Seed Size, Ginning Rate, and Net Ginning Energy requirements in Upland Cotton

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Introduction

- Watson (1879) – The time for ginning and net ginning energy depends on lint %, amt. of fuzz and seed size, in that order.
- Federow (1933) – Strength of fiber seed attachment affects the differences in power required to gin seed cotton.
- Smith et al. (1943) – larger and more fuzzy-seeded cottons required more time and energy to gin than the smaller and less fuzzy-seeded varieties.

Objective

To study the effect of seed size on ginning rate and ginning energy requirement in upland cotton.

Materials and Methods

- During 2015 and 2016, nine diverse cotton cultivars for seed size were grown at Stoneville, MS.
- AR 9317-26 and DP 555 BG/RR - 'small' , SI of < 10 gm, FM 832, FM 966 and MD 15 'intermediate' SI of 10 to 12 gm. Breeding lines 201-2, 107-1, and 152-1 'large' , SI of >12 gm.
- Plants were grown in 40' single row plots 12.2m X 1.0m in size. Fifty randomly selected bolls were hand-picked from each plot to measure seed index, gin turnout, lint yield, ginning energy, ginning rate, fuzz percentage, fibers/seed, seed surface area , HVI and AFIS quality parameters
- Net ginning energy was measured as (Wh kg^{-1} lint), and ginning rate was measured as (g lint s^{-1})

Statistical Analyses

. Statistical analyses of all properties associated with the genotypes were performed using Proc ANOVA (SAS, 2004).
. Simple Pearson's correlation test was used to estimate the level of relationships between traits.

Results

. Mean square values for seed size were highly significant for all traits. (Table 1).
. Small and intermediate seeded genotypes have significantly higher ginning rate than larger seeded genotypes (Tables 2).
. Larger seeded genotypes have higher fuzz % and require significantly higher energy to gin than smaller seeded genotypes (Tables 2 , and Figure 1)
. Seed index was positively and significantly correlated with net ginning energy, fuzz %, seed surface area, and fiber strength but negatively and significantly correlated with lint turnout and lint yield (Figure 2). The relationship with fiber length were negative but not significant. (Table 3).

- Overall, the smaller seeded genotypes have better ginning efficiency than the larger seeded genotypes. (Higher ginning rate, lower ginning energy, plus higher yields).
- Ginning energy was more affected by seed size than ginning rate.
- More genotypes should be included in the test to get more valid conclusions.

Table 1. Mean squares and levels of statistical significance of cultivars and seed size .

Source	DF	GR	NGE	TO	Lint Yield	Fuzz %§	Seed Index	Length	Unif.	Strn.	Fibers/ Seed
Cultivars	8	0.16**¶	2.1**	36.7**	5.1 x 10^{5}**	14.6**	10.7**	0.04**	6.6**	37.6**	2.7 x 10^{7}**
Seed Size	2	0.29**	5.25**	39.3**	9.2 x 10^{5}**	61.9**	28.7**	0.02**	11.4**	67.6**	2.7 x10^{7}**
Year	1	12.7**	1.59*	1.56	2.6 x 10^{3}	0.44	16.5**	--	--	--	3.0 x 10^{788}
Location	1	0.03	3.95**	62.9**	1.4 x 10^{5}	6.46	12.1**	0.002*	0.74	50.8**	1.5 x 10^{7}*
Rep.	4	0.03	0.6	8.5**	7.6 x 10^{4}**	1.9**	0.9**	0.008*	0.8	7.1**	6.9 x 10^{9}**
R-square		0.86	0.41	0.27	0.42	0.42	0.61	0.29	0.29	0.60	0.30
CV (%)		5.7	6.13	5.4	19.3	18.1	6.7	5.9	1.4	4.8	10.5
Mean		2.60	8.10	37.0	1062	7.82	11.4	1.19	84.7	34.4	15211.8

†Ginning rate (GR) was measured as g lint sec^{-1}.
‡Net ginning energy (NGE) was measured as Wh kg^{-1} lint
§Fuzz percent was measured as (weight of delinted seed/weight of fuzzy seed) X 100.
¶Values followed by *, and **, are significant at P<0.05, and P<0.01, respectively

Table 2. Summary of all data by individual varieties across years and locations during 2015 and 2016 summarized by seeds size.

Entry	Seed Size	SI (gm)	GR (g lint s^{-1})	Energy (Wh kg^{-1} lint)	TO (%)	Yield (Kg/ha)	Fuzz %	# Sds in One lb	Seed Sur. area (mm^2)	Fibers/ seed
107-1, plant 45	Big	12.5	2.41	8.53	35	1097	9.07	4176	119.8	15270
152-1, Plant 49	Big	11.6	2.47	8.62	37	1122	9.41	4190	112.3	16994
201-2, Plant 49	Big	12.1	2.56	8.34	37	1165	8.50	4176	118.3	15556
TAM 182-34-ELS	Big	12.4	2.65	8.38	37	1186	8.20	4280	111.3	14172
MEAN		12.2	2.52	8.47	36	1142	8.80	4206	115.4	15498
FM 832 Okra	Int.	11.1	2.57	8.49	36	1140	8.23	4400	111.7	14443
FM 966	Int.	11.2	2.73	8.38	37	1011	7.78	4301	120.8	17515
MD 15 Okra	Int.	11.4	2.70	8.22	37	1003	7.18	4280	114.1	15153
MEAN		11.2	2.67	8.36	37	1051	7.73	4360	115.5	15704
AR 9317-26	Small	9.9	2.80	7.09	36	1291	4.68	4952	109.6	12311
DP 555 BG RR	Small	9.5	2.75	7098	42	1705	7.35	5080	99.5	15492
MEAN		9.7	2.77	7.54	39	1499	6.01	5016	104.5	13901

Table3. Correlations of Seed size with ginning energy, ginning rate and other indices.

	Ginning Energy	Ginning Rate	Seed Size	Turnout	Fuzz %	Fibers/ Seed	Seed sur. Area	Unif	Fiber Length	Fiber Strength
Seed Index	0.44**	0.22	0.68**	-0.62**	0.35**	-0.29	0.90**	0.05	-0.21	0.45**
	(N=108)	(N=108)	(N=108)	(N=108)	(N=108)	(N=108)	(N=108)	(N=54)	(N=54)	(N=54)

Fig 1. Effect of Seed Index on Net Ginning Energy

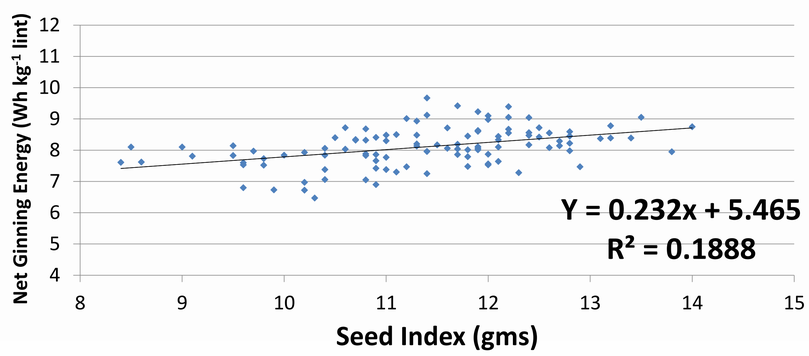

Fig 2. Effect of Seed Index on Lint Yield