PEANUT SCIENCE

The Journal of the American Peanut Research and Education Society

ARTICLE

Pod Yield Production Among Peanut (*Arachis hypogaea* L.) Cultivars in South Carolina

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ARTICLE INFORMATION

Keywords:
Harvest, groundnut

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DOI: 10.3146/0095-3679-491-PS21-11

ABSTRACT

The objective of this work was to compare peanut yield production potential for runner and Virginia market type cultivars in South Carolina. Cultivar selection decisions are integrally linked to pod yield production potential of a planted field and are often based on available historic and recent yield data. To aid farmers in this process, 24 and 27 field experiments were conducted in South Carolina between 2015 and 2020 for runner and Virginia type cultivars, respectively, to examine yield production potential. Top grouping runner type cultivars consisted of Georgia-16HO, FloRun 331, TUFRunner 297, and Georgia-12Y. Virginia type cultivars within the statistical grouping with the greatest yield included Walton and Bailey II. Total sound mature kernels among runner type cultivars was greatest for Georgia-16HO and Georgia-06G, followed by TUFRunner 297, Georgia-14N, TUFRunner 511, and Georgia-18RU. Virginia type cultivars did not significantly vary with regard to total sound mature kernels in this study. Results generated from this work may be useful as a reference to help inform cultivar selection decisions.

INTRODUCTION

The amount of pod yield produced per field is a primary factor in determining the value of a load of farmer stock peanut (*Arachis hypogaea* L.). Increasing pod yield potential continues to be a focus of current peanut breeding programs as reflected by the 130 to 200% gain in pod yield from 1967 to 2017 (Chamberlin 2019, Holbrook 2019). Where contract and seed availability allow for choices among different cultivars, decisions on cultivar selection regularly consider their potential for favorable yield production. Among grade characteristics for Segregation I loads of farmers' stock peanut under current USDA grading schedules, total sound mature kernel (TSMK) content has the greatest premium: approximately 3.5 and 13.9 times that of other and extra large kernels, respectively (USDA FSA 2020). Consequently, cultivars with increased TSMK at a given yield level represent a greater potential value. Recently released cultivars are frequently compared to previously-released standards for context of yield and grade performance; however, limitations in availability of or access to this data (i.e., when results from only one or two experiments are considered) leaves uncertainty regarding the consistency of yield production potential over multiple growing seasons. The objective of this study was to examine pod yield production in South Carolina for runner and Virginia market type peanut cultivars among experiments conducted from 2015 to 2020. Corresponding TSMK content was additionally examined.

MATERIALS AND METHODS

Data from over 50 experiments conducted in South Carolina from 2015 to 2020 were examined for meeting selection criteria to be included in the analysis. Experiments were conducted at the Edisto Research and Education Center (33.364N, -81.329E on Barnwell loamy sand: fine-loamy, kaolinitic, thermic Typic Kanhapludults) and the Pee Dee Research and Education

Center (34.289N, -79.738E on Norfolk loamy sand: fine-loamy, kaolinitic, thermic Typic Kandiudults) in Blackville and Florence, SC, respectively. Harvested plot size was generally two rows on 96-cm centers by 12-m in length. Viable studies each needed to have been conducted with a minimum of two cultivars, report pod yield (or TSMK) for each cultivar, and contain the necessary information to calculate the sampling variance per study (Madden and Paul 2011, Paul *et al.* 2008). Studies needed to be reasonably free of observed confounding factors (e.g., excessive animal feeding or water damage at harvest) that might otherwise interfere with the integrity of reported yield data. Following screening, peanut yield data were compiled from 24 and 27 field experiments conducted between 2015 and 2020 for runner and Virginia type cultivars, respectively (Table 1). Total sound mature kernels data was compiled from 18 field experiments for both runner and Virginia type cultivars. After study-level screening, cultivars needed to be represented in a minimum of three experiments to be included in the analysis. Within individual experiments, peanut was managed based on Extension recommendations (Anco *et al.* 2021) and inverted near physiological maturity (Boote 1982) within a reasonable period of time for the trial. Yield was measured using a Hobbs two-row combine fitted with a load cell basket and standardized to 10% moisture. Proportion TSMK was determined according to USDA standards (USDA AMS 2019).

Table 1. Cultivar frequency within field experiments conducted in South Carolina from 2015 to 2020.

		Yield data		Total sound mature kernel data	
Market type	Cultivar	Studies	Years	Studies	Years
Runner	ACI 3321	9	4	8	4
	AU-NPL 17	12	4	11	4
	FloRun 107	4	3	4	3
	FloRun 331	16	4	13	4
	Georgia-06G	21	6	17	6
	Georgia-09B	10	6	9	6
	Georgia-12Y	13	6	9	6
	Georgia-13M	11	4	9	4
	Georgia-14N	7	6	7	6
	Georgia-16HO	17	4	14	4
	Georgia-18RU	10	3	8	3
	TUFRunner 297	22	6	17	6
	TUFRunner 511	14	4	10	4
	TifNV-High O/L	12	5	9	5
Virginia	Bailey	25	6	16	6
	Bailey II	10	4	9	4
	Contender	3	3	3	3
	Emery	18	5	10	4
	Sugg	4	2	3	2
	Sullivan	22	6	13	6
	Walton	8	4	4	2
	Wynne	12	5	8	4

Log pod yield (kg/ha) data were analyzed using the GLIMMIX procedure in SAS (SAS 9.4, Cary, NC) according to a two-stage multitreatment unconditional network meta-analysis (Madden *et al.* 2016, Piepho *et al.* 2012). Cultivar was included in the model as a fixed effect, and study estimates were weighted per the inverse of their respective study sampling variance. Random effects included study and the interaction of cultivar and study, with the residual error term held at 1 (Madden *et al.* 2016). Runner and Virginia market type data were analyzed separately. Estimated mean pod yield production per cultivar was separated according to Fisher's protected LSD at the 0.05 probability level. Proportion TSMK was analyzed according to a single-stage analysis on the raw data including random effects for study and its individual interactions with replication and cultivar, the latter of which was fitted with a first-order factor analytical covariance structure (Madden *et al.* 2016).

RESULTS AND DISCUSSION

Among runner type peanut, yield significantly varied among cultivars at $P < 0.0001$. Estimated variance terms for study and the interaction of study and cultivar were 0.0321 (SE = 0.00971) and 0.00299 (SE = 0.000544), respectively. Cultivars in the top statistical grouping for pod yield included Georgia-16HO, FloRun 331, TUFRunner 297, and Georgia-12Y (Table 2, > 5970 kg/ha). Among these four cultivars, only Georgia-12Y exhibits normal oleic acid levels. Pod yield production for FloRun 331 above that of Georgia-06G was slightly greater in this study compared to that reported by

Tillman (2021) (740 versus 570 kg/ha, respectively). The analogous comparison between pod yield of TUFRunner 297 and Georgia-06 was similarly evident (690 compared to 380 kg/ha, respectively) (Tillman 2018). Georgia-16HO yield production in the present study was comparable to that reported by Branch (2017) (6240 versus 6180 kg/ha, respectively), whereas yields of Georgia-09B and FloRun 107 in that same study (5910 and 5650 kg/ha, respectively) were reported to be greater than corresponding amounts from this study (5450 and 4980 kg/ha, respectively).

Table 2. Peanut pod yield production in South Carolina for runner type cultivars from 2015 to 2020.

Cultivar	Yield Estimate		Lower 95% CI	Upper 95% CI
	kg/ha			
Georgia-16HO	6243	a[a]	5755	6774
FloRun 331	6172	ab	5686	6699
TUFRunner 297	6123	ab	5654	6631
Georgia-12Y	5975	abc	5499	6491
TUFRunner 511	5862	bcd	5394	6371
Georgia-18RU	5849	bcd	5361	6382
ACI 3321	5827	bcd	5334	6365
TifNV-High O/L	5766	cde	5302	6270
AU-NPL 17	5705	cdef	5242	6209
Georgia-13M	5539	def	5086	6033
Georgia-09B	5448	ef	5003	5932
Georgia-06G	5429	f	5012	5880
Georgia-14N	5017	g	4586	5488
FloRun 107	4980	g	4504	5506

[a]Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD at P < 0.05.

Pod yield was significantly different among Virginia type cultivars at P < 0.0001. Estimated variance terms for study and the interaction of study and cultivar were 0.0338 (SE = 0.00997) and 0.00202 (SE = 0.000681), respectively. Cultivars in the top statistical grouping for pod yield included Walton and Bailey II (Table 3, > 5270 kg/ha). With the exception of Contender and Sugg, all remaining cultivars were included in the second-greatest yielding group. Within the examined data, pod yield of Bailey II was comparable to Bailey. Bailey has long been a preferred Virginia type cultivar to plant in SC for its high yield production, relatively small seed size among Virginia type cultivars, and historical disease resistance package (Anco *et al.* 2021), and its pending industry replacement by Bailey II in the Virginia-Carolinas Region, in part due to the presence of the high-oleic trait in the latter cultivar, will provide farmers with a cultivar that performs as good or better with respect to pod yield production. In South Carolina, Contender exhibited a high degree of susceptibility to infection by tomato spotted wilt (Anco *et al.* 2021). Thus, although recommendations were followed to reduce development of tomato spotted wilt during these experiments (Anco *et al.* 2020, 2021, Kemerait *et al.* 2018), the greater susceptibility of Contender compared to other Virginia type cultivars could have contributed to a relatively lower realized yield at harvest.

Table 3. Peanut pod yield production in South Carolina for Virginia type cultivars from 2015 to 2020.

Cultivar	Yield Estimate		Lower 95% CI	Upper 95% CI
	kg/ha			
Walton	5638	a[a]	5153	6170
Bailey II	5272	ab	4846	5735
Bailey	5234	b	4848	5650
Wynne	5091	bc	4689	5527
Sullivan	5086	bc	4708	5493
Emery	5039	bc	4659	5449
Contender	4784	cd	4282	5345
Sugg	4336	d	3932	4782

[a]Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD at P < 0.05.

Runner type peanut TSMK was significantly different among cultivars at P < 0.0001 and was greatest for Georgia-16HO and Georgia-06G (71 to 72%), followed by TUFRunner 297, Georgia-14N, TUFRunner 511, and Georgia-18RU (70 to 71%) (Table 4). Virginia type cultivars did not significantly vary with respect to TSMK (P = 0.1172), ranging from 65 to 67% (Table 5). For context, a 2% increase in TSMK roughly corresponds to a 112 kg/ha increase in pod yield (Kirk *et al.* 2021; USDA FSA 2020), illustrating the greater impact increased production of pod yield has on economic value compared to TSMK content.

Table 4. Peanut total sound mature kernel content in South Carolina for runner type cultivars from 2015 to 2020.

	Total sound mature kernels			
Cultivar	Estimate		Lower 95% CI	Upper 95% CI
	%			
Georgia-16HO	72.1	a[a]	70.7	73.4
Georgia-06G	71.1	ab	69.8	72.5
TUFRunner 297	70.6	b	69.3	71.9
Georgia-14N	70.3	bc	68.7	71.8
TUFRunner 511	70.0	bc	68.5	71.6
Georgia-18RU	69.9	bcd	68.0	71.9
TifNV-High O/L	69.4	cd	68.0	70.9
FloRun 331	69.4	cd	68.0	70.8
Georgia-09B	69.0	cdef	67.4	70.7
AU-NPL 17	68.7	de	67.2	70.2
Georgia-13M	67.3	fg	65.8	68.8
FloRun 107	67.1	eg	64.9	69.3
ACI 3321	66.5	g	64.9	68.1
Georgia-12Y	66.5	fg	64.3	68.7

[a]Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD at P < 0.05.

Table 5. Peanut total sound mature kernel content in South Carolina for Virginia type cultivars from 2015 to 2020.

	Total sound mature kernels		
Cultivar	Estimate	Lower 95% CI	Upper 95% CI
	%		
Bailey	66.3[a]	64.7	68.0
Bailey II	66.5	64.6	68.5
Contender	67.1	64.6	69.6
Emery	66.3	64.4	68.3
Sugg	67.3	64.3	70.2
Sullivan	65.2	63.2	67.3
Walton	64.9	61.8	67.9
Wynne	65.0	62.3	67.8

aTotal sound mature kernels did not significantly vary among Virginia type cultivars in this study (P = 0.1172), precluding statistical mean separation.

SUMMARY AND CONCLUSIONS

Due to the current structure of the peanut industry, the potential for an individual cultivar to produce competitive or favorable amounts of pod yield and TSMK continues to be a desirable trait. This study presents quantitative data comparing the pod yield production and TSMK content of several common cultivars for runner and Virginia market type peanut grown in SC from 2015 to 2020. Farmers may consider these results alongside individual production needs (e.g., disease resistance package, cultivar maturity length, and presence of high-oleic chemistry trait) when selecting cultivars for production.

ACKNOWLEDGMENTS

Support for this work was provided by the South Carolina Peanut Board, the National Peanut Board, and Georgia Seed Development. Technical Contribution No. 7007 of the Clemson University Experiment Station. This material is based upon work supported by NIFA/USDA, under project number SC-1700592.

LITERATURE CITED

Anco D., Thomas J.S., Marshall M., Kirk K.R., Plumblee M.T., Smith N., Farmaha B., and J. Payero. 2021. Peanut Money-Maker 2021 Production Guide. Clemson University Extension, Circular 588.

Anco D.J., Thomas J.S., and W.S. Monfort. 2020. Efficacy and profitability of insecticide treatments for tomato spotted wilt management on peanut in South Carolina. Plant Dis. 104:1096-1104.

Boote K.J. 1982. Growth stages of peanut (Arachis hypogaea L.). Peanut Sci. 9:35-40.

Branch W.D. 2017. Registration of 'Georgia-16HO' peanut. Journal of Plant Registrations 11:231-234.

Chamberlin K.D. 2019. Not your grandma's goobers: Designing the future of peanut breeding. Peanut Science 46:91-98.

Holbrook C.C. 2019. Peanut yield gains over the past fifty years. Peanut Science 46:73-77.

Kemerait R., Culbreath A., Prostko E., Brenneman T., Tubbs S., Srinivasan R., Abney M., Monfort S., Rabinowitz A., Tillman B., Dufault N., Rowland D., Mulvaney M., Small I., Hagan A., Sarver J., Anco D., and N. Smith. 2018. Peanut Rx – Minimizing diseases of peanut in the southeastern United States. The 2018 version of the peanut disease risk index. University of Georgia Extension, Athens, GA.

Kirk K., Smith N., Anco D., Butts C.L., Turner A.P., and B.B. Fogle. 2021. Peanut Loan Rate Calculator. Clemson University Cooperative Extension. Available at: https://www.clemson.edu/extension/agronomy/PrecisionAgriculture/calculators/.

Madden L.V. and P.A. Paul. 2011. Meta-analysis for evidence synthesis in plant pathology: An overview. Phytopathology 101:16-30.

Madden L.V., Piepho H.P., and P.A. Paul. 2016. Statistical models and methods for network meta-analysis. Phytopathology 106:792-806.

Paul P.A., Lipps P.E., Hershman D.E., McMullen M. P., Draper M.A., and L.V. Madden. 2008. Efficacy of triazole-based fungicides for Fusarium head blight and deoxynivalenol control in wheat: A multivariate meta-analysis. Phytopathology 98:999-1011.

Piepho H.P., Williams E.R., and L.V. Madden. 2012. The use of two-way linear mixed models in multitreatment meta-analysis. Biometrics 68:1269-1277.

Tillman B.L. 2018. Registration of 'TUFRunner '297'' peanut. Journal of Plant Registrations 12:31-35.

Tillman B.L. 2021. Registration of 'FloRun '331'' peanut. Journal of Plant Registrations 15:294-299.

USDA AMS. 2019. Inspection Instructions for Farmers' Stock Peanuts. Available at: https://www.ams.usda.gov/grades-standards/farmers-stock-peanut-inspection-instructions.

USDA FSA. 2020. Peanut Premiums and Discounts for 2020 Crop Year. Available at: https://www.fsa.usda.gov/Assets/USDA-FSA-Public/usdafiles/Price-Support/pdf/2020/2020%20-Peanut%20Premiums%20and%20Discounts.pdf.