Evaluation of Genetic Stock of Desi Cotton (Gossypium arboreum)

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A total of 138 accessions of *Gossypium arboreum* of diverse origin were evaluated for seven morphological traits *i.e.* days to first flower, plant height (cm), number of monopods, number of bolls per plant, boll weight (g), seed cotton yield per plant (g), and ginning per cent. The genotypes Ac 64 was observed as earliest (64 days to first flower) along with good number of bolls (118), seed cotton yield (185 g per plant) and ginning out turn (40.8 %). The genotypes FFS-1 had recorded highest seed cotton yield (250 g per plant) whereas, HD 328 had recorded highest boll weight (2.7 g) among these lines. Based on this study, it is advocated that these lines could be used in crossing programme for improvement of *diploid* cotton.

Key Words: Evaluation Genetic stock, Desi Cotton, Gossypium

Introduction

Cotton is the most important commercial crop of India. Although cotton is grown for fibre but its seeds are also an important source of food oil and the meal is a protein rich by-product used as feed for ruminant livestock. Out of 51 species, four lint bearing species of genus *Gossypium*, *viz*., *hirsutum* and *G. barbadense* are tetraploid known as New World Cottons (2n=4x=52) and *G. arboreum* and *G. herbaceum* are diploid (2n=2x=26) and cultivated. *G. hirsutum* is commonly known as Upland cotton or American cotton, *G. barbadense* as Egyptian or Sea Island cotton whereas diploids *G. arboreum* and *G. herbaceum* commonly known as *desi* or Old World cottons.

In Haryana, farmer's preference is for American cotton particularly after the availability of Bt. cotton hybrids since last 3-4 years. Bt. cotton hybrids had less incidence of bollworms particularly *Helicoverpa* and secondly frequent picking of cotton is required in *desi* cotton. Availability of pickers is becoming a big problem in North zone. In spite of such problems there is sizeable (about 15%) area under *G. arboreum* in Haryana. The desi cotton species are inherently resistant to sucking pests and cotton leaf curl virus disease. As cotton leaf curl virus disease is transmitted by white fly and *desi* cotton are being resistant to sucking pests (white fly, jassid and aphids).

Germplasm is the basic raw material for any crop improvement programme. Conservation and use of genetic resources have great significance. It may either be introduced from other sources and may be developed by concerned breeder from his own material. The availability of genetic variability in germplasm and its proper use is very important (Singh and Mohan, 1999; Sangwan *et al.*, 2004; Van Esbroeck and Bowman, 1998). For maintaining adequate variability the germplasm should include land races, obsolete varieties, varieties and parents of hybrids, breeding lines with genetic markers and other morphological variants, wild forms and their relatives. Hence, collection, evaluation, maintenance, categorization and utilization of germplasm have special significance. The precise evaluation of genetic stock and dissemination of findings is important for their utilization in breeding programme. The systematically evaluated genetic resources of crop plays pivotal role in crops improvement. In the present study, germplasm of *G. arboreum* was evaluated for some traits of economic importance and identified the superior lines for future use in breeding programme.

Materials and Methods

The experimental material consisted of 138 accessions of *G. arboreum* of diverse origin, grown in a single row of 6 m length during *Kharif* 2007. The spacing between rows was 67.5 cm and plants in a row were kept 30 cm apart. Recommended agronomic and plant protection measures were adopted. The season remained by and large favorable for cotton crop. Diseases attack was negligible and incidence of boll worms was also low. Observations were recorded on seven traits *i.e.* days to first flower, plant height (cm), number of monopods, number of bolls per plant, boll weight (g), seed cotton yield/plant (g), and ginning per cent. Some morphological traits like plant body colors, leaf shape and flower colors were also observed. All the data were recorded on randomly selected five competitive plants and averaged.

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Table 1. Overall mean and range of different characters in germplasm of desi cotton

Character	Range	Mean values
Days to first flower	64-97	80
Plant height (cm)	90-225	164
Number of monopods/plant	0-13	3.3
Boll number per Plant	13-167	65.7
Boll wt (g)	1.4-3.1	2.0
Seed cotton yield/plant (g)	18-250	102
Ginning per cent	26.1-46.3	37.3

Results

Wide range of variability was observed for different traits and their range and mean values are given in Table 1. The findings of the present study for different traits are discussed individually.

Days to first flower

Earliness is an important agronomic trait. Typically, it is measured by number of days to first flower (when data is to be recorded on individual plant basis) or days to 50% flowering (data to be recorded in a population or a plot) meaning that first flower had appeared in about 50% plants of a particular plot. Early maturing genotypes have a great advantage in cases where terminal drought is common occurrence. It also escapes high pest or disease incidence, abnormal weather conditions and field is timely vacated for sowing of next crop. It is not necessary that early flowering genotype will also mature early as cotton plant has indeterminate growth habit. Therefore, date of commencement of flowering or peak flowering or date of bursting of the first boll can be regarded as only indication of earliness. The number of days to 50% flowering ranged from 64 (AC 41) to 97 (30822 BLL) days after sowing with mean value of 80 days (Table 1). Earliest flowering genotypes were AC 41 (64), D 462 P4 (68), B 4 (70), FFS 15 (70), HD 123 (72), D 462-P5 (72) (Table 2) and these genotypes can be utilized in crossing programe for reducing the days to flowering.

Plant height

The role of plant height is not very clear in cotton. Requirement of plant height may vary according to the objective. For machine picking, the sympodial variety with less height will be more desirable. Under poorly managed conditions tall genotypes with more monopods will be more suitable. In general plant height around 150 cm is most appropriate. The plant heights ranged from 90 (Jubli) to 225 cm (Vira) with mean value of 164 cm (Table 1).

Number of Monopods per Plant

Monopods are the vegetative branches and they do not bear the bolls directly on them. However, they bear sympods which are fruit bearing branches. Varieties/ hybrids having more monopods have great advantage as most of the farmer's unable to maintain the proper plant stand. Monopodial varieties under such situations compensate the vacant space to some extent by using this space with more monopods. Secondly, the seed of cotton hybrids are more costly so monopodial hybrids can be sown on wider spacing, thus seed requirement will be less and ultimately reduce the production cost. The

Table 2. Superior genotypes for seed cotton yield (single plant basis) among germplasm of desi cotton with other traits

SNo.	Genotype	Days to 50% flowering	Plant	Mono height (cm)	Number pods	No of bolls per plant	Seed wt (g)	GOT yield/plant (g)	Remarks (%)
1	FFS-1	95	165	13	167	2.2	250	38.6	
2	HD 408	80	160	5	155	2.1	220	38.5	
3	HD 372	86	180	4	147	2.3	208	37.8	
4	FFS-16	77	180	4	135	1.9	210	40.1	
5	AC 3028	92	175	3	108	2.9	200	36.1	
6	NGPA 1-9-1	77	185	2	127	1.8	195	40.2	
7	HD 328	82	210	3	90	2.7	190	42.4	VeryTall
8	CAD 306	82	150	5	102	2.3	190	35.2	
9	DS 5	76	120	4	110	2.0	186	38.0	
10	302	82	160	3	120	1.7	185	39.0	
11	HD404	82	195	5	110	2.4	185	38.2	
12	HD 20	87	190	4	95	2.3	185	39.9	
13	AC 41	64	185	3	116	1.8	185	40.8	Very early
Mean	82	173	4.5	122	2.1	199	38.7		
	HD123 (check)	72	145	4	28	2.5	59	38.7	
	Mean of all accessions	80	164	3.3	65.7	2.0	102	37.3	

number of monopods per plant ranged from 0 (H476-5) to 13 (BH 05 VIII) with mean value of 3.3 (Table1). Maximum number of monopods were observed in the genotypes namely FFS 1 (13), HD 369 (10), DS 5-2 (8), AKA 9410 (8), CISA 317, 2204 and P 248/98 (7).

Number of Bolls per Plant

The number of bolls per plant were observed to be the major yield contributing trait. It is the net outcome of flower produced and flower or bolls shed. Emphasis should be given on the selection of genotypes with more number of effective bolls. The deterioration of lint yield and quality may be caused by environmental factors and incidence of pests and diseases. The number of bolls per plant ranged from 13 (BH 05 VIII) to 167 (FFS 1) with mean value of 65.7 (Table 1). This character besides genotypic differences may also be widely influenced by environmental factors like high attack of boll worms, spacing, moisture at flowering and boll development stage, weather conditions etc. Number of bolls is not a stable character in different environmental conditions. The genotypes identified with maximum numbers of boll per plant are listed in (Table 3).

Boll weight

Final seed cotton yield is directly proportional to boll weight, as larger bolls weight increases the seed cotton yield with same number of small or medium bolls. Larger bolls were observed advantageous as they can be easily picked up and had less trash content. In the present time, farmers are more receptive to a variety/hybrid with larger boll size, even they sacrifice little yield advantage of smaller boll variety or hybrid. Picking rates are more expensive in varieties/ hybrids having smaller bolls and availability of pickers is also a problem in such cases because of difficulty in picking. The boll weight, in the present study, ranged from 1.4 (AC 3377) to 3.1 g PL 375 and the mean for this character was 2.0 g (Table 1). In general, boll size in North zone is smaller than South and Central zone because of short boll development period in this zone. Most of the released *desi* varieties/hybrids have boll size between 2.2-2.6 g. There is urgent need to give more emphasis for improvement of this character. The germplasm needs to enrich with accessions having boll weight around 3.5 g so that future varieties/hybrids may have boll size of at least 2.7 to 3.0 g and hence more acceptable to the farmers. Good boll entries were PL 375 (3.1 g), HD 248 and AC 3028 (2.9 g), HD 453 (2.8 g), HD 328, PA 464 and AH 11 (2.7 g) as given in Table 3 and use of these entries to improve boll size is advocated.

Seed cotton yield

Yield in cotton is a very complex character and has different meaning for farmers, ginners and textile owner. As the farmers wants more seed cotton yield, ginners are more interested in higher ginning per cent, where as textile owners requirement is better quality fibres. Keeping all in mind, a cotton breeder had to satisfy all the above three categories to some extent. Primary components of yield in cotton are: number of plants per unit area, number of bolls per plant and boll weight. As low as 18 g (BH 05 VIII) seed cotton yield per plant was observed and maximum yield was 250 g (FFS 1) with a mean value of 102 g yield/plant (Table 1). The genotypes which are having high seed cotton yield are listed in the (Table 3).

Ginning Percent

Table 3. Elite germplasm lines for different traits of desi cotton

SNo.	Characters	Name of germplasm line
1	Days to 50% flowering	AC 41 (64), D 462 P4 (68), B 4 (70), FFS 15 (70), HD 123 (72), D 462-P5 (72)
2	Monopods/plant	FFS 1 (13), HD 369 (10), DS 5-2 (8), AKA 9410 (8), CISA 317, 2204 and P 248/98 (7)
3	Number of bolls/ plant	FFS 1 (167), AC 3347 (164), HD 408 (155), HD 372 (147), DS 5-2 and FFS 16 (135), NGPA 1-9-1 (127), AKA 9410 (122), 302 (120), AC 41 (116), 3031 (111), HD 404, PL 375-1, DS 5, FFS 12 and G, cot 19 P1 (110),
4	Boll wt (g)	PL 375 (3.1), HD 248 and AC 3028 (2.9), HD 453 (2.8), HD 328, PA 464 and AH 11 (2.7)
5	Seed cotton yield/plant (g)	FFS 1 (250), HD 408 (220), FFS 16 (210), HD 372 (208), AC 3028 (200), NGPA 1-9-1, HD 328, and CAD 306 (190), DS 5 (186), 302, HD 404, HD 20 and AC 41 (185)
6	Ginning per cent	0479 (46.3), RG 255 (46.0), HD 302 (45.7), LD 327 and LD 805 (45.4), DS 5 (44.8), FFS 14 (44.4)

Values in parentheses are mean value of a particular genotype

Note: GBW denotes for Green Broad White; GNW denotes for Green Narrow White; RNP denotes for Red Narrow Pink; GDNW denotes for Green Deep Narrow White; RNR denotes for Red Narrow Red; GNY denotes for Green Narrow Yellow; RBP denotes for Red Broad Pink

This is a character of economic importance and it is the lint percent to that of total seed cotton yield. In general ginning percent is inversely proportional to the fibre quality in cotton. As cotton is mainly grown for lint, so, higher ginning per cent is a big advantage. The lowest ginning per cent was 26.1 (AC 3233) and highest was 46.3 (0479) and average was 37.3 (Table 1) for this character. Thirty five accessions have ginning per cent 40 or more indicating very good material for this character. Seven lines having highest ginning per cent *i.e.* 44.4 or more are given in Table 3. Such lines can be utilized for the development of variety with high ginning percent. To improve ginning per cent use of genotypes, namely, 0479 (46.3), RG 255 (46.0), HD 302 (45.7), LD327 and LD 805 (45.4), DS 5 (44.8), FFS 14 (44.4) is advocated.

Morphological Observations

The observations were also recorded for morphological characters *i.e.* plant body color, lobing of leaves and flower color. Out of 138 accessions, 115 accessions had green plant body color and 23 had red plant body color. With respect to lobing of leaves, 114 had narrow lobes or okra type or normal leaves, 4 had deep narrow lobes and 20 accessions had broad lobes. Large variations was observed for flower color *i.e.* white (58), cream (4), pink (15), red (4) and yellow (54). Out of 13 best yielding genotypes, 10 had green plant body and 3 had red plant body color, 11 genotypes had narrow/deep narrow lobes and 7 accessions had white, 3 yellow, 2 pink and 1 red petal color. Among the top yielding accessions for seed cotton yield on morphological basis we can conclude that it is the green plant body color having narrow lobed leaves with white petal colour is most common.

Discussion

The mean seed cotton yield of best yielding 13 genotypes was 199 g per plant as compared to 102 g of mean of all accessions and 59 g of local check (LC) variety HD 123 (Table 2). The average number of bolls per plant in these genotypes was 122 as against 65.7 of mean of all accessions and far less than that of local check. With regard to boll weight, there was large variation among these highest yielding genotypes *i.e.* 1.7 g to 2.9 g with average boll weight of 2.1 g almost similar to that mean of all accessions (2.0 g) and much lower than local check (2.5 g). The perusal of Table 2 indicated that it is number of bolls per plant which played more role towards higher seed cotton yield rather than boll weight. Mean number of days to first flower of selected genotypes was 82 almost similar to that of general mean and local check was 10 days earlier in flowering. Mean plant height of best yielding genotypes was 173 cm as compared to 164 cm mean of all accessions and 145 cm of local check. This indicated that optimum plant height in desi cotton is around 170 cm. Mean number of monopods per plant of good yielding accessions was 4.5 as against 3.3 of mean of all accessions. This indicated that better seed cotton yield genotypes had more numbers of monopods. Best yielding genotypes had ginning per cent 38.7 same as that of local check and better than mean of all accessions (37.3). This is mainly because all these 13 accessions had coarse fibre and such genotypes are more adopted in North Indian conditions. Coarse genotypes in general had more ginning per cent and vice versa.

Conclusion

We can conclude that some of the accessions had very good seed cotton yield potential and such accessions can be tried for their direct exploitation in larger plot and in different environments. As cotton crop is very sensitive to change in environmental conditions. Many a times data recorded for seed cotton yield on single plant basis may give contradictory results compared to data of per plot or per hectare basis. The results described in this paper are based on the data of one year so it can be considered as a preliminary study of superior accessions for a particular trait.

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