

Evaluation of *Gossypium* genotypes for oil content and component fatty acids

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ABSTRACT

Seed samples of 550 diverse genotypes of *Gossypium hirsutum* (Upland cotton) and *G. arboreum* (Desi cotton) were analysed for oil content by NMR method. Accessions with high oil content were further screened for fatty acid profile by Gas Liquid Chromatography. Variation in the seed oil content was more in *G. arboreum* (17.2 to 26.5%) as compared to *G. hirsutum* (17.1 to 24.4%). Wide variation for individual fatty acid was observed in both the species. Percent linoleic acid varied from 40.9 to 58.7%, oleic acid from 9.7 to 29.4%, palmitic acid from 21.9 to 30.6% among American cotton genotypes. Similarly, among Asiatic cotton genotypes, percent linoleic acid ranged from 38.5 to 55.1%, oleic acid from 15.9 to 33.7% and palmitic acid from 24.08 to 36.3%. Myristic acid (<1%) and stearic acid (<2%) constituted the minor fatty acids. Abundance diversity available in this material opens avenues for improving cotton seed oil quality.

Introduction

Cotton is the second most important oilseed crop in the world (Wilkins *et al.*, 2000). Limited information is available on the variability in the oil content and fatty acid composition of the Indian cotton genotypes. As the oil quality is affected by both genetic and environmental factors, it becomes pertinent to evaluate genotypes for oil content and component fatty acids to design breeding strategies for the development of cotton varieties with high oil content and appropriate levels of various fatty acids.

Experimental procedure

In the present study, 316 and 234 diverse genotypes of *Gossypium hirsutum* (Upland cotton) and *G. arboreum* (Desi cotton), respectively, were grown at Punjab Agricultural University Regional Station, Faridkot during *khari* 2001. Representative dried seed samples were analyzed for oil content using wide line NMR (New Port Analyzer Model MK III A). For fatty acid analyses, oil was extracted by the method of Kartha and Sethi (1957). The fatty acids were esterified with sodium methoxide and analyzed using Gas Liquid Chromatography AIML Model 5700 series with 6% butandiole succinate column six feet in length x 1/4" outer diameter. The column was operated at 200 °C with nitrogen flow rate of 60 ml/min and hydrogen flow rate of 40 ml/min. Data were recorded on data processor Chromatopach E1A. The quality analyses were carried out in the Oilseed section, Department of Plant Breeding, PAU Ludhiana.

Results and Discussion

Oil content exhibited variation from 17.1% to 24.4% in *G. hirsutum* and 17.2% to 26.5% in *G. arboreum* genotypes. Slightly more variation was observed in the Asiatic cotton genotypes studied. Based on percent oil content, genotypes were divided into five categories (Tables 1 and 2). It is evident that the majority of the genotypes had oil contents ranging from 19.1% to 21.0% and 22.1% to 24.0% in *G. hirsutum* and *G. arboreum*, respectively. Cotton genotypes with high oil contents are shown in Tables 3 and 4.

Linoleic, palmitic and oleic acids were the major fatty acids present in the cotton oil. The minor fatty acids comprised myristic acid and stearic acid. The range of component fatty acids in both the *Gossypium* species is given in Table 5. It is evident that fatty acid profile is dominated by unsaturated fatty acids. Of these fatty acids, oleic acid is important for increasing the keeping quality of the oil while linoleic acid is beneficial to health. The top 20 *Gossypium* genotypes with high oleic and linoleic acids are given in Tables 6 and 7. The results indicate that there is abundance of linoleic acid in the oil of the material studied. Since linoleic and oleic acid contents are negatively correlated, it should not be difficult to breed cotton varieties with high amount of oleic acid along with appropriate content of linoleic acid. Similarly, cotton varieties with maximum amount of linoleic acid (and minimum oleic acid) may be developed for heart patients.

The present investigation has provided a deep insight into the total oil content and fatty acid profile of 550 *Gossypium* genotypes. Since majority of the genotypes belong to geographically diverse areas and pedigrees, it is likely that they may possess different alleles for high oil content and component fatty acids. It would, therefore, be rewarding to include these genotypes in the breeding programs to transfer novel alleles for improving cotton oil quality.

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References

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Table 1. Categories of *G. hirsutum* genotypes based on percent oil content.

Sr.No.	Percent oil content	Number of genotypes
1.	Less than 18.0	3
2.	18.1 – 19.0	14
3.	19.1 – 21.0	150
4.	21.1 – 23.0	126
5.	Above 23.0	23

Table 2. Categories of *G. arboreum* genotypes based on percent oil content.

Sr.No.	Percent oil content	Number of genotypes
1.	Less than 18.0	2
2.	18.1 – 20.0	5
3.	20.1 – 22.0	43
4.	22.1 – 24.0	117
5.	Above 24.0	67

Table 3. *G. hirsutum* genotypes with more than 22.0% oil content.

Sr. No.	Genotype	Percent oil content	Sr. No.	Genotype	Per cent oil content
1.	Taskant 3	24.4	34.	IC 2119	22.6
2.	B 52-NC-63	24.3	35.	LH 1918	22.6
3.	F 1967	24.0	36.	WC Mess 17	22.6
4.	Brown Lint CSA	23.9	37.	PUSA 19-17	22.5
5.	May Acala	23.9	38.	RAC 9553	22.5
6.	MD 128	23.8	39.	RS 2114	22.5
7.	Model A	23.8	40.	F 444	22.4
8.	LH 1640	23.6	41.	F 776	22.4
9.	334	23.5	42.	F 1861	22.4
10.	LH 1961	23.5	43.	PUSA 45-3-6	22.4
11.	CSH 660	23.4	44.	PUSA 95	22.4
12.	DS 56	23.4	45.	RS 2096	22.4
13.	LH 1587	23.4	46.	RS 810	22.4
14.	M 18	23.2	47.	1334	22.4
15.	PIL 1	23.2	48.	B 59-1513 B	22.4
16.	RS 2094	23.2	49.	F 1942	22.4
17.	Acala 5625	23.1	50.	MCU 7	22.4
18.	F 1945	23.1	51.	F 1894	22.3
19.	G.Cot .10	23.1	52.	F 1985	22.3
20.	A 140	23.0	53.	F 1424	22.2
21.	CNH 13	23.0	54.	SGNGR 10	22.2
22.	F 1794	23.0	55.	PIL 8-5	22.5
23.	HS 220	23.0	56.	F 1947	22.2
24.	F 1828	22.8	57.	F 1995	22.2
25.	RCH 9740	22.8	58.	2096	22.2
26.	DLH 1588	22.8	59.	66-11-BH-51	22.2
27.	F 1997	22.7	60.	A 321	22.2
28.	RS 2106	22.7	61.	H 1224	22.2
29.	SGNGR 15	22.7	62.	ARB 9009	22.1
30.	Tide Water	22.7	63.	Mysore 14/66	22.1
31.	F 1728	22.6	64.	TCH 1599	22.1
32.	CA 7795	22.6	65.	RAC 1594	22.1
33.	CNH 1018	22.6			

Table 4. *G. arboreum* genotypes with more than 24.0% oil content.

Sr. No.	Genotype	Percent oil content	Sr. No.	Genotype	Percent oil content
1.	A 14	26.5	35.	AC 66	24.7
2.	LD 134	26.4	36.	B-4	24.7
3.	V 434	26.3	37.	Chinese million dollar	24.7
4.	H 168	25.9	38.	H 506	24.6
5.	H 336	25.9	39.	Olatasifolium B India	24.6
6.	H 94	25.9	40.	5787	24.6
7.	Malvi- 9	25.9	41.	741	24.6
8.	Ob	25.9	42.	AC 61	24.6
9.	H 171	25.8	43.	H 448	24.5
10.	A 516	25.7	44.	M-53-7	24.5
11.	H 486	25.6	45.	W-2-Ragan	24.5
12.	N 1123-NR	25.5	46.	H 116	24.4
13.	Dhulia-9-9-2	25.5	47.	LD 160	24.4
14.	LD 191	25.4	48.	AC 26	24.4
15.	Patiala Wfself	25.4	49.	H 457	24.3
16.	221	25.3	50.	M 14	24.3
17.	CC-1-1-3-3-3	25.3	51.	M 2638	24.3
18.	Gao-CB-4	25.2	52.	Malvi	24.3
19.	K 58-240	25.0	53.	873	24.3
20.	5348	25.0	54.	CC-1-1-3-3-4	24.3
21.	Gao 16	25.0	55.	D 47-20	24.3
22.	P 3135	24.9	56.	DC 92	24.3
23.	35/16/409	24.9	57.	H 5A	24.2
24.	7127-2-3-1	24.9	58.	H 407	24.2
25.	H 435	24.8	59.	Mollisoni- 30	24.2
26.	H 262	24.8	60.	G 166	24.2
27.	1526	24.8	61.	Gao-42	24.1
28.	D 135.149	24.8	62.	Indicum-18	24.1
29.	H 233	24.7	63.	LD 178	24.1
30.	H 471	24.7	64.	Shayamali	24.1
31.	M 54	24.7	65.	5204	24.1
32.	Raniben	24.7	66.	5599	24.1
33.	422	24.7	67.	AC 41	24.1
34.	4829	24.7			

Table 5. Range of component fatty acids (%).

Sr. No.	Fatty acid	Variation in fatty acid (%)	
		<i>Gossypium hirsutum</i>	<i>Gossypium arboreum</i>
1.	Myristic acid (14:0)	0.39 – 0.89	0.00 – 0.99
2.	Palmitic acid (16:0)	21.89 – 30.55	24.08 – 36.33
3.	Stearic acid (18:0)	1.07 – 1.89	1.24 – 1.85
4.	Oleic acid (18:1)	9.7 – 29.43	15.95 – 33.7
5.	Linoleic acid (18:2)	40.9 – 58.66	38.43 – 55.14

Table 6. Top 20 genotypes of *G. hirsutum* with high oleic acid and linoleic acid.

Ranking	Genotype	Oleic acid (%)	Genotype	Linoleic acid (%)
1.	F 1988	29.43	F 1977	58.66
2.	M 18	29.02	HS 220	57.40
3.	PUSA 180	28.09	F 776	55.43
4.	F 1995	27.70	F 1945	55.23
5.	LH 1900	26.16	F 1979	54.90
6.	LH 1960	25.63	F 1794	54.66
7.	Acala 5623	25.18	F 1888	54.44
8.	334	25.10	F 1973	53.31
9.	F 1854	24.81	F 1378	53.23
10.	GTSV 35	24.68	LH 1961	53.15
11.	F 1607	24.62	F 1971	52.98
12.	G.Cot. 12	24.20	H 1123	52.96
13.	Brown Lint CSA	24.04	F 1914	52.91
14.	F 1985	23.97	F 1978	52.89
15.	May Acala	23.97	F 1936	52.76
16.	F 1980	23.96	F 1906	52.72
17.	F 1962	23.92	RS 2096	52.26
18.	LH 1587	23.91	RS 2098	52.16
19.	F 1946	23.48	RS 2097	52.12
20.	F 1984	23.20	F 1959	52.10

Table 7. Top 20 genotypes of *G. arboreum* with high oleic acid and linoleic acid.

Ranking	Genotype	Oleic acid (%)	Genotype	Linoleic acid (%)
1.	LD 837	33.70	Shayamali	55.14
2.	Chinese million dollar	33.34	H 94	53.66
3.	LD 844	33.00	873	53.19
4.	Gao-CB-4	31.26	7275	53.09
5.	LD 839	31.05	H 2 (wr)	51.45
6.	LD 793	29.68	1526	51.53
7.	LD 778	29.30	M 2638	51.51
8.	RG 8	28.95	M-53-7	51.43
9.	35/16/409	28.54	LD 807	51.14
10.	LD 843	28.32	LD 307	51.04
11.	LD 794	27.94	H 168	50.56
12.	B-4	27.93	H 233	50.51
13.	LD 694	27.88	DC 92	50.40
14.	H 486	27.88	Ass 97	49.99
15.	Dhulia-9-9-2	27.85	K-58-240	49.92
16.	LD 191	27.77	H 171	49.87
17.	LD 790	27.75	LD 491	49.59
18.	IC	27.72	M 54	49.20
19.	AC 546	27.56	892	49.18
20.	Malvi-9	27.45	5348	49.02