification strategy has been used to introduce two folate biosynthetic enzymes into peanut. The two key pathway enzymes are GTP cyclohydrolase I (GCHI) and aminodeoxychorismate synthase (ADCS), both obtained from the model plant Arabidopsis. GCHI has been shown to control flux through the folate pathway and ADCS can be limiting in GCHI over-expressing plants as shown previously in other studies. Genes for the two enzymes have been placed under the control of publically available or licensable vector DNA components allowing seed-specific expression of folate biosynthetic enzymes in peanut kernels. Peanut embryonic callus from twelve Virginia and five Runner type cultivars have been transformed using particle bombardment. Two different bombardment strategies were implemented; circular plasmid transformation and linear minimal cassette transformation. Minimal cassette transformation was used facilitate the elimination of unwanted DNA elements such as the vector backbone and antibiotic resistance or other selectable markers and to allow simultaneous introduction of multiple traits. Regeneration and testing of transgenic plants are in progress.
Lack of significant seed production is a major limitation to genetic improvement of rhizoma peanut (Arachis glabrata Benth). The first objective of this study was to evaluate the seed producing potential of rhizoma peanut cv. 'UF Tito' and 'UF Peace'. The second objective was to assess tissue culture regeneration induced in explants derived from seeds obtained from both cultivars. In a field experiment, plant canopy characteristics were observed and seeds were harvested from 50 cm² subplots. Plant height, canopy spread, canopy density, flowering density, immature pegs per subplot, pedicel length, seed per subplot, individual seed weight, 100-seed weight, and flowers per subplot were recorded. Preliminary results revealed significant differences (P<0.05) between the two cultivars for all characters measured except canopy spread and canopy density. Mean seed yield of 'UF Peace' (404 ± 57 Kg ha⁻¹) was significantly higher than that of 'UF Tito' (167 ± 52 Kg ha⁻¹), but 100-seed weight of 'UF Tito' (28.8 ± 2.5 g) was higher than 'UF Peace' (20.0 ± 0.9 g). Shoot regeneration on semi-solid MS media with 4.4 gl⁻¹ thidiazuron and 2.2 gl⁻¹ 6-(alpha-dimethylallylamino)-purine or 6-benzylaminopurine was induced in seed derived explants from both cultivars. Browning of explants due to oxidation of phenolic compounds was a major obstacle to high frequency shoot formation. Experiments are currently underway to determine if supplementation of the culture media with activated charcoal or ascorbic acid will improve the frequency of shoot formation.
Calcium is one of the most limiting nutrients in the production of peanuts, and deficient seed calcium concentration is known to cause reductions in seed quality and germination. However, little research has been done to investigate the possibility of improving the Ca concentration by traditional breeding. In order to investigate the genetic control of seed Ca concentration a series of experiments were conducted. Seeds of 44 commercial varieties and 7 breeding lines differing in maturity, seed vigor, and resistance to leaf spot were sampled from yearly variety tests conducted in 2005 through 2008 at two locations (Marianna, FL and Gainesville, FL). Calcium and potassium concentrations were measured for 10 seeds per sample by inductively coupled plasma spectroscopy. These data were analyzed using Proc MIXED to calculate variance components, which were then used to determine broad sense heritability. Grade data were also collected for these varieties and compared with the calcium and potassium data using Proc CORR to determine whether a correlation existed between seed characteristics and seed calcium and potassium concentrations. The calculated broad-sense heritability was 0.33, which indicates the potential for peanut breeders to develop cultivars with higher seed calcium concentration. However, potassium concentration was affected to only a small degree by either environmental or genetic factors. Calcium concentration was correlated with various grade components, in particular those related to seed and pod size, as well as hull percentage. Potassium concentration was not correlated with any grade components.
In Virginia – Carolina region precipitation amount is adequate but its distribution is not for peanut production. Soils are sandy in most fields; they have reduced water holding capacity and lose water faster than plants can uptake. Under these conditions plants experience short but frequent drought episodes. Development of more water-efficient cultivars and with ability to adapt to this type of drought is, therefore, imperative.

In 2009, a study was initiated to examine early season transpiration ratio of thirty Virginia-type peanut (Arachis hypogaea var. hypogaea) cultivars and advanced breeding lines at the Tidewater Agricultural Research and Experiment Station in Suffolk, VA. Transpiration ratio was derived from the leaf CO2 assimilation (A)/transpiration (E) rate (A:E), and from A/stomatal conductance to water vapor (gs), (A:gs). Both, A:E, and A:gs are known to be correlated to the whole plant water use efficiency (WUE) in peanut and other crops. Variation among the genotypes was significant for all traits evaluated. Average A:E was 2.46 mmol CO2 mol-1 H2O at the end of a 3-week period without rain (PWR), 2.23 before the PWR, and 2.41 when the PWR was interrupted by rain. Similarly, A:gs was 46.7 µmol CO2 mol-1 H2O before the PWR, 69.4 during PWR, and 40.43 after the PWR. A:gs was 77.4 µmol CO2 mol-1 H2O for NC-V 11,77.1 for VA-98R, 71.9 for CHAMPS, and 71.6 for Florida Fancy during the PWR; A:gs was 49 µmol CO2 mol-1 H2O for Phillips and 47.9 for Georgia 08V during the PWR. The A:gs ranged from 59 to 65 µmol CO2 mol-1 H2O for Gregory, Perry, Bailey, and Sugg. For the same characteristic, N05006, N05008, and N04074FCT exceeded 90 µmol CO2 mol-1 H2O, showing the greatest transpiration efficiency during the PWR.
Oil Content of Commercial Peanut Varieties Grown Under Reduced Irrigation and Seeding Rate in West Texas.

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Eight commercial varieties representing all four market types of peanut have been tested under three irrigation levels and three seeding rates in 2006, 2007 and 2008 at two locations with differing soil types in West Texas. Irrigation levels consisted of 75, 50 and 25% of reference evapotranspiration replacement. Seeding rates were 100, 50 and 25% of the normal seeding rates based on market type. The 75% (full) irrigation rate has shown to be higher in oil content and produce more gallons of oil per acre than the 50 and 25% rates. No significant differences have been found for oil content or gallons of oil per acre for the three seeding rates. This suggests that reducing seeding rates can reduce input costs without sacrificing profits to the producer. Varietal difference have been found, with Olin and Spanco yielding higher oil contents than NM Valencia C and TamnutOL06 for the erect varieties, and the runner varieties Flavorrunner 458, TamrunOL02 and TamrunOL07 yielding higher oil contents than the Virginia variety Gregory. The runner and Virginia varieties have shown to produce more gallons of oil per acre than the Spanish and Valencia varieties due differences in yield. Minimizing inputs such as irrigation and seeding rate combined with proper varietal selection can allow for profitability of growing peanuts for oil in West Texas.
Late leaf spot (Cercosporidium personatum) is one of the predominant pathogens causing reduction in pod yield for peanut producers in the southeastern U.S. Cultivar improvement and reduced fungicide use through improved understanding of host-pathogen interactions offer a promising way to improve yield and reduce cost of peanut production. Therefore, we collected data on disease severity, leaf gas exchange, growth, partitioning and yield of two commercial runner type varieties differing in late leaf spot resistance under fungicide treated and non-treated conditions in the field. Leaf spot pressure was fairly heavy near Gainesville, Florida, in 2009, resulting in significantly greater area under disease progress curve (AUDPC) values for Carver compared to York, consistent with their disease resistance ratings for leaf spot.

Accordingly, total pod yield was greater for York, averaging 3346 kg ha⁻¹ compared to 2821 kg ha⁻¹ in Carver. A biweekly commercial fungicide schedule increased yield by 533 kg ha⁻¹. Interestingly, there was no significant interaction between cultivar and fungicide schedule, indicating that the benefit of fungicide was the same in absolute terms for both varieties. However, the relative increase in yield due to York was only 13% in fungicide-treated plots compared to 26% in untreated plots. Although not significant, fungicide seemed to increase both pod number and average pod size in both cultivars. Fungicide did not affect defoliation in York, but reduced defoliation in Carver. Reductions in leaf photosynthesis at comparable disease severities tended to be greater in York, which could help explain why AUDPC values were greatly reduced compared to Carver while yield only increased marginally. Thus, future efforts to enhance leaf spot resistance should focus on sustaining leaf photosynthesis following infection, which would complement reduced defoliation and spread of disease.
Simulating Weather Effects on Yield of Different Peanut Cultivars in the Georgia Variety Performance Trials with the CSM-CROPGRO-Peanut Model.

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The Peanut Variety Performance Tests conducted annually in Georgia and other states are valuable data sources for plant breeders and farmers to compare variety performance. These trials offer additional opportunity to evaluate weather risk on peanut production as well as cultivar by environment interactions. In this research, we used the CSM-CROPGRO-Peanut model to simulate peanut yield for the rainfed and irrigated trials conducted at Tifton, Plains, and Midville and to evaluate weather risk from rainfall pattern, rainfall deficit, and heat stress on production. We also evaluated cultivar differences in yield potential under irrigated and rainfed conditions. Simulations were conducted for 1997 through 2009 seasons for both irrigated and rainfed conditions across the three sites. Site characteristics for inherent soil fertility were adjusted to give the mean yield across cultivars per site under irrigated conditions. Site characteristics of soil water holding capacity and rooting pattern with depth were adjusted to set mean yield across cultivars per site under rainfed conditions. Then cultivar traits of life cycle and partitioning intensity were adjusted to mimic differences among cultivars in life cycle and yield potential in irrigated and rainfed conditions. Irrigated predictions were reasonably close with the default model traits, but to accurately predict yield under rainfed conditions required modifying soil traits to increase water-holding capacity and create deeper rooting pattern. Cultivars were compared to the Georgia Green cultivar because it is the dominant cultivar and because it was part of the trials across all years and sites.
Assessment of ‘Tifguard’ Cultivar for Disease and Nematode Management of Peanut.

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‘Tifguard’ is a peanut cultivar that was released in 2007 and it is highly resistant to the peanut root-knot nematode (Meloidogyne arenaria). From the 2010 Peanut Rx disease risk index, Tifguard has been rated at 10, 15, and 10 points for resistance to tomato spotted wilt virus, leaf spot diseases, and stem rot, respectively. Based upon these ratings, Tifguard is thought among the most disease-resistant cultivars currently available to growers. Trials were conducted between 2007 and 2009 to assess the disease and nematode resistance of Tifguard compared to ‘Georgia Green’. The experimental design used in each trial was a randomized complete block design with four to six replications per study. Trials were conducted in fields naturally infested with M. arenaria in 2007 and 2009 on the Coastal Plain Experiment Station in Tift County, GA and in 2009 on a commercial field in Decatur Co., GA. In 2007, the average post-season root-gall rating for Georgia Green was 3.78 (0-10 scale) while Tifguard rated 0.07. In the same trial, Tifguard yielded 4891 lb/A while Georgia Green yielded 2762 lb/A. In the two trials conducted in Tifton in 2009, Tifguard with Thimet (5 lb/A) yielded 3430 lb/A and 2338 lb/A while Georgia Green yielded 2439 lb/A and 1726 lb/A, respectively. Post-season galls per 2 g of root tissue were 171.8 for the Georgia Green and 19.8 for Tifguard. In the commercial field study, the end of season root-gall rating and yield for Georgia Green were 3.0 and 2635 lb/A, respectively, and for Tifguard, 0.083 and 4925, respectively. In fungicide trials conducted in Tifton in 2008 and 2009, leaf spot and stem rot ratings were numerically lower for Tifguard than for Georgia Green. Tifguard is an appropriate cultivar to plant in the southeastern United States for the management of M. arenaria, tomato spotted wilt virus, leaf spot, and stem rot, and for its yield potential.
Variation Among Botrytis cinerea Isolates Obtained from Peanut Fields in West Texas.

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Botrytis blight, caused by Botrytis cinerea, is considered a minor disease of peanut (Arachis hypogaea). Recent epidemics occurring in Georgia and west Texas occurred under low temperatures (~20 °C) and increased precipitation. Symptoms characteristic of Botrytis blight include prolific sporulation and the development of darkly pigmented mycelia; however, in Texas the disease is easily confused with Sclerotinia blight, caused by Sclerotinia minor or S. sclerotiorum. Recent observations have shown that all three pathogens are present within the region. The objective of this study was to document genotypic and phenotypic differences of B. cinerea isolates (n = 33) obtained from peanut fields. Reference isolates of S. minor, S. sclerotiorum and Sclerotium rolfsii (causal agent of Southern blight) were included for comparison. Growth chamber studies were conducted to determine the influence of temperature on hyphal growth and sclerotial development in vitro. Hyphal growth was measured 24, 48, and 72 after inoculation onto potato dextrose agar. Data were used to calculate area under hyphal growth curve values. Sclerotia production was assessed after 2 weeks incubation. Isolates were arranged in a randomized complete block design with three replications and the study was conducted three times. Data were subjected to analysis of variance and means were separated via Fisher’s Protected LSD (P≤0.05). Evaluation of isolates revealed considerable differences in colony color, sporulation, and the production of sclerotia. Mycelia of B. cinerea were placed into three categories white, light or dark gray. Mycelia of the S. minor and S. rolfsii isolates were white, compared to the darkly pigmented mycelia of the S. sclerotiorum isolate. Hyphal growth of the B. cinerea isolates evaluated varied by temperature. The optimum temperature ranged between 15 and 25 °C for most isolates; however, several isolates exhibited abnormally slow growth and did not respond to changes in temperature. Temperature optima for the S. minor and S. sclerotiorum isolates were between 20 and 25 °C, whereas, maximum S. rolfsii growth was observed at 30 °C. Differences in the appearance and production of sclerotia were observed among isolates. A total of 14 isolates failed to produce sclerotia, whereas, sclerotial production for the remaining isolates was grouped into four categories based on size (small or large) and frequency (few or abundant). Optimal temperature for the production of sclerotia varied for the B. cinerea isolates evaluated. Overall, the optimum temperature for sclerotia production was between 15 and 20 °C; however, several isolates were capable of forming sclerotia from 10 to 25 °C with one isolate producing an appreciable number of sclerotia at 30 °C. Results from previous studies indicated that the optimal temperature range for Botrytis blight infection is 15 to 20 °C. From this study, the temperature optima for B. cinerea was within this range for many of the isolates evaluated; however, growth for several isolates occurred between 20 and 25 °C, which is more consistent with Sclerotinia spp. This coupled with the various morphological characteristics of B. cinerea isolates may further complicate diagnosis Sclerotinia blight.
Response of Nematode Resistant (Tifguard) and Susceptible (C724-19-25) Peanut to Fungicides and Fumigants in a Field with Meloidogyne arenaria and Cylindrocladium parasiticum.

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Experiments were conducted in 2008 and 2009 to evaluate the effects of root knot nematode (Meloidogyne arenaria) and Cylindrocladium black rot (CBR) caused by Cylindrocladium parasiticum on a nematode-susceptible (C724-19-25) and a nematode-resistant peanut genotype (Tifguard). C724-19-25 is an F4-derived F5 sister line of Tifguard, and therefore similar except for the gene introduced for nematode resistance. All plots were coversprayed with Bravo and Convoy to control leaf spot and stem rot. Treatments included the following: 1) Vapam (15 GPA) which is active on nematodes and CBR, 2) Proline (5.7 oz in furrow) + Provost (10.3 oz sprays 3-6), and 3) Provost (10.3 oz sprays 3-6), both of which are active on CBR but not nematodes, 4) Vapam + Proline + Provost, and 5) nontreated control. Nematode damage was greater in 2009 with ratings of 4-5 on C724-19-25 (0-10 scale with 0 = no galling), and Tifguard had almost no galling.

Nontreated plots had 21 – 43% CBR and, incidence was higher on C724-19-25 than Tifguard in 2009 when nematode damage was more severe. Vapam did not reduce nematode galling either year, and reduced CBR in 1 of 2 years for each cultivar. Treatments 2 and 4 reduced CBR in all cases except for C724-19-25 in 2008, but Provost alone (Trt 3) only reduced CBR on Tifguard in 2008. Treatment 4 increased yield on both genotypes in 2008 only. Treatment 2 increased yield on C724-19-25 in 2008 only, and treatment 1 increased yield on Tifguard in 2008 only. Yield was generally higher on Tifguard, especially with the nematode damage to C724-19-25 in 2009 (4932 and 3557 lb/A, respectively, in nontreated plots). Although Tifguard is considered susceptible to CBR, the excellent resistance it has to root knot nematode also results in reduced CBR incidence due to the interaction of those two diseases on root health.
Comparison of Fungicides and Fungicide Mixtures for Post-Infection Efficacy Against Early Leaf Spot.

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In the southeastern U.S., management of leaf spot diseases of peanut (Arachis hypogaea) caused by Cercospora arachidicola and Cercosporidium personatum is heavily dependent on multiple applications of fungicides. With the protectant fungicide chlorothalonil, application before infections occur is essential. The strobilurin fungicide pyraclostrobin allows flexibility in time of application and spray interval for leaf spot control, and has provided excellent control with initial applications that were much later than would be effective for chlorothalonil. Growers are encouraged to make initial applications of any fungicide before infection occurs, but for various reasons, that is not always possible. In recent years, pyraclostrobin has been used successfully in situations where leaf spot infections were already established. These type of applications represent increased risk of developing resistance to pyraclostrobin. The objective of this study was to determine whether other fungicides or fungicide mixtures could be effective for stopping leaf spot epidemics after infection had occurred. Fifteen fungicide treatments, including a nontreated control and chlorothalonil (1.26 kg a.i./ha) (Bravo WeatherStik) standard were applied twice, with first application at 70 days after planting (DAP) and a second application at 85 DAP. Leaf spot ratings of all plots were > 2.1 on the Florida 1-10 leaf spot severity scale before the first fungicide was applied. All plots received a cover spray of chlorothalonil (1.26 kg a.i./ha) 105 DAP. Early leaf spot (C. arachidicola) was the predominant foliar disease observed. Among fungicide treatments, final Florida 1-10 scale leaf spot severity ratings were 9.3 for the nontreated control; 7.6 in the chlorothalonil (1.26 kg a.i./ha) standard; 5.9 for mixtures of chlorothalonil (0.84 kg a.i./ha) and thiophanate methyl (0.20 kg a.i./ha) (Topsin 4.5F); 5.3 for prothioconazole (0.2 kg a.i./ha) (Proline 480 SC); and ranged to 4.4 (LSD = 0.6) in three fungicide treatments. Of those three treatments, two consisted of different formulations of pyraclostrobin (Headline 2.09 EC and Headline 250 SC). The third treatment consisted of tank mixtures of chlorothalonil (0.84 kg a.i./ha), prothioconazole (0.10 kg a.i./ha), and thiophanate methyl (0.20 kg a.i./ha). Results corroborated that the 2.09 EC formulation of pyraclostrobin is an effective treatment after leaf spot infections have occurred. These results indicate there is no difference in efficacy of the 2.09 EC and 250 SC formulations of pyraclostrobin. In addition, applications of mixtures of chlorothalonil, prothioconazole and thiophanate methyl provided levels of leaf spot control similar to that of the pyraclostrobin treatments. This combination may represent a non-strobilurin fungicide alternative to pyraclostrobin for use in situations where leaf spot epidemics have started in advance of the initial fungicide application.
Early peanut planting (prior to 5 May) is restrained in South Carolina due to concerns of increased risk from tomato spotted wilt tospovirus and stem rot, Sclerotium rolfsii Sacc. However, the ability to begin planting earlier has several potential advantages to include taking advantage of favorable soil moisture; reduced risk of late leaf spot, Cercosporidium personatum (Berk. and Curt.) Deighton; greater opportunity for rain-fed fields to recover from mid-season drought stress; less buying point congestion; and a reduced risk of yield and quality losses in wet harvest years (including less risk to cotton which typically is harvested after peanuts). Standard and resistant virginia-type varieties (cultivars NC-V 11 and Bailey, respectively) were planted on four dates (18 April, 1 May, 19 May, and 3 June) and treated with three levels of soil fungicide protection (none, tebuconazole 2X, and tebuconazole 4X). All treatments were protected from leaf spot with five total applications of either chlorothalonil or a chlorothalonil + tebuconazole tank-mix. A standard phorate in-furrow treatment (4.4 lb 15G/ac) was used to suppress thrips and spotted wilt disease in all plots. Leafhopper injury, Empoasca fabae (Harris), was greater in Bailey than NC-V 11. Thrips injury, Frankliniella fusca (Hinds), and tomato spotted wilt stunting were greater in NC-V 11 and in earlier plantings. Stem rot incidence was reduced only on the final planting date, with mean stem rot infections exceeding 25% of row length in untreated NC-V 11 for each of the first three plantings. Stem rot was markedly affected by variety, in that even the untreated Bailey plots had 92, 96, 81, and 48% less stem rot than 4x soil fungicide treatments of NC-V 11 on the above four planting dates, respectively. Soil fungicide level had a significant effect on stem rot incidence, but there was less fungicide response in Bailey. Variety had a marked effect on yield, in that for every planting date, untreated Bailey plots produced greater yield than 4x fungicide treatments of NC-V 11. Crop value (based on yield, TSMK, and ELK) was significantly affected by variety and soil fungicide level. Crop value was not affected by planting date across varieties, but there was significant interaction of planting date and variety for crop value. For NC-V 11 the greatest crop value was obtained with maximum soil fungicide treatment and a mid-May planting. However, Bailey produced greater crop value than NC-V 11, and optimum crop values were attainable with earlier planting dates and less soil fungicide. These results and those of three previous test years demonstrate a remarkable level of disease resistance in Bailey that can potentially be exploited to allow S. C. growers to plant earlier and reap benefits beyond the direct advantage of disease resistance. Bailey will require increased protection from potato leafhopper injury and will probably require greater use of growth regulator or guidance systems due to excessive canopy growth.
A peanut field, north of Giddings in Lee County, TX, planted with the peanut cv. OLin in 2009 had about 5% incidence of Sclerotinia blight on October 29. Diseased stems of peanut plants were collected, and a culture of Sclerotinia minor (SM.TX1) was generated from a single sclerotium, and maintained at 25±2 C on Potato-Dextrose-Agar medium containing 100 ppm streptomycin sulfate. The pathogenicity of the SM.TX1 isolate along with an S. minor isolate from Oklahoma (SM.M6) was tested on two peanut cultivars, Okrun (OK) and Tamspan 90 (T-90). The pathogenicity tests were performed as described by Faske et al (Peanut Sci. 33:7-11, 2006). Starting three days after inoculation, lesion length measurements were recorded for the infected stems and continued on a 24 hour basis through day 7, after which time the rate of lesion expansion (RLE) in mm/day was calculated. The pathogenicity test was conducted twice. In the first experiment, mean RLE on cv. OK for SM.TX1 was 31, which was significantly (P > 0.001) higher than that of SM.M6 at 26. On cv.T-90, RLE for SM.TX1 was 22, which was significantly (P > 0.022) higher than that of SM.M6 at 19. In the second experiment, mean RLE on cv. OK for SM.TX1 was 19, which was significantly (P > 0.006) higher than that of SM.M6 at 10. On cv. T-90, RLE for SM.TX1 was 19, which was significantly (P > 0.005) higher than that of SM.M6 at 8. These findings demonstrate that the new S. minor isolate SM.TX1 is more virulent than that of the Oklahoma isolate SM.M6 under greenhouse test conditions, and the new S. minor isolate SM.TX1 has the potential to be more damaging under field conditions.
New Sources of CBR Resistance Among Runner-Type Peanut Cultivars.

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Cylindrocladium Black Rot (CBR) caused by Cylindrocladium parasiticum Crous, Wingfield, & Alfenas syn. C. crotalariae (Loos) Bell & Sobers is a major disease problem in southeast U.S. peanut (Arachis hypogaea L.) production. Field trials were conducted during the past two years (2008-09) at a test site that has a long history of continuous peanut production (> 30 yrs) near the Coastal Plain Expt. Station to evaluate for CBR resistance among runner-type peanut cultivars. All plots were artificially inoculated with microsclerotia of C. parasiticum at approximately 50 days after planting each year. Highly significant differences (P≤0.05) were found among the cultivars for both CBR resistance and tomato spotted wilt virus (TSWV) resistance which was also present each year, but the predominant disease was CBR. Georgia Greener, Georgia-06G, Georgia-07W, Georgia-02C, and Carver were consistently found to be the most resistant; whereas, C-99R and Tifguard were the most susceptible each year. In a separate test conducted in 2009 at a different location, Georgia Greener also had the least difference and Tifguard had the greatest difference between noninoculated versus inoculated plots for pod yield. These combined test results demonstrate that useful levels of CBR resistance are currently available in promising new sources of runner-type peanut cultivars.
New In-Furrow Fungicide Options Provide Control of Cylindrocladium Black Rot of Peanut in Virginia and Runner Cultivars.

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Two trials in 2009 planted with either Brantley (trial 1) or CHAMPS (trial 2) evaluated suppression and control of CBR with foliar sprays of Provost 433SC 8 or 10.7 fl oz/A, and a seed-furrow treatment at planting with Proline 480SC 5.7 fl oz/A or Propulse 400SC 14.69 fl oz/A. Reference standards included 1) three foliar sprays of Provost at the low or high rate followed by Bravo 720SC 1.5 pt/A and 2) Vapam 42% 7.5 gal/A with foliar sprays of Provost followed by Bravo. No significant differences in CBR incidence were found in treatments with the low or high rate of Provost. Proline in the seed furrow and foliar sprays of Provost 10.7 fl oz significantly reduced CBR incidence by 43 and 33% while the Vapam standard reduced incidence by 52 and 55% in trial 1 and 2, respectively. Propulse in furrow reduced CBR incidence by 83% in trial 1 and 57% in trial 2. Yield was increased significantly (P=0.01) by treatments with Propulse in furrow or Vapam in trial 1. No significant differences in yield were detected in trial 2, however, yield was highest for Propulse in furrow or Vapam treatment.

The response of peanut cultivars to Proline or Vapam for control of CBR was evaluated in 2009. Main plots were treated with and without Proline or Vapam and subplots were planted to either Virginia- or runner-type cultivars. Proline in furrow suppressed CBR significantly in Virginia-type cultivars on 25 Aug and 11 Sep, but only Vapam significantly reduced CBR incidence on 14 Oct. Bailey and Perry without Proline or Vapam exhibited good CBR resistance, Florida Fancy showed moderate resistance, and CHAMPS was highly susceptible. CBR incidence tended to be lower in runner-type cultivars with the most susceptible cultivar being GA Green and the least susceptible being GA-02C. Treatments with Proline across runner-types suppressed CBR incidence significantly on 11 Sep, whereas only Vapam significantly reduced CBR incidence on 14 Oct. Yield of Virginia-type cultivars tended to increase with Proline and were significantly increased by Vapam. Similarly, runner-type yields were increased significantly by only Vapam. The total value of yield was improved $53 and $75/A by Proline and $172 and $127/A by Vapam on Virginia- and runner-type cultivars, respectively. These studies provided evidence that in-furrow application of Proline suppresses CBR, whereas Propulse provides CBR control that is similar to Vapam. Additional studies in 2010 are designed to determine if Propulse in furrow could become an acceptable replacement for Vapam.
The diseases caused by root-knot nematodes (Meloidogyne arenaria), Sclerotinia minor (Sclerotinia blight), and the Tomato Spotted Wilt Virus are factors that limit yields and productivity of peanut in Texas. Moderate to high levels of resistance to each of these separate diseases has been developed previously, but not in a single peanut genotype. Here we report the development of multiple disease resistant peanut lines. Further, these resistance traits have been introgressed into peanut genotypes that also have ratios of oleic to linoleic fatty acids (O/L) of greater than 10. Resistance to root-knot nematodes suppresses nematode reproduction by more than 90% and was developed by introgression of the resistance from wild Arachis spp. into A. hypogaea. Moderate resistance to the TSWV and Sclerotinia blight was derived from the cultivar Tamrun 96. The high O/L ratio trait was derived from SunOleic 95R. Several lines with yield potential equal to that of the popular cultivar Tamrun OL07 and superior to Florunner have been identified.
Impact of tillage, planting date, cultivar, and row pattern on peanut yield as well as on the severity of tomato spotted wilt virus (TSWV), leaf spot diseases, and stem rot was evaluated on a site maintained in a peanut – cotton – peanut rotation. Rows for the conservation tillage plots were laid out in rye killed with Roundup in early March with a KMC subsoiler + coulter + rolling basket rig. Conventional tillage plots were turned with a moldboard plow and worked to seed bed condition with a disk harrow. Peanut cultivars Georgia Green and Tifguard were planted on April 24, May 14, and June 2, 2009. Row spacing included single 36-in or twin rows spaced 7 in apart on 36-in centers. The experimental design was a split-split-split plot with tillage as the whole plot, planting date as the split plot, peanut cultivar as the split-split plot and row spacing as the split-split-split plot, which consisted of four 30-ft rows in four replications. All plots received seven applications of Bravo Weather Stik 6F at 1.5 pt/A at 2-wk intervals for leaf spot control. While TSWV hit counts and leaf spot severity was assessed just prior to plot inversion, stem rot incidence was determined immediately after plot inversion. While TSWV was similar across all planting dates on conventional-till Georgia Green and Tifguard peanuts, disease incidence was lower on both cultivars under conservation tillage on the June 2 compared with the April 24 planting date. TSWV incidence was significantly lower for the twin than single row conventional-till peanuts but disease ratings for conservation-till single and twin row peanuts were similar to the single row conventional-till peanuts. While tillage did not have a significant impact on leaf spot severity on Tifguard, higher leaf spot ratings were seen for the conventional- than conservation-till Georgia Green peanuts. Regardless of tillage practices, Tifguard had lower leaf spot ratings than Georgia Green. In addition, higher leaf spot ratings were noted for conventional- than conservation-till peanuts at the May 14 but not the other planting dates. For the conventional-till peanuts, leaf spot ratings were higher at the May 14 than April 24 planting date but were similar across all planting dates for the conservation-till peanuts. On Georgia Green, stem rot incidence declined at each successive planting date, while Tifguard had less stem rot damage at the later two compared with the April 24 planting date. Stem rot incidence was lower on Tifguard than Georgia Green as well as under conservation than conventional tillage. Yield of Georgia Green and Tifguard varied by tillage practices and planting date. When under conventional tillage, Tifguard had higher yields than Georgia Green at the April 14 and June 2 but not at the May 14 planting date but yields of both cultivars under conservation tillage, which were usually lower compared with the same cultivars under conventional tillage, were similar at April 14 and June 2 planting dates. Higher yields were obtained with the twin compared with single row peanuts. The combination of the least disease and highest yields would likely be realized by planting Tifguard on twin rows in late May or early June using conventional tillage.
Comparison of Varietal Grade and Yield Performance in Florida (USA) versus Queensland (Australia).

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In Australia and the USA, peanut is routinely graded with the larger kernels referred to as ‘Jumbos’. They attract appreciable price premiums because they are more mature, better tasting, and hence increase profitability for both growers and the industry. Factors such as drought, insect, disease incidence and other stresses are known to affect the proportion of ‘Jumbos’, however even in the absence of such stress factors large differences across environments have been observed, but not documented. In this study we compared kernel grades of 4 peanut cultivars; Chifley (UF00620), Holt (UF98509), Page (UF97611) and UF 37 (UF05308) grown in Bundaberg, Queensland, Australia (24o 51’ S, 152 o 21’ E), and in Gainesville, Florida, USA (29o 39’ N, 82 o 20’ W). All crops were grown under non-limiting conditions. Kernel grades were determined using the standard USA grading system. When averaged over all cultivars, peanuts grown in Bundaberg had nearly a third more ‘Jumbos’ compared to Gainesville (43% compared to 33%). The proportion of ‘Jumbos’ at Bundaberg would have been even higher if most of the 14.5% of sound splits resulting from over dry samples were included. ‘Medium’ grade kernels were considerably higher in Gainesville (42%) compared to Bundaberg (11%). For both ‘Jumbo’ and Medium’ grades, cultivar and location differences were highly significant, however their interactions were not. The sound mature kernels (SMK’s) produced at Bundaberg had 100-kernel weights which were 17% higher than at Gainesville. The Bundaberg environment was also more favorable for obtaining higher average pod yields (6.7 t/ha compared to 5.6 t/ha at Gainesville). These yield results are also well supported by our peanut crop modeling analyses using the Agricultural Production Systems Simulator (APSIM), where average potential pod yields of 8.2 t/ha at Bundaberg and 6.4 t/ha at Gainesville were predicted during the period from 2001 to 2009. The higher proportion of ‘Jumbo’ kernels, and higher 100-kernel weight and yields in the Bundaberg compared to Florida environments appears to be related to higher solar radiation and lower maximum temperatures. The effect of these climatic factors on these yield and quality attributes needs to be confirmed as it could lead to the identification of homoclimes of Bundaberg which could be targeted for high quality peanut production.
Characterization of Early-Maturing Peanut Breeding Lines.

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We have identified a high-yielding, early-maturing runner line that yielded as well as or better than FlavorRunner 458 and Tamrun OL02 and matures earlier by approx two weeks. Seeds have a high oleic:linoleic fatty acid composition and are similar in size to Florunner. Several related lines yield well also but do not mature as early. Runner lines of a different population have demonstrated high yield, excellent shellout, and early maturity, and have some potential for tolerance to TSWV and Sclerotinia. Advanced Spanish and Valencia breeding lines outyield check varieties and are tolerant to Sclerotinia minor.
Genotypic Variation in the Antioxidant Activity of Peanuts.

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‘Functional foods’ promote human health beyond the provision of essential nutrition, and are a major growth area for the agrifood industry and related research activity. It would be advantageous to incorporate functional food traits into the national peanut breeding program as criteria of kernel quality, with the ultimate goal of developing new cultivars that would boost health-focused product development, differentiation, and marketing. Peanut kernels contain a range of antioxidant phytochemicals including several phenolic acids, flavonoids and stilbenes (e.g. resveratrol), which benefit consumer health through apparent anti-inflammatory, antimicrobial and anticancer activities. We screened 58 genetically diverse peanut lines from the Australian breeding program for their antioxidant activity using four popular in vitro assays, i.e. the ORAC, ABTS, DPPH and Folin-Ciocalteu Total Phenols assays. This paper discusses the extent of genotypic variation in antioxidant activity, role of in vitro assays, their methodology and potential for their incorporation as future selection criteria in the breeding program.
Genetic Gain for Pod Yield in the North Carolina State University Peanut Breeding Project.


The peanut breeding program at N.C. State University released its first cultivar derived from hybridization and selection in 1952. Since 1944 when W.C. Gregory was hired, the program has been led by a series of trained plant breeders including D.A. Emery, J.C. Wynne, and for the past 20 years, T.G. Isleib. One of the measures of success of a breeding program is its rate of genetic gain, ΔG, especially for yield. Since 1990, a database has been maintained of yield and grade means for lines entered in trials in North Carolina as part of the in-state testing program (the “N.C. database”). A similar database has been maintained for line means in the individual tests conducted as part of the Peanut Variety and Quality Evaluation (PVQE) program, the official variety test for the Virginia-Carolina production region (the “PVQE database”). These databases provide the information necessary to estimate genetic gain. In the N.C. database, yields were analyzed for all lines that were retained for testing in three or more years; in the PVQE database for two or more years. Because lines are generally tested at least two years in the N.C program before “graduating” to the PVQE program, these subsets both contain similar arrays of lines although the N.C subset includes more and more recent lines while the PVQE subset includes only those lines considered productive enough to advance to the regional testing program. Effects of years and locations were removed, and mean yields for lines were adjusted to a common environmental level. The first year of evaluation of each line was identified, and the adjusted means were used as dependent variables in a regression against first year of testing. Separate regressions were performed for lines released as cultivars and those still considered experimental. Using the N.C database, the gain for cultivars was curvilinear, characterized by a quadratic equation that was relatively flat in the period represented by NC 7 through Perry then increased at approximately the same rate as the experimental lines which showed a linear response increase in yield over time, Y = 40.03X – 76461 (r = 0.54, P<0.05), i.e., yield increased by 40 lb/A yr. Genetic gain was less when only the elite lines tested in the PVQE program were considered: Y = 27.072X – 49820 (r = 0.59, P<0.05). The relative lack of ΔG observed for the period represented by NC 7 (first year of testing 1974) through Perry (first year of testing 1993) may reflect the occurrence of new diseases during the time frame of data collection, 1990-2009. Old cultivars that were selected and released prior to the advent of Tomato spotted wilt and Sclerotinia blight across the VC region would be unlikely to perform well in trails conducted from the mid-1990s on.
To maximize their usefulness, core and mini core collections should be dynamic. The peanut core collection was developed in the early 1990's, and the mini core was developed in the late 1990's. Research has shown that these collections can be used to improve the efficiency and effectiveness of identifying valuable traits in the entire germplasm collection, and both of these collections have been widely used to mine valuable genes from the germplasm collection. However, both of these collections need to be updated and revised to better represent additions to the entire collection and changing needs of the peanut breeding community. The first objective was to add accessions to represent additions to the entire collection since the core was selected. Data were generated and analyzed, and it was concluded that 41 accessions need to be added to the core collection. A subsample of these accessions will also be added to the mini core collection. Recent discussions in the Peanut Crop Germplasm Committee has indicated the need for homogeneous accessions for some users of these germplasm collections. We examined evaluation data to identify accessions in the core and the mini core which appear to be heterogeneous. The possibility of the selection and storage of homogeneous subsamples will be discussed.
Peanut varieties with high oleic/linoleic acid ratios have become preferred by the peanut industry due to their increased shelf life and improved health benefits. Many peanut breeding programs are trying to incorporate the high oleic trait into new and improved varieties and are in need of diagnostic tools to track its inheritance early in development and at the single seed level. Traditionally, gas chromatography has been used to accurately determine the properties of peanut oil, but this method generally requires modification of oil after extraction and possible destruction of the seed sample. In this study, oil was extracted from approximately 0.10 g of peanut seed tissue taken from the distal end, leaving the embryonic end of the seed intact for subsequent germination. Over 100 samples were processed, covering runner, Spanish and Virginia market types. Oil extractions were analyzed for oleic/linoleic acid ratio using (1) capillary electrophoresis (CE) and (2) gas chromatography (GC). Results showed that the two methods are 100% in agreement in determining whether a peanut seed is “high-oleic” or “normal oleic” in oil content. Furthermore, the two methods are highly correlated ($r = 0.96; p < 0.0001$) with respect to determining the exact oleic/linoleic acid ratio from each sample. Results from this study validate the use of CE as a diagnostic tool for breeding programs to identify individual high oleic peanut seed for further testing and development.
Release of ‘Sugg’ Virginia-Type Peanut Cultivar.


The peanut breeding program at N.C. State University, in collaboration with state and federal scientists in North Carolina, Virginia, and South Carolina, announces the release of Sugg virginia-type peanut (Arachis hypogaea L.) cultivar. Sugg, named in honor of Norfleet “Fleet” Sugg and the late Joseph “Joe” Sugg, two cousins who served consecutively as executive directors of the N.C. Peanut Growers Assoc. from 1966 through 1993, was developed by the N.C Agric. Res. Serv. and was released in 2009. It is an F6-derived inbred line deriving 50% of its ancestry from virginia-type cultivar Gregory, 25% from Gregory sister line N90010E, and 25% from Sclerotinia-resistant runner cultivar Tamrun 98. Sugg is partially resistant to resistant to three of the four most common diseases in the Virginia-Carolina peanut production area: Cylindrocladium black rot (CBR), Sclerotinia blight (SB), and tomato spotted wilt virus (TSWV). It is susceptible to early leaf spot. It has seeds with pink testa averaging 886 mg seed-1, mean jumbo pod content of 44%, fancy pod content of 44%, extra large kernel content of 48%, sound mature kernel content of 66%, and total kernel content of 74%. Yield and grade of Sugg were evaluated over 8 years in the N.C. State Univ. trials, over 5 years in the three-state Peanut Variety and Quality Evaluation (PVQE) program, and over one year in the Uniform Peanut Performance Test (UPPT). Its yield has been superior in all those testing programs. In the 2005-2009 PVQE trials, yield of Sugg was greater than the mean yield of other virginia-type cultivars tested over the same period (5229 vs. 4928 kg ha-1, P<0.01) but less than the yield of Bailey (5229 vs. 5462, P<0.05), the highest yielding cultivar tested, and not different from the yield of NC-V 11 (5229 vs. 5098 kg ha-1, ns), the next highest-yielding cultivar. Sugg has superior pod brightness for use in in-shell peanut products, and its flavor profile is comparable to that of Florunner, the US peanut industry's flavor standard.
Cultivated peanut (Arachis hypogaea L.) is a tetraploid of relatively recent evolutionary origin. Evidence suggests that most orthologous genes from the two (A and B) ancestral genomes are transcribed and probably functional. The probability of identifying phenotypic changes in a mutant population of such a polyploid is therefore low. Mutations in genes potentially underlying a phenotype can be determined using a screening tool such as TILLING (Targeting Induced Local Lesions IN Genomes). This reverse genetics tool requires knowledge of gene sequence. We have generated a mutant population through chemical mutagenesis and screened it for mutations in allergen (Ara h 1 and Ara h 2) and fatty acid desaturase (FAD2) genes. An array of mutations has been identified, most of which are silent or missense. Two knockout mutations have been recovered, one in each of Ara h 1 (A-genome) and Ara h 2 (B-genome) genes. The Ara h 2 mutant does not produce the protein encoded by the B-genome gene. Protein analysis of the Ara h 1 mutant is presently being conducted. Interestingly, FAD2 mutants representative of the known functional changes in these genes that alter oleic to linoleic acid ratios in the seed were found in the mutant population.
Studying Nodulation Signaling using Non-nodulating Peanut Lines: Determining if the Constraint in Peanut Nodule Formation is Due to a Local or Systemic Signal.

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Grafting experiments have been useful in discerning the regulation of important processes such as the effects of root and shoot systems in controlling nodulation, protein accumulation, translocation of flowering hormones, systemic RNA silencing, etc. The study of the peanut root nodule initiation and development is facilitated by the availability of peanut mutant lines that do not nodulate (Nod-), and its sister normal nodulating lines (Nod+) identified by Gorbet and Burton (1979). Reciprocal, self grafted and ungrafted seedlings were used to study the effect of the shoot and root on peanut nodulation. Previously sterilized, seeds were planted in 20 cm plastic pots, and sowed in 2:1 sand-vermiculite mixture. Growth chamber temperature was held at 16°C to 30°C and incandescent 100 bulbs extended photoperiod to 14 hours. Seven-to-ten day-old seedlings were grafted using the “straw-band” technique, and once the graft had taken, plants were inoculated with commercial Bradyrhizobium. Plastic bags were placed on plants to maintain high humidity. Either nitrogen free plant nutrient solution or 5 mM KNO3-supplemented nutrient solutions were used twice per week. The plant nodules were harvested 45 days after planting and characterized. Without exception, plants with Nod- mutant shoots grafted onto Nod+ roots were nodulated. In contrast, plants with Nod- roots and Nod+ shoots were nodule free, suggesting that the non-nodulating phenotype was strictly root controlled. The symbiotic event involves the molecular interaction between the plant and the rhizobia; during the initial stages, the host produces exudates called flavonoids and the rhizoid respond synthesizing lipo-chito-oligosaccharides or Nod factors and attach to the host. In a preliminary analysis, roots exudates of Nod- and Nod+ plants were analyzed via reverse C18 HPLC/UV (280 nm) (-) ESI-MS. The flavonoid standards were apigenin, chrysin, genistein, kaempferol, luteolin, and naringenin. When compared to these standards, the root exudates from Nod+ contained naringenin and apigenin. None of the six flavonoids were positively identified in the Nod- root exudates. Also, different root structures were observed among these non-nodulating mutants. Experiments are underway to confirm these findings and they will be discussed.
Human allergy to peanut is due at least in part to hypersensitivity against the 2S, 7S and 11S seed storage proteins. Despite their importance in conditioning peanut allergy, a systematic identification of all the subunits comprising these proteins has not been reported. For this purpose a library of cDNA produced from A. hypogaea cv. Tifflrunner at seed mid-maturation was sequenced using 454 FlexTitanium Technology from Roche. After assembly, about 32000 contigs were recovered from nearly 859000 raw sequences that represented genes transcribed during seed-fill. Analysis of genes sequences isolated from cDNA libraries produced at seed mid-maturation facilitated description of the diversity of families of genes encoding seed storage proteins. The 2S, 7S and 11S storage protein subunits were resolved into 8, 4 and 20 subgroups, respectively, based on sequence homologies. This result revealed that the complexity of peanut seed storage protein genes was substantially greater than that implied by immunological designations presently in use. PCR primer pairs specific for each seed storage family subgroup were created and used to amplify DNA seed mid-maturation cDNA isolated from A. duranensis and A. ipaensis. This permitted identification of those sequences that originated from A genome and those that came from B genome. A proteomic approach confirmed that seed storage proteins profiles of A. ipaensis and A. duranensis were different from one another and that the 2D electrophoretic pattern obtained from A. hypogaea seed proteins had spots originating from both putative progenitors.
Update on the Long Term Storage of Arachis Seeds.

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Germination tests were conducted on Arachis spp. seeds stored for varying lengths of time, ranging from twelve to 36 years. Previous tests had indicated that after 30 years many of the seeds had reached the maximum storage time. However, seeds from some of those same lots which produced zero germination at 30 years did actually germinate at 36 years, so not all seeds were dead six years ago. The most viable of the seed lots came from the Arachis section, and the least viable were members of the Erectoides section. This is the same result we have had in previous germination studies on these lots and other lots of the same groups but not necessarily the same species. The species tested included: A. duranensis (3 accessions), A. correntina (4), A. villosa (1), A. stenosperma (1), A. kuhlmannii (1), A. monticola (1), A. hypogaea (2), A. batizocoi (1), A. paraguariensis (2), A. dardani (2), A. rigonii (1), and A. triseminata (1). The sections represented were: Arachis (14 accessions), Erectoides (2), Heteranthae (2), Procumbentes (1), and Triseminatae (1). The overall average germination for the sections was: Arachis – 28.7, with a range from 0 to 70%; Erectoides – 18.6, with a range from 4.5 to 60%; Heteranthae 21.5 with a range from 14.9 to 20%; Procumbentes – 66.2% and Triseminatae 21%. In section Arachis, A. duranensis has survived the best at 62.6%, and large seeded A. hypogaea has done very poorly at 0% survival. The “old” A. monticola which is highly introgressed with A. hypogaea was only slightly better than A. hypogaea at 1.3% (one seed of 74 germinated and made a plant). Arachis correntina has not survived well for the 36 years, with an average over four accessions of 2.2% (6 plants from 276 seed), and one accession had no germination of 49 seed. Arachis batizocoi was the only B genome species known in 1973 and it had 14 of 53 seed still viable; 26.4%. Conclusions from study of our long term storage of Arachis seed include: some species will store for extended times well beyond 25 years; other species will not store beyond the 20 to 25 year range. It appears that the large seeded A. hypogaea are among the lowest survivors beyond 25 years. In separate tests, some accessions of A. hypogaea fastigiata vulgaris (Spanish) germinated above 95% when stored past the 30 year time frame.
Valencia peanuts are generally grown as an irrigated crop in eastern New Mexico and west Texas. Water is getting scare due to increase number of dairies in the region. Most of the peanut growing area is under Ogallalla aquifer. The objective of our research study is to identify and screen for drought tolerant lines among Valencia mini core collection. For any breeding program to be successful we need to identify germplasm lines that are tolerant to drought and at the same time yield high. Recently a Valencia core was developed from the USDA collection using 26 morphological descriptors. In this study we grew 80 PI's from the Valencia core collection developed by NMSU at Brownfield, Texas under full irrigation and limited irrigation. This paper will discuss the results in more detail.

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Aflatoxins are toxic and carcinogenic metabolites produced by Aspergillus flavus Link ex. Fries and A. parasiticus Speare. Pre- and post-harvest contamination of peanut by aflatoxin is a major problem worldwide, causing profit loss for the peanut industry and raising serious human and animal health concerns. Peanut genotypes with resistance to aflatoxin accumulation should be an important part of an integrated aflatoxin management program. Aflatoxin content is expensive to measure and exhibits high environmental variation, thus, the use of molecular markers tightly linked to the trait would improve selection efficiency. This study was conducted to identify AFLP markers tightly linked to genetic factors controlling reduced aflatoxin accumulation after infection with Aspergillus flavus. A segregating F2 population was generated by crossing high-aflatoxin accumulating cultivar Gregory with low-aflatoxin accumulating interspecific tetraploid line GP-NC WS 2, phenotyped for aflatoxin accumulation using an in vitro assay, and screened with AFLP markers previously identified to be associated with reduced aflatoxin accumulation. An F-test was used to determine whether markers were associated with the trait, a genetic linkage map was generated, and interval mapping was used to identify regions of the genome that influence aflatoxin accumulation. Gregory supported significantly more aflatoxin production by A. flavus than GP-NC WS 2, and the F2 population exhibited high-parent heterosis. Thirty-five of 38 AFLP markers used to screen the F2 population had segregation distortion favoring the A. hypogaea cultivar. Six markers were significantly associated with reduced aflatoxin accumulation at the 5% significance level. Thirty-three markers were included in a genetic linkage map covering 60 cM. A putative QTL was identified at map position 9 cM that explains 6% of the variation for the trait. Linked markers could be utilized in a marker-assisted selection program to identify individuals that support low levels of aflatoxin accumulation.
Peanut production can be significantly impacted due to the duration or severity of drought in rainfed fields or limited water availability when plants need water the most, even in irrigated fields. Selection of drought resistant or tolerant variety can be very challenging due to location or year to year variability. Determining plant response to water deficit at different development stages may give us clues as the mechanism of drought resistance or tolerance, and the comparison of these responses across different peanut genotypes may indicate what plant mechanism was selected based on environmental challenge. In this experiment, five different runner peanut genotypes were evaluated for both mid- and late-season drought. These five tested genotypes were characterized by 400 SSR markers for an estimation of genetic similarity. Specific physiological measurements were conducted to confirm plant water stress. Leaves were collected from plants under different stages of water stress for gene expression study to determine possible mechanism of drought resistance. Understanding molecular response in different peanut genotypes will help in the development of peanut genotypes that will have superior drought tolerance.
Progress in Breeding Peanut for Resistance to Leaf Spot Diseases.

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Breeding peanut for resistance to leaf spot diseases (Early leaf spot [Cercospora arachidicola S. Hori] and Late leaf spot [Cercosporidium personatum (Berk and M. A.Curtis)]) has been a goal of the University of Florida peanut breeding program for over 30 years. Moderate resistance was identified in PI203396 and related lines in the early 1970’s. Using PI203396, six cultivars with moderate resistance to leaf spot have been developed by the University of Florida since 1986. However, only one of these cultivars was commercially successful. The other five suffered from poor seed germination and/or poor seedling vigor and commercial production was terminated as a result. In addition to their resistance to leaf spot, these lines share common characteristics such as late relative maturity and resistance to spotted wilt and white mold diseases. Growers would benefit from this combination of traits so there is a need to understand why this group of germplasm suffers from poor seed germination. On-going research to determine the cause of poor seed germination and/or poor seedling vigor has identified several factors. First, the seed storage environment was found to reduce the germination and vigor of seeds of DP-1 but not other cultivars. Second, seeds of DP-1 were found to contain less calcium than other cultivars. In peanut, insufficient seed calcium concentration is linked to poor seed germination. Subsequently, seeds of several other lines and cultivars with characteristics and genetic background similar to DP-1 were found to have lower seed calcium concentration than other cultivars. Third, electrolyte leakage of seeds of DP-1 was greater than other cultivars and was correlated with germination and seedling emergence. Preliminary data suggests that the antioxidant capacity of DP-1 is less than other cultivars which could explain greater electrolyte leakage. This report will summarize the status of research in these areas.
Evaluating Peanut Seed and Leaf Proteome for Use in Drought Tolerance Screening.

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In peanut, water stress (WS) significantly lowers plant resistance to Aspergillus flavus infection leading to aflatoxin contamination of peanut seed. One of the strategies adopted to decrease the risk of aflatoxin contamination in peanut is to identify and develop drought-tolerant peanut genotypes through molecular breeding. Objective of this research was to study changes in leaf and seed proteome of drought-tolerant (DT) and drought-susceptible (DS) peanut genotypes due to WS for evaluating the possibility of using leaf proteome as a biochemical marker for determining drought tolerance. Over twenty peanut genotypes with diverse drought-tolerance characteristics collected from ICRISAT and ANGR Agricultural University, India were used in this study. Peanut plants growing in pot culture under greenhouse conditions were subjected to WS for 0 to 28 days. Seeds and leaves were collected from irrigated (control) and water stressed plants and analyzed by 2-DE. Differentially expressed proteins were identified using MALDI-TOF Mass Spectrometry. Peanut seed proteome showed that in DT genotypes expression of methionine-rich proteins was either maintained or up-regulated while they were significantly suppressed in DS genotypes when subjected to WS. Likewise, in leaf tissue of DT genotypes several photosynthesis and defense related proteins were over expressed due to WS while these proteins were either partially or completely suppressed in DS genotypes. In addition, four new proteins were induced following WS in drought-tolerant cv. Vemana. We have identified these proteins as serine/threonine protein phosphate PP1, glycine betaine, peroxidase 43 and SNF1 protein kinase which plays a role as defense. These data showed that the proteomic responses of both seed and leaf tissue of DT or DS genotypes are similar and hence, either tissue can be used for evaluating drought-tolerance characteristics of peanut germplasm.

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To investigate regulatory processes and mechanisms underlying the response of peanut to abiotic stresses like heat, drought and salt, we adopted a systems biology approach. We have used the three “omics” platforms to study the response of a stress tolerant genotype in comparison to a susceptible line in leaf, root and pod tissues. Several clusters of gene, proteins and metabolite profiles were identified with different time-scales. We will discuss our findings on genes and proteins involved in a variety of cellular functions like lipids and starch synthesis, signal transduction, energy metabolism, seed maturation including desiccation tolerance, and proposed models demonstrating how novel pathways may impinge on the molecular mechanism of abiotic stress tolerance in peanuts.
In response to the limited peanut butter contamination incident of 2006/7, studies were initiated to examine the effect of various time and temperature protocols on log kill levels for Salmonella on peanuts. The objective of the work was to establish time and temperature parameters necessary to reduce Salmonella on contaminated raw peanuts by a minimum of four logs using both oil and dry roasting conditions. Data from that study to include different market types of peanuts and a wide range of time and temperature protocols will be presented. Recently, contamination of peanut butter with Salmonella was responsible for 8 deaths and numerous illnesses. Cross-contamination from food handlers and processing are the major avenues of Salmonella contamination in food but poor sanitation and temperature abuse are also causes of Salmonella contamination. In response to requests from the peanut industry in general and manufacturers in particular, numerous roaster oven temperatures were evaluated as a needed first step to confirm that peanut roasters can and do deliver the appropriate time and temperature necessary for an appropriate Salmonella kill. Temperature profiles of ovens evaluated generally meet the time and temperature parameters necessary to achieve a 4 log kill of Salmonella.
An ELISA as a Quality Control Tool for Peanut Allergens in Processed Foods.

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Peanut allergy has become one of the most severe allergies afflicting modern living because of its persistency and the life-threatening symptoms. The prevalence of peanut allergy is estimated at 0.4–0.6% in children and 0.3 – 0.7% in adults in developed countries. Without effective treatments and therapies for peanut allergy, sensitive and specific detection methods for tracing hidden or undeclared peanut allergens in processed foods are essential for consumer protection. This paper presents the development of a sensitive double-antibody-sandwich (DAS)-ELISA for the rapid detection of traces of peanut allergens in processed foods as a quality control tool. The sensitivity of the DAS ELISA for peanut allergens has been enhanced by utilising antibodies raised against different peanut cultivars. The assay exhibits a limit of detection of 1.4 µg L-1 and the range of detection of 1.4 – 300 µg L-1. Among the potential cross reactive food allergens tested, including tree nuts and legumes, only pine nut, cashew, blue lupin, and green bean show slight cross reactions. Preliminary validation using twelve food products spiking with peanut proteins at 11-300 µg L-1 showed acceptable recoveries (80-122%), suggesting that this assay can be adopted as a effective quality control tool for the food processing industry.
Characterization of Folates in Peanuts.

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The folate levels in a group of raw and roasted samples selected from the 2007 and the 2008 Uniform Peanut Performance Trials (UPPT) and from a set of raw samples from the Core of the Core of the Peanut Germplasm collection grown in 2006 and 2008 were determined. The samples were digested in protease and amylase to free the vitamers from the matrix. The homogenized samples were treated with an additional enzyme to deconjugate the polyglutamates. The different monomers of the folates present were determined using High Performance Liquid Chromatography coupled to Mass Spectrometry (HPLC-MS). Raw samples from the UPPT were found to have significantly higher levels of total folates compared to roasted. There were significant differences in folates between years for the Core of the Core samples although the relative relationship among samples remained the same in both years. The predominate vitamers found were 5-methyl-tetrahydrofolate and 5-formyl-tetrahydrofolate regardless of origin, PI or year.
Since the early 1990s, the peanut breeding program at N.C. State University has monitored flavor of advanced breeding lines so that flavor could be used as a criterion in cultivar release decisions. The number of samples that can be assayed for flavor in a year are limited, so only advanced breeding lines have been monitored. As data have accumulated, lines with superior flavor profiles have been retained. The NCSU flavor database was mined to calculate the response of flavor attributes to selection over time, genetic gain or ∆G. Data on virginia-type cultivars, NCSU breeding lines tested for at least two years, and flavor standards Florunner and Georgia Green were analyzed and means computed, adjusted for appropriate covariates (linear and quadratic effects of roast color and intensity of the fruity attribute that can interfere with the perception of roasted peanut and sweet sensory attributes). In order to relate sensory attribute response to time, each genotype was characterized as to the first year it was subjected to replicated testing of yield and grade. Regression of the intensities of sensory attributes on time revealed that ∆G has been greater in magnitude for the breeding lines developed in the late 1990s through the 2000s than it was for cultivars released from 1979 through 2005 (first tested 1974 through 2000). The response of breeding lines was +0.046 flavor intensity units (fiu) for roasted peanut, +0.58 fiu for sweet, and -0.032 fiu for bitter, compared with values of +0.008, +0.005, and -0.005 for the cultivars.

We attribute this accelerated rate of gain for flavor to our program of regular monitoring of the flavor of advanced lines.
Physico-chemical Properties of Peanut Pancakes Made from an Instant Mix.

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Pancakes are very popular breakfast food items in several countries with different regional names. Majority of the commercial pancake formulations include all purpose flour as a major ingredient. Pancakes made with partially defatted peanut flour as a major ingredient will provide enormous nutritional benefits for consumers. The objective of this study was to develop a peanut pancake instant mix with light roasted partially defatted peanut flour (12%fat). Peanut pancake mix was prepared at 20, 30, 40 and 50% replacement of wheat flour along with other ingredients. Pancakes were made by mixing measured amount of instant mix with water and peanut oil with a wire whisk for about 2 min then 40 ml batter was poured on a griddle preheated to 190°C and cooked for 1.5 min on each side. Pancake made with 100% wheat flour was used as the control. Viscosity of the batter was determined at 20, 50 and 100 rpm using a brook-field viscometer and the values increased with increase in peanut flour concentration when compared with control. Color was determined using a Hunter colorimeter and expressed as color difference (ΔE) and the values were lower than control and shown variable trend among the samples. Textural properties were determined using an Instron Universal Testing Machine and the results indicated hardness, cohesiveness and chewiness values decreased with increasing peanut flour where as springiness values increased. Bulk density of the prepared pancakes was measured by using glass beads and the values showed variable trend among the samples when compared with the control. Moisture, fat, ash and protein content were determined using a vacuum oven, gold fisch fat extractor, muffle furnace and a LECO nitrogen analyzer, respectively. Peanut pancake had higher protein content and increased with increasing peanut flour. The developed peanut pancake instant mix has shown promise as a functional breakfast food item to replace regular wheat pancake mix.
Chemical and Bioactivities Characterization of Peanut Skin Phytochemicals.

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Peanut skins contain substantial quantity of phytochemicals which deserve research attention. In this study, peanut kernel skins of four different-colored genotypes, including black, black-pink mix, red and pink were subjected to water extraction and followed by quantification and HPLC analysis. As further isolation and identification, one or both of cyanidin-3-sambuoside and cyanidin-3-sophoroside were identified as the major pigment of the black and black-pink colored skins. Total phenolics and flavonoid contents of all test skins were ranged from 40 to 68 mg gallic acid/g skin and from 0.1 to 19.6 quercetin/g skin, respectively. Higher flavonoid contents were detected in the extracts of black and black-pink mix skins than in other colored skins. As subjection of the water-extracts to bioactivities characterization, DPPH (α,α-diphenylhydrazyl) scavenging activities tested at 0.04 mg skin/mL water were equivalent to 4.4 to 10.8 µg/mL of butylated hydroxytoluene (BHT), reducing powers tested at 0.4 mg skin/mL water were equivalent to 29.3 to 137 µg/mL Vit C, and antioxidative potencies tested at 2 mg skin/mL water were equivalent to 14.3 to 51.6 µg/mL BHT. When the black and pink colored skin extracts were subjected to anti-inflammatory activities assessment with RAW 264.7 macrophage cells, the extracts were effective in inhibition of nitric oxide (NO) and IL-1β biosynthesis. As generalized, bioactive phytochemicals of peanut skins in regardless of color merit value-added product developments.
Peanut roots as a Potent source of Bioactive Compounds in Inhibition of Advanced Glycation End Products (AGEs) Formation.

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Serum protein glycation and formation of advanced glycation end products (AGEs), usually enhanced by hyperglycemia, are closely related to subsequent complication of diabetes. Glycation is a nonenzymatic reaction between amino group of proteins and carbonyl group of reducing sugars. With an attempt to facilitate glycation to save time in screening of antiglycation compounds from peanut roots, a reliable procedure by reaction of bovine serum albumin (BSA) and fructose at 50°C for 24 h to form products with fluorescence enabling spectrophotometric quantification was suggested to be in substitute of reaction at 37°C for 7 days. As subjection of the products to electrophoresis, both reacted SDS-PAGE protein patterns were identical. By the procedure in determination of antiglycation activities of the 80% methanol-extracts of dried peanut roots (1:20, w/v), most root extracts exhibited higher activities in inhibition of AGEs formation than did 1 mM aminoguanidine (AG), used as a positive control. The extracts were also inhibitory to formation of Amadori products and middle products of α-dicarbonyl compounds. Chemical and bioactivities characterization of the bioactive compounds of peanut roots in development of value-added products were also conducted.
Sensory Quality of Peanut Products Using an E-Nose.

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Human sensory panels have long been the standard for determining the sensory quality of foods. Many times the food tested poses health risks and undesirable flavors. Safety of human panels must be taken into consideration in the process. Fortunately technology has progressed to the point where an electronic nose (E-Nose) can be used to make the process faster, more efficient, less biased, and most importantly safer. JLA, an international system of laboratories and support for the system, has examined the use of the E-Nose for the purpose of sensory quality control.

JLA in conjunction with Alpha M.O.S. tested good sensory products including three common off-flavors with varying intensities. Samples were sent to Alpha M.O.S. and results indicated a clear resolution on PCA cluster analysis of low intensity off-flavors from desirable sensory samples. As a result of this study, JLA has acquired an E-Nose. During the 2009 harvest, JLA sampled peanuts from Virginia-Carolina, Southeastern and Southwestern production areas. Over three hundred samples were analyzed in triplicate on the E-Nose side-by-side with sensory panels. Ninety percent of samples scored within two standard deviations for “roasted peanutty” intensity with excellent repeatability on the E-Nose instrument. Results from this study as well as ongoing validation experiments will be presented.
Quantification of Peanut and Oilseed Texture as a Function of Processing.


Texture is critical to consumer acceptability of many products including peanuts. Texture is a complex sensory experience that primarily relates to the way a product feels in the mouth; however, audio and visual inputs are also important. Limited data is available regarding peanut texture as a function of processing, genetic and/or environmental factors. Accordingly, texture sensory data was collected for a range of commercially available peanuts processed under different conditions including dry roasting, oil roasting and water blanching/oil roasting among others. Select cultivars grown in different environments and subsequently processed equivalently were also tested. Two instrumental methods to quantify mechanical properties of the peanuts were also used to characterize samples. The first method involved individual compression testing of multiple split cotyledons whereas the second test utilized a Kramer shear cell (KSC) for simultaneous compression testing of multiple peanuts from a given sample. Moisture, oil, protein, sugar, density, and color data complemented sensory and mechanical data. Equivalent data was also collected for other common oilseeds including almonds, cashews and hazelnuts for comparison. Dry roasting or oil roasting generally decreased “hardness” while increasing sensory perception of “crunchiness” for peanuts and other oilseeds. Good correlations among oil and moisture contents were observed with sensory texture terms and mechanical measures. Instrumental relationships to sensory texture data are of particular interest due to the costs and time needed for collecting sensory data. In a comparison of 35 products, KSC peak force values linearly correlated with product hardness (R² = .74). Poorer correlations were observed in instrumental data and panel scores of “crunchiness” or “crispiness”. These terms, unlike “hardness”, which only accounts for perceived force during chewing, also account for perceived sound during chewing. This suggests the importance of collecting and quantifying audio data instrumentally to better predict and understand peanut and oilseed texture.
Tomato spotted wilt virus has made significant changes to the way peanuts are grown in the southeast. There was no defense against the disease when it first occurred and yield and quality losses were severe. Symptoms first began around 1990 with losses reaching about 15% in 1997 followed by another peak in 2005 when about a 9% yield loss occurred. Scientists in the tri-state area developed a TSWV index to help reduce losses from this disease. There are no varieties that are immune to TSWV but some have tolerance and this along with planting date, plant population, insecticide use, row patterns, tillage and use of Classic or not all influence the amount of disease that can occur. Strip tillage into cover crops has been shown to reduce the incidence by about 50%. Our research has shown that peanuts can be strip tilled into killed bahiagrass reducing TSW by another 50% (very little TSW observed) allowing susceptible varieties to be planted at the normal planting date (pre TSW problems) while making yields that can only be made in the conventional system when planted 3-4 weeks later. This paper will discuss these and other advantages to this system and the reason this should be the 8th factor to consider in the TSWV index model.
Evaluating Inoculation of Two Peanut Cultivars after Long-Term Continuous Corn Production.

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To maximize N-fixation, peanuts (Arachis hypogaea L.) need to have abundant nodulation with active Rhizobium. In fields with a recent history of peanut in rotation, inoculation may not be necessary because of adequate Rhizobia survival in the soil. However, in fields that have not been planted to peanut for five years or more, inoculation may be necessary to achieve optimized production. An experiment was planted in Tifton, GA during 2008-2009 in a field that had previously been planted to 25+ years of continuous corn to evaluate peanut response (yield, grade, nodulation, foliage color, plant biomass) to inoculation. Two peanut cultivars (‘Georgia-06G’ and ‘AP-3’) were planted as a main plot effect with three inoculation treatments (untreated, Optimize Lift, and Vault Liquid) as a sub-plot effect in a split plot design. There were no treatment interactions among the assessed variables in either year. Georgia-06G yielded and graded higher than AP-3 averaged over inoculant treatments, and also had darker foliage and larger plant biomass. When averaged over cultivars, the inoculant treatments outperformed the untreated peanuts in yield, nodulation, and foliage color. Inoculated peanuts averaged 1623 lb/ac more than non-inoculated peanuts in 2008, and 492 lb/ac higher in 2009. The sharp decline is attributed to a very wet season in 2009, especially within the first week after planting, potentially washing rhizobia away from the seed and/or killing some bacteria in the anaerobic conditions of the water-logged soil. These results show inoculation of peanuts in fields without native rhizobia is imperative to maximizing peanut performance. There are also indications that genetic variation in foliage color can be nearly as drastic as differences between inoculated and non-inoculated peanuts. Therefore, it is important that growers do not misdiagnose inoculant failure from planting different peanut varieties with drastically different hues in the same field.
New peanut cultivars are available with very high yield potential and high levels of disease resistance. With rising input costs and shrinking return margins, all efforts must be made to harvest the full yield produced. Peanut crops are susceptible to high levels of pod loss during digging from a complex of factors. Peanut yield and grade generally improve until optimal maturity. At maturity, individual pods begin releasing from the plant, so late digging often causes considerable yield loss. The genetic characteristics of peg strength are likely to vary among cultivars and are currently unknown. In 2009, studies were conducted to measure peg strength and recover pods from soil in two studies. The first included early and late digging dates on cultivars Tifguard and Georgia-06G that included fungicide treatments purported to improve peg strength. The second experiment included 6 cultivars over 2 planting dates. After mechanical digging and harvest, hay was raked from the plot surface. A modified 2 row peanut shaker was used to dig and sift soil to recover pods left in the soil at digging. Pod yield, scavenged yield, and peg strength will be reported.
Conservation Tillage as a Solution to Drought in Both the Southeastern and Western Peanut Growing Regions.

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Conservation tillage cropping systems were introduced in the 1970s and much research has documented positive benefits such as decreased erosion, general soil improvement (carbon sequestration), and decreased labor, time, and fuel devoted to land preparation. Strip tillage, in-row subsoiling followed by a narrow seedbed preparation, is the most popular form of conservation tillage and research has validated that it can be used in peanut successfully despite concerns regarding digging, pegging, and disease. Often overlooked in discussions regarding conservation tillage are changes to crop physiology and growth, which have frequently resulted in greater water use efficiency while maintaining yield.

Given that irrigation water is abundant but highly politicized in the Southeast, and that irrigation capacities are already decreased in the Western peanut regions, this drought mitigation should become the focus of conservation tillage research. Data that demonstrates this important concept will be presented from 2006-2009 research projects in Dawson, GA, and Lubbock, TX.
Evaluating the Potential of Variable Rate Fungicide Application to control Sclerotinia blight.

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Profit margin has continued to decrease in southwest peanut (Arachis hypogaea L.) production over the last several years. The most logical ways to increase profit margin is to either increase yields or decrease inputs. Precision management technologies have been adopted relatively slow in peanut production. Fungicide application is the largest expense in many peanut fields, especially in Sclerotinia blight (Sclerotinia minor) infected fields. Use of current technology may allow for targeting fungicide applications to control Sclerotinia. The objectives of this study were to 1) determine the potential of using active sensors, in-season, to determine variable rate applications for control of Sclerotinia and 2) determine the potential for using past season aerial imagery and other data layers to delineate fungicide management zones. Two separate Sclerotinia control trials were sensed at 2 to 3 wk intervals with a handheld GreenSeekerTM sensor to determine NDVI. In addition, two peanut fields in SW Oklahoma were identified in 2009 and aerial photographs were taken. Fields were grid soil sampled on 0.5 ac grid size to determine sclerotia densities throughout the field. Use of the GreenSeekerTM sensor was highly correlated with control of Sclerotinia and pod yield after October 1. Prior to this date, correlation in yield and NDVI was poor. Use of aerial imagery, elevation, and soil type appear to hold some promise in reducing fungicide application to control Sclerotinia.
Investment Analysis of Conventional vs Conservation Tillage Equipment for Peanut.

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Peanuts are a capital intensive crop because of the specific inputs and equipment needed to produce and harvest a high yield crop. When investing in equipment, farmers have a choice between traditional peanut production equipment (conventional tillage) and reduced tillage equipment (conservation tillage). There has been growing interest in conservation tillage peanut production because of incentives from government programs, benefits to soil and water quality, and cost savings on labor and equipment. An investment analysis of conventional tillage peanut production equipment was compared to that of conservation tillage equipment. The impact of higher fuel and chemical prices on the investment decision were evaluated using a sensitivity analysis. Break-even yields and prices needed to realize a return on investment were also calculated.
Potential Economic Impact of the Conservation Stewardship Program on U.S. Peanut Farms.

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The Food, Conservation, and Energy Act (FCEA) of 2008 established the Conservation Stewardship Program (CSP) with an optional supplemental payment for adopting a Resource Conserving Crop Rotation (RCCR). This program is to be administered through USDA/NRCS and will be available to all producers in the United States if they comply with enrollment criteria. In order to receive payments, the participant will sign a 5 year contract, agree to implement the CSP plan, operate and maintain the conservation activities, and maintain and make available appropriate records documenting applied conservation activities and production system information. A participant may receive an optional supplemental payment for adopting a RCCR, but must first comply with CSP criteria. After the first sign-up period in late 2009, the combined payments for CSP/RCCS have ranged from $40/Ac to $80/Ac per year. The CSP/RCCR has a yearly payment limitation of $40,000 per individual and a 5 year payment limit of $200,000 per contract. The CSP/RCCR is considered in compliance with the World Trade Organization (WTO) green box requirements and is viewed as a potential viable option for an alternative farm safety net to historical farm programs that are under much scrutiny in the upcoming Farm Bill. The National Center for Peanut Competitiveness (NCPC) analyzed the potential economic impact of this program on their 22 U.S. Representative Peanut Farms. Data based on conversations with state NRCS staff were incorporated into the modeling. Preliminary results indicate the program to be a viable option for U.S. peanut producers.
Production costs of commodities typically grown in the Southern United States have declined to some extent since the record high costs realized during the 2008 growing season. Unfortunately, commodity prices have also declined for most commodities. Given the fluctuation of costs of production coupled with uncertainties in the commodity markets it is difficult to predict the economic viability of the current year, let alone what the future holds for the U.S peanut farms. To address this question for Southern agriculture and more specifically the peanut farming industry, the National Center for Peanut Competitiveness (NCPC) utilized its U.S. Representative Peanut Farms Database. Using FAPRI’s January 2010 Baseline, 6 of the 22 farms, or 27% are forecast to have good economic viability for 2010 through 2015. Three farms, or 14% are forecast to have marginal economic viability, and 13 farms, or 59% are forecast to have poor economic viability by 2015. Although the January 2010 forecast shows some improvement over the August 2009 FAPRI Baseline where only 18% of the farms were green, the results still indicate troubling economic times for most representative peanut farm. This analysis is not promising for the United States peanut farming industry. Unless overall profitability of all crops produced on a peanut farm in the United States increases, the economic viability is in jeopardy for this sector of the country.