Single- and Twin-Row Peanut Production within Narrow and Wide Strip Tillage Systems

Kipling S. Balkcom,* Francisco J. Arriaga, Kris B. Balkcom, and Deborah L. Boykin

Peanut

Increased production costs and potential benefits of maintaining surface residue has renewed interest in conservation tillage systems for peanut (*Arachis hypogaea* L.) production. We determined surface residue cover from rye (*Secale cereale* L.) or oat (*Avena sativa* L.) cover crops after two strip tillage systems (narrow vs. wide) and planting operations with different row configurations (single vs. twin). We also compared plant populations, yields, and total sound mature kernels for three peanut cultivars ('ANorden', 'AP-3', and 'Georgia-02C') across each treatment combination. Seven site-years were examined across similar soil types in Alabama and northern Florida during the 2004 to 2006 growing seasons. The highest surface residue counts were for the narrow tillage system planted in single rows. Final plant stands were influenced by an interaction between cultivar and row configuration, with 'ANorden' planted in single rows below recommended rates. Peanut yields were affected by strip tillage system and row configuration, but differences among cultivars were also observed. Twin-row peanut yields were 5% greater than single-row peanut yields in the narrow strip tillage system but were similar across strip tillage systems. Cultivars 'AP-3' and 'Georgia-02C' yielded 20% higher than 'ANorden'. Total sound mature kernels were only affected by peanut cultivar, with the cultivar 'Georgia-02C' producing the highest-quality peanut, followed by 'ANorden' and 'AP-3'. These results indicate that growers interested in using twin rows for peanut production can also take advantage of a narrow strip tillage system that maximizes surface residue coverage and subsequent benefits.

Traditional peanut production has typically involved moldboard plowing followed by several secondary tillage operations to create a smooth seedbed, bury crop residues that may increase disease pressure, and reduce weed competition by burying weed seeds (Colvin and Brecke, 1988; Colvin et al., 1988; Jordan et al., 2001b). In the southeast United States, peanut is grown on highly weathered Ultisols generally characterized by coarse textures, poor structure, and organic matter content <1.0% (Radcliffe et al., 1988). Poor soil structure and low organic matter content are exacerbated by the multiple tillage operations required in conventional tillage peanut production. In addition, mechanical digging of peanuts at harvest promotes decomposition of crop residues and oxidation of soil organic matter. Slight increases in soil organic matter can improve soil structure, water-holding capacity, and infiltration (Dabney, 1998; Dabney et al., 2001). An option to facilitate organic matter increases is to increase crop residue inputs by using conservation tillage practices that include a high-residue cover crop.

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A decline in soil productivity, concerns over soil erosion, and rising production costs have promoted grower interest in conservation tillage systems for peanut (Grichar, 2006; Jordan et al., 2001b). Conservation tillage that includes a high-residue cover crop enhances soil physical properties (Schwab et al., 2002). Residues are known to decrease evaporation and increase water infiltration (Lascano et al., 1994). A typical peanut conservation tillage system involves planting a winter annual cereal cover crop, chemically terminating the cover crop in the spring, and using an in-row subsoiler with coulters and baskets (strip tillage) to prepare a seedbed. However, this strip tillage operation typically disrupts approximately one third to one half of the row width to create a smooth seedbed to facilitate planting operations but simultaneously incorporates beneficial surface residue that can diminish potential benefits of residue coverage (Reeves, 1994). A different form of strip tillage used for row crops in the region, such as cotton (*Gossypium hirsutum* L.), might be more appropriate for strip till peanut. The same in-row subsoiler is used, but the coulters and baskets are replaced with rubber pneumatic tires to close the slit created by the subsoiler shank. This type of tillage operation provides belowground disruption of any compacted zones present beneath the row while maximizing the amount of residue retained on the soil surface.

The obvious benefits associated with maintaining cover crop surface residues include protecting the soil from erosion during high precipitation periods, such as winter and early spring months (Balkcom et al., 2007b); improving water infiltration by reducing soil crust formation and creating channels as roots decompose that allow water to infiltrate (Williams and Weil, 2004); and increasing C inputs to enhance soil quality (Reeves, 1997). As a result, the National Resources Conservation Service promoted a

Abbreviations: GCS, Gulf Coast Research and Extension Center; TSMK, total sound mature kernels; TSWV, tomato spotted wilt virus; WFREC, West Florida Research and Education Center; WGS, Wiregrass Research and Extension Center.

Table 1. Soil taxonomy and initial soil test values for seven environments at three locations during the 2004–2006 growing seasons.

Crop year	Location†	Soil series‡	Family	Soil pH	Mehlich I extractable			
					Ca	P	K	Mg
					mg kg^{-1}			
2004	GCS	Malbis fsl	fine-loamy, siliceous, subactive, thermic Plinthic Paleudult	6.1	835 (H)§	28 (VH)	46 (H)	116 (H)
	WGS	Dothan ls	fine-loamy, kaolinitic, thermic Plinthic Kandiudult	6.0	345 (H)	46 (VH)	99 (VH)	52 (H)
2005	GCS	Red Bay sl	fine-loamy, kaolinitic, thermic Rhodic Kandiudult	5.8	355 (H)	15 (H)	56 (H)	60 (H)
	WFREC	Orangeburg sl	fine-loamy, kaolinitic, thermic Typic Kandiudult	–¶	–	–	–	–
	WGS	Dothan ls	fine-loamy, kaolinitic, thermic Plinthic Kandiudult	5.6	175 (H)	40 (VH)	53 (VH)	25 (H)
2006	GCS	Malbis fsl	fine-loamy, siliceous, subactive, thermic Plinthic Paleudult	5.7	400 (H)	11 (H)	48 (H)	100 (H)
	WGS	Dothan ls	fine-loamy, kaolinitic, thermic Plinthic Kandiudult	5.7	222 (H)	41 (VH)	82 (VH)	34 (H)

† GCS, Gulf Coast Research and Extension Center; WFREC, West Florida Research and Extension Center; WGS, Wiregrass Research and Extension Center.

‡ fsl, fine sandy loam; ls, loamy sand; sl, sandy loam.

§ H, high, VH, very high (soil test categories based on Alabama Experiment Station recommendations) (Adams et al., 1994).

¶ Initial soil test values were lost before analysis at the WFREC location.

residue management practice through the Environmental Quality Incentive Program to encourage growers to retain residue on the soil surface. In Alabama, this program pays growers $123 ha^{-1} up to 3 yr for moderately intensive management of crop residues. The program requires growers to plant a winter cover crop into existing crop residue, fertilize the cover crop with at least 34 kg N ha^{-1}, and use a tillage system that maintains at least 50% of the residue on the soil surface after the planting operation is completed.

There are concerns about peanut establishment and subsequent seed-to-soil contact when the tilled zone is reduced in a narrow strip tillage system. These concerns have become much more prevalent since producers in the Southeast began shifting from single-row patterns to twin-row patterns (spaced 17.9–22.9 cm apart) centered on 91- to 102-cm rows (Jordan et al., 2001b). The shift to twin rows is the result of a decreased incidence of tomato spotted wilt virus (TSWV) compared with single rows (Baldwin et al., 1998; Brown et al., 2005) and a potential for increased peanut yields of twin rows over single rows (Jordan et al., 2001a).

Improved disease resistance, particularly to TSWV, is a major factor southeastern growers must consider when selecting peanut cultivars (Culbreath et al., 2000). However, the new cultivars' initial evaluations focused on yield and disease resistance in clean-tilled environments (Colvin and Brecke, 1988). Information on these cultivars' performance in conservation tillage is lacking (Colvin and Brecke, 1988). Our objectives were (i) to determine the amount of winter cover crop surface residue remaining after field operations with a narrow- and wide-strip tillage system and planting operations with single- and twin-row configurations and (ii) to compare final plant stands, yield, and peanut quality of three recently released cultivars across strip tillage systems and single- versus twin-row configurations.

Materials And Methods

Field experiments were conducted at the Gulf Coast Research and Extension Center (GCS) in Fairhope, Alabama (30°32′N, 87°52′W) and the Wiregrass Research and Extension Center (WGS) in Headland, Alabama (31°21′N, 85°19′W) during the 2004 to 2006 growing seasons. The 2005 growing season included a location at the West Florida Research and Education Center (WFREC) in Jay, Florida (30°46′N, 87°8′W). Soil types and initial soil test ratings for each location are summarized in Table 1. Soil test ratings were based on 20 composited soil cores (1.9-cm-diam. probe) collected in mid-October to correct any nutrient deficiencies in the surface 20 cm of soil. Soil pH was determined in a 1:1 soil/water extract, and Ca, P, K, and Mg levels were extracted with the Mehlich I extractant. Soil test ratings were based on Alabama Agricultural Experiment Station recommendations (Adams et al., 1994).

Treatments consisted of three runner market type peanut cultivars, two tillage systems, and two row configurations. The experimental design was a randomized, complete-block, split-split plot design. Main plots were peanut cultivars ('ANorden', AP-3', and 'Georgia-02C') with four replications at GCS and WFREC and three replications at WGS. Subplots were tillage systems (narrow strip tillage and wide strip tillage), and sub-subplots were row configurations (single and twin rows).

Twin rows were centered over the specified row spacing (97 cm at GCS; 91 cm at WGS and WFREC) at each location and 19 cm apart. The implements used for the tillage systems were KMC Generation I Rip-Strips (Kelly Manufacturing Co., Tifton, GA). The narrow strip tillage configuration consisted of a coulter, shank, and pneumatic press wheels, and the wide strip tillage configuration consisted of a coulter, shank, two sets of coulters, rolling basket, and drag chain. The narrow strip tillage system was designed to minimize surface soil disturbance and to till a zone approximately 30 cm wide, whereas the wide strip tillage system tilled a zone approximately 45 cm wide. Subsoiling depth for both implements was 35 to 40 cm and performed within 2 d ahead of planting. Sub-subplot dimensions were 3.9 m wide (4- to 38-in rows) at GCS and 3.7 m wide (4- to 36-in rows) at WFREC and WGS with 9.2-m-long rows at each location.

A cover crop of rye or oat was established the preceding fall of each crop year with a no-till drill seeded at 100 kg ha^{-1}. Cover crop species, planting dates, and termination dates for each location are summarized in Table 2. Biomass samples were determined immediately before chemical termination by cutting all aboveground tissue from two 0.25-m^2 areas at random within each plot and weighing after drying 72 h at 55°C. Termination dates were not based on cover crop growth stage but were administered at least 3 wk ahead of the anticipated peanut planting date to maximize biomass production and allow sufficient time for soil moisture recharge by natural rainfall (Balkcom et al., 2007a; Dabney, 1998). After biomass sample collection, all plots were rolled with a cover crop roller and chemically terminated with glyphosate [*N*-(phosphonomethyl) glycine]. Approximately 3 wk after cover crop termination, each strip tillage operation was administered to the appropriate subplot, and subsequent peanut cultivars were planted at 215,400 plants ha^{-1} for single and twin rows, with an intended final population of at least 143,200 plants ha^{-1}. Individual plant populations for both single rows of the twin-row configuration were reduced by one half to provide a plant population equivalent to the single-row configuration. Peanut planting and harvest dates are summarized in Table 3. At each location, single rows were planted with a John Deere 1700 MaxEmerge Plus (Deere & Co., Moline, IL) planter equipped with Dawn row cleaners (Dawn Equipment Co., Sycamore, IL). At GCS and WFREC, twin rows were planted at each location with the same planter; however, a shifter was attached to the tractor three-point hitch to offset the planter units and enable two passes of the row units to accomplish the twin-row configuration. The tractor was driven down the single row plots again after the planting operation to eliminate differences associated with equipment traffic. At WGS, twin rows were planted with a Monosem (Monosem Inc., Edwardsville, KS) twin row planter that had a coulter mounted in front of each individual row. The cultivar 'Georgia-02C' is a later-maturing cultivar and was typically harvested after the other two cultivars (Table 3).

Table 2. Cover crop species, planting dates, termination dates, and biomass produced across 7 site-years during the 2004–2006 growing seasons in southern Alabama and northern Florida.

Crop year	Location†	Species	Planting date	Termination date	Biomass
					kg ha^{-1}
2004	GCS	rye	14 Nov. 2003	31 Mar. 2004	2730 (940)‡
	WGS	oat	5 Nov. 2003	28 Apr. 2004	2845 (560)
2005	GCS	rye	17 Nov. 2004	4 Apr. 2005	2480 (900)
	WFREC	oat	12 Nov. 2004	19 Apr. 2005	4240 (570)
	WGS	oat	10 Nov. 2004	27 Apr. 2005	4680 (1300)
2006	GCS	rye	14 Nov. 2005	21 Apr. 2006	6480 (1430)
	WGS	oat	9 Nov. 2005	20 Apr. 2006	2840 (570)

† GCS, Gulf Coast Research and Extension Center; WFREC, West Florida Research and Extension Center; WGS, Wiregrass Research and Extension Center.

‡ Standard deviation in parentheses.

Surface residue counts were determined using the line transect method (Morrison et al., 1993) before peanut emergence using two 7.6-m-long transects placed at a 45° angle to the peanut rows in the form of an 'X' in each plot. Plant populations were determined approximately 3 wk after planting by counting all emerged peanut plants from three 3-m sections within each sub-subplot.

Peanuts were mechanically harvested from the two center rows of each plot to determine yield and total sound mature kernels (TSMK). Yield was determined by weighing freshly harvested pods in the field and adjusting the weight based on a subsample that was dried to 10% moisture. That subsample was shelled and graded to determine TSMK. Normal cultural practices were administered by experiment station superintendents and based on Alabama and Florida Cooperative Extension recommendations. Immediately after planting, the pre-emergence herbicide pendimethalin [N-(1-ethylproply)-3,4-dimethyl-2,6-dinitrobenzenamine] was applied to control early-season weed pressure. If required, a post-emergence herbicide mixture that contained paraquat (1'-dimethyl-4,4'-bipyridinium), bentazon [3-(1-methylethyl)-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide], acifluorfen sodium 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate, and butyrac [dimethylamine salt of 4-(2,4-dichlororphenoxy) butyric acid] was applied to control weed escapes. Approximately 35 to 40 d after planting, a 14-d fungicide spray schedule that included chlorothalonil (tetrachloroisophthalonitrile) and azoxystrobin [methyl (E)-2-{2-[6-(2-cyanophenoxy) pyrimidin–4-yloxy]phenyl}-3-methoxyacrylate] was initiated up to 2 wk before peanut digging. All plots were treated to control peanut leaf spot caused by the fungus *Cercospora arachidicola* and *Cercosporidium personatum* and the white mold fungus *Sclerotium rolfsii*. Lambda-cyhalothrin [(RS)-α-cyano-3-phenoxybenzyl 3-(2-chloro-3,3,3-trifluoropropenyl)-2,2,-dimethylcyclopropanecarboxylate] was applied as needed to control insects. At WGS, irrigation was only applied to prevent extreme moisture stress and consisted of <135 mm throughout the growing season. No other locations were irrigated.

Data were analyzed using a general linear mixed model procedure provided by SAS (Littell et al., 2006). Year and location interactions with treatments measure random environmental conditions and represent a component of error. If year and location interactions were homogenous, then these factors were combined as 7 site-years of data representing different environmental conditions. Initial analyses on each dependent variable were performed to measure the effect of years and locations as fixed effects. These analyses enabled us to measure the magnitude of year and location interactions with treatments. We determined that year and location had similar influences on treatment effects. Therefore, year and location were combined into one factor called environment and treated as a random effect in the final analysis. The final analysis for surface residue, plant population, yield,

Table 3. Peanut planting dates and harvest dates across 7 site-years during the 2004–2006 growing seasons in southern Alabama and northern Florida.

Crop year	Location†	Cultivar	Planting date‡	Combining date
2004	GCS	ANorden	20 May 2004	21 Oct. 2004
		AP-3		21 Oct. 2004
		Georgia-02C		21 Oct. 2004
	WGS	ANorden	18 May 2004	7 Oct. 2004
		AP-3		7 Oct. 2004
		Georgia-02C		7 Oct. 2004
2005	GCS	ANorden	20 May 2005	11 Oct. 2005
		AP-3		11 Oct. 2005
		Georgia-02C		11 Oct. 2005
	WFREC	ANorden	25 May 2005	14 Oct. 2005
		AP-3		14 Oct. 2005
		Georgia-02C		14 Oct. 2005
	WGS	ANorden	12 May 2005	7 Oct. 2005
		AP-3		7 Oct. 2005
		Georgia-02C		18 Oct. 2005
2006	GCS	ANorden	19 May 2006	25 Oct. 2006
		AP-3		25 Oct. 2006
		Georgia-02C		25 Oct. 2006
	WGS	ANorden	15 May 2006	20 Oct. 2006
		AP-3		20 Oct. 2006
		Georgia-02C		2 Nov. 2006

† GCS, Gulf Coast Research and Extension Center; WFREC, West Florida Research and Extension Center; WGS, Wiregrass Research and Extension Center.

‡ All peanut cultivars were planted on the same date at each location.

Table 4. Percent surface residue cover measured across 6 site-years† during the 2004–2006 growing seasons in southern Alabama.

Tillage system	Row configuration		Mean	ANOVA		
	Single	Twin		Tillage (T)	Row configuration (RC)	T × RC
	%			*Pr* > *F*		
Narrow	59.2	54.7	57.0	0.0068	0.0089	0.3904
Wide	50.4	47.9	49.2			
Mean	54.8	51.3				

† The site-year at the West Florida Research and Education Center was omitted from this analysis.

and TSMK included variety, tillage, spacing, and their interactions as fixed effects with environment, environment×variety, environment×tillage(variety), environment×spacing(variety tillage), rep(environment), rep×variety(environment), and rep×tillage(variety environment) as random effects. We treated environment as a random effect to average our results across all 7 site-years. Treatment differences were considered significant if $P > F$ was ≤0.10. Comparisons among more than three treatment means were separated by least significant difference.

Results and Discussion

Surface Residue

The surface residue counts from WFREC were lost, so the surface residue analysis included the remaining six environments. Mean surface residue cover was greater for narrow-strip tillage compared with wide-strip tillage, whereas mean surface residue cover was greater for single-row compared with twin-row plantings (Table 4). The effect of tillage width on surface residue cover was greater than the effect of row configuration indicated by a 7.8% difference between tillage widths compared with a 3.5% difference between row configurations. The greatest surface residue cover was observed in the narrow-strip tillage system planted in single rows, whereas the smallest surface residue cover was observed in the wide-strip tillage system planted in twin rows. Twin rows planted into the narrow strip tillage system produced numerically greater surface residue cover than either row configuration in the wide strip tillage system.

The amount of cover crop biomass produced varied with planting date, termination date, and species (Balkcom et al., 2007a). Our study used rye and oat, which are the most prevalent cover crops used in conservation tillage peanut production. Previous research has documented that rye works well in conservation systems for cotton production (Bauer and Busscher, 1996; Daniel et al., 1999), but some peanut producers prefer oat. Oat is preferred because it does not produce as much biomass as rye, which the growers feel enables them to perform tillage and planting operations more easily. However, less biomass production could reduce surface residue. The narrow-width strip tillage system maximizes the amount of residue on the soil surface, regardless of the cover crop species used, to help growers achieve 50% residue cover after planting.

Peanut Populations

Final peanut plant stands were not affected by peanut cultivar or tillage alone, but an interaction was observed between peanut cultivar and row configuration (Table 5). All peanut cultivar and row configuration combinations averaged across environments were above the recommended final plant stands, except single rows from the 'ANorden' cultivar (Fig. 1). However, all single rows, regardless of cultivar, produced similar final plant stands, but single-row plant stands were less than twin rows. The highest final plant stands were recorded in twin rows for the 'AP-3' cultivar.

The discrepancy between observed plant populations is surprising because initial seeding rates were equivalent for row configurations and peanut cultivars. At WGS, two different planters were used because a twin-row planter was available at that location; however, as with the other locations, careful calibrations were performed to ensure that seeding rates were equivalent. Despite the care taken to ensure that seeding rates were equivalent, no two planters can be expected to perform exactly the same. At the other locations, the same planter was used in either a single- or double-pass scenario. The lower plant populations observed for single rows were averaged across all seven environments, which decreases the possibility that major differences occurred between planter units. No previous documentation has been found that compares final plant stands between single and twin rows planted at the same initial seeding rate. If the initial seeding rates were the same, there would be no reason to expect a difference between row configurations; however, in our experiment, a better stand was observed in the twin-row configuration. Sconyers et al. (2007) provides diagrams that illustrate the differences between single- and twin-row configurations. The interplant spacing is maximized for the twin-row configuration, which may promote better plant emergence and increased final plant stands.

Colvin and Brecke (1988) cited previous work that proposed certain cultivars from other crops may perform better in different tillage systems, but results have been inconclusive. It is doubtful that peanut plant breeders would screen cultivars based on single- and twin-row configurations, but many state peanut specialists examine new cultivar performance across different tillage systems in single- and twin-row configurations.

Table 5. Analysis of variance *F* values and *P* values for peanut plant populations, yield, and total sound mature kernels across seven site-years during the 2004–2006 growing seasons in south Alabama and northern Florida.

Source of variation	Numerator df	Plant population		Peanut yield		Total sound mature kernels	
		F value	*P* value	*F* value	*P* value	*F* value	*P* value
Cultivar (C)	2	2.19	0.1543	*3.51*†	*0.0628*	*20.37*	*0.0001*
Tillage (T)	1	0.63	0.4301	0.04	0.8513	0.74	0.3923
C × T	2	0.70	0.4997	0.77	0.4745	0.36	0.7024
Row configuration (RC)	1	130.52	*0.0000*	0.31	0.5772	1.52	0.2224
C × RC	2	3.97	*0.0244*	1.26	0.2860	1.21	0.3053
T × RC	1	0.01	0.9119	*5.61*	*0.0192*	0.63	0.4306
C × T × RC	2	0.19	0.8308	0.39	0.6753	0.39	0.6790

† Values in italics are significant at the 0.10 level of probability.

Previous research has shown that final peanut plant stand is one factor among several production practices that can influence the severity of TSWV incidence for the upcoming growing season in a particular field (Brown et al., 2005). A final plant stand of at least 143,200 plants ha^{-1} is recommended to reduce TSWV yield losses associated with peanut plant populations. This plant stand does not reduce the numbers of plants infected with TSWV, but with lower plant populations, the percentage of infected plants is higher, and the associated yield losses are more detrimental (Brown et al., 2005).

Peanut Yields

Peanut yields of 'AP-3' (4582 kg ha^{-1}) and 'Georgia-02C' (4555 kg ha^{-1}) were equivalent and approximately 20% greater than 'ANorden' (3807 kg ha^{-1}) yields when averaged across environments (Table 5). The cultivar 'ANorden' is no longer available to southeastern peanut producers due to low yields associated with a weak disease resistance (Kris Balkcom, Alabama Extension Peanut Specialist, personal communication). A significant interaction between strip tillage width and row configuration was observed for peanut yields across environments (Table 5; Fig. 2). Surprisingly, twin-row peanut yields were greater in the narrow strip tillage system compared with single-row peanut yields, whereas no peanut yield differences were observed between row configurations in the wider strip tillage system (Fig. 2). When yields were compared across tillage systems, all yields were statistically equivalent.

There was a yield advantage to using the narrow tillage system and twin-row planting option. This may be attributed to increased moisture conservation at planting and during the growing season compared with the wider strip-tillage system. The amounts of surface residue observed between narrow and wide strip-tillage systems (Table 4) supports a theory that soil moisture may be increased in the narrow strip-tillage system, but the yield response was not consistent across these seven environments (Fig. 2). Coulters and baskets used behind the shank for a wide strip-tillage system may not be necessary for twin-row peanuts, allowing beneficial surface cover to remain on the soil surface and allowing growers to remain eligible for Environmental Quality Incentive Program payments associated with surface residue maintenance.

No clear explanation exists for why twin-row yields were not superior to single-row yields, but other studies have also produced inconsistent results. Brecke and Stephenson (2006) found a 9% yield increase averaged over 4 yr for twin rows compared with single rows across different herbicide regimes in strip tillage. On the other hand, Jordan et al. (2001a) showed inconsistent yield responses for twin rows compared with single rows across 7 site-years, but seeding rates were higher for twin rows, and all plots were planted with conventional tillage practices. The lack of a consistent yield response for twin rows compared with single rows in our study may be attributed to the two conservation tillage systems and cover crops used in the experiment. Conventional tillage practices that leave the soil bare may attract thrips, which vector TSWV, compared with soil covered with crop residue (Marois and Wright, 2003). Because crop residues were retained in all plots, potential yield reductions, associated with thrips damage in single rows and completely bare soil, were diminished. Culbreath et al. (2008) reported that highly disease-resistant cultivars, particularly TSWV, may not require a twin-row configuration to

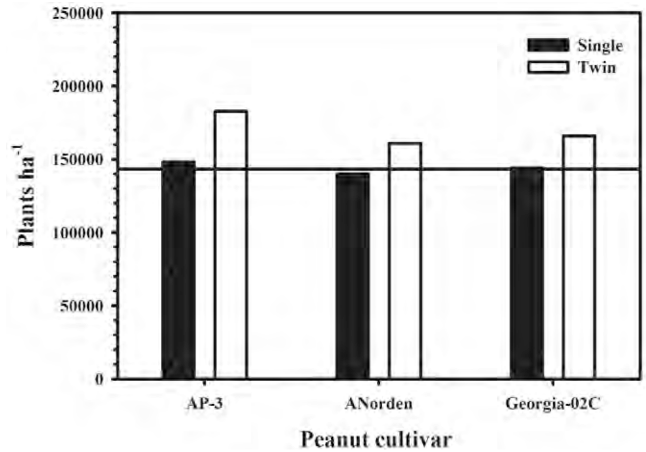

Fig. 1. Final plant stands for peanut cultivars and row configurations measured across seven environments during the 2004 to 2006 growing seasons. The recommended final plant stand is represented by the solid horizontal line. LSD = 2635 plants ha^{-1} for comparing single vs. twin row spacings for a given cultivar. LSD = 5570 plants ha^{-1} for all other comparisons.

maintain or enhance peanut yield. The disease resistance of the cultivars combined with conservation systems and cover crops may also have benefitted single-row production.

Total Sound Mature Kernels

Overall, TSMKs (the sum of sound mature kernels and sound splits expressed as a percentage) were low and only affected by peanut cultivar when averaged across all environments (Table 5). The highest TSMKs recorded were for the cultivar 'Georgia-02C' (71.1), followed by 'ANorden' (68.2) and 'AP-3' (66.8). All values were different from each other, indicating that 'Georgia-02C' produced the highest quality peanut, regardless of strip tillage system or row configuration, across the seven environments examined in our study. We do not believe that the low TSMKs were the result of tillage practices or nutrient deficiencies. Although our study includes more modern cultivars, Colvin and Brecke (1988) reported no differences in peanut quality between conventional and mini-

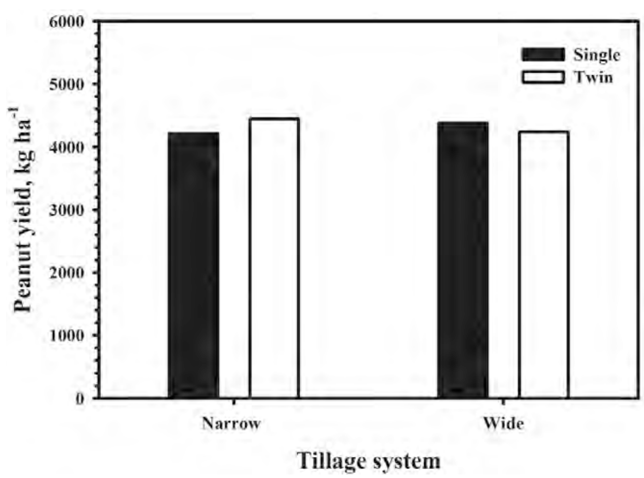

Fig. 2. Peanut yields for tillage systems and row configurations measured across seven environments during the 2004 to 2006 growing seasons. LSD = 184 kg ha^{-1} for comparing single vs. twin row configurations for a given tillage; LSD = 217 kg ha^{-1} for all other comparisons.

mum tillage peanut production for eight peanut cultivars that included runner, Virginia, and Spanish market types.

Conclusions

Peanut is probably one of the most difficult crops to include in a rotation without negatively influencing soil quality benefits associated with surface residue. Crops that produce harvestable portions above ground allow minimal soil disturbance, whereas the belowground fruiting habit of peanut requires a mechanical digging operation, which is basically a conventional tillage operation. Growing other crops using conservation practices in rotation with peanut will help offset the negative impacts of the peanut digging operation on soil quality. The use of cover crops and narrow width strip tillage systems is also a sound strategy to reduce soil organic matter loss. Twin-row peanut production is an important cultural practice that growers can use to maintain and/or increase peanut yields. However, strip tillage systems that include cover crops to maximize surface residue retention are required to promote soil sustainability. We observed the greatest surface residue cover for the narrow-strip tillage system planted in single rows. All combinations except the wide-strip tillage system planted with twin rows maintained 50% surface residue coverage. Although an interaction was observed between cultivar and row configuration, final plant stands indicate that proper equipment set-up enabled recommended final plant stands for peanut to be achieved, except for 'ANorden' planted in single rows. There was an interaction observed between strip tillage system and row configuration for peanut yields. Twin-row peanut yields were superior to single-row peanut yields in the narrow strip tillage system, but peanut yields compared across strip tillage systems were equivalent. Cultivar differences were also observed. The cultivars 'AP-3' and 'Georgia-02C' yielded approximately 20% higher than 'ANorden'. Total sound mature kernels, a measure of peanut quality, were only affected by peanut cultivar, with 'Georgia-02C' producing the highest quality peanut, followed by 'ANorden', and 'AP-3'. These results indicate that growers interested in using twin rows for peanut production can also take advantage of a narrow strip tillage system to maintain yields and maximize surface residue coverage and subsequent benefits.

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