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GENOTYPE × ENVIRONMENT INTERACTIONS FOR SEED-OIL AND PROTEIN CONTENT IN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT

Pattern of inter- and intraseasonal variation for seed-oil and protein content was examined in 10 elite cultivars and 5 experimental hybrids for 3 years. The cultivars showed a general trend of decrease in oil content at the third harvest in each year, but different levels of protein over the years and harvests. Effects of years, cultivars, harvests, and their two-factor interactions were highly significant for oil content. Third order interaction of years × cultivars × harvest times was not significant. A small increase in oil content over parents was recorded in the F_1, and decline in F_2. Protein content was relatively lower in the F_1 as compared to the respective parents.

Key words: *Gossypium hirsutum*, oil content, protein content, harvest time.

A wide range of variability is observed among the contemporary cultivars and germplasm collections of cotton for seed quality components of economic importance [1, 2]. Considerable variation in oil and protein content may be associated with years, locations and their interactions [3–6]. The indeterminate flowering pattern in cotton results in a period of several weeks of boll set. Large intraseasonal variation encountered in seed-oil and protein content of cotton also need to be studied genetically [7, 8]. The present investigation has been undertaken to examine the nature of genotype × environment (G × E) interactions for seed-oil and protein content in *Gossypium hirsutum*. Five experimental hybrids were also tested for inter- and intraseasonal variation in oil and protein content.

MATERIALS AND METHODS

The material comprised the contemporary cultivars L-147, DHY-286, Narmada, SRT-1, and Khandwa-2 and an elite selection, T 3-11, chosen on the basis of comparable yield and maturity duration. MCU-6 is a cultivar from South Zone. IC-794, IC-481 and IC-934 are exotic entries with high seed oil index (oil per seed, mg). The 10 true breeding strains and 5 experimental hybrids, viz., Khandwa-2 × L-147, L-147 × Khandwa-2, Khandwa-2 × T3-11, Khandwa-2 × IC-794, and L-147 × T3-11, were grown at Nagpur (21° 26′ N and 79°.49′ E) in the Central Zone of cotton cultivation, during the crop of 1983–84, 1984–85, and 1985–86 under normal agronomic practices in randomised complete block design with three replications and

20 plants/plot-row under rainfed conditions. The hybrids were spaced at 90 × 125 cm. The crop was sown each year in the first week of July. Seed cotton was harvested at first boll maturity, with the second and third harvests at 30-day intervals thereafter. Oil was determined on a wide-line Newport Nuclear Magnetic Resonance Analyser, using 10 g delinted, dried seed samples. Nitrogen was estimated by the analytical procedure described by Jackson [9], and converted into protein content. In the F test, year effects were considered as random, with the effects of harvests and entries as fixed.

RESULTS AND DISCUSSION

In general, the F_1 had higher oil content than the parents, while the protein content decreased in the hybrids (Table 1). Oil content in parents ranged between 17.7 and 26.6%, while that in the hybrids fell in the range of 23.1 and 26.9%. Oil and protein contents in the hybrids tend to be more or less consistent over different harvests. Differences in the oil content of hybrids between first and second harvest were small, with comparable estimates of SE. Results of combined analysis of

Table 1. Comparative performance of 10 lines, 5 experimental hybrids and their progenies for seed-oil and protein percentage across three seasons and in three harvests each year

Strain, hybrid	Seed-oil percentage									Seed-protein percentage								
	1983–84			1984–85			1985–86			1983–84			1984–85			1985–86		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III
SRT-1	23.9	24.1	22.3	23.3	20.4	22.4	21.4	23.5	21.5	28.7	27.3	23.5	28.1	31.1	30.3	27.1	33.2	27.3
L-147	25.9	26.4	25.8	22.6	21.7	23.9	23.8	22.7	21.1	23.9	24.0	22.0	24.3	28.7	28.8	24.0	24.5	32.6
DHY-286	21.9	22.6	21.3	23.1	21.3	22.8	23.4	23.5	22.3	29.3	24.0	24.9	26.4	27.6	28.7	25.5	25.1	32.8
Narmada	23.0	22.8	22.0	22.0	20.9	22.9	19.4	19.7	19.3	28.3	33.6	27.6	25.3	24.8	26.6	31.2	28.5	29.3
Khandwa-2	23.7	24.0	24.0	23.1	20.4	23.8	22.9	22.0	21.6	27.8	28.1	26.4	27.4	27.6	30.4	31.7	27.7	27.5
MCU-6	22.7	22.8	21.2	23.2	21.5	21.3	23.2	22.6	22.7	30.6	31.2	27.2	27.7	30.0	29.7	23.1	28.6	28.9
T3-11	22.5	23.7	24.3	20.3	17.7	21.6	23.1	23.3	22.7	31.5	30.0	24.6	28.2	29.6	29.4	32.0	28.8	28.8
IC-794	26.6	26.3	25.7	23.7	21.9	22.9	24.6	23.5	22.8	25.2	26.6	27.6	26.1	29.1	29.4	28.2	29.8	29.4
IC-934	22.4	22.9	21.3	21.5	21.3	22.1	18.2	18.4	19.2	28.6	22.4	30.1	25.4	30.9	29.7	24.6	31.4	24.4
IC-481	23.8	23.3	22.7	23.4	21.6	22.4	23.1	23.0	21.2	32.7	26.2	24.6	24.9	26.7	31.6	24.1	32.0	26.1
SE	0.69	1.00	0.86							2.85	3.02	4.25	2.97	2.09	3.17	4.53	2.60	3.14
LSD (5%)	1.42	2.03	1.76							—	6.34	—	—	—	—	—	—	—
Khandwa 2 × L-147*	25.5	26.0	23.5							21.5	22.5	23.3						
L-147 × Khandwa-2*	25.9	26.0	24.1							26.1	26.5	17.6						
Khandwa-2 × T3-11*	24.3	25.0	23.5							23.1	24.6	21.7						
Khandwa-2 × IC-794	24.6	25.3	23.1							22.9	24.3	24.1						
L-147 × T3-11	25.9	26.9	24.4							23.3	24.8	25.1						
SE	0.49	0.43	0.42							3.50	2.18	3.74						
LSD (5%)	1.07	0.93	0.93							—	—	—						

*F_1 studied in 1983–84 only.

variance of the cultivars over years and harvests are presented in Table 2. Effects of years, cultivars, harvests, and years × cultivars, years × harvests, and cultivars × harvests interactions were highly significant for oil content. The years × cultivars × harvests interaction was not significant. Seed-oil content of all genotypes was relatively higher during the 1983–84 season, probably because of regular rainfall during the first half of the boll development phase. Distribution of rainfall in the subsequent years was more irregular. The years × harvests interaction was highly significant in such conditions.

The effects of years, cultivars, harvest times, and their two- and three-factor interactions were not significant in the case of protein content. The years × harvests interaction, however, was highly significant (Table 2). Increase in protein content at later harvests is in agreement with Kohel and Cherry [2]. The results of the present study suggest that it is essential to keep harvest time under consideration for effective sampling and genotypic evaluation for oil and protein content.

Table 2. Combined analysis of variance in 10 entries over 3 years and 3 harvests for seed-oil and protein content

Source of variation	Seed-oil percentage		Protein percentage	
	d.f	M.S.	d.f	M.S.
Replications	3	2.7	2	16.8
Years (Y)	2	93.2** (0.25)	2	21.5 (1.00)
Error (a)	6	3.8	4	44.4
Cultivars (C)	9	36.2** (0.32)	9	27.2 (1.10)
Y × C	18	15.8** (0.58)	18	22.1 (1.46)
Error (b)	81	1.8	54	16.4
Harvest times (H)	2	10.9** (0.14)	2	19.1 (0.63)
Y × H	4	22.7** (0.32)	4	61.3** (1.33)
C × H	18	2.6** (0.50)	18	17.9 (1.98)
Y × C × H	36	1.6 (0.82)	36	21.8 (3.39)
Error (c)	180	1.1	120	17.6

*, **Significant at 5% and 1% levels, respectively. SE given in parentheses.

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