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Short Communication

Effect of Seed Index on Varietal Performance in Upland Cotton (*G. hirsutum* L.)

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Seed index, a measure of mass of one hundred seeds, is an important economic trait to be determined before release of any crop variety. Seed mass reflects potential food reserves, a seed has for germination and seedling growth, and is crucial for successful stand establishment in the field [1, 2]. Seed index was one of the three traits which showed large inbreeding depression and thereby significantly lower seed cotton yield observed in F2 seeds of six hybrids in upland cotton [3]. It has been suggested that seeds with higher index should be selected for producing a uniform crop stand and higher yield in cotton [4, 5]. However, cotton shows a wide range of intra-varietal variability for seed mass due to its indeterminate growth, allowing seeds to set and develop over an extended period [6]. Temporal and positional difference of bolls on plants and pollen availability for fertilization [7] also contribute to seed size variation. Variations in the size and form of seeds affect germination, emergence and final yield. Delinting and size grading was reported to be beneficial to increase planting quality of cotton seeds [8]. Based on specific gravity, only one out of the two grades prepared is commercially being used which constitute wide range of seed indices within a lot.

Acid delinted, pre-cleaned and graded seed lots of four popular *G. hirsutum* varieties: Surabhi, Khandwa2, F-1861 and NH 545, were obtained from various breeding stations. Individual seed mass was determined for 10,000 seeds in each varietal lot. Though each variety contained seeds with an index ranging from a minimum of 3g to a maximum of 12g, the major portion (>80%) was comprised of seeds with index from 5.5g up to 9.5g, each contributing more than 10 per cent towards the total (Table 1). Only in varieties, Surabhi and F 1861 the seeds with index 9.5-10.5g constituted about 10 per cent. Therefore, an experiment was undertaken to compare seeds with these indices to assess their effect on seed cotton yield, as well as to estimate the percentage yield increase, which can be obtained by eliminating the indices causing lower yield. The field experiment was laid out in a randomized complete block design in a factorial arrangement with two replications. Each treatment consisted of 4 rows and 10 dibbles with 60cm spacing between rows and 60cm spacing between dibbles. Care was taken during sowing to place 3 seeds per dibble at uniform 2cm sowing depth in all treatments to minimize variation. Standard management practices were implemented regarding fertilizer application, pest management and harvest in all treatments. The characters evaluated were per cent emergence, seedling height, seedling (shoot) dry weight, cotyledonary leaf area, (all measured at 15-20 days after emergence), nitrogen uptake (measured at 90 days after emergence) and seed cotton yield. The observations were recorded on five normal plants (selected at random from the net plot excluding the border) in each treatment after final emergence and mean values per plant was calculated for all traits.

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Varietal differences were significant for all characters except seedling height. Surabhi yielded the highest seed cotton yield per plant followed by NH 542, F-1861 and Khandwa 2 (Table 2). Nitrogen content was also highest in seeds of the variety Surabhi. Varietal differences in nitrogen content in seeds have been reported earlier in cotton [9]. Other characters showed a similar pattern, with variety Surabhi showing greatest values. Significant difference occurred among the seed indices in all four varieties for seed cotton yield per plant (Table 2). Seeds with the highest index (10g in Surabhi and F 1861 and 9g in Khandwa2 and NH 545) gave significantly greater seed cotton yield/plant than seeds with lower indices. This was related to the other growth parameters of seedlings and mature plants. Seedling emergence in the field was significantly greater and more rapid for seeds with the higher indices. Seedling emergence time has been reported to be a measure of seed vigor in cotton [6, 10, 11] as well as cereals [12]. Seedling growth characters differed significantly among the seed sizes which were evident from as early as fifteen days after emergence. Seedlings with the highest seed index showed significantly higher mean values for seedling height, seedling dry mass and cotyledonary leaf area in all the four varieties. Significant positive correlation between yield and seedling vigor (r = 0.988) has also been observed earlier in cotton [13]. Greater embryonic reserves produce bigger seedlings with larger cotyledonary leaf areas which have been related to seed size in various other crops [14, 15, 16]. Seed indices showed significant variation for nitrogen uptake in different genotypes of cotton having different seed sizes. Percentage nitrogen uptake also varied significantly with seed index, with the lowest values being found in seeds with smaller index and increasing proportionately with increase in seed index. Low nitrogen content has been reported in those varieties of cotton where seed size was small [17]. The present study revealed the role of seed index/seed mass in realizing

Table 1. Variation for seed index in *G. hirsutum* varieties

Surabhi	%of size (out of total 10,000 seeds)	F1861	%of size (out of total 10,000 seeds)	Khandwa 2	%of size (out of total 10,000 seeds)	NH545	%of size (out of total 10,000 seeds)
2.6- 3.5 g	0.93	2.6-3.5 g	1.4	2.6- 3.5 g	1	2.6-3.5 g	0.9
3.6-4.5 g	3.33	3.6-4.5 g	1.5	3.6- 4.5 g	3.9	3.6-4.5 g	2.7
4.6-5.5 g	6.64	4.6-5.5 g	3.7	4.6- 5. 5 g	7.9	4.6-5.5 g	10
5.6-6.5 g	11.95	5.6-6.5 g	14	5.6-6.5 g	13	5.6-6.5 g	19
6.6-7.5 g	16.95	6.6-7.5 g	31	6.6- 7.5 g	22	6.6-7.5 g	24
7.6-8.5 g	22.11	7.6-8.5 g	27	7.6- 8.5 g	23	7.6-8.5 g	19
8.6-9.5 g	17.32	8.6-9.5 g	14	8.6- 9.5 g	18	8.6-9.5 g	14
9.6-10.5 g	10.22	9.6-10.5 g	5	9.6-10.5 g	9	9.6-10.5 g	6.3
10.6-11.5 g	6.79	10.6-11.5 g	1.1	10.6-11. 5 g	2.2	10.6-11.5 g	2
11.6-12.5 g	2.90	11.6-12.5 g	0.3	11.6-12.5 g	0.4	11.6-12.5 g	0.6
12.6-13.5 g	0.58	12.6-13.5 g	0.2	12.6-13.5 g	0.1	12.6-13.5 g	0.1
13.6-14.5 g	0.22						

Table 2. Effect of variety and seed index on seedling growth and plant yield

Varieties	Emergence %	Cotyledonary leaf area (mm^2)	Seedling height(cm)	S.D.M.(g) (of 10 seedlings)	%N uptake by seed	Seed cotton yield/plant (g/plant)
V1 (NH 545)	72.2	11.29	23.00	1.69	3.15	80.26
V2 (Khandwa 2)	60	10.98	22.9	1.65	2.92	55.44
V3 (F-1861)	70.5	11.87	23.7	2.01	3.17	73.14
V4 (Surabhi)	78.3	11.63	22.1	2.15	3.31	88.38
C.D. @ 0.5%	2.2	0.79	NS	0.19	0.13	8.64
Seed Sizes						
S1(5g to 6g)	48.5	9.58	19.62	1.55	2.14	64.70
S2 (6g to 7g)	68.3	11.10	22.12	1.70	3.41	67.03
S3(7g to 8g)	70	11.63	23.50	1.93	3.77	72.58
S4(8g to 9g)	78.3	11.75	23.50	1.93	3.77	79.41
S5(9g to 10g)	82	13.14	25.87	2.35	2.61	87.78
C.D. @ 0.5%	2.5	0.89	1.72	0.21	0.15	9.66

higher yield in *G. hirsutum*. Similar study in Jute also suggested that increase in the size of seed at planting was beneficial in terms of plant growth and components of seed yield and its quality production of large and medium seeds, emergence, emergence rate index, seed weight, seedling dry matter and seedling vigour index of the graded produce [18]. The superiority of large and medium seeds over others in terms of plant growth, seed production and quality was attributed to increased seed weight with high initial capital of food reserves causing greater absolute growth rate of seedlings and plants.

The yield increase which can be obtained by increasing the proportion of seeds with higher index was calculated for each variety by deducting the actual yield from expected yield which could have been obtained if the seeds with the highest index in each variety i.e. 9g in varieties, NH545 and Khandwa 2; 10g in varieties, F-1861 and Surabhi constitute the major portion of the varietal seed lot. Accordingly, the percentage yield increases were 27.3%, 13.2%, 9.6% and 1.6% respectively for F-1861, Surabhi, NH-545, and Khandwa-2. It is therefore, suggested that more seed grading for higher seed index and selection of highest grades during a breeding programme will help to enhance the performance of varieties being developed.

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