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IDENTIFICATION OF LOW TEMPERATURE REQUIREMENTS FOR COOL GERMINATION TESTING FOR DIFFERENT EGYPTIAN COTTON *Gossypium barbadense* L. VARIETIES

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ABSTRACT

The cool germination test as a stress test is usually conducted to evaluate and rank the different cotton seed lots which are offered for sale to assess their planting value or to determine their storage potential for carry over. The cool germination test at 18ºC for 7 days can be used with confidence for *Gossypium hirsutum* L. but the applicability of this test to *G. barbadense* L. is not known. This research was conducted to investigate the effect of using different temperatures i.e. 16, 18 and 20ºC for 7 days on different seed samples from 2 seed classes i.e. breeder seed and foundation (basic) seed classes from 8 Egyptian cotton *G. Barbadence* L. varieties representing all the cultivated cotton varieties in Egypt during 2002 planting season. In addition to determining the temperature which could be applied in the cool germination testing for the Egyptian cotton variety seeds, it is proposed that the emerged seedlings could be classified to 3 categories. The first category seedlings which already have achieved 4 cm or more as a combined root – hypocotyl length, measurement is made from the tip of the radicle (primary root) to the point of attachment to the cotyledons, these are considered as high vigor or strong seedlings. The second category, or the medium vigor seedlings have 2-<4 cm combined length. The last category or the low vigor seedlings have less than 2 cm as combined length.

The findings of this study propose that using 20ºC for 7 days for *G. barbadense* L. can be applied with confidence in cool germination test as the percentage of high vigor seedlings or the total of the 3 categories were close or similar to the percentage germination.

INTRODUCTION

Egyptian cotton has played a prominent role in Egypt's economic and social, as well as political history for the last one and half century. The Egyptian cotton is characterized by its superior quality which gives Egypt a comparative advantage in which a comprehensive cotton industry could be developed (Abdel Salam, 1999). Despite the fact that cotton is considered one of the important cash crops in the country, there are not enough studies which investigate the minimum temperature requirements as well as the optimum conditions of cotton seed germination which should be provided for different cotton varieties in different environments, as most studies in Egypt, focus on the lint characteristics (Baskin,1998).

Planting cotton seed early under low temperatures and relatively high soil moisture may cause complication to seed germination in the field and may give false feeling for a germination failure and the need for replanting. The cool germination test using 18ºC for 7 days can only be used with confidence for *G. hirsutum* L.*,* but the applicability of this test to *Gossypium barbadense* L. is not known (ISTA, 1995).

The optimum or the soil temperature at which earliest germination and most rapid seedling growth may be expected is near 34ºC. For Egyptian cotton, the optimum temperature for a week's exposure, as in a germination test, is about 32ºC (Printice 1972 and Munro 1987). In Egypt, it is recommended to sow cotton seeds when a total cumulative temperature degrees of 160 is completed for 10 successive days, measured at 5 cm soil depth and at 8.00 am (MOA, ARC, 1998).

This study investigates the response of different Egyptian cotton varieties seed lots to cool germination testing which can provide better information about the most favorable date for planting cotton seed which will reduce the quantity of planting seeds especially when the high cost acid delinted seeds are used, in addition to getting more benefits from the preceding crop.

MATERIALS AND METHODS

Random seed samples were drawn from finally cleaned seed lots representing 2 different seed classes i.e. foundation (FS) and breeder (BS) seed classes. The tested cotton seed lots are representing all the 8 cotton varieties which are cultivated in Egypt during 2002 planting season. All the tested seed samples were drawn from linted and processed seed lots.

4 replicates from the pure fraction each of 50 seeds from each seed lot were exposed to cool germination test as prescribed in the ISTA Handbook of Vigor Test Methods, 1995, and to the standard germination test as in the ISTA International Rules for Seed Testing, 1999.

Cool Germination Test: In the ISTA guidelines for cool germination vigor testing, 4 replicates each of 50 seeds are planted between two pre-moistened paper towels which are conditioned on 18ºC overnight before planting. Seeds are germinated under 18 $\pm$ 0.5ºC constant temperature for 7 days in the dark, rolled towels are placed in near upright position in containers and covered with a polythene bag. At the end of the test period, seedlings are classified into normal and abnormal seedlings. The normal seedling which the combined hypocotyls – root length (from the root tip to the point of attachment to the cotyledons) is 4cm or longer are classified as "high vigor", ISTA and Ferguson, 1995. The remaining seedlings and seeds are not counted.

In this study, to investigate the temperature which could be applied in cool germination testing for *G. barbadense* L., 3 different temperatures i.e. 16, 18, and 20ºC for 7 days were applied. Furthermore, the germinated seedlings were classified to 2 categories; the first is the high vigor which includes only all the normal seedlings having a combined hypocotyls – root length of 4 cm or longer. The second category or the medium vigor seedlings which have a combined length of 2 cm to less than 4 cm, and finally the low vigor seedlings which are less than 2 cm in the combined length.

Standard Germination Test: Another 4 replicates each of 50 seeds were drawn at random and were exposed to the standard germination test according to the ISTA , 1999. The seeds were planted between paper towels as 50 seeds per towel. The towels were incubated on 25ºC for 12 days (the final count), the normal seedlings were counted after 4 and 12 days.

$$\text{The percentage germination is calculated as} = \frac{\text{No. of Seeds germinated as normal seedlings}}{\text{No. of seed tested}} \times 100$$

Since the cool germination test is measuring the emergence potential of cotton seed from different qualities to germination under low temperature and wet soil conditions, the results were compared with the results of the standard germination test which is conducted under more favorable conditions(McCarty and Baskin, 1994).

All the obtained data were exposed to proper statistical analysis of a randomized complete block design according to Little and Hills, 1978, and using MSTAT computer program with 5% level of significance.

RESULTS AND DISCUSSION

Tables (1-3) illustrate the results of cool germination testing using 16, 18 and 20ºC as compared with the routine germination test.

Table 1: Mean results of cool germination testing of different Egyptian cotton varieties and seed classes using 16°C - 7days as compared to Germination test.

Cotton Varieties	Seed Classes	Seedling Classification H.V(> 4cm)	M.V.(2-<4cm)	50 Seeds L.V(< 2cm)	Total	Total %	Seed Germination % No.	%
Giza 70	F.S	0.55	0.1	0.1	0.75	1.5	36	72
	B.S	0.1	0.1	0.1	0.3	0.6	38	76
	mean	0.33	0.1	0.1	0.53	1.1	37	74
Giza 80	F.S	0.1	0.1	0.1	0.3	0.6	32	64
	B.S	0.1	0.1	4.25	4.45	8.9	36	72
	mean	0.1	0.1	2.18	2.38	4.75	34	68
Giza 83	F.S	0.1	0.1	11.75	11.95	23.9	40.25	80.5
	B.S	0.1	0.1	2.25	2.45	4.9	34	68
	mean	0.1	0.1	7.2	7.2	14.4	37.13	74.25
Giza 85	F.S	0.1	0.1	0.1	0.3	0.6	40	80
	B.S	0.1	0.1	0.1	0.3	0.6	40.75	81.5
	mean	0.1	0.1	0.1	0.3	0.6	40.38	80.75
Giza 86	F.S	0.1	0.1	0.1	0.3	0.6	39.25	78.5
	B.S	0.1	0.1	0.1	0.3	0.6	36.5	73
	mean	0.1	0.1	0.1	0.3	0.06	37.88	75.75
Giza 88	F.S	0.1	0.1	22.25	22.45	44.9	33	66
	B.S	0.1	0.1	16	16.2	32.4	36.75	73.5
	mean	0.1	0.1	19.13	19.33	38.66	34.88	69.75
Giza 89	F.S	0.1	0.1	0.1	0.3	0.6	37	74
	B.S	0.1	0.1	0.1	0.3	0.6	39.5	59
	mean	0.1	0.1	0.1	0.3	0.6	33.25	66.5
Giza 90	F.S	0.1	0.1	3.75	3.95	7.9	35	70
	B.S	0.1	0.1	6.75	6.95	13.9	35.5	71
	mean	0.1	0.1	5.25	5.45	10.9	35.25	70.5
Means		0.13	0.1	4.27	4.47	8.94	36.22	72.4
L,S,D at 0.05		0.1857	N.S	2.609			4.061	

Table 2: Mean results of cool germination testing of different Egyptian cotton varieties and seed classes using 18°C -7days as compared to Germination test

Cotton Varieties	Seed Classes	Seedling Classification		50 Seeds	Total	Total %	Seed Germination %	
		H.V(> 4cm)	M.V.(2-<4cm)	L.V(< 2cm)			No.	%
Giza 70	F.S	0.55	27.75	8.25	36.55	73.1	36	72
	B.S	0.1	14.5	11.25	25.85	51.7	38	76
	mean	0.33	21.13	9.75	31.21	62.4	37	74
Giza 80	F.S	0.1	0.1	17.75	17.95	35.9	32	64
	B.S	2.28	22.5	7.75	32.53	65.1	36	72
	mean	1.19	11.3	12.75	25.24	50.5	34	68
Giza 83	F.S	0.1	0.1	21.25	21.45	42.9	40.25	80.5
	B.S	0.1	13.5	19	32.6	65.2	34	68
	mean	0.1	6.8	20.13	27.03	54.1	37.13	74.25
Giza 85	F.S	0.1	4	25.25	29.35	58.7	40	80
	B.S	2.75	28	8.25	39	78	40.75	81.5
	mean	1.43	16	16.75	34.18	68.3	40.38	80.75
Giza 86	F.S	1.75	23.5	9	34.25	68.5	39.25	78.5
	B.S	1.05	11	7.75	19.8	39.6	36.5	73
	mean	1.4	17.25	8.38	27.03	54.1	37.88	75.75
Giza 88	F.S	0.1	0.1	19.75	19.95	39.9	33	66
	B.S	0.1	8.75	25.5	34.35	68.7	36.75	73.5
	mean	0.1	4.43	22.63	27.16	54.3	34.88	69.75
Giza 89	F.S	0.33	24	8.25	32.58	65.2	37	74
	B.S	1.03	20	13	34.03	68.1	39.5	59
	mean	0.68	22	10.63	33.31	66.6	33.25	66.5
Giza 90	F.S	1.75	15	6.25	23	46	35	70
	B.S	6	20.75	9.5	36.25	72.5	35.5	71
	mean	3.88	17.88	7.88	29.64	59.3	35.25	70.5
Means		1.12	14.6	13.61	29.35	58.7	36.22	72.4
L,S,D at 0.05		1.99	6.063	5.402			4.061	

Table 1, illustrates the mean results of cool germination using 16ºC which show that there was almost no significant response to this temperature for all the 3 categories of the combined length as compared to the standard germination results especially for the high-vigor seedlings i.e. 4 cm or more (ISTA, 1995). Some varieties showed some but insignificant response in the low-vigor category as in the varieties G.83, G.88 and G.90.

When 18ºC was used, a very slight response occurred as high-vigor seedlings. All the varieties produced more medium vigor seedlings except the varieties G83 and G88 which had produced more low-vigor seedlings as stated in table 2. The resulting high vigor seedlings from all tested varieties were significantly less than the results of the standard germination test.

Table 3 shows the mean results of the cool germination test using 20ºC which manifest better response as related to the high-vigor seedlings for all the tested varieties especially for the varieties G.70, G.86 and G.89. The total numbers of the proposed 3 vigor categories (high, medium and low) approaches the germinated seed numbers of all tested varieties .It is worth mentioning that according to the variety zone planning, the 3 cotton varieties G.70, G.86 and G.89 are allocated in North Delta, G.85 in Middle and South Delta, while the varieties G.80, G.83 and G.90 were released to cover Middle and Upper Egypt where higher temperatures are prevailing. The variety G.88 is a new release which is allocated in North Delta (AICOTEXA, 2002).

Table 3: Mean results of cool germination testing of different Egyptian cotton varieties and seed classes using 20°C - 7days as compared to standard Germination test.

Cotton Varieties	Seed Classes	Seedling Classification - 50 Seeds			Total	Total %	Seed Germination %	
		H.V(> 4cm)	M.V.(2-<4cm)	L. V(< 2cm)			No.	%
Giza 70	F.S	35.75	4.75	2.5	43	86	36	72
	B.S	27	5.75	4.25	37	74	38	76
	mean	31.38	5.25	3.38	40	80	37	74
Giza 80	F.S	28	6	0.75	34.75	69.5	32	64
	B.S	29.75	5	3.25	38	76	36	72
	mean	28.88	5.5	2	36.38	72.76	34	68
Giza 83	F.S	26.25	6	1.27	33.45	66.9	40.25	80.5
	B.S	28.5	3	1.75	33.25	6.5	34	68
	mean	27.38	4.48	1.5	33.35	66.7	37.13	74.25
Giza 85	F.S	34.5	1.5	1	37	74	40	80
	B.S	33.5	2.5	1	37	74	40.75	81.5
	mean	34	2	1	37	74	40.38	80.75
Giza 86	F.S	38	3.5	1.5	43	86	39.25	78.5
	B.S	23	4.5	4.5	32	64	36.5	73
	mean	30.5	4	3	37.5	75	37.88	75.75
Giza 88	F.S	27	6.5	0.5	34	68	33	66
	B.S	26.75	3	1.75	31.5	63	36.75	73.5
	mean	26.88	4.75	1.13	32.75	65.5	34.88	69.75
Giza 89	F.S	38.5	2.75	0.75	42	84	37	74
	B.S	26.75	6.75	1.75	35.25	70.5	39.5	59
	mean	32.63	4.75	1.25	38.63	77.26	33.25	66.5
Giza 90	F.S	25.25	4	3	32.25	64.5	35	70
	B.S	29	2.75	2	33.75	67.5	35.5	71
	mean	27.13	3.38	2.5	33	66	35.25	70.5
Means		29.85	4.26	1.97	36.08	72.16	36.22	72.4
L,S,D at 0.05		6.982	3.184	1.328			4.061	

Maximum germination for cotton occurs over the range of 24-30ºC in a 7 days period and there was no difference in germination of high quality *G. hirsutum* seed over range of 18-32ºC, but in medium quality seed this range was reduced to 20-30ºC (ISTA, 1995). The cool germination test using 18ºC for 7 days period was prescribed to be used with confidence for this species, but the applicability of the test to *G. barbadense* L. has not been investigated. This study provides information on the potential emergence of seed samples from 8 cotton varieties represent all the cultivated cotton varieties in Egypt using 3 different temperatures i.e. 16, 18 and 20ºC. It is concluded that 20ºC can be used with confidence with the Egyptian cotton varieties which belong to *Gossypium Barbadense* L. in cool germination test since the cool germination results at 18ºC (as high vigor seedlings) were significantly far form the standard germination test.

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تحديد درجات الحرارة المنخفضة اللازمة لإجراء اختبار الإنبات البارد بالنسبة لأصناف القطن المصري المختلف

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يستخدم اختبار الإنبات البارد عادة في تقييم وتركيب رسائل (لوطات) بذور القطن التي يتم إعدادها كتقاوي طبقا لقيمتها الزراعية أو لتحديد مدى صلاحية هذه الرسائل للتخزين لاستخدمها كتقاوي في المواسم التالية. ويستخدم اختبار الإنبات البارد بتعريض البذور إلى درجة حرارة ١٨ مئوية لمدة أسبوع مع القطن الأمريكي (الهيرسوتم) بدرجة كبيرة من الثقة طبقا للقواعد الدولية لفحص البذور ولكن لم تعرف حتى الآن درجة الحرارة التي يمكن استخدامها بالنسبة للقطن المصري (الباربادنس). وقد اجري هذا البحث باستخدام درجات حرارة مختلفة هي ١٦، ١٨، ٢٠°م لمدة سبعة أيام على عينات عشوائية مختلفة من درجتين من درجات الإكثار هما جيل المربى وجيل تقاوي الأساس من ٨ أصناف القطن المصري تمثل كل الأصناف المنزرعة من موسم الزراعة ٢٠٠٢ في مصر.

وقد قسمت البادرات الناتجة من هذا الاختبار إلى ثلاث فئات طبقا لطول البادرة التي تقاس بالمسافة بين قمة البادرة وحتى نهاية الجذر الأولي (طول السويقة الجانبية السفلي + الجذر الأولي) بحيث تضم الفئة الأولى وهى ذات الحيوية العالية إي البادرات التي يصل طولها ٤سم أو اكثر والثانية وهى متوسطة الحيوية التي يصل طولها ٢سم إلى اقل من ٤سم والثالثة اقلها حيوية التي لا يصل طولها ٢سم .

وتوصي الدراسة بأنه يمكن إجراء هذا الاختبار باستخدام درجة حرارة ٢٠°م لمدة سبعة أيام بدرجة كبيرة من الثقة على بذور أصناف القطن المصري من اختبار الإنبات البارد كاختبار لحيوية البذور كما وجد إن مجموع الفئات الثلاث مساوي أو قريب من نتيجة اختبار الإنبات القياسي أو العادي.

قام بتحكيم البحث

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