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2013 Southeastern Peanut Research Initiative
Final Report

Title: Evaluation of replant decisions as affected by plant stand

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The use of reduced/conservation tillage have been widely studied and published. But while numerous benefits have been reported with strip tillage, it can present logistical issues when deciding how to replant peanut seed. The relative narrow width of the stripped seedbed may prevent adding seed without mechanically damaging the original stand, and may necessitate a new strip to the side of the original in order to add seed to the previously established stand. The objectives of this study were to explore the effects of multiple replant scenarios in strip tillage on peanut pod yield, grade, TSWV, and SSR incidence and to ultimately determine the most agronomically sound system for replanting peanut in strip tillage.

Materials and Methods

Irrigated field trials were conducted on a Candler fine sand (hyperthermic, uncoated Lamellic Quartzipsamments) (USDA-NRCS, 2013) at the University of Florida Plant Science Research and Education Unit near Citra, FL in 2012 and 2013. The rye cultivar Wrens Abruzzi was planted in mid-November at a depth of 1.9 cm and at a seeding rate of 101 kg ha^{-1}. Rye was planted into land that had been disk-harrowed and separated into beds 1.8 m wide. The rye had matured naturally prior to peanut planting and termination with glyphosate was not necessary. All plots were planted to rye, which was mowed to a stubble height of 5 cm in treatments that were not to include cover, prior to tillage in the spring. A rotary tiller was used in no-cover treatments in order to remove all vegetation. A strip-till implement with sub-soil shanks at a depth of 30 cm and ground-driven crumblers was used to create a 18-cm-wide seedbed prior to peanut planting in all treatments.

Preemergence herbicide applications at all site-years consisted of a tank-mix of pendimethalin (0.93 kg a.i. ha^{-1}), diclosulam (27 g a.i. ha^{-1}), and flumioxazin (107 g a.i. ha^{-1}); all of which were watered into the soil after application. Glyphosate (2.24 kg a.i. ha^{-1}) was also applied in order to assist in removal of vegetation prior to peanut plant emergence. Peanut cultivar Georgia-06G was planted at a depth of 5 cm and a row spacing of 0.91 m in rows 12.2 m in length. All plots were initially seeded at 19.7 seeds m^{-1} and replanting treatments occurred when those plants from the initial planting date reached full emergence. Initial planting dates and replanting dates can be found in Table 4.1.

Eight replant regimes were tested:

1) Plant stand of 13.1 plants m^{-1} (optimum) with rye cover and no replanting
2) Plant stand of 5.9 plants m^{-1} (below-optimum) with rye cover and no replanting
3) Re-strip in the original strip, destroying the original stand and replanting at the full seeding rate

4) Re-strip beside the initial row and supplement at a reduced seeding rate
5) Burn down the initial stand with glufosinate herbicide (656 g a.i. ha^{-1}) and replant in the original strip at the full seeding rate
6) Supplement the initial stand by adding seed at a reduced seeding rate in the initial strip
7) Plant stand of 13.1 plants m^{-1} (optimum) with no cover and no replanting
8) Plant stand of 5.9 plants m^{-1} (low) with no cover and no replanting

Peanut plants were thinned by hand to a stand of 5.9 plants m^{-1} in treatments 2-6 and 8 prior to replanting in order to represent a plant stand that would be considered below-optimum. Treatments 1 and 2 represent a peanut crop grown in a strip-till scenario into a rye cover crop at both an optimum and below-optimum stand, respectively that is allowed to grow at that stand throughout the growing season. Similarly, treatments 7 and 8 represent an adequate and below-adequate stand allowed to grow throughout the season, but under a bare-ground scenario with no crop residue interference on the soil surface. Treatments 4 and 6 represent a supplemental replant situation. In treatment 4, the strip-till rig was run approximately 19 cm to the side of the original strip and 11.6 seeds m^{-1} were added in order to supplement the initial below-optimum stand. In treatment 6, the planter units were moved 9 cm to the side and seed were added at 11.6 seeds m^{-1} within the original strip. Treatments 3 and 5 represented a complete replant scenario. In treatment 3, the strip-till rig was run in the original strip in order to destroy the poor stand, while in treatment 5, the original stand was destroyed with glufosinate herbicide. In both treatments, plots were replanted at the full 19.1 seeds m^{-1} rate.

Gypsum ($CaSO_4$) was applied at a rate of 2240 kg ha^{-1} on 29 May and 7 June in 2012 and 2013 respectively. Fungicide applications were made based on guidelines provided by the high-risk model of the Peanut Disease Risk Index. In-season herbicide applications included *S*-metolachlor (2.14 kg a.i. ha^{-1}) and imazapic (70.1 g a.i. ha^{-1}).

Treatments were evaluated for pod yield, grade (total sound mature kernels [TSMK]), and incidence of TSWV in 2012. Incidence of TSWV was extremely low in 2013 and did not warrant rating for TSWV. Likewise, incidence of SSR was too low to warrant rating in either year. Peanut maturity was determined at each site-year using the hull scrape method. Inversion and harvest dates can be found in Table 4.2. After harvest, yields were adjusted to 7% moisture. Peanuts were graded by the USDA Federal-State Inspection Service in Tifton, GA. Grades are reported as % TSMK.

Treatments were arranged in a randomized complete block with four or five replications. Statistical analyses were performed using PROC MIXED in SAS 9.3[14]. Data were analyzed by analysis of variance and differences among least square means were determined using multiple pairwise t-tests (P=0.05). For analysis purposes, the replant treatment effect was treated as fixed while year and was treated as random.

Results

Pod yield was significantly affected in both years (Table 4.3). In 2012, the optimum plant stand with no cover and no replant treatment resulted in the highest numerical yields. Yield of those plots were matched statistically by the below-optimum stand, no cover, no replant treatments at both locations, and by the optimum stand, rye cover, no replant treatment at

Citra 2012. Pod yields were 8.7%, and 9.3% greater on average in non-replanted, cover-free plots than in non-replanted plots with cover in 2012 and 2013, respectively.

When considering only those plots with cover, the yield at the below-optimum plant stand (5.9 plants m^{-1}) was only reduced in 2012 when compared to the optimum plant stand (13.1 plants m^{-1}). In that site-year, yield was increased by 24.5% by supplementing the stand within the original strip. In 2013, all replant treatments resulted in numerically higher yields than the non-replanted, below-optimum plant stand treatment with cover. Destroying the original stand and completely replanting the plot at the full seeding rate increased yield by 16.0%, which represented a significant increase over the non-replanted treatment.

Grade was affected by treatment in 2012 (P=0.009) and 2013 (P=0.0542) (Table 4.4). In 2012, the presence or absence of cover crop did not influence grade when replant treatments were not applied. When comparing only those plots with cover, grade of both complete replant treatments were higher than that of the non-replanted plots by an average of 1.9 points. In 2013, results were similar, as those plots receiving the complete replant treatment were among the highest grading, although differences were not as pronounced as in 2012.

Summary and Conclusions

While questions about yield and other production factors were the main consideration for this project, there are logistical questions that were answered as well. Of main concern was the possibility of supplementing the original stand in the original strip-tilled seedbed. Observations from these trials indicate that this is possible, although great care needs to be taken when using the original strip. The original plants proved to be resilient, as they were able to remain viable even after being run over by the planter units during the replanting process. Growers would benefit from automated guidance when attempting to supplement below-optimum initial stands within the original strip-tilled seedbed.

Yield results were mixed across years. In 2013, yields at 5.9 plants m^{-1} were equal to 13.1 plants m^{-1}, illustrating how peanut plants can adapt to below-optimum plant stands and how yield potential can be maintained at levels below what would be considered optimum. In 2012, yield was decreased by 25% when stand was reduced from 13.1 to 5.9 plants m^{-1}. Although a decrease was observed in only one of two years, the magnitude of the potential decrease means that replant considerations are still valid when stands fall below optimum. While it is difficult to predict when a yield loss will occur as the result of a reduced plant stand, knowing that a 25% decrease is possible may justify replanting in all poor plant stand situations for the purpose of insurance against that large potential loss.

A major consideration that must be made when deciding on a replant strategy is to determine if a viable replant option is available. When replanting the below-optimum stand did show yield benefits, the optimum replant treatment was not consistent. In 2012, a 24.6% yield increase was discovered when supplementing the original stand within the original strip-tilled seedbed. All other replant treatments yielded similarly to the non-replanted treatment. In 2013, destroying the initial stand with herbicide and replanting completely resulted in a 16.0% increase in yield. While all other replant treatments were equal in yield to this treatment, they were not greater than the no-replant treatment.

When taking results from all site-years into consideration, it is difficult to make a recommendation with complete confidence to a grower that has a below-optimum plant stand in a field planted in strip-tillage. Because costs will be less when supplementing versus completely replanting and equal benefit was seen as often from the former as the latter, a grower is likely to be better advised to supplement the initial stand when the decision is made to replant. When considering costs in combination with yield results, the best option would be to supplement the initial stand within the original seedbed. While the logistical difficulties with this option may present a challenge, extra care when replanting make the option feasible. As mentioned previously, growers would benefit from tractor-mounted guidance systems when attempting to utilize this replant method.

These results showed no consistent gain in yield by replanting. This result, in combination with the finding that no yield loss may occur when stands are reduced from 13.1 to 5.9 plants m^{-1}, should encourage growers to continue to properly manage a peanut crop with a below-optimum plant stand that cannot or will not be replanted. While grade was affected by replant treatment in some cases, the impact was not large enough to be strongly considered when a replant decision is made. Pod yield, time management, and ultimately profitability should be the major factors.

Table 4.1. Initial planting dates and replanting dates in Citra, FL in 2012 and 2013.

	2012	2013
Planting Date	27-Apr	1-May
Replant Date	23-May	23-May
Days between initial planting and replanting	26	22

Table 4.2. Inversion and harvest dates in and Citra in 2012 and 2013.

Replant Treatment		2012	2013
No-Replant (1, 2, 7, 8)	Inversion Date	21-Sep	7-Oct
	Harvest Date	25-Sep	11-Oct
Supplemental (4, 6)	Inversion Date	21-Sep	7-Oct
	Harvest Date	25-Sep	11-Oct
Complete (3, 5)	Inversion Date	9-Oct	7-Oct
	Harvest Date	16-Oct	11-Oct

Table 4.3. Peanut pod yield for each replant treatment in Citra, FL in 2012 and 2013.

	2012	2013
Treatment	Yield (kg ha^{-1})	
OS[a], no replant, rye cover	5599 a	5016 c
BOS[b], no replant, rye cover	4174 cd	5465 bc
Re-strip, replant at full SR[c]	4772 bc	6194 ab
Supplement in new strip	4021 d	5744 abc
Burndown, replant at full SR	4434 bcd	6337 a
Supplement in original strip	5199 ab	6265 ab
OS, no replant, no cover	5682 a	5478 bc
BOS, no replant, no cover	4947 abc	5981 ab
Pr>F	0.0014	0.0357

[a]OS = Optimum Stand
[b]BOS = Below-Optimum Stand
[c]SR = Seeding Rate
Numbers with similar letters within a column are not significantly different at the P value listed at the bottom of the column.

Table 4.4. Peanut grade (% total sound mature kernels (TSMK)) for each replant treatment in Citra, FL in 2012 and 2013.

	Citra 2012	Citra 2013
Treatment	Grade (% TSMK)	
OS[a], no replant, rye cover	77.1 bc	78.4 a
BOS[b], no replant, rye cover	76.4 cd	76.4 b
Re-strip, replant at full SR[c]	78.9 a	78.2 a
Supplement in new strip	76.6 bcd	77.4 ab
Burndown, replant at full SR	77.7 ab	77.6 ab
Supplement in original strip	76.7 bcd	76.4 b
OS, no replant, no cover	76.2 cd	78.4 a
BOS, no replant, no cover	75.6 d	78.2 a
Pr>F	0.0009	0.0542

[a]OS = Optimum Stand
[b]BOS = Below-Optimum Stand
[c]SR = Seeding Rate
Numbers with similar letters within a column are not significantly different at the P value listed at the bottom of the column.