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LABORATORY TESTS IN RELATION TO FIELD EMERGENCE OF SOME EGYPTIAN COTTON (*Gossypium barbadense* L.) VARIETIES.

BY

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ABSTRACT

Conducting vigor tests such as cool germination, Tetrazolium test in addition to the standard germination test would be important to identify high cotton seed quality for planting or for storing as a carry over seed. The objective of the present study was to determine the value of some laboratory tests for predicting the performance of cotton seed under field conditions. Laboratory and field experiment were conducted on samples of nine certified seeds lots representing three Egyptian cotton varieties namely the extra long stable Giza 70 and the long stable Giza 86, Giza 89 which occupy high percentage of the cultivated cotton area in Egypt. Laboratory tests were included standard germination, cool germination, accelerated aging germination these tests require a relatively long period at least ten days to be a accomplished, other quick laboratory or short tests such as electrical conductivity, seed cutting, free fatty acids and tetrazolium test were also included. Field emergence experiments were carried out at Kafr- Elshik Research station during 2005 and 2006 growing seasons. The results revealed that the standard germination test has failed to predict field emergence of cotton seed lots. Conducting cool germination or tetrazolium test as a supplementary test in addition to standard germination should reveal additional information on emergence ability of cotton seed under field conditions. The results of this study provide several alternative combinations which can be applied with lower costs and shorter time according to the available facilities. Furthermore, the results realize the importance of introducing vigor tests in the routine at testing stations to evaluate precisely the quality of cotton seed intended for sale and planting.

INTRODUCTION

The most widely method for sowing cotton seed in Egypt is known as the sand-covering methods. About 7-10 seeds or less (3-4 of dilute acid delinted seeds) are planted per hole using a dibble pushed into the soil and the seeds dropped in behind it., (Abd Elsalam 1999). The seeds are covered with sand or coarse silt to provide warmer conditions surround the seeds and the young seedling can penetrate the soil easily and thus permits better germination, especially in colder weather in early planting. In fact, the number of seeds planted per hole is greater than the number of seedling required and therefore thinning to 2-3 plants per hole is necessary. However, in many cases germination and seedling emergence fail because of several reasons such as applying poor quality seeds and poor preparing of the seed bed. The cotton seed is tested, approved, labeled for sale under control of the government. The certified cotton seed is supplied to the farmers every season because cotton seed is rapidly deteriorated under open- air storage conditions which are commonly used in Egypt. Furthermore, the suitability of a seed lot for sowing or trade is depending on the results of the germination test conducted under favorable conditions in the laboratory (ISTA, 2003). The results of the germination test are reported as total germination but it does not provide reliable information on the speed on evenness of germination which is particular importance for seed performance under field conditions, (Agrawal 1996). The results of germination do not provide enough information on the growth of seedlings and deterioration in the vigor of the seed which can occur before a significant decline in germination is taken place, (Reports 1972). Furthermore, seed lots which perform similarly under optimal conditions in the laboratory may vary in their reaction to environmental factory such as soil bed preparation soil moisture and pathogen infection .In other words, cotton seed sown in the field is subjected to environmental conditions which are not exposed in the laboratory so that precise field emergence based on the figure of germination test is unlikely to be the same at different sites.. For the reasons mentioned above, the international seed testing Association encourages seed testing stations to used vigor tests which are designed to indicate expected field performance of seed lots. The recommended and suggested vigor test are describing in the three hand books (Perry 1981; Fiala, 1987; Hampton and Tekrony, 1995). The objectives of this study were to examine various seed vigor tests for their ability to rank seed lot quality and to predict field emergence of cotton seeds.

MATERIALS AND METHODS

Seed samples of three cotton varieties grown in Egypt namely the extra long stable Giza 70 and the long stable Giza 86 and Giza 89 were utilized in this study. The samples of each variety were drown randomly from different certified seed lots. All seed samples were 2004 and 2005 harvests and supplied by the central Administration for Seed Testing and Certification, (CASC) Ministry of Agricultural and Land Reclamation. Seed samples were subjected to the following tests at the laboratory of Seed Technology Research Section (STRS), Agricultural Research Center, Giza, Egypt:

Standard germination (SG): It was measured according to the method outlined in the rules for seed testing (ISTA 1996). Four replications of 50 seeds per lot were planted in boxes of 40x20x20 cm dimensions and contained sterilized sand. The boxes were then watered and kept at $27\pm1^{\circ}$ C in the germination chamber for 10 days. Normal seedling were counted and expressed as the germination percentage.

Cool Germination test (CG): It was conducting according to the procedures outlined in Handbook of Vigor Test Methods (1983). Test procedures are similar to standard germination test with the exception of subjection planted seeds to low temperature of 18° C for one week after which the boxes contained planted seeds are converted to optimal growth conditions.

Accelerated aging test (AA): The procedure used was similar to that proposed by (AOSA 1983). Four replicates of 100 seeds per lot were placed in one layer on the upper surface of a stainless steel wire mesh screen (10x10 openings per square inch). The screen was fixed into plastic box (16x10.5x5.5 cm) containing 50 ml of distilled water, allowing air space of approx. 2.5 cm between the water surface and the bottom surface of the screen. Seeds were aged at a uniform 45± 0.3 °C and 95%-100% relative humidity. Both temperature and relative humidity were maintained for 48 hours, then seeds were removed and 4 replicates of 50 seed were subjected to standard germination test according to the international rules (ISTA, 1999).

Tetrazolium Test (TZ): 4x100 seeds of each sample were soaked at room temperature. Then, the seeds were cut with a sharp blade in such a way that the whole embryo of each seed was existed without any mechanical damage. Fragments of the cotyledon and test attached to the embryo were removed. The embryos were immersed in 0.5% solution of 2,3,5, triphenyl tetrazolium chloride for 4 hours at 20 °C in dark in the incubator. Later the embryos were rinsed with water and transferred in Petri dish containing water to avoid drying seed. Completely-staining embryos of each replicate were calculated through magnifying lens (5x) under fluorescent light.

Electrical conductivity (EC): Conductivity was measured on samples of 25 seeds of each lot according to the procedures outlined by (AOSA, 1983). The seeds were weighed and placed in Erlenmeyer flasks (250 ml) containing 200 ml of deionised water and cover by aluminum foil. The flasks were then placed in an incubator chamber at 25° C for 24 hours. The conductivity of seed steep water was measured immediately after the removal of samples from the incubator with a pipette-type conductivity cell attached to a bulk conductivity meter. The seed conductivity values were expressed as μ mhos/gm.

Cutting Test (Cutt.T): The cutting test was conducted to obtain a quick estimate of seed quality. Using a seed cutting instrument which consists of a bar and a flap, 50 seeds can be held in the concave cavities at one time and a sharp knife can be passed in the clearance between the base bar and the flap to cut the 50 individual seeds placed in cavities. The seeds are then rated for the fullness and color of their contents (Munro, 1987). Good seeds have a whitish to yellowish-green color, while immature, mechanically or insect damaged seeds are easily recognized, because they are empty or have a small, shriveled and dark embryo. When seeds appear brown to brownish yellow, the quality is poor (McCarty and Baskin, 1994).

Free fatty acidity determination (FFA): 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 lot (McCarty and Baskin, 1994). The FFA was determined according to the official methods reported by (AOAC, 1990).

Field Emergence (FE): A completely randomized block design with four replications 100 seeds each were utilized for each of the two seasons (2005 and 2006) at the Kafr-Elshek experimental station. The seeds were planting on March 15, 18 respectively. All recommended agricultural practis for growing cotton were followed. Seedling emergence was recorded at time intervals until constant and the highest figure was used.

All data were subjected to the standard analysis of variance procedures outlined by (Steel and Torrie 1984). Simple correlation coefficient were calculated to compare the association between values resulted from the standard germination and vigor tests as well as seedling emergence in the field . The partial regression and multiple regression techniques outlined by (Pindyck and Rubinfeld 1981) were also utilized in order to obtain more accurate estimation for the relationship between laboratory tests and field emergence of some Egyptian cotton varieties.

RESULTS AND DISCUSSION

Table (1) shows germination of cotton seeds under optimal conditions (standard germination test) and suboptimal conditions (Cool and accelerated aging germination tests) and under field conditions (field emergence). The germination percentages under optimal conditions were ranged between 81 to 89% and between 79-84% in 2005 and 2006, respectively. The slight decline in germination percentage in 2006 season might be due to storage the seed for one year under cool room temperature of -10° C. On the other hand, field emergence was ranged between 66-72% and between 63-70% in 2005, 2006, respectively. Furthermore, the result in Table (3) showed that there were insignificant positive correlation between standard germination and field emergence (R= 0.472 and 0.539 in 2005 and 2006, respectively). This means that the standard germination test did not predict the field emergence and performance of a seed lot of cotton varieties. The data of relative field emergence have been proved this conclusion where they were ranged between 77-86 and 79-85% in 2005 and 2006, respectively. This might explain why not all sowing seeds were germinated in the field and therefore, the farmer is used to sow several seeds per hill to insure high potential for rapid uniform emergence and development of normal seedlings under field conditions. This means also that another seed quality parameter should be utilized for cotton seeds intended for field planting purpose.

Table (1) shows also that cool germination percentages were lower than those of standard germination and ranged between 71-80%and 68-74% in 2005 and 2006, respectively. Germination differences between standard germination and cool germination may reflect the fact that Egyptian cotton varieties are sensitive to low temperature which should be considered by plant breeder when selection for new varieties. In contrast with standard germination the data in table (3) showed that there were significantly positive correlation between cool germination and relative field emergence (R= 0.727 and 0.697) in 2005 and 2006, respectively. The disadvantage of using cool test is that it required longer period than standard germination test. In addition, if Egyptian cotton varieties are tolerant to low temperature, it is possible to obtain insignificant correlation between cool test and field emergence, and any deviation from ideal test conditions could affect the results by influencing the development of normal seedlings or by favoring the spread of micro-organisms, Reborts (1972). Finally if the test is carried out for a large number of seed samples so that the seed lots may be sold before the test is accomplished.

Table (1): Standard, cool, accelerated aging germination and field and relative field emergence of seed lots of three cotton varieties in 2005, 2006 seasons.

Variety and Seed lot	Standard Germination %	Cool germination %	A. aging germination %	Field Emergence %	R. field Emergence %
			2005		
Giza 70					
lot 1	89	73	70	70	79
lot 2	86	72	69	69	80
lot 3	82	73	72	66	80
Giza 86					
lot 4	85	76	69	71	84
lot 5	83	76	66	71	86
lot 6	81	71	65	69	85
Giza 89					
lot 7	86	80	71	72	84
lot 8	85	75	70	71	84
lot 9	83	72	70	68	82
L.S.D. at 5% level	n.s	V=4.022	L=2.083 V*L=3.607	V=2.137	
			2006		
Giza 70					
lot 1	81	73	65	69	85
lot 2	79	71	63	65	82
lot 3	84	73	66	67	80
Giza 86					
lot 4	80	70	65	68	85
lot 5	79	71	61	63	80
lot 6	81	69	62	65	80
Giza 89					
lot 7	83	74	67	70	84
lot 8	80	73	62	68	85
lot 9	80	70	65	63	79
L.S.D. at 5% level	V=2.203 L=2.384 V*L=4.130	V=2.672 V*L=4.669	V=1.480 V*L=3.508	V=3.728	

Table (1) shows the results of accelerated germination test which caused a more rapid drop in germination capacity where they were ranged between 65-72 and 61-67% in 2005 and 2006, respectively. The differences in germination percentages between standard and aging germination reveals the actual physiological condition of a seed lot and the deterioration seed lots give higher differences than good seed lots, Agrawal (1996). Seed lots used in 2005 season had lower germination than those used in 2006 season, due to the fact that cotton seeds are subjected to deteriorate even under controlled of the most importance that there were insignificantly positive between accelerated aging germination and field emergence (R=0.474 and 0.342 in 2005 and 2006 seasons).

Table (2) shows the percentage of completely staining seed embryos where it was higher in 2005 than in 2006 season. The values of staining embryo were also higher than the values of standard germination test (Table 1). Often the embryos in Teterazolium test stain normally, but the seed fail to germinate because of critically located breaks in one or more embryonic structures, Moore (1962). This result agreed with that stated by El-emery and Elrabie (1996) where Teterazolium test did reveals noting to the physiological and physical conditions of other seed structures expecting the embryo of the seed. Occasionally, the embryos might be stained due to fungus infection which causes dark red staining in the endosperm of the seeds.

On the other hand, Table (3) showed that the correlation coeffient for the relationship between the values of Teterazolium test and field emergence was significant (R=0.872 and 0.722 for 2005 and 2006 season, respectively). But, the correlation coefficient for the relationship between field emergence and other tests such as Ec, cutting and free fatty acids determination was insignificant in both seasons (Table 3). El-emery and Elrabie (1996) found that the value of EC test was not reliable index of seed viability under laboratory and field conditions. They added that there were substantial differences in conductivity values of seed samples which had similar laboratory germination and field emergence.

Table (4) shows the multiple correlation coefficients for the relationship between a combination of two or more laboratory and vigor tests and field emergence. A combination of standard germination and Tetrazolium test was more promising to predict field emergence than one test alone. Where the value of the correlation coefficient was significant (R=0.800 and 0.739 for laboratory test and Tetrazolium test and field emergence in 2005 and 2006 seasons, respectively), whereas it was insignificant for the relationship between standard germination and field emergence (Table 2).

However, the Tetrazolium test can not be regard as a complete substitute for the standard germination test in all circumstances; it can be used in conjunction with standard germination test to provide additional information on the condition of a seed lot and for precise evaluation of cotton seed quality and for predicting field emergence. The multiple correlation coefficients for the relationship between a combination of standard germination and other laboratory tests; accelerated aging, electrical conductivity, free fatty acids and cutting tests, and field emergence was insignificant. I.e.1 (R=0.472, 0.495, 0.473 and 0.517 in 2005 season, respectively; I.e.2 (R=612, 0.582, 0.658 and 0.517 in 2006 season). On the other hand the multiple correlation coefficient for the relationship between a combination of standard germination +cool germination or tetrazolium tests + any other laboratory tests was significant i.e.1 A combination included standard germination +tetrazolium + cutting and field emergence was significant (R=0.906 in 2005 season), i.e.2. A combination included standard germination + cool germination + accelerated aging tests and field emergence was significant (R=0.785 in 2005 season. These result revealed the importance of conducting cool test or tetrazolium test as supplementary test in addition to standard germination test to predict field emergence of seed lots. However, taking into consideration, the economic costs of conducting more than one laboratory test is more expensive and time consuming as in the case of conducting standard germination and cool germination. Furthermore, the possibility of using the tetrazolium test alone for quick evaluation of cotton seed lots required special training for seed analysts at test stations avoid misinterpretation of the results.

Table (2): Quick vigor tests and field emergence of different seed lots of three cotton varieties in 2005, 2006 seasons.

Variety and Seed lot	Tetrazolium %	Electrical conductivity (µS/g)	Cutting test %	F.F.A. %	Field Emergence %
		2005			
Giza 70					
lot 1	90	31.2	94	1.02	70
lot 2	86	32.8	91	1.39	69
lot 3	86	36.6	90	1.48	66
Giza 86					
lot 4	92	33.1	92	1.38	71
lot 5	90	36.2	90	1.52	71
lot 6	89	35.1	90	1.42	69
Giza 89					
lot 7	92	31.8	94	1.08	72
lot 8	90	32.2	92	1.28	71
lot 9	87	32.5	92	1.16	68
L.S.D. at 5% level		V=1.745			
		2006			
Giza 70					
lot 1	86	37.5	93	1.50	69
lot 2	82	38.1	92	2.05	65
lot 3	84	37.5	90	1.83	67
Giza 86					
lot 4	83	39.2	90	2.00	68
lot 5	80	40.2	91	2.43	63
lot 6	85	35.5	92	1.91	65
Giza 89					
lot 7	87	36.3	93	1.76	70
lot 8	86	36.9	92	1.65	68
lot 9	84	38.8	90	1.70	63
L.S.D. at 5% level	n.s	V=1 143	L=1.967 V*L=3.407	n.s	V=3.728

Table (3): Correlation coefficient (R) of different laboratory measures of cotton lots with field emergence, 2005 and 2006 seasons.

Traits	2005	2006
S.G	0.472^{ns}	0.539^{ns}
C.G	0.727^{*}	0.697^{*}
A.A.	0.474^{ns}	0.342^{ns}
TZ	0.875^{**}	0.722^{*}
EC	-0.451^{ns}	-0.476^{ns}
Cutt.T.	0.482^{ns}	0.484^{ns}
F.F.A.	-0.360^{ns}	-0.568^{ns}

Table (4): The estimated results for the relationship between selecting Laboratory measures of cotton varieties and field emergence

Source of correlation	2005	2006
S.G*CG	0.776	0.721
S.G.*TZ	0.894	0.738
SG*EC	0.494	0.582
SG*AA	0.471	0.611
SG*Cutt	0.516	0.706
SG*FFA	0.472	0.657
SG*CG*TZ	0.900	0.569
SG*CG*AA	0.784	0.622
SG*TZ*EC	0.894	0.765
SG*TZ*AA	0.904	0.749
SG*TZ*cutt	0.906	0.762
SG*TZ*FFA	0.902	0.746
SG*EC*AA	0.547	0.625
SG*EC*Cutt	0.517	0.763
SG*EC*FFA	0.535	0.661
SG*AA*FFA	0.590	0.683
SG*AA*Cutt	0.549	0.723
SG*Cutt*FFA	0.719	0.745
SG*EC*TZ*AA	0.905	0.795
SG*Cutt*EC*FFA	0.742	0.781
SG*AA*TZ*EC*Cutt*FFA	0.953	0.866

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الإختبارات المعملية وعلاقتها بإنبات الحقل فى تقاوى بعض أصناف القطن المصرية

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تعتبر نتائج الإختبارات المعملية التى تشتمل على تقدير نسبة الإنبات والنظافة والخلو من الأمراض المحمولة على التقاوى هى الأساس فى تحديد مدى صلاحية تقاوى القطن للبيع للمزارعين. وترتبط نتائج كل أختبار بنتائج الإختبارين الآخرين إلى حد كبير . ويولى المزارعين أهمية خاصة إلى نسبة الإنبات كمؤشر عن جودة تقاوى القطن. وتهدف هذه الدراسة إلى التحقق من دقة أختبار الإنبات المعملى في التنبؤ بأداء تقاوى القطن تحت ظروف الحقل، وتحديد مدى الحاجة إلى ادخال بعض الإختبارات الأخرى لتقييم حيوية التقاوى بالإضافة إلى أختبار الإنبات أو كبديل عنه، مثل الإختبار البارد وأختبار الشيخوخة وكذلك بعض الإختبارات السريعة مثل التترازوليم والتوصيل

الكهربى وتقدير الأحماض الدهنية الحرة والفحص الظاهرى للجنين، ومدى أرتباط ذلك بإنبات البذرة تحت ظروف الحقل أسوة بما هو متبع فى محطات فحص البذور فى كثير من دول العالم المتقدم. أشتملت التجارب المعملية والحقلية على عينات من التقاوى المعتمدة من ثلاث أصناف من القطن هى جيزة ٧٠ ، جيزة ٨٦ ، جيزة ٨٩ وثلاث لوطات من كل صنف تم سحبها فى موسم ٢٠٠٥ بحيث أستخدم جزء منها مباشرة وتم تخزين الجزء الآخر تحت درجة حرارة ١٠ °م لحين أستخدامها فى الموسم التالى ٢٠٠٦. أوضحت النتائج فشل أختبار الإنبات المعملى تحت الظروف المعملية فى التنبؤ بأداء البذرة تحت ظروف الحقل، وحساسية أصناف القطن التى شملتها الدراسة إلى درجة الحرارة المنخفضة، ولعل ذلك من الأسباب التى تبرر أستخدام المزارعين لأكثر من بذرة فى الجورة الواحدة. كما دلت القيم غير المعنوية للإرتباط البسيط للعلاقة بين قيم بعض الإختبارات الأخرى مثل أختبار الشيخوخة والتوصيل الكهربى والفحص الظاهرى للأجنة وتقدير الأحماض الدهنية الحرة على فشل هذه الإختبارات ايضا فى التنبؤ بإنبات البذرة تحت ظروف الحقل . كما أكدت القيم غير المعنوية للإرتباط المتعدد لإختبار الإنبات والإختبارات المذكورة على نفس النتيجة. وفى المقابل كانت القيم المعنوية للإرتباط البسيط للعلاقة بين قيم أختبارات الإنبات البارد والتترازوليم مؤشرا على فعالية إجراء واحد منهما على الأقل للتنبؤ بإنبات التقاوى تحت ظروف الحقل. كما أن القيم المعنوية للإرتباط المتعدد للعلاقة بين قيم أختبار الإنبات المعملى وأحد هذين الإختبارين يعد مؤشرا إضافيا على فعالية إجرائهما لتقييم حيوية التقاوى وإنباتها تحت ظروف الحقل. وتوفر هذه الدراسة عدة توليفات أو بدائل تتضمن أختبار الإنبات المعملى وواحد أو أكثر من الإختبارات الأخرى الممكن إجرائها فى وقت قصير وبتكلفة أقل والتى يقترح إدراجها ضمن أختبارات فحص التقاوى فى مصر قبل طرح التقاوى للبيع.