PERFORMANCE OF NEW GLANDLESS COTTON LINES AS A FUNCTION OF SOIL TYPE AND NITROGEN RATES

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Abstract

The prospect of commercial glandless cotton production is currently being explored in New Mexico due to low pest pressure and successful preliminary testing of selected glandless cultivars. However, existing glandless cultivars have relatively lower yields when compared to commercial glanded cultivars. Breeding efforts at New Mexico State University have focused on improving the seed and lint yields of the glandless cotton, and this has led to the release of new glandless lines. Three new lines of glandless cotton NM 13P1088, NM 13P1115 and NM 13P1117 were compared to existing glandless cultivars (Acala GLS and STV glandless). Field trials were set up at two locations with contrasting soil textures (sandy loam and clay loam) in the Las Cruces area. Additionally, the effects of two levels of nitrogen fertilizer (80 Ib N/ac and 160 Ib N/ac) were tested on the glandless cotton. Results showed that the effect of cultivars and soil texture were significant on yields, while the effect of fertilizer rate was not significant. NM 13P1117 had a significantly higher lint yield than the other lines and cultivars tested. Acala GLS had the best fiber quality, followed by one of the new lines (NM 13P1088). Generally, yields were significantly higher in clay loam soil than in the sandy loam soil, while the fiber quality measurements were not significantly affected by soil texture. This trial shows that the newly developed glandless lines could eventually replace the obsolete glandless lines.

Introduction

Commercial glandless cotton production could be a reality in New Mexico where a low pest pressure and productive glandless cultivars have been evaluated. However, existing glandless cultivars have relatively lower yields when compared to commercial glanded cultivars.

Idowu et al., (2014) compared Acala GLS, a glandless cultivar released in 2000 with Acala 1517-08, a conventional glanded cotton cultivar developed for the New Mexico's environment. This study found that Acala GLS had about 12% lower seedcotton, lint and cottonseed yield compared to Acala 1517-08. Zhang et al., (2014) found in similar multiple tests, that Acala GLS (glandless) produced only 65-80% of the lint obtained from Acala 1517-08 and 46-75% of the lint from glanded commercial transgenic cultivars.

Both of these studies (Idowu et al., 2014; Zhang et al., 2014) highlighted the need for the development of new glandless cultivars that will perform well in New Mexico in order to enhance the potential commercialization of glandless cotton. For easy adoption of glandless cotton, it is important to develop new lines that will have yields and fiber qualities that can compete effectively with already existing commercial cultivars.

The objectives of this study were

i) To evaluate yield and fiber quality of the newly developed glandless cotton lines in New Mexico, comparing them with existing glandless cotton cultivars.
ii) To study the response of the genotypes grown in two different soil types and at two nitrogen application rates.

Materials and Methods

Five genotypes were evaluated. Three of the genotypes are the new glandless cotton lines developed in New Mexico (NM 13P1088, NM 13P1115 and NM 13P1117) and the remaining two are already existing glandless cultivars (Acala GLS and STV Glandless).

Two sites with contrasting soil textures were chosen for the trial. The first site was located 8 miles off campus, at the New Mexico State University (NMSU) Leyendecker Plant Science Center in Las Cruces, NM with a sandy loam soil (Thermic Typic Torrifluvents [USDA-NRCS, 1999]). The second site was located on campus, at the Fabian Garcia Plant Science Center Farm with a clay loam soil (Thermic Vertic Torrifluvents [USDA-NRCS, 1999]).

Two nitrogen fertilizer application rates (80 lb N/ac and 160 lb N/ac) was applied in form of urea. Trials were established on beds spaced 40-inches apart at both sites and were furrow irrigated. Cultural practices were according to those prescribed by NMSU. Planting at both sites was done during the third week of May 2015, while harvest took place during the first week in November 2015.

Agronomic parameters monitored during the season included plant height, number of fruiting branches, number of squares, number of abscised fruiting sites and number of bolls formed. At maturity, 25 open bolls were collected from each plot (2 bolls/plant) for lint percentage and fiber quality evaluation. Quantitative field yield was assessed for each plot by harvesting 2 rows, 20 feet long. Fiber quality was analyzed by High Volume Instrument (HVI) at Cotton, Inc. (Cary, NC). The analysis of variance (ANOVA) was performed on different measurements to assess the significance of genotype, soil texture, fertilizer rate and their interactions.

Results and Discussion

The results show that the genotype effect was significant for most of the yield and all the fiber quality parameters (Table 1). Soil textural effect was also significant for yield measurements but not for fiber quality parameters (Table 1). Nitrogen rate was not significant for all the measured parameters (Table 1). Interaction effects were mostly not significant except for significant variety × soil texture interactions for boll weight, fiber length, uniformity index, fiber strength and short fiber content (Table 1).

Table 1. ANOVA results of the effects of different factors and their interactions on cotton yield and fiber quality traits.

Traits	Genotype	Texture[a]	N-Rate[b]	Variety × Texture	Variety × N-Rate	Texture × N-Rate
Seedcotton yield (lb/ac)	**	**	ns	ns	ns	ns
Lint yield (lb/ac)	*	**	ns	ns	ns	ns
Cotton seed yield (lb/ac)	ns	**	ns	ns	ns	ns
Lint percentage (%)	**	ns	ns	ns	ns	ns
Boll weight (g)	**	ns	ns	**	ns	ns
Micronaire (Mic)	**	ns	ns	ns	ns	ns
Fiber length (in)	**	ns	ns	**	ns	ns
Uniformity index (%)	**	ns	ns	**	ns	ns
Fiber strength (g/tex)	**	ns	ns	*	ns	ns
Fiber Elongation (%)	**	ns	ns	ns	ns	ns
Short fiber content (%)	**	ns	ns	**	ns	ns

**: significant at 1% level, *: significant at 5% level; ns: not significant.
a: Soil texture effect; b: Nitrogen application rate effect.

While NM 13P1117 had the highest lint percentage, followed by NM 13P1115, other genotypes did not differ significantly in lint percentage (Table 2). The boll weight of Acala GLS was significantly higher than those of the new lines, while STV Glandless had significantly lower boll weight (Table 2).

The new line, NM 13P1117, produced the highest seedcotton yield, but was not significantly higher than other cultivars except for the STV Glandless (Figure 1A). However, the lint yield of the new line (NM 13P1117) was significantly higher than the other tested lines and cultivars (Figure 1B).

Table 2. Boll weight, lint percentage and fiber quality measurements for five evaluated glandless genotypes in New Mexico

Traits	NM 13P1088	NM 13P1115	NM 13P1117	Acala GLS	STV Glandless
Lint percentage (%)	40.7 c	41.8 b	45.3 a	40.7 c	40.4 c
Boll weight (g)	5.52 b	5.48 b	5.50 b	6.24 a	5.04 c
Micronaire (MIC)	4.4 bc	4.5 b	4.8 a	3.7 d	4.3 c
Fiber length (in)	1.19 b	1.18 b	1.10 c	1.23 a	1.12 c
Uniformity index (%)	84.5 b	83.8 c	82.8 d	85.1 a	81.9 e
Fiber strength (g/tex)	34.2 b	31.4 c	28.5 d	36.0 a	26.7 e
Fiber Elongation (%)	5.69 b	6.32 a	5.80 b	4.63 c	4.68 c
Short fiber content (%)	7.13 d	7.62 c	8.13 b	6.88 e	9.00 a

a, b, c, d, e - Values followed by the same letter are not significantly different for any given trait.

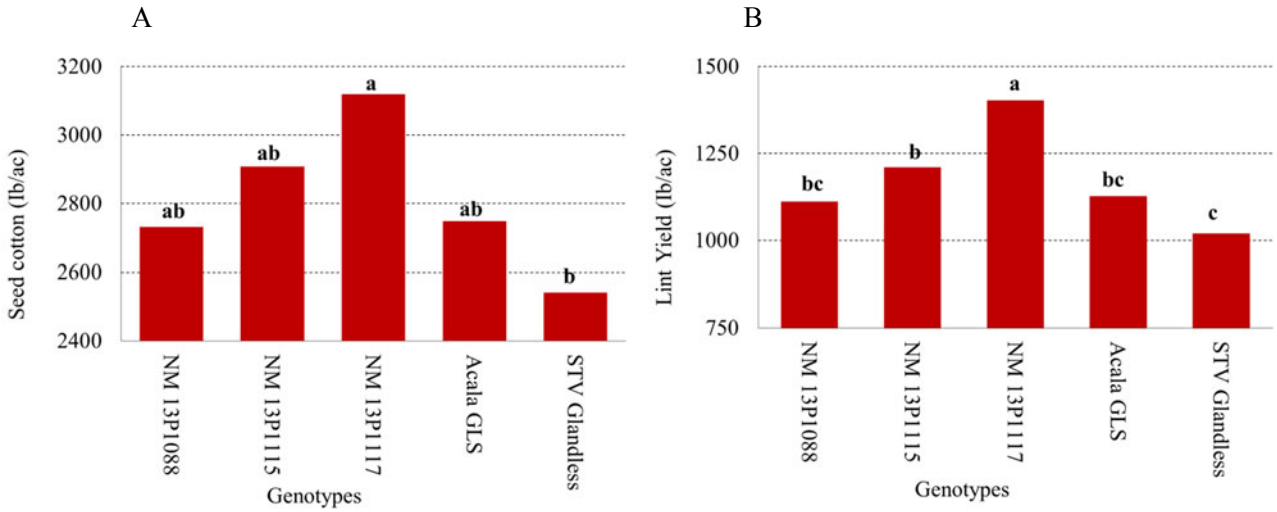

Figure 1 A & B. Seedcotton (A) and lint (B) yields of the new glandless cotton lines compared to the existing glandless cultivars.

Among the five lines, Acala GLS had the best fiber quality traits, with the micronaire in the premium range and the best fiber length, uniformity index, fiber strength; and lowest short fiber content (Table 2). However, Acala GLS was closely followed by one of the new lines (NM 13P1088) which also had very good fiber traits (Table 2).

Yields were greater from the cotton grown on the clay loam soil as compared to the sandy loam soil and the nitrogen rates applied did not have any effect on yield and fiber quality.

Summary

This study shows that the new glandless lines are promising and could eventually boost the commercial production of glandless cotton in New Mexico. A new line NM 13P1117, had a significantly greater lint yield (at least 25% higher) than the existing glandless cultivars, while another new line NM 13P1088 had very good fiber quality. More testing of these new lines will be needed across different cotton production areas in New Mexico to assess their yield potentials and fiber quality.

References

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