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BIOCHEMICAL CONSTITUTES OF DIFFERENT COTTON (*GOSSYPIUM HIRSUTUM*) GERMPLASM

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Abstract: The present investigation was carried out at Main Cotton Research Station, Navsari Agricultural University, Athwa farm, Surat during 2016. Protein, phenol, gossypol, reducing sugar and tannin were analyzed from *Gossypium hirsutum* germplasms. Our study revealed that out of 12 cotton varieties, high protein was found in genotype 8 (Full okra leaf) (0821-B-4-11-7), low in genotype 7 (Red thick leaf and red flower) (IAN-1327). High phenol was observed in genotype 10 (Small leaf and medium ball size) (C-1622, low in genotype 12 (Big ball size) (Demeter 111(1)). High gossypol was found in genotype 10 (Small leaf and medium ball size) (C-1622) low in genotype 3 (Thick, smooth and less hairy leaf) (Bar-12/13). High reducing sugar was found in genotype 2 (Semi and Small Okhra leaf) (Pentense Na-4 Chines) and low in genotype 9 (Stay green type) (C-1998). High tannin was found in genotype 5 (Monopodial and open plant type) (ISC-67-413) and low in genotype 3 (Thick, smooth and less hairy leaf) (Bar-12/13).

Keywords: Cotton, Germplasm, Protein, Gossypol.

Introduction

Cotton belongs to the genus *Gossypium* under tribe *Gossypieae* of family *Malvaceae*. The name of the genus is derived from the Arabic word goz, which refers to a soft substance [1]. The origin of the genus *Gossypium* is dated to around 5-10 million years ago. The genus *Gossypium* to which cultivated cottons belong, contains about 45 diploid (2n = 2x = 26) and five allotetraploid (2n = 4x = 52) species, all of which are basically tropical perennials. Two of the diploids, *G. arboretum* L. and *G. herbaceum* L. and tetraploid species are *G. hirsutum*, *G. tomentosum, G. mustelinum, G. barbadense*, and *G. darwinii*. New species continue to be discovered [2].

G.hirsutum known as upland cotton, native to Central America, Mexico, the Caribbean and southern Florida (90% of world production); *G.barbadense* known as extra-long staple cotton, native to tropical South America (8% of world production); *G.arboreum* known as tree cotton, native to India and Pakistan (less than 2%); *G.herbaceum* known as Levant cotton,

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native to southern Africa and the Arabian Peninsula (less than 2). India is the pioneer country in the world for development of cotton hybrid for commercial cultivation [3]. If the germplasm do not have information on characterization, evaluation and biochemical analyses, their utilization is limited. Characterization of germplasm using biochemical fingerprinting has got special attention. Researchers can use information to make decisions regarding the choice for selecting superior genotypes for improvement or to be used as parents for the development of future cultivars through hybridization.

Materials and Methods

The experimental material (Leaves) 12 varieties of *Gossypium hirsutum* of were obtained from Main Cotton Research Station, Navsari Agricultural University, Athwa Farm, Surat.

Table 1: Germplasm used in the study

Sr. No.	Germplasm	Special Characters
1	C-1579	Compact & Sympodial
2	Pentense Na-4 Chines	Semi & Small Okhra Leaf
3	Bar-12/13	Thick, Smooth & Less Hairy Leaf
4	EC-12062(511-2339-1688-1637)	Broad Leaf
5	ISC-67-413	Monopodial & Open Plant Type
6	ISC-75-1-12	Small Leaf
7	IAN-1327	Red Thick Leaf & Red Flower
8	0821-B-4-11-7	Full Okhra Leaf
9	C-1998	Stay Green Type
10	C-1622	Small Leaf & Medium Ball size
11	Acala-15170X BJA-592-SP-2	Small Ball Size
12	Demeter 111(1)	Big Ball Size

Biochemical Analysis

Protein content determination: Protein extraction and estimation elucidated by the method of Lowry [4]. Protein in the sample was estimated at 660 nm using bovine serum albumin as standard and expressed amount of protein mg per gm.

Phenol content determination: Phenol extraction and estimation elucidated by the method of Malick [5]. Phenol in the sample was estimated at 650 nm using Catechol as standard and expressed amount of phenol mg per gm.

Gossypol content determination: Gossypol extraction and estimation elucidated by the method of Bell [6]. Gossypol in the sample was estimated at 550 nm using Gossypol acetate as standard and expressed amount of gossypol.

Reducing sugar content determination: Reducing sugar extraction and estimation elucidated by the method of Somogyi [7] and Miller [8]. Reducing sugar in the sample was

estimated at 510 nm using D-Glucose as standard and expressed amount of reducing sugar mg per g.

Tannin content determination: Tannin extraction and estimation elucidated by the method of Schanderl [9].Tannin in the sample was estimated at 700 nm using Tannic acid as standard and expressed amount Tannin mg per g.

Results and Discussion

The results obtained in the present investigations have been presented in table 2

Protein: Protein was maximum in leaves of variety 0821-B-4-11-7(294.68 mg/g) followed by leaves of variety EC-12062(511-2339-1688-1637) (275.79 mg/g) and minimum in leaves of variety IAN-1327-1 (84.53mg/g) followed by leaves of Demeter 111(1) (14.28mg/g), (Table 2). Similarly other scientists Yao and Pandey worked on *Gossypium hirsutum* and they found leaf protein *(*8.1mg/g) and (42.8 mg/g) respectively [10; 11]. Cultivars with high crude oil concentrations also tend to have lower protein concentrations [12]. In present study revealed that more healthy plants increased levels of proteins which in turn help them to resist pathogenesis. Cotton varieties 0821-B-4-11-7 and EC-12062(511-2339-1688-1637) were healthier than IAN-1327-1 and Demeter 111(1).

Phenol: Phenols are important components functioning as defence mechanisms against pathogen attack. Phenols occur naturally in plants and they do have antimicrobial properties which prevent fungal spore germination and toxin production [13]. Phenol was maximum in leaves of variety C-1622 (1029.75mg/g) followed by Pentense Na-4 Chines (995.04mg/g) and minimum in variety C-1998 (222.00mg/g) followed by IAN-1327(320.35mg/g), (Table 2). Similarly other scientist Damodaran worked on 10 cultivars of *G. hirsutum* leaves [14]. They found phenol content in the leaves were maximum in LRK 5166, (195mg/g) and MCU-5V T, (201mg/g) followed by SUVIN, (217mg/g). Minimum phenolic content in leaves was recorded in NHH 44, (189mg/g) followed by Paiyur-1, (193mg/g). Higher levels of phenol found plants, when they are healthy, if plant has disease then phenol level is low [6]. In present study revealed that varieties C-1622 and Pentense Na-4 Chines were healthy and more defense system than C-1998 and IAN-1327.

Gossypol: Gossypol is a yellowish phenolic pigment distributed throughout the cotton plant. It occurs in both free and bound forms of which the former is much more harmful. The occurrence of gossypol lowers the quality of products; however, it confers resistance to the cotton plant against a number of pests and diseases. Leaf gossypol was maximum in variety C-1622 (56.41mg/g) followed by 0821-B-4-11-7 (47.58mg/g) and minimum in variety Bar-

12/13(19.16mg/g) followed by C-1579 (23.81mg/g), (Table 2). Similarly other scientist Chakrabarty *et al.* worked on six cotton lines- five *G. arboreum* and one *G. herbaceum* lines, Desi-1, AC24, 30821, AKH4, Jayadhar, G135-49 and they found (220.0µg/g), (160.0 µg/g), (190.0 µg/g), (200.00) µg/g, (248.7 µg/g), (230.0 µg/g) gossypol respectively[15]. Gossypol contents vary with the variety [16], geographic and species variation as well as isomeric contents [17]. In present study revealed that varieties C-1622 and 0821-B-4-11-7 were healthier and more immune power than Bar-12/13 and C-1579 variety.

Reducing Sugar: Ackerson and his collegues found reducing sugar contents twice higher than in leaves of non stressed plants [18]. Leaf reducing sugar was maximum in variety Pentense Na-4 Chines (160.35mg/g) followed by Acala-15170X BJA-592-SP-2 (151.93mg/g) and minimum in variety Demeter 111(1) (43.21mg/g) C-1998 (29.03mg/g) (Table 4.1.1). Similarly other scientist Damodaran, *et al*. worked on 10 cultivars of *G. hirsutum*, LRA5166, LRK516 PAIYUR-1, MCU-7, SUVIN, MCU5VT, SUPRIYA, NHH44, SAVITHA, SURYA. They found maximum reducing sugar content in leaves was recorded in MCU-7, 3.78 mg/g followed by Savitha, 3.7mg/g. Minimum reducing sugar content in leaves was exhibited by MCU 5 VT, 2.12 mg/g followed by Supriya, 2.2mg/g [14]. In present study revealed that varieties Pentense Na-4 Chines and Acala-15170X BJA-592-SP-2 were stressed plants, in compare to C-1998 and Demeter 111 plants.

Tannin: Tannin plays defense role for plants to immune to attack birds and diseases. Borkar reported that the cotton cultivars highly resistant to bacterial blight contained 51% more tannin than the susceptible lines whereas, the moderately susceptible lines possessed 22-48% higher tannin compared to highly susceptible cultivars [19]. The tannin content however decreased during the course of pathogenesis. Leaf tannin was maximum in variety ISC-67-413 (93.60mg/g) followed by C-1622 (88.50mg/g) and minimum in variety Bar-12/13 (30.63mg/g) followed by C-1998 (34.03mg/g) and Demeter 111(1) (34.03mg/g) (Table 2).

Table 2: Biochemical concentrations in leaves of cotton varieties (mg/g of tissue)

Sr. No.	Cotton line/ Variety	Total Protein	Total Phenol	Gossypol	Reducing Sugar	Tannin
1	C-1579	196.45	579.95	23.81	103.83	78.29
2	Pentense Na-4 Chinese	270.60	995.04	42.66	160.35	85.09
3	Bar-12/13	264.93	323.24	19.16	66.82	30.63
4	EC-12062(511-2339-1688-1637)	275.79	513.42	39.82	129.54	73.18

5	ISC-67-413	228.10	430.26	26.41	97.63	93.60
6	ISC-75-1-12	193.62	648.65	38.51	102.72	69.78
7	IAN-1327	84.53	320.35	33.88	51.30	68.07
8	0821-B-4-11-7	294.68	599.48	47.58	82.78	49.35
9	C-1998	224.32	222.00	30.12	29.03	34.03
10	C-1622	256.43	1029.75	56.41	83.22	88.50
11	Acala-15170X	238.49	869.21	46.03	151.93	86.80
12	BJA-592-SP-2 Demeter 111(1)	114.28	310.95	37.82	43.21	34.03

References

[1] Gledhill, D. 2008. The names of plants. Cambridge University Press, p. 182.

[2] Wendel, J.F., Curt, L.B. and Edward P.A. 1992. Genetic diversity in *Gossypium hirsutum* and the origin of upland cotton. *American Journal of Botany*, 1291-1310.

[3] Anonymous (2015) The cotton Corporation of India Ltd. Annual Report (45th Annual Report 2014-15), Mumbai, CCI.

[4] Lowry, O., Nira, J., Rosebrough, A., Lewis F. and Rose, J.R. 1951. Protein measurement with the folin phenol reagent. *Journal of boil. Chem.,* 193(1): 265-275.

[5] Malick, C.P. and Singh, M.B. 1980. In: Plant Enzymology and Histo-enzymology, Kalyani Publications, New Delhi, p.286.

[6] Bell, A.A. (1967). Formation of gossypol in infected or chemically irritated tissues of *Gossypium species*. *Phytopathology*, 57(7):759.

[7] Somogyi, M. 1952. Notes on sugar determination. *Journal of biological chemistry,* 195(1): 19-23.

[8] Miller, G.L. 1959. Use of dinitrosalicylic acid reagent for determination of reducing sugar. *Analytical chemistry*, 31(3):426-428.

[9] Schanderl, S.H. 1970. In: Method in food analysis, *Academic press,* New york, p.709

[10] Song, C., Ying, M., Peng, Y., Huang, J., Qian, S. and Xu, Y.1990. Relations among *Gossypium Species* Based on Seed Protein Electrophoresis [J]. Jiangsu, *Journal of Agricultural Sciences*, 1: 002.

[11] Pandey, S.N. and Thejappa, N.(1975). Study on relationship between oil, protein, and gossypol in cottonseed kernels. *Journal of the American Oil Chemists Society*, 52(8):312-315.

[12] Pettigrew, W.T. and Dowd, M. K. 2012. Interactions between irrigation regimes and varieties result in altered cottonseed composition. *J. Cotton Sci*. 16:42-52.

[13] Vidhyasekaran, P. and P. Durairaj. 1973. Role of auxin-phenol complex cin shot-hole syndrome development in mango incited by colletotrichumgloeosporioides. *Indian Phytopathology.*

[14] Damodaran, P.N., Udaiyan, K. and Jee, H.J. 2010. Biochemical changes in cotton plants by *Arbuscular Mycorrhizal* colonization. *Research in Biotechnology*, 1(1).

[15] Chakrabarty, P.K.P.M., Mukewar, S.R. and Sravan Kumar, V. 2002. Biochemical factors governing resistance in diploid cotton against grey mildew. *Indian Phytopathology*, 55(2): 140-146.

[16] Taneja, A.D., Sharma, A.P., Sharma, J.L. and Jain, D.K. 1993. Biochemical changes in cottonseed of different *hirsutum* genotypes during development. *J. Ind. Soc. Cott. Impr.* 18:75-81.

[17] Percy, R.G., Calhoun, M.C. and Kim, H.L. 1996. Seed gossypol variation within *Gossypium barbadense* L. cotton. *Crop Science*, 36(1):193-197.

[18] Ackerson, R. C. and Richard, R.H. 1981. Osmoregulation in cotton in cotton in response to water stress I. Alterations in photosynthesis, leaf conductance, translocation and ultra structure. *Plant physiology*, 67(3):484-488.

[19] Borkar, S.G. 1989. Tannin content of cotton cultivar in relation to bacterial blight resistance and its dynamics during different reactions induction by *Xanthomonas campestrisp- Malvacearum*-cotton reaction. *Indian J of Patho*., 1:142-144.