

Development and Yield of Upland Cotton Grown Using Different Tillage Systems in Virginia

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Abstract

Tillage studies were conducted in Suffolk, Virginia from 2013-2016 comparing the effects of conventional, minimal, no tillage, and a strip tillage control, on early season growth and lint yield of four contemporary varieties. Phytogen 499 WRF, Deltapine 1321 B2RF, Deltapine 1028 B2RF, and Fibermax 1944 GLB2 were assessed for responses in plant height, soil compaction, lint yield, and lint quality with a split-plot design. Soil compaction was greatest in the no-till treatment with depths to a root restrictive layer ranging from 7.62 - 12.7 cm, resulting in shorter plant heights compared to other tillage methods in 2 out of 4 years. Significant differences in plant heights ($P < 0.05$) between tillage treatments were observed weekly starting at the fifth week after planting in both the 2013 and 2014 study. Deltapine 1321 B2RF had consistently taller plant heights in all years, with significant varietal differences being present in all sampling intervals for 2014 and 2015. In-season plant development seemed to be impacted more by varietal differences than tillage. No-till resulted in slightly lower yields compared to other tillage treatments, however no significant differences in lint yields among tillage treatments were observed in any year. Lint yield differed among varieties in 2013 and 2014. Deltapine 1321 B2RF produced the highest lint yields of 1,746.3 kg. ha⁻¹, 1,467.2 kg. ha⁻¹, and 692.9 kg. ha⁻¹ in 2013, 2014, and 2015, respectively. Differences in lint quality factors were strongly influenced by variety, however tillage was only observed to effect micronaire with differences in 2013 ($P = 0.0064$). There was no tillage by variety interaction in any year, supporting the idea that varieties respond similarly across tillage systems.

Objectives

- 1) Determine the effect of different tillage systems on early season cotton development for four commonly grown cotton varieties and soil compaction during the growing season.
- 2) Evaluate the interaction of cotton varieties and tillage practices on lint yield and quality of cotton produced in the upper Southeast coastal plain.

Materials and Methods

- Conducted yearly from 2013-2016
- Split-plot experimental design ($t=16$) with tillage as the main plot factor and variety as the subplot factor
 - Tillage treatments: No-till, Conventional, Minimum, Strip-till (control)
 - Varieties: PHY 499 WRF, DP 1321 B2RF, DP 1028 B2RF, FM 1944 GLB2
- Plots were 12 rows wide by 10.7 m in length with a row spacing of 91 cm
- Sub-plots were two rows wide and two rows on either side of sub-plots served as border between tillage treatments
- Plant heights were recorded weekly in centimeters from four weeks after planting (WAP) until eight WAP
- In-season soil compaction measurements were taken at the matchhead square (MHS) growth stage within tillage treatment across varieties using an analog *DICKEY-john* dial soil penetrometer
- Plots were harvested using a modified commercial CASE IH two-row cotton picker which had load cells and recorded seed cotton weights
- Statistical analysis was performed using Proc GLIMMIX in SAS 9.3 and ANOVA was run on stand counts, plant heights, soil compaction, total nodes, nodes above white flower, and yield. Tukey-Kramer's HSD method was used to detect differences in treatment using $\alpha=0.05$ significance level.

Experimental Site Information

Table 1: Study site information by location and year.

Location	Year	Soil Type	Latitude	Longitude
3	2016	Eunola loamy fine sand	36.66263	-76.73599
2	2015/2014	Suffolk loamy sand	36.68293	-76.75793
1	2013	Eunola loamy fine sand Kenansville loamy sand	36.66356	-76.73528

Early Season Plant Heights

Table 2: Plant heights during the 4th through 8th week after planting for the main effect of tillage during 2013-2016.

Tillage System	Plant Height (cm)				
	4 th	5 th	6 th	7 th	8 th
2016					
No-Till	14	21	34	49	63
Conventional Tillage	13	20	33	48	63
Minimum Tillage	13	21	33	51	65
Strip Tillage	14	23	39	58	71
Pr > F	NS	NS	NS	NS	NS
2015					
No-Till	18	21	26	39	47
Conventional Tillage	21	25	31	44	54
Minimum Tillage	20	25	33	46	57
Strip Tillage	20	25	33	45	57
Pr > F	NS	NS	NS	NS	NS
2014					
No-Till	32	47 b*	60 b	75 b	84 b
Conventional Tillage	37	55 a	69 a	86 a	92 a
Minimum Tillage	36	55 a	69 a	86 a	94 a
Strip Tillage	35	52 ab	67 ab	82 ab	89 ab
Pr > F	NS	0.0271	0.021	0.0195	0.0207
2013					
No-Till	13	20 b*	32 b	51 b	69 b
Conventional Tillage	14	22 ab	37 a	57 a	74 ab
Minimum Tillage	14	22 ab	37 a	56 a	75 a
Strip Tillage	15	23 a	39 a	59 a	77 a
Pr > F	NS	0.0226	0.0113	0.007	0.0085

*Values with different letters within sampling interval are significantly different at $\alpha = 0.05$.

In-Season Soil Compaction

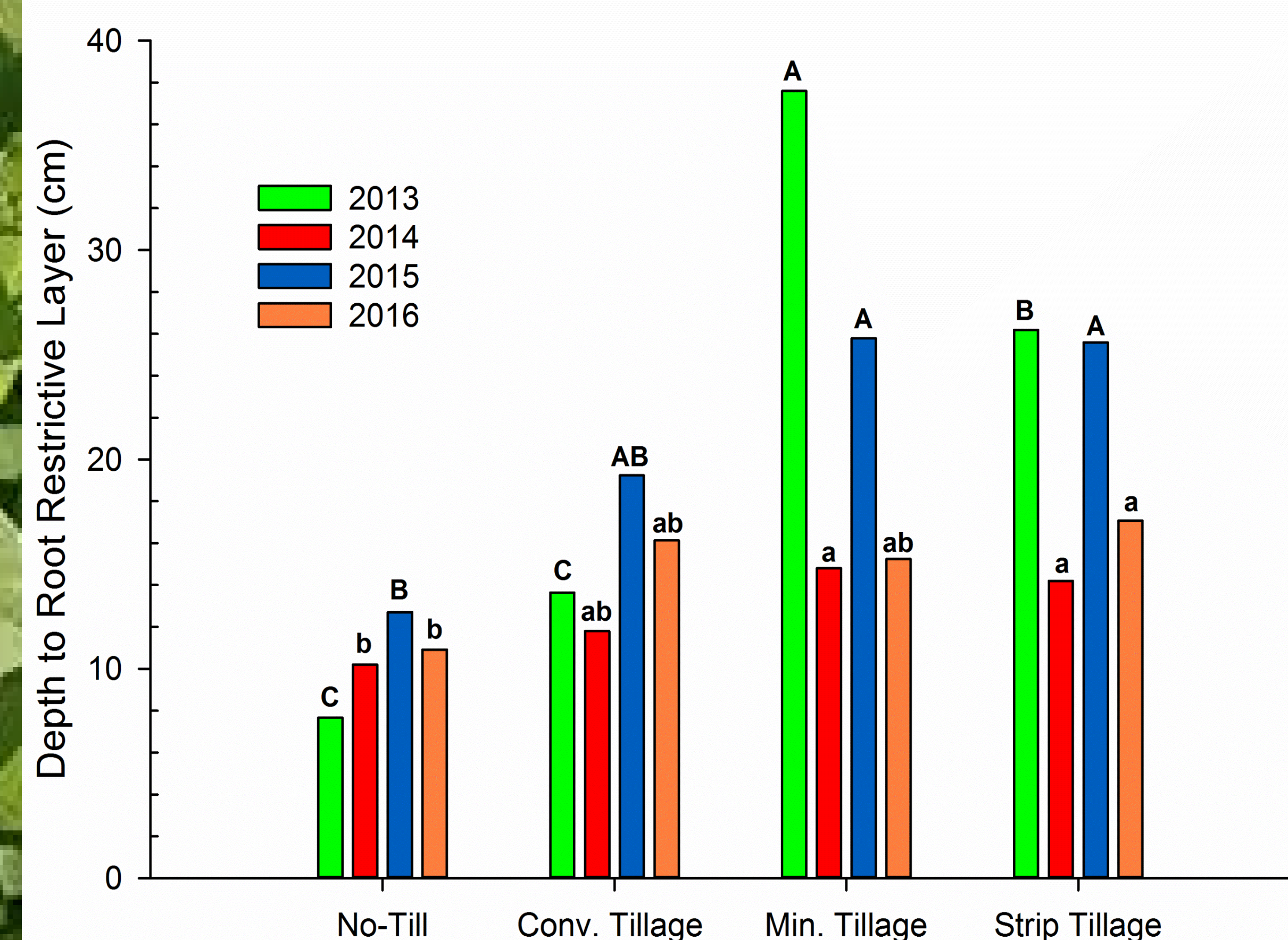


Fig. 1: In-season soil compaction for tillage treatments in 2013-2016. *Values with different letters within year are significantly different at $\alpha = 0.05$.

Tillage Lint Yields

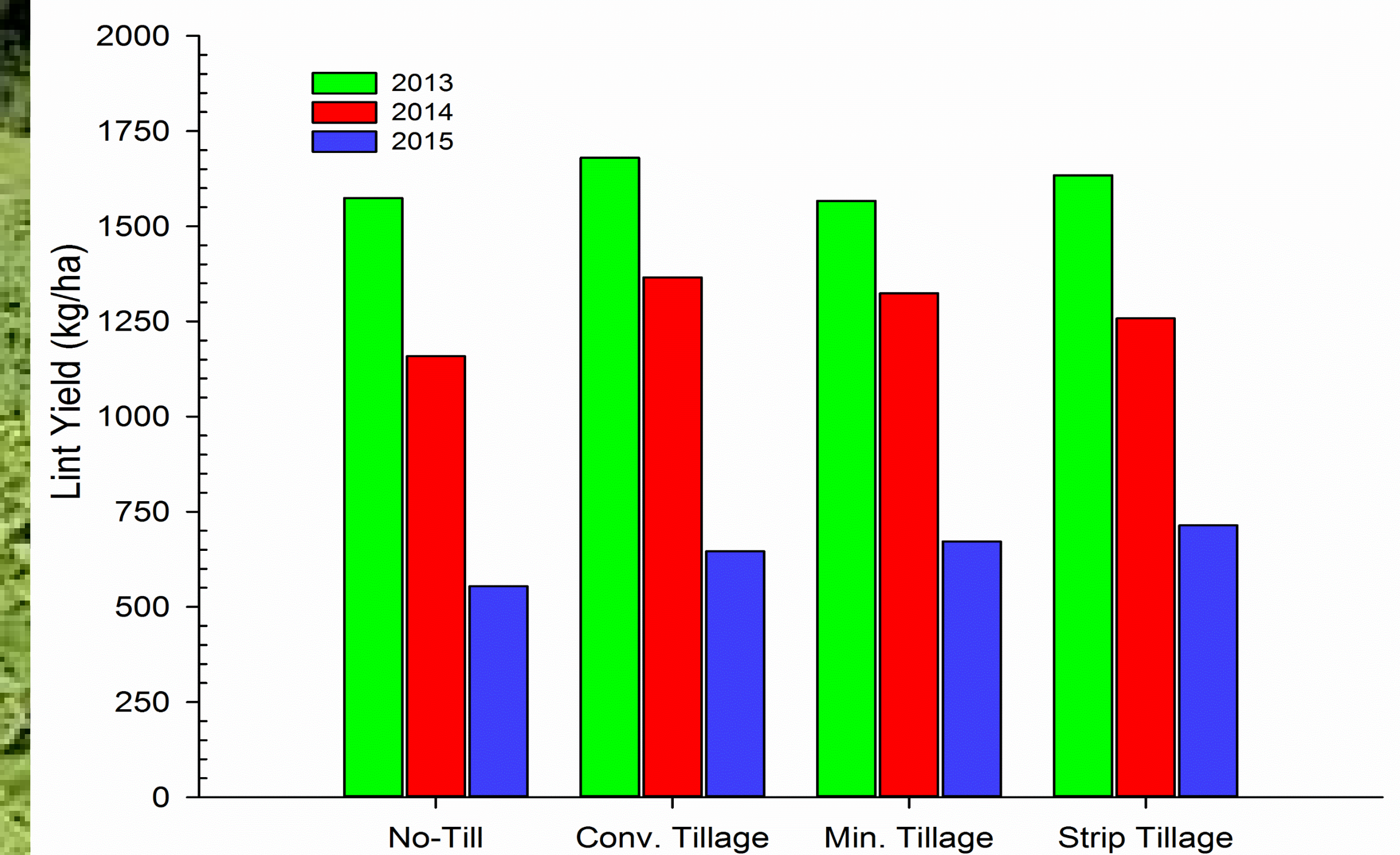


Fig. 2: Lint yield for the main effect of tillage treatment during trials from 2013-2015.

Varietal Lint Yields

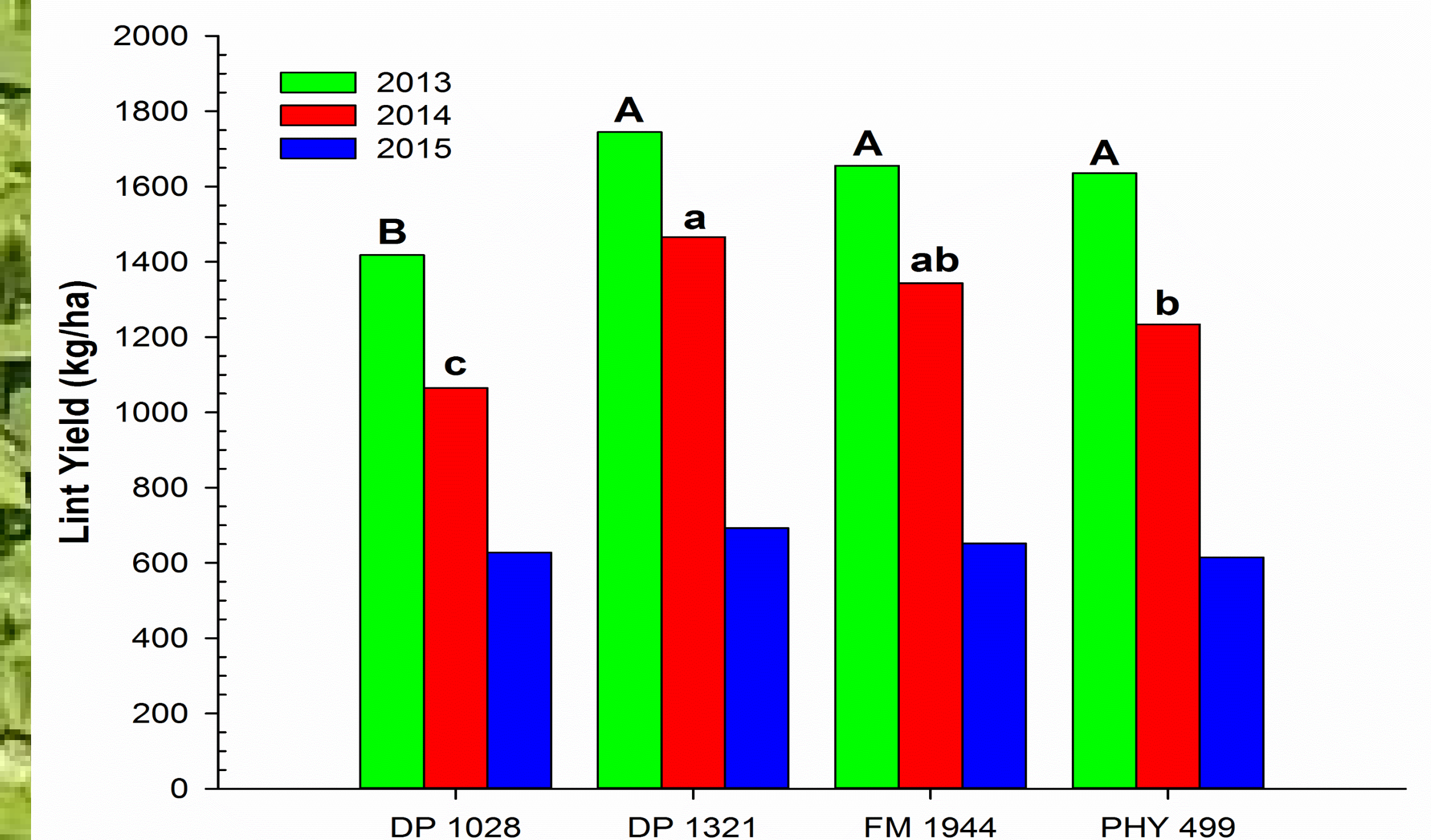


Fig. 3: Lint yields for the main effect of variety during trials from 2013-2015. *Values with different letters within year are significantly different at $\alpha = 0.05$.

Summary

- No differences in lint yields based on tillage treatment during 2013-2015
- DP 1321 consistently the highest yielding variety, most likely due to early maturing variety and later planting dates
- No-till and conventional tillage treatments resulted in shorter plant heights compared to strip tillage during 2013 and 2014
- Strip tillage and minimum tillage generally had deeper depths to a root restrictive layer, resulting in less soil compaction than no-till and conventional tillage
- No observed tillage by variety interaction in any of the study for any dependent variable

Acknowledgments

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