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ASSESSMENT OF SOME CHEMICAL INDICATORS FOR SOME CULTIVATED EGYPTIAN COTTON *Gossypium barbadense* L. VARIETIES

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ABSTRACT

Laboratory tests were conducted to characterize the chemical composition on seed samples from the three extra long stable G45, G70 and G88 and the six long stable cultivars G80, G83, G85, G86, G89 and G90 which represent all the nine cultivated Egyptian cotton varieties during 2002 planting season. Each variety was represented with two seed classes. In addition to the determination of total proteins, carbohydrates and oil percentages, the seed storage proteins were separated according to their molecular weight using sodium dodecyl sulphate gelelectrophoresis (SDS- PAGE) method. The free fatty acids also were estimated as an index of seed quality. It was apparent that there were significant differences between varieties as well as between seed classes of the same varieties.

Keywords: Egyptian Cotton varieties, Chemical composition, SDS-Page.

INTRODUCTION

The Egyptian Cotton has played a very important role in Egypt's economic, social as well as political history for the last one and half century. The Egyptian Cotton is distinguished by its superior quality which gives Egypt a comparative advantage in which a comprehensive cotton industry could be developed. The two main components of seed cotton are the lint and the seed. The lint usually comprises almost on third while the seeds provide two thirds of the weight of seed – cotton. Cotton seed as obtained from the gin and after removing lint is composed of the kernel or the embryo, the hull or the coat surrounding the kernel and the fuzz or linters, which are the short fibers attached to hull and not removed in the ginning process Abdel-Salam, (1999).

Recently cotton seed has progressed from an almost worthless commodity to a major source of income Prentice, (1972). Seed can provide significant quantities of edible oil and protein – rich food for livestock Munro, (1987). Refined cottonseed oil is used in food industry, and in some parts of the world it is the preferred vegetable oil. The cottonseed meal remaining after oil extraction is used as a protein–rich Food for ruminant animals in most areas of the world Robbelen, Downey and Ashri, (1989). The Egyptian cotton varieties differ significantly in their oil content Abdel-Salam, (1999). The Variability of oil content in Egyptian cotton cultivars is not unexpected, since this crop has not subjected to many conscious selections Osman, (1979).

The discrimination between cotton and other oilseed cultivars can be achieved by the analysis of seed storage proteins using electrophoresis Cooke, (1999). The differences in proteins can be detected after separation by gelelectrophoresis according to their molecular weight by denaturing sodium dodecyl sulphate gelelectrophoresis (SDS- PAGE) De Loose and Gheysen, (1995). This study focuses on the characterization of the

differences in oil and protein content as important economic attributes of the nine Egyptian cotton cultivars representing all the cotton varieties that were cultivated during the 2002 planting season.

MATERIALS AND METHODS

Three replications each of 100 seeds from eighteen Egyptian cotton seed lots were drawn randomly to determine their chemical characteristics. Each of the nine commercial varieties was represented with two seed lots from two seed classes namely foundation and certified seed classes. The first or the foundation seed class was produced in 2002, and the second or the certified class was of 2000 production. The nine tested varieties are divided according to their staple length as stated by Abdel-Salam, (1999) to the following two categories:

1- Extra long staple (over 1 3/8 inches): Giza45, Giza70 and Giza88.
2- Long staple (over 1 ¼ inches): Giza80, Giza83, Giza85, Giza86, Giza89, and Giza90.

These experiments were carried out at the Seed Technology Research Laboratory in the Field Crops Research Institute, Agricultural Research Center, Giza in 2003. A complete randomized complete block design with three replications was used, all the obtained data were recorded and calculated and were exposed to proper statistical analysis according to Little and Hills, (1978) and using MSTAT computer program with 1% and 5% levels of significance.

Protein percentage was determined using Kjeldahl apparatus as nitrogen percentage according to the Association of Official Agricultural Chemists AOAC. Percentages of protein were obtained by multiplying nitrogen percentages by the factor 6.25 Sadasivam and Manickam, (1996).

Oil percentage was determined using a soxhlet apparatus for 12 hours according to the AOAC methods and using petroleum ether of boiling point 40 – 60 °C

Carbohydrates percentage was determined according to Agrawal and Dadlani, (1987)

Electrophoresis of total soluble proteins: Electrophoresis methods have proved to be extremely useful tool in variety identification Cooke, (1999).

Sodium dodecyl sulphate –polyacrylamide gel electrophoresis (SDS-PAGE) was applied and the banding patterns of the total soluble proteins were obtained from the seeds of 18 random samples representing two seed classes of each of the 9 tested varieties.

The sampled seed coats were removed after soaking in water for 8 hours. The seeds were crushed and then defatted with acetone over a period of 6 hours. Soluble proteins were extracted from single seeds and SDS-PAGE was conducted according to the protocol described by Sadasivam and Manickam, (1996). The SDS is an anionic detergent which binds strongly to and denatures proteins. The protein – SDS complex carries net negative charge, hence move towards the anode and the separation is based on the size of the protein. Table 3 and figure 1 show the SDS-PAGE of total soluble proteins of the nine tested varieties.

RESULTS AND DISCUSSION

Chemical Analysis:

The dermination of chemical composition included the carbohydrates, protein, oil and free fatty acids percentages. The ratio of proteins to carbohydrates, and of oil to protein percentages were also calculated.

The results which have been shown in table 1 reveal that there were significant differences between varieties, and even within the same variety between the two seed classes. The highest carbohydrates percentage was 40.39% of G.85 and the lowest was 33.56% of G.70. There were also clear variations appeared in the same table regarding the protein percentages. The highest protein percentage was 25.6% of G.83 and the lowest was 21.47% of G.89. The ratio between the protein and the carbohydrates percentages was narrower and ranged between 0.56 in G.90 (the new released variety) to 0.69 of G.70 (one of the oldest varieties).

Table 1: The carbohydrates and proteins percentages of 9 cotton varieties produced in 2000 and 2002 seasons:

Stable length and Variety		Carbohydrates %			Proteins %			Prot/Car
		2000	2002	Mean	2000	2002	Mean	%
Extra Long								
	G.45	40.73	39.71	40.22	19.76	25.79	22.78	0.57
	G.70	32.11	35	33.56	23.5	22.6	23.05	0.69
	G.88	35.85	42.98	39.42	24.65	20.97	22.81	0.58
Long								
	G.80	33.39	44.08	38.74	24.38	23.63	24.01	0.62
	G.83	44.06	33.6	38.83	27.6	23.6	25.60	0.66
	G.85	35.89	44.88	40.39	25.09	23.55	24.32	0.6
	G.86	37.1	40.76	38.93	25.35	24.81	25.08	0.64
	G.89	33.4	41.53	37.47	17.06	25.87	21.47	0.57
	G.90	39.84	36.02	38.93	19.83	23.72	21.78	0.56
				38.49			23.43	
LSD	0.05			0.93			1.39	
	0.01			1.28			1.91	

In table 2 there were significant differences in 6 varieties from the 9 varieties and within most of the varieties in the oil percentages. The oil percentages varied between 17.67% in G.83 to 26.27 of G.89. These results are in conformity with results obtained by Eid and El-Enany (1981), and Eid and Hassan (1986). The ratio between oil / protein in the nine varieties showed a wider variation, this ratio ranged from 69.02% in G83 to 122.38% in G89. The variation in oil percentages was wider than the variation in the percentages of protein as has been shown in tables 1 and 2. Free fat acidity is used quite extensively as an index of seed quality, McCarty and Baskin (1994). The 1.0 percent level of free fatty acids is the most acceptable upper level for seeds. The free fatty acids percentages revealed that the FFA ranged from 2.3 to 3.55 % and all the results obtained were above the1% level of FFA which reflect high levels of deterioration. The free fatty acids usually build up under high temperatures and high seed moisture content. Immature and Insect infested and mechanically damaged seeds would have a much higher FFA content or more than 1% which results from breakdown of fats and oils to fatty acids and glycerol as seed deterioration progresses.

Separation of inferior quality seeds should be made as well as, using mature seeds from the early cotton picking for either planting or carry over purposes will reduce the FFA percentage.

Table 2: Oils and free fatty acids percentages of 9 cotton varieties produced in 2000 and 2002 seasons.

Stable length and Variety		Oil %			Free fatty acids %			Oil/Prot %
		2000	2002	Mean	2000	2002	Mean	
Extra Long								
	G.45	23.62	28.1	25.86	2.97	2.94	2.96	113.52
	G.70	19.75	17.65	18.70	1.43	3.6	2.52	81.13
	G.88	23.8	20.12	21.96	2.74	3.93	3.34	96.27
Long								
	G.80	19.27	22.61	20.94	3.08	3.01	3.05	87.21
	G.83	20.31	15.02	17.67	2.48	2.7	2.59	69.02
	G.85	23.06	22.7	22.88	2.96	2.1	2.53	94.08
	G.86	24.17	22.17	23.17	2.06	3.3	2.68	92.38
	G.89	26.85	25.69	26.27	3.52	3.57	3.55	122.36
	G.90	17.66	19.65	18.66	2.14	2.45	2.30	85.67
				21.79			2.84	
LSD	0.05			1.28			0.3	
	0.01			1.75			0.41	

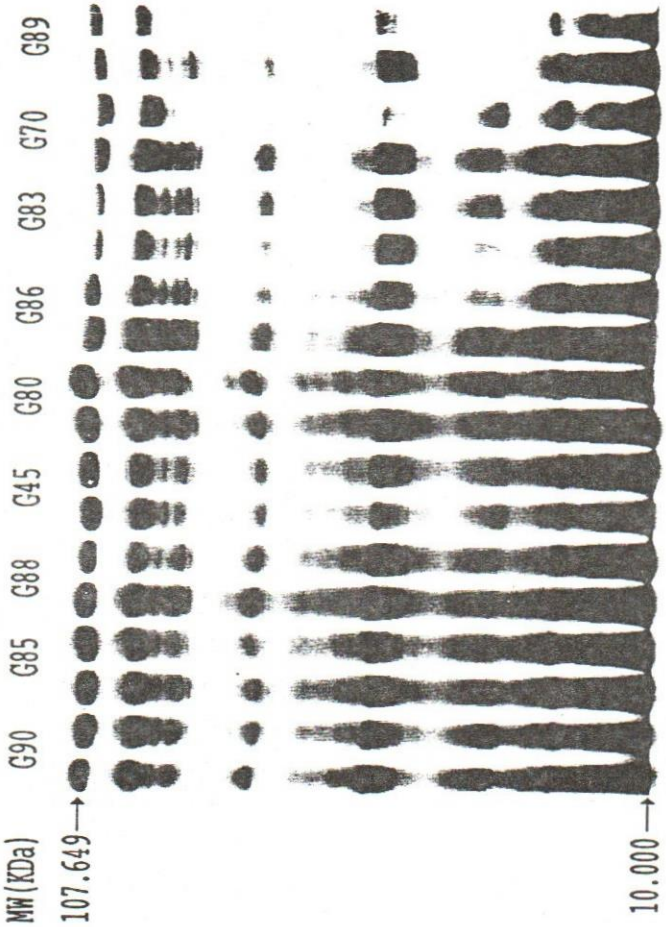
SDS-PAGE Electrophoresis:

Table 3 Shows the results of the SDS_PAGE electrophoresis of the soluble proteins of the 18 genetic material samples.

The positions and molecular weights in Kilodaltons are demonstrated in both table 3 and figure 1. The molecular weights of the soluble protein ranged between 10.000 to 107.649 Kilodaltons distributed among 18 bands in all the tested 18 samples from the 9 varieties. There are similarities in protein banding pattern. There were differences in banding intensity as has been shown in fig.1.

Table 3: The SDS-PAGE patterns of soluble proteins of 18 seed samples representing two seed classes of 9 Egyptian cotton varieties.

M.W	G.90		G.85		G.88		G.45		G.80		G.86		G.83		G.70		G.89	
Kilo Dalton	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002	2000	2002
107.649	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
98.568	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
75.397	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
65.153	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
50.893	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
44.128	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
40.559	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
36.314	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
35.549	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
34.284	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
32.329	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
31.119	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
29.532	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
27.025	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
26.225	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
22.454	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
14.338	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
10.000	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Bands present	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18



Figer1: The use of SDS-PAGE method to seperate the total soluble proteins of 2 seed clases from each of the nine of the Egyptian cotton varieties showing the position of bands according to their molecular weight(in Kilodoltons)

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تحديد بعض الخواص الكيميائية لأصناف القطن المصري

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قسم بحوث تكنولوجيا البذور . معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية

أجريت الاختبارات المعملية لتحديد التركيب الكيمائي لعينات من ثلاث أصناف من أصناف القطن المصري فائق طول التيلة وستة أصناف طويلة التيلة تمثل جميع أصناف القطن المصري المنزرعة في موسم ٢٠٠٢ . وقد مثل كل صنف عينيتين عبارة عن درجة الأساس والتي أنتجت عام ٢٠٠٢ والأخرى من درجة المعتمد والتي أنتجت تقاوي الأساس لها عام ٢٠٠٠ . وبالإضافة إلى تحديد النسبة المئوية للكربوهيدرات والبروتينات ونسبة الزيوت فقد تم تقدير الأحماض الدهنية الحرة كدليل يستخدم لتقدير جودة التقاوي وصلاحيتها للاستخدام في أغراض الزراعة وكذلك تم فصل أجمالي البروتينيات الذائبة كهربيا باستخدام دوديسيل سلفات الصوديوم وذلك طبقا لأوزانها الجزيئية. وقد ظهر من هذا البحث وجود فروق معنوية بين أصناف القطن التي تم اختبارها بل كانت هناك فروق جوهرية بين درجة إكثار نفس الصنف.