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Relation of Bulk Density of Acid Delinted Cottonseed to Field Performance

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RELATION OF BULK DENSITY OF ACID DELINTED COTTONSEED TO FIELD PERFORMANCE[1]

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ABSTRACT

Acid delinted seed of the Stoneville 7A and Stoneville 213 varieties of cotton were separated into four seed density classes with a gravity separator. The quality of seed from the four density classes and an ungraded control was compared in laboratory and field performance tests. Germination, field emergence, rate of emergence and seedling dry weight (3 wks.) generally increased as bulk density of the seed increased. Lint yield also increased as bulk density of the seed planted increased although plant populations were equal for all seed density grades. Yields from plots planted with high density seed were significantly higher than those planted with low density seed but not higher than the yields of plots planted with ungraded seed.

Additional index words: Gossypium hirsutum, seed density, germination, seed quality, yield.

INTRODUCTION

It has been well established that germination and emergence of cottonseed are strongly influenced by seed weight or density. Arndt *et al.* (1), Chester (4, 5), and MacDonald (11) separated acid delinted cottonseed into two fractions based on their density relative to water. Those seed which floated in water were classed as light seed or "floaters," while those which sank were classed as heavy seed or "sinkers." Laboratory germination and field emergence of the "sinkers" were much higher and more rapid than of the "floaters." Muhtaror (12) also found that large, heavy cottonseed were superior to medium or small, light seed in stand establishment.

Justus *et al.* (9) separated cottonseed into small, medium and large size classes and then separated the seed in each size class into heavy and light seed. On the basis of field trials they concluded that the heavy seed from each size class were about equal in performance but much superior to the light seed. In an exhaustive study, Gregg (8) demonstrated that germination percentage, vigor as measured by a variety of tests, emergence percentage, rate of emergence, and seedling survival were positively correlated with bulk density of the seed, while free fat acidity (of the seed) was negatively correlated with seed bulk density. In a less extensive but more rigorous study involving individual cottonseed, Tupper (13) found that seed density had such a strong influence on germination percentage,

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rate, and uniformity that it overshadowed the influence of seed weight on these characteristics. High density seed were superior in every characteristic measured. Kunze *et al.* (10) reported a "strikingly consistent" correlation between seed density and emergence in cottonseed.

Since previous studies of the relation of density to quality and performance of cottonseed have been largely concerned with emergence and stand establishment, the present study was undertaken to evaluate the influence of seed density on performance parameters in cotton beyond the stand establishment stage.

Materials and Methods

One seed lot each of Stoneville 7A and Stoneville 213 certified cottonseed produced in Mississippi in 1968 were obtained from a local processor after acid delinting in January, 1969. The seed were placed in cold storage at 7°C and 45% relative humidity until April, at which time they were removed for separation and preparation for planting.

The seed in each lot were separated into four density grades with an Oliver Model Hi-Cap 50 gravity separator. The discharge end of the deck was divided into four equal lengths. Seed discharged from the highest one-fourth of the discharge end were highest in density and were designated as density grade D-1, seed discharged over the next highest one-fourth of the discharge end were next highest in density and were designated as density grade D-2 and so on, until density grade D-4 was obtained, which represented the lightest seed discharged over the lowest one-fourth of the discharge end of the gravity table. A portion of each seed lot was not density graded and used as the control.

Weight per bushel determinations were made with a Boerner weight per bushel scale. Germination tests consisted of four replications of 50 seed each conducted as prescribed in the Rules for Testing Seed (2). Field emergence and survival were determined in early May of 1969 from plantings consisting of four replications of 100 seed each. Emergence counts were made at 7, 14 and 21 days. After 21 days the seedlings were pulled from the field and oven dried for 24 hours at 130°C to determine average seedling dry weight.

Yield tests were planted May 24 in a randomized complete block design with five treatments, *i.e.*, seed density grades D-1, D-2, D-3, D-4 and control (ungraded), and six replications. Each plot consisted of three rows 40 inches apart and 30 feet long. Five hundred seed were planted per row in hills 8 inches apart. The stands were adjusted to three plants per hill by the end of the second week after emergence. Only the center row of each three-row plot was used for yield measurement. Cultural practices, fertilization, weed control and insect control were as recommended for cotton production in the hill section of Mississippi.

The plots were periodically harvested by hand. The accumulated harvest from each plot was weighed after air drying for 1 month to determine seed cotton yield. Lint percentage was determined by ginning four 3-pound samples randomly selected from the harvest. This was used to compute lint yield per acre.

Results and Discussion

Bulk density of the four gravity table separates ranged from 49.3 lbs/bu (D-1) to 36.8 lbs/bu (D-4) and from 50 lbs/bu (D-1) to 41.4 lbs/bu (D-4) for Stoneville 7A and Stoneville 213 varieties, respectively (Table 1). Ungraded seed of the Stoneville 7A lot had a bulk density of 47.3 lbs/bu as compared to 46.0 lbs/bu for the Stoneville 213 seed.

Germination percentage did not decrease significantly until bulk density of the seed dropped below about 45 lbs/bu (Table 1). Field emergence percentages, however, consistently decreased as seed bulk density decreased. The heaviest seed, class D-1, were superior to all other density classes including the ungraded seed in field emergence for both varieties.

Table 1. Germination, bulk density, field emergence, seedling dry weight and lint yield of different seed density classes from two lots of acid delinted cottonseed.

Density Class	Seed Per Class (%)	Germ. (%)	Density lbs/bu	Fld. Emerg. (%)	3-wk. D.W. gm/plt	Lint Yield lbs/A
			Stoneville 7A			
D-1	31	82 a*	49.3	78 a	.80 a	989 a
Ungraded	--	81 a	47.3	60 b	.65 b	900 a
D-2	28	76 ab	45.9	61 b	.74 ab	820 b
D-3	25	68 b	42.3	54 c	.68 b	929 a
D-4	16	42 c	36.8	32 d	.27 c	774 c
			Stoneville 213			
D-1	29	85 a	50.0	85 a	.68 a	1027 a
D-2	28	83 a	48.3	74 b	.67 a	969 a
Ungraded	--	77 a	46.0	70 b	.58 b	944 a
D-3	23	79 a	46.5	65 bc	.58 b	851 b
D-4	19	59 b	41.4	46 d	.52 b	772 b

* Means not followed by the same letter differ significantly at the 5% level.

Early seedling growth also increased as bulk density increased. Dry weight of D-1 seedlings 3 weeks after planting was 17-23% greater than that of the control or ungraded seed and 31 to 200% higher than the dry weight of D-4 seedlings. Observations during the growing season indicated that differences in plant size among seed density classes persisted up to about 40 days after planting, at which time plants from low density seed seemed to "catch-up." Plants from D-1 seed, however, began flowering 2-4 days sooner than those from ungraded seed and 6-10 days earlier than those from D-4 seed.

Lint yield decreased as bulk density of the seed planted decreased. Yields of the two highest density fractions and the control, however, did not significantly differ in the Stoneville 213 variety. In the Stoneville 7A variety the same trend prevailed except that the D-3 class seed switched places with the D-2 class seed.

Since differences in yield between D-1 seed, the highest density, and ungraded seed were not significant, the usefulness of gravity grading of cottonseed might be questioned. Although yields of the D-1 and ungraded seed classes did not differ in this study, the superiority of the high density seed was manifested in many characteristics important in economically successful cotton production.

High density seed produced an earlier, better and more uniform stand which developed into plants visibly larger up to 40 days after planting. A uniform, vigorously growing stand of this sort materially reduces early season weed problems. Plants produced from the highest density seed flowered and matured 2-4 days sooner than those produced by ungraded seed. This effect of seed density on earliness is most important from the standpoint of harvest.

The more rapid and uniform emergence of the high density seed undoubtedly contributed to the higher yields from high density seed as compared to low density seed. Wanjura *et al.* (14), Broyles (3) and Delouche and Caldwell (6) have discussed the dominant influence of the earliest emerging seedlings on earliness and yield in cotton.

Seed in the low density seed classes were characterized only in terms of bulk density or bushel weight. Nevertheless, it was evident that these density classes contained a high percentage of "unfilled," immature seed, rotten seed (boll rot), and badly mechanically damaged seed. These observations are in agreement with those of Ferguson and Turner (7) and Gregg (8).

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