Ginning Efficiency in Upland Cotton – a value added trait in cotton improvement

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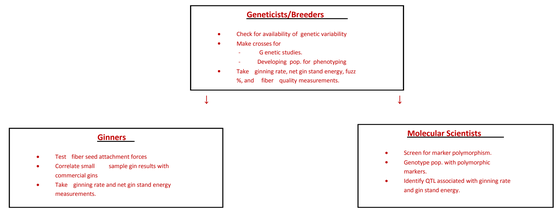
Introduction

- Ginning efficiency is improved by increasing the ginning rate and/or reducing ginning energy. The rate of ginning might be increased and the energy required for ginning reduced through breeding for low fiber-seed tenacity.
- Genotypes with high fiber-seed attachment force tend to reduce gin productivity by increasing power requirements, slowing the system and increasing fiber damage as measured by short fiber contents and neps.

Objective

- To investigate the potential for developing a breedeig program for improved ginning efficiency

Collaborations



Research Progress

(a) Evaluation of Cotton Genotypes for Ginning Rate and Net Gin Stand Energy

- Forty-six conventional and transgenic genotypes were planted in replicated trials at two locations in Stoneville, MS during 2008 and 2009.
- The cotton was ginned in a 10-saw laboratory gin stand to evaluate ginning energy requirements and ginning rates.
- Power consumed by the gin stand was measured and recorded with a Yokogawa power meter.
- Ginning efficiency was based on measurements of gin stand energy (Wh kg^{-1} lint) and ginning rate (g lint s^{-1}).

Results

- The 46 Genotypes were classified into:

(1) Low net energy, fast ginners
(2) High net energy, fast ginners
(3) Low net energy, slow ginners
(4) High net energy, slow ginners

- Fuzz percent was negatively associated with ginning rate but positively associated with net ginning stand energy (Table 1)
- Overall genotypes that ginned faster and required less energy to gin had lower nep size, nep count and short fiber content.

Yokogawa Power Meter

Table 1. Correlations between ginning rate, net ginning energy and fuzz % in four different crosses

	AR 9317-26 X FM 842ne		JJ 1145ne X Arkot 9608ne		MD 52ne X MD 25		TAM 182-34 ELS X AR 9317-26	
	Gin. Rate	Net gin Energy	Gin. Rate	Net gin Energy	Gin. Rate	Net gin Energy	Gin. Rate	Net gin Energy
Fuzz Percent	-0.68*	0.83**	-0.54*	0.45	-0.23**	0.32**	-0.48**	0.54**
Fiber Length					-0.01	0.36**	0.01	0.34**
Fiber Strength					-0.09*	0.50**	0.05	0.35**
Ginning Rate	---	-0.74*	---	-0.44*	---	-0.08*	---	-0.46**

* Significantly different at P<0.05 in t test.
** Significantly different at P<0.05 in t test.

Publication – Efrem Bechere, J.C. Boykin, and W.R. Meredith. 2011. Evaluation of Cotton Genotypes for Ginning Energy and Ginning Rate. The Journal of Cotton Sci. 15:11-21.

(b) Genetics of Ginning Efficiency

- Two crosses made by Dr. Meredith (Ark 9317-26 X FiberMax 832ne and JJ 1145ne X Ark 9608ne) were used.
- F_2 from each cross bulked to produce F_3 from which 62 individual plants per population were randomly harvested in 2009 to produce progeny rows.
- The progeny rows were planted in randomized complete block design with two replications at two sites in Stoneville, MS during 2010 and 2012.
- Data was collected on ginning energy requirement, ginning rate and fuzz percent and estimation of broad sense heritability, variance components, genotypic and phenotypic correlations and selection responses were made (Table 2)

Table 2. Heritability and genetic advances for ginning rate, net ginning energy and fuzz % from two crosses

	Ark 9317-26 X FM 832ne			JJ 1145ne X Arkot 9608ne		
	Fuzz %	Ginning rate	Net ginning energy	Fuzz %	Ginning rate	Net ginning energy
Broad sense heritability	0.61	0.16	0.38	0.76	0.15	0.31
Genetic Advance from selection	2.4	0.09	0.71	3.56	0.08	0.35

Publication – Efrem Bechere, J.C. Boykin, and L. Zeng. 2014. Genetics of Ginning Efficiency and its Genotypic and Phenotypic Correlations wit Agronomic and Fiber Traits in Upland Cotton. Crop Sci. 54:507-513.

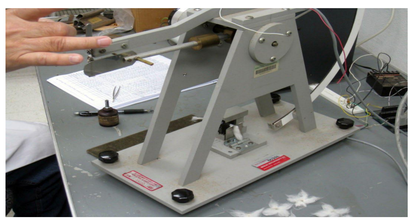
(c) Fiber seed attachment forces

- Measured with a modified SDL2 Cotton Seed Attachment Tester (Shirley Dev. Ltd, Didsbury, Man. , UK.
- A pendulum was raised & released to pass through the fiber bundle to shear the tuft of fiber cotton from the seed.

Table 3. Fiber seed attachment, net gin stand energy, ginning rate and fuzz %.

Cultivars	Fiber-seed attachment force (cN*cm/mg fiber)	Net gin stand energy (Wh kg^{-1} lint)	Ginning rate (g lint s^{-1})	Fuzz %
PHY 72	64.1 a[†]	11.8	2.72	12.4
TAM 182-34 ELS	56.8 abcd	12.0	3.11	11.3
JJ 1145ne	55.0 abcd	10.3	3.12	12.1
SG 747	53.0 bcde	9.7	3.02	14.7
MD 15 (Okra)	49.5 cde	10.0	3.21	10.6
FM 832 (Okra)	49.4 cdef	10.5	3.15	12.4
DP 555 BR	44.9 ef	9.9	2.96	12.8
SC-9023 - NS (Naked seed)	43.9 ef	9.0	2.89	8.2
AR 9317-26 (Naked seed)	36.1 g	7.5	3.09	6.4
LSD (0.05)		0.4	0.37	1.3

[†]Numbers followed by similar letters are not significantly different from each other



Fiber-seed attachment force tester

Publication – Boykin, J.C., E. Bechere, and W.R. Meredith. 2012. Cotton genotype differences in fiber-seed attachment force. J. Cotton Sci. 16:170-178.

(d) Molecular Study

- Two Poplns. developed for QTL analysis.

Conclusions

(1) Enough genet. var. exists in cult. cultivars.
(2) High heritability & genet. Adv. From seln.
(3) Genotypes with lower fiber-seed attachment force require less energy to gin and gin faster.
(4) Fuzz % can be used for selecting gin Eff. lines. It is cheaper and faster to measure.

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