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# EFFECT OF STORAGE PERIOD AND TYPE ON SEED QUALITY AND VIGOR ATTRIBUTES OF SOME EGYPTIAN COTTON.Varieties (*Gossypium barbadense* L)

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## ABSTRACT

Laboratory and field tests were conducted to determine the chemical composition and to investigate the effect of storage period and type on the seeds of three extra long staple and three other long staple varieties of Egyptian cotton *Gossypium barbadense* L. Random seed samples from the tested varieties were exposed to storage under room temperature and under deep freezing (-20 °C) conditions for two years. The stored samples were subjected to chemical composition analysis and to vigor testing including the determination of free fatty acids and accelerated aging to each storage period, as well as the field emergence. Generally, there was great deal of variability between seed classes, varieties, type and period of storage. This variability may not be unexpected since the breeding of this crop focuses on the lint quality more than any other aspect.

These were significant differences between storage periods as fresh production performed better in the free fatty acids percentage and generally in the vigor testing values. Under the deep freezing storage conditions, seeds require drying to the safe limits before cold storage in addition to the separation of the mechanically damaged seed. Hence, these precautions affect the performance under these conditions.

**Keywords:** Egyptian cotton varieties, Chemical composition, Vigor values, Storage type and period.

## INTRODUCTION

Egyptian cotton is playing a very important role in Egypt's economic, social and also political history for the last one and half century. The cotton seeds constitute about 60% by weight of the gin-run (raw) cotton (Abdel Salam, 1999). There are several major factors influencing the vigor and viability of a seed lots. These factors include genotype, nutrition and growth condition of the mother plant, seed maturity at harvest, the physical handling of the seed during ginning and processing , seed moisture content and storage condition, (Gelmond, 1979; and Perr,1981). Recently Cotton seeds became a major source of income, as seeds provide considerable quantities of edible oil and a protein rich cottonseed mal. The highest seed quality should be selected for planting cotton. Determination of some cottonseed vigor values help predicting the storage and field performance as some of the seed testing may indicate the pathway which the seeds will follow during storage as carry over or in the field as planting seeds. There is an increasing interest for using physiological or metabolic measurements in seed quality testing and evaluation since seed deterioration leads to reduce the seed quality, field performance and consequently the stand establishment

(McDonald, 1999). In addition to the determination of the percentages of protein, carbohydrates, and oil content, some vigor tests were conducted to evaluate the free fatty acidity and accelerating aging as affecting the field performance. The free fatty acids and accelerated aging are indicators for the physiological changes due to the time and type of seed storage.

## MATERIALS AND METHODS

One kilogram seed sample was drawn randomly from lots representing two seed classes namely foundation and certified seed classes from 6 Egyptian cotton varieties during 3 successive cotton growing seasons 2000-2002 and stored under room temperature condition which range between 24–28 °C seasons (2000-2002).Another sample from each of the foundation and certified seed classes drawn and of 2000 production season was stored under deep freezing conditions (-20°C)until the beginning of 2003. Then, all the seed samples were exposed to chemical analysis to determine the percentage of protein, carbohydrates as well as oil content. Free fatty acids, accelerated aging and field emergence testing were conducted to determine seed quality attributes which affect the seed lot storage capacity, field emergence and performance.

**Chemical Composition:** Protein, carbohydrates, and oils percentages were determined according to the procedures prescribed by the Association of Official Analytical Chemists (AOAC), 1990. Percentages of protein were obtained by multiplying the obtained nitrogen percentages by the factor 6.25 as stated by Sadasiuam and Manickam (1996). Oil percentage was determined using the Soxhlet apparatus for 12 hours according to the AOAC methods and using petroleum ether of boiling point 40-60 °C . Carbohydrate percentages were determined according to Agrawal and Dadlani (1987).

**Free Fatty Acidity (FFA) Determination:** As seeds deteriorate, their oil content breaks down into glycerol and free fatty acids. Seeds with less deterioration have a FFA content of 1.0% or less. Free fatty acids usually build up under high temperature as well as high moisture conditions. Therefore, free fatty acidity percentage is quite extensively used as an index of seed quality and to rate the seed lots (McCarty and Baskin, 1994). The FFA was determined according to the official methods reported by AOAC, 1990.

**Accelerated aging test:** A sub-sample of about 100 gm of each sample was drawn at random and placed in one layer deep on upper surface of a stainless steel wire mesh screen which was fixed into a plastic box containing 50 ml of distilled water, allowing air space of about 2.5 cm between the water surface and the bottom surface of the steel wire mesh screen. Seeds were aged at a uniform 45 ± 0.3 °C and 100% relative humidity, both temperature and relative humidity were maintained for 48 hours. Seeds were removed and 3 replicates each of 50 seeds were planted directly in 3 layer germinator

paper towels as in standard germination test according to the International Seed Vigor Testing Handbook, 1995 and the International Rules for Seed Testing, ISTA, 1999 and 2004.

**Field emergence percentage:** Three replicates each of 100 seeds were drawn randomly from each tested seed in rows (approx. 5 m long). The number of emerged seedlings was calculated at 14 days after planting at time intervals until become constant, the highest figures were used and expressed as the percentage of field emergence. All laboratory experiments were conducted at Seed Technology Research Department, Field Crops Research Institute, FCRI in the Agricultural Research Center, ARC, Giza. Field emergence experiment was carried out in the National Gene Bank farm in Giza. Seed moisture content was determined using the oven method as stated in the International Seed Testing rules, ISTA, 1999. It was ranged between 10.25 to 11.4%. All the obtained data were exposed to proper statistical analysis of a randomized complete block designed according to Little and Hills, 1978, and using MSTAT computer program with 5% and 1% levels of significance.

## RESULTS AND DESCUSSION

**a- Chemical composition:** The percentages of proteins in the six tested cotton varieties as have been shown in tables (1-4) varied from 22.88% in the year 2000 production to 24.38% of the year 2001, and to 23.99% in the year 2002, while it was 26.12% for the seeds of the year 2000 production which have been stored under –20 °C.

It was noted also that there is a significant variability between most of the six tested varieties, even between the different seed classes of each tested variety in both carbohydrates and oil percentages. The carbohydrates percentages were 38.38, 33.59 and 37.09 for the years 2000,2001 and 2002 respectively while it was 44.49 for the seeds which were produced in 2000 and stored under –20 °C. The variability in oil percentages were less than in carbohydrates and proteins.

**b- Vigor Indicators:** Free Fatty Acidity, FFA: The obtained results as has been shown in tables 1-4 were in conformity with McCarty and Baskin 1994, as free fatty acids usually build up under high temperatures and high seed moisture conditions. The FFA percentages were 6.05, 3.91 and 2.95 in the year 2000, 2001 and 2002 respectively which indicate the high FFA percentage in the seeds stored under the room temperature for two years and was lower in the freshly produced seeds. The use of gin-run or fuzzy seeds which tend to cling to each other preventing seeds to be free flowing, so the ever present light, mechanically or insect damaged, and immature seeds cannot be largely removed by screening to improve seed germination percentage. Immature, insect and mechanically damaged seed would have a much higher FFA content which is recognized as a major of reducing seed vigor and viability, and involves the accumulation of degenerative changes

and products which result in loss of germination ability, McCarty and Baskin, 1994, and all the results were above 1% .

**Accelerating aging test – AA:** The results appear in tables 1-4 show successive increase in the results of AA test which were 30-72, 35.63 and 37.75 in the years 2000,2001, and 2002 respectively. It is apparent from the results that there is variability not only between varieties but also between seed classes within each variety.

**Field emergence:** In the year 2000 production the variety G70 gave the highest performance (table1) while the variety G86 was highest in the year 2001 production (table2), while the variety G89 was the highest in 2002 season (table3). The variety G80 exceeded the other varieties significantly. For the seeds stored under deep freezing conditions for two years as has been shown in (table4).

**Table 1: Chemical composition and response to some vigor testing of cotton seed samples of 2000 production season and stored at room temperature**

| Variety | Seed Class | Chemical Composition | | | Vigor Testing Results | | |
|---|---|---|---|---|---|---|---|
| | | Protein | Carbohy--drates | Oil | F. F. A. | A. A. | Field Emergence |
| **Extra Long Staple Varieties:** | | | | | | | |
| G.70 | Found. | 22.16 | 41.54 | 23.38 | 4.92 | 42.30 | 70.00 |
| | Certif. | 19.51 | 37.03 | 26.30 | 5.79 | 36.30 | 35.00 |
| G.88 | Found. | 25.65 | 42.27 | 27.21 | 6.28 | 45.30 | 30.00 |
| | Certif. | 23.52 | 35.87 | 24.65 | 7.47 | 40.00 | 76.00 |
| **Long Staple Varieties:** | | | | | | | |
| G.80 | Found. | 25.91 | 34.08 | 23.64 | 5.12 | 15.70 | 50.00 |
| | Certif. | 23.60 | 40.36 | 24.88 | 4.27 | 13.70 | 45.00 |
| G.83 | Found. | 19.41 | 36.88 | 19.90 | 6.79 | 4.70 | 14.00 |
| | Certif. | 20.79 | 40.22 | 21.01 | 6.83 | 24.30 | 39.00 |
| G.86 | Found. | 20.91 | 39.69 | 22.18 | 5.34 | 40.70 | 60.00 |
| | Certif. | 20.52 | 36.00 | 23.87 | 7.27 | 29.00 | 66.00 |
| G.89 | Found. | 25.69 | 38.21 | 24.56 | 3.76 | 34.30 | 25.00 |
| | Certif. | 24.89 | 37.54 | 23.85 | 8.80 | 39.30 | 14.00 |
| Means | | 22.88 | 38.38 | 23.79 | 6.05 | 30.72 | 43.67 |
| L.S.D | 0.05 | 0.38 | 0.42 | 0.37 | 0.17 | 4.68 | 0.49 |
| | 0.01 | 0.51 | 0.57 | 0.50 | 0.23 | 6.36 | 0.66 |

This may reflect different dormancy levels for the different tested varieties. Specially, the extra long staple varieties G88 and G70 and the long staple variety G86 of the 2000 production season (table1). The variety G86 again had the best performance for the 2001 season (table2), and G89 exceeded the other varieties significantly for the shortest period of storage under room temperature (table3).

**Table 2: Chemical composition and response to some vigor testing of cotton seed samples of 2001 production season and stored at room temperature:**

| Variety | Seed Class | Chemical Composition | | | Vigor Testing Results | | |
|---|---|---|---|---|---|---|---|
| | | Protein | Carbohy--drates | Oil | F. F. A. | A. A. | Field Emergence |
| Extra Long Staple Varieties: | | | | | | | |
| G.70 | Found. | 26.14 | 43.33 | 22.46 | 5.60 | 44.50 | 21.00 |
| | Certif. | 21.01 | 31.29 | 20.83 | 3.39 | 42.50 | 16.00 |
| G.88 | Found. | 23.11 | 39.19 | 24.35 | 5.72 | 39.00 | 24.00 |
| | Certif. | 24.70 | 30.22 | 27.56 | 3.74 | 38.00 | 18.00 |
| Long Staple Varieties: | | | | | | | |
| G.80 | Found. | 26.81 | 30.67 | 27.87 | 5.31 | 38.50 | 44.00 |
| | Certif. | 23.52 | 30.22 | 26.93 | 5.80 | 41.00 | 45.00 |
| G.83 | Found. | 28.12 | 32.06 | 23.67 | 2.18 | 15.00 | 43.00 |
| | Certif. | 22.32 | 30.81 | 23.81 | 4.05 | 14.50 | 47.00 |
| G.86 | Found. | 20.47 | 35.40 | 25.10 | 1.20 | 37.00 | 64.00 |
| | Certif. | 25.83 | 31.49 | 26.59 | 1.78 | 37.00 | 62.00 |
| G.89 | Found. | 26.01 | 33.51 | 23.56 | 4.56 | 43.00 | 14.00 |
| | Certif. | 24.53 | 34.90 | 23.05 | 3.57 | 37.50 | 0.00 |
| Means | | 24.38 | 33.59 | 24.65 | 3.91 | 35.63 | 33.17 |
| L.S.D | 0.05 | 0.46 | 0.68 | 1.86 | 0.22 | 6.33 | 25.5 |
| | 0.01 | 0.64 | 0.96 | 2.63 | 0.31 | 8.93 | 35.9 |

**Table 3: Chemical composition and response to some vigor testing of seed samples stored at room temperature, seed of 2002 season production:**

| Variety | Seed Class | Chemical Composition | | | Vigor Testing Results | | |
|---|---|---|---|---|---|---|---|
| | | Protein | Carbohy--drates | Oil | F. F. A. | A. A. | Field Emergence |
| Extra Long Staple Varieties: | | | | | | | |
| G.70 | Found. | 26.09 | 36.21 | 20.96 | 3.70 | 41.00 | 27.00 |
| | Certif. | 24.94 | 33.85 | 27.28 | 2.54 | 39.00 | 20.00 |
| G.88 | Found. | 20.97 | 42.98 | 20.12 | 3.93 | 37.00 | 46.00 |
| | Certif. | 24.65 | 35.83 | 23.80 | 2.74 | 45.00 | 22.00 |
| Long Staple Varieties: | | | | | | | |
| G.80 | Found. | 24.38 | 33.39 | 19.27 | 3.08 | 24.00 | 15.00 |
| | Certif. | 23.63 | 44.08 | 22.61 | 3.01 | 35.00 | 52.00 |
| G.83 | Found. | 23.60 | 33.60 | 15.02 | 2.70 | 38.50 | 31.00 |
| | Certif. | 27.60 | 44.06 | 20.31 | 2.48 | 35.50 | 17.00 |
| G.86 | Found. | 24.81 | 40.76 | 22.17 | 3.30 | 36.50 | 39.00 |
| | Certif. | 25.35 | 37.10 | 24.17 | 2.06 | 40.50 | 59.00 |
| G.89 | Found. | 15.56 | 33.40 | 25.69 | 3.57 | 44.00 | 67.00 |
| | Certif. | 26.31 | 29.76 | 27.15 | 2.28 | 37.00 | 67.00 |
| Means | | 23.99 | 37.09 | 22.38 | 2.95 | 37.75 | 38.5 |
| L.S.D | 0.05 | 1.91 | 0.84 | 1.25 | 0.17 | 5.13 | 9.99 |
| | 0.01 | 2.69 | 1.33 | 1.76 | 0.24 | 7.24 | 14.08 |

**Table 4: Chemical composition and response to some seed vigor attributes of seed samples of season 2000 production stored at –20 oC :**

| Variety | Seed Class | Chemical Composition | | | Vigor Testing Results | | |
|---|---|---|---|---|---|---|---|
| | | Protein | Carbohy--drates | Oil | F. F. A. | A. A. | Field Emergence |
| **Extra Long Staple Varieties:** | | | | | | | |
| G.70 | Found. | 27.35 | 45.08 | 25.35 | 4.97 | 40.70 | 44 |
| | Certif. | 28.06 | 45.96 | 23.69 | 4.20 | 37.30 | 29 |
| G.88 | Found. | 23.11 | 44.75 | 22.69 | 1.96 | 34.70 | 39 |
| | Certif. | 22.80 | 41.40 | 23.24 | 1.64 | 34.30 | 49 |
| **Long Staple Varieties:** | | | | | | | |
| G.80 | Found. | 27.54 | 38.18 | 26.86 | 4.69 | 41.00 | 53.0 |
| | Certif. | 27.30 | 46.78 | 25.59 | 3.95 | 35.00 | 46.0 |
| G.83 | Found. | 26.16 | 44.97 | 23.39 | 5.38 | 31.00 | 31.00 |
| | Certif. | 24.17 | 45.78 | 22.58 | 3.95 | 31.30 | 36.00 |
| G.86 | Found. | 24.37 | 42.91 | 25.81 | 5.63 | 36.70 | 36.70 |
| | Certif. | 25.63 | 42.38 | 25.63 | 5.09 | 41.00 | 41.00 |
| G.89 | Found. | 27.16 | 47.72 | 26.21 | 4.20 | 38.70 | 49.00 |
| | Certif. | 29.75 | 47.96 | 24.48 | 1.95 | 39.70 | 37.00 |
| Means | | 26.12 | 44.49 | 24.63 | 3.97 | 36.78 | 40.81 |
| L.S.D | 0.05 | 0.97 | 1.58 | 0.43 | 0.21 | 6.33 | 0.49 |
| | 0.01 | 1.32 | 2.15 | 0.59 | 0.28 | NS | 0.66 |

The wide variability was clear and apparent in all the analysis and factors which were investigated. This variability exclusively included significant differences between different varieties seed classes, productions years, and seed storage types and periods. It is concluded that the apparent differences between cotton varieties and seed classes especially what related to the seed vigor testing may be due to a wide range of factors which include genotype, growing conditions of mother plants, seed maturity at harvest, and physical handling of seeds during ginning and processing which may cause different degrees of mechanical damage to seeds. Seed moisture content in addition to storage conditions are very important factors in seed deterioration during the seed storage. It is important to consider all these factors when selecting seed lots either for planting or for carry-over.

## REFERNCES

Abdel Salam, M. E. (1999). The Egyptian Cotton Production, Quality and Marketing. El Kalema Press, Giza, Egypt. 488 pp.

Agrawal, P. K. and Dadlani, M. (1987). Techniques in Seed Science and Technology. Editors, South Asian Publishers, New Delhi, India pp 105-107.

AOAC. (1990) Official Methods of Analysis of the Association of Official Analytical Chemists 15th ed. Washington DC 20004 USA.

Gelmond, H. (1979) A review of factors affecting seed production. Seed Sci. & Technol., 7. 39-46.

ISTA (1995). Handbook of Vigor Test Methods (ed. J. G. Hampton and D. M. Tekrony) 3rd edition. International Seed Testing Association. Zurich, Switzerland pp. 117.

ISTA (2004). International Rules for Seed Testing, Edition 2004, The International Seed Testing Association (ISTA) 8303 Basserdorg, CH Switzerland

ISTA (1999). International Rules for Seed Testing. Supplement to Seed Sience and Technology. 27 : pp 333.

Little, T. M. and Hills, F. J.. (1978) Agricultural Experimentation, design and analysis. John Wiley & Sons, Inc. New York. USA pp 350.

McCarty, W. H. and Baskin, C. C. (1994) Cotton Seed Quality Evaluation. Cooperative Extension Service. Mississippi State University MS. USA. 11 pp.

McDonald, M. B. (1999) Seed deterioration: Physiology, Repair and Assessment. Seed Sci. & Technol., 27, pp. 177-237.

Perry, D. A. (1981). Handbook of Vigor Test Methods. International Seed Testing Association, Zurich, Switzerland. Pp. 88.

Sadasivam, S. and Manickam, A. (1996) Biochemical Methods. New Age International (P) Limited. Second Edition, New Delhi 110002. India.

## تأثير نوع ومدة التخزين على صفات جودة وقوة إنبات بذور بعض أصناف القطن المصري

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أجريت اختبارات معملية وحقلية لدراسة التركيب الكيميائي وكذلك تأثير مدة وطريقة تخزين بذور غير مزالة الزغب من درجتين من درجات إكثار البذور من إثنين أصناف فائقة طول التيلة بالإضافة إلى أربعة أصناف أخرى من الأصناف الطويلة التيلة من القطن المصري. وقد وضعت عينات عشوائية من بذور الأصناف الستة في تخزين تحت ظروف درجة حرارة الغرفة بالإضافة إلى التخزين العميق (-٢٠ °م) لمدة سنتين حيث خضعت هذه العينات إلى التحليل الكيميائي لتقدير النسب المئوية للكربوهيدرات والبروتينات وكذلك نسبة الزيت. كما خضعت هذه العينات للاختبارات الدالة والمؤثرة على قوة الإنبات مثل اختبار نسبة الأحماض الدهنية الحرة وإحداث التدهور السريع صناعياً وكذلك نسبة الإنبات الحقلي. وقد ظهر بصورة عامة فروق كبيرة بين الأصناف ودرجات الإكثار المختلفة تحت كل ظرف من ظروف ومدة التخزين التي عرضت لها البذور ولكن ظهر أن البذور الحديثة الإنتاج احتوت على نسب أقل من الأحماض الدهنية الحرة كما أن بذور العينات المختلفة تتطلب خفض نسبة الرطوبة بها وكذلك فصل البذور غير السليمة قبل التخزين.