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Efficiency of some Seed Vigor Tests for Field Emergence Prediction of Onion Seed

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ABSTRACT

Laboratory and field experiments were conducted to evaluate the accuracy of different seed vigor tests for prediction of onion seed performance in field. Seed vigor tests under evaluation were accelerated aging (24, 48 and72 h), salt saturated accelerated aging (24,48 and 72 h) , controlled deterioration and brick gravel test, beside standard germination test. Accelerated aging at 48 h and controlled deterioration tests showed insignificant differences with field emergence % and provided the same classification of the onion seed lots found by the emergence of seedlings in the first season. But, standard germination test and other vigor seed tests recorded significant differences of quantitative relation with field emergence %. Standard germination test, accelerated aging 48 h, controlled deterioration and brick gravels tests were a significantly contributing variables to variation in field emergence % according to simple regression analysis. But, we had not reliability of the simple regression analysis to evaluate seed vigor tests for prediction of onion seed performance in field. It could be concluded that the prediction of field emergence of onion seed can be effectively done by using accelerated aging 48 h and the controlled deterioration tests, for standardization accelerated aging 48 h and the controlled deterioration tests for field emergence prediction of onion seed lots, they should be tested in different laboratories.

Keywords: Onion, seed, vigor, tests, emergence.

INTRODUCTION

Onion (*Allium cepa* L.) is an important crop in most parts of the world and onion seeds represent a high commercial value and existence of favorable vigor tests of onions is a desirable (Rodo and Marcos- Filho, 2003). Germination %, which that reflects to the standard germination test, can't always indicate seed lot potential performance in the field, especially when field conditions are not favorable (Hampton & Tekrony, 1995). Although many researchers indicated significant correlation between germination percentage in laboratory and field emergence in field they demonstrated a conflicts results with the prediction of seed performance in the field. (Khan *et al*., 2010).Seed vigor tests are more suitable than standard germination tests in estimating field emergence; however, no test is considered specialist under highly contrary environmental conditions and some vigor tests have a main problem , which is a low relationship between these tests and real performance of seed in field, it's hard to trust in these tests because of the large gap difference between laboratory situation and field situation, especially under unfavorable environmental conditions (Sohani, 1998). Different tests have been presented to identify seed vigor and field emergence prediction of various plants like accelerated aging test for peas (Hampton and Tekrony, 1995), seed conductivity test for safflower (Khavari *et al*., 2009), cold test for corn (Noli *et al*., 2008), deterioration test and cool test for sugar beet (Hampton and Tekrony, 1995), which some of them are accepted internationally now.

To date, no one vigor test is a universally accepted for onion seeds but some vigor tests are dependable for their effectiveness and research continues moving towards standardization. For assessment and classification onion seed lots based on vigor, the following tests have shown a relation to seedling emergence: controlled deterioration (Powell, 1995); accelerated aging and cold test (Piana *et al*., 1995). Mcdonald (1999) indicated that speed of germination, seedling growth rate and electrical conductivity tests were positively correlated to onion seed vigor. But Torres (1998) did not identify the electrical conductivity as a reliable test for onion seeds. Wang and Hampton (1991) reported that CD (Controlled Deterioration) and EC (Electrical conductivity) tests were more sensitive and accurate for predicting red clover (*Trifolium pratense* L.) of field emergence than the standard germination test and germination index tests. Given the importance of this topic, the present study was conducted to evaluate the accuracy of different seed vigor tests for prediction of seed performance in field and ranking onion seed lots.

MATERIALS AND METHODS

Laboratory and field experiments were carried out during 2014/2015 and 2015/2016 seasons at the Laboratory of Seed Technology Unit in Mansoura and Tag AL-Ezz , Agric. Res. Station Farm, ARC, Dakahlia Governorate, Egypt, to study efficiency of some seed vigor tests for prediction of field emergence and classification some onion seed lots based on seed vigor. Ten onion seed lots of Giza red cultivar were obtained during two seasons (five lots each year) from seed testing station in Mansoura, Dakahlia Governorate, Central Administration for Seed Testing and Certification, Giza, Egypt. Different lots under study were numbered from 1: 5 for first season and 6: 10 for second season. Sample of each lot weighted 20.0 g.

1-Standard germination test: Germination percentage was determined according to the international rules of ISTA (1993) .

2-Accelerated aging germination test. This test was carried out according to (Delouche and Baskin ,1973)

3-Saturated salt accelerated aging test: The SSAA (Saturated Salt Accelerated Aging) was suggested by Jianhua & Mcdonald (1996).

4-Controlled deterioration test: It was conducted according to (Powell, 1995).

5- Brick gravel test. It was done as per the procedure given by Perry (1981).

6-Field emergence %.

The statistical analysis was conducted separately for each test using a completely randomized design for laboratory experiment and randomized complete block design for field experiment as described by Gomez and Gomez (1984). The differences among means were compared using Tukey test at the level of 5 % by software SPSS version 14. Regression analysis was done to determine the linear relationship between various vigor tests with field emergence. The significance of the fitted model was assessed by R2 (Co-efficient of determination).

RESULTS

Germination % of seed lots was above the minimum germination standards (>80%) which is usually wanted for marketing onion seeds as shown in Tables 1 and 2.Field emergence percentage, germination percentage, accelerated aging germination (24, 48 and 72 h), saturated salt accelerated aging (24, 48 and 72 h), controlled deterioration and brick gravel test of lots 1: 5 in first season (2014/2015) are shown in Table (1). Insignificant differences between field emergence %, accelerated aging 48 h, controlled deterioration and brick gravel test of 5 lots were found in the first season. Significant differences were obtained between field emergence %, standard germination test (G %), accelerated aging 72 h and saturated salt accelerated aging 24 h. Non significant differences were observed between saturated salt accelerated aging 48 h and field emergence % only in lots 3 and 5. Saturated salt accelerated aging 72 h showed insignificant differences with field emergence % only in lots 1 and 4.

Table 1. Field emergence % (FE%), germination % , accelerated aging (24, 48 and 72 h), salt saturated accelerated aging (24, 48 and 72 h), controlled deterioration and brick gravel of lots in 2014/2015 season.

Test \ Lot	1	2	3	4	5
Field emergence % (FE%).	76 c	74 c	69 cd	70 def	69 cd
Germination % .	92 a	91 a	85 a	87 a	84 a
Accelerated aging 24 h.	81b	79 b	74 b	72cd	73 b
Accelerated aging 48 h.	73 cd	72 cd	67 de	69 ef	66 de
Accelerated aging 72 h.	70 d	69 e	64 f	64 g	60 f
Saturated salt accelerated aging 24 h.	83 b	80 b	76 b	77 b	73 b
Saturated salt accelerated aging 48 h.	81 b	79 b	71 c	73 c	70 bc
Saturated salt accelerated aging 72 h.	72 cd	71 de	66 ef	68 f	65 e
Controlled deterioration.	74 cd	72 cd	69 cd	70 def	69 cd
Brick gravel test.	75 c	74 c	69 cd	71cde	68 cde
CV %.	4.6	2.6	2.4	2.7	3.1

Results in Table (2) clearly showed the same trends of accelerated aging 48 h, controlled deterioration and brick gravel tests with field emergence %, where no significant differences were obtained of them in lots (6:10). Saturated salt accelerated aging 48 h showed insignificant differences with field emergence % only in lots 7, 9 and 10. Other tests as accelerated aging at 24 and 72 h and saturated salt accelerated aging at 24 and 72 h recorded significant differences with field emergence %. The highest values of normal seedling were obtained with germination % test (Laboratory optimum conditions) in all 5 lots in first and second seasons, but the lowest values of normal seedling were recorded with as accelerated aging test at 72 h in both seasons.

Table 2. Field emergence % , germination % , accelerated aging (24, 48 and 72 h), salt saturated accelerated aging (24, 48 and 72 h), controlled deterioration and brick gravel of lots in 2015/2016 season.

Test \ Lot	6	7	8	9	10
Field emergence % (FE%).	69 d	64 cd	65 de	73 c	65 cd
Germination % .	86 a	83 a	84 a	89 a	83 a
Accelerated aging 24 h.	74 c	69 b	70 b	77 b	69 b
Accelerated aging 48 h.	68 de	62 de	64 e	71 cd	63 de
Accelerated aging 72 h.	62 f	58 f	61 f	68 d	60 e
Saturated salt accelerated aging 24 h.	77 b	69 b	70 b	77 b	70 b
Saturated salt accelerated aging 48 h.	73 c	65 c	68 bc	72 c	67 bc
Saturated salt accelerated aging 72 h.	66 e	61 e	61 f	68 d	61 e
Controlled deterioration.	70 d	65 c	67 cd	74 bc	67 bc
Brick gravel.	70 d	62 de	66 cd	72c	65 cd
CV %.	2.9	2.9	2.7	3.9	3.1

Qualities of seed lots (1: 5) as evaluated by the different vigor tests are given in Table 3. Laboratory tests used were able to rank and separate the seed lots into various quality groups on the basis of critical value of Tukey test. Standard germination test and accelerated aging 24 h divided onion seed lots (1:5) into two groups only, but other tests divided lots (1:5) into three groups. Accelerated aging 48h and controlled deterioration tests provided the same separation of the lots found by the emergence of seedlings in the first season. Other tests in Table (3) which ranked lots into three groups as field emergence % but they recorded separation of lots different from field emergence % .

Table 3. Comparison of onion seed lots using germination % and seed vigor tests in 2014/2015 season.

Test / Lot	F E %	G %	AA 24 h	AA 48 h	AA 72 h	SSAA 24 h	SSAA 48 h	SSAA 72 h	CD	BG
1	76 a	92 a	81 a	73 a	70 a	83 a	81 a	72 a	74 a	75 a
2	74 ab	91 a	79 a	72 ab	69 a	80 ab	79 a	71 a	72 ab	74 a
3	69 c	85 b	74 b	67 c	64 b	76 bc	71 bc	66 bc	69 c	69 bc
4	70 bc	87 b	72 b	69 bc	64 b	77 bc	73 b	68 b	70 bc	71 b
5	69 c	84 b	73 b	66 c	60 c	73 bc	70 c	65 c	69 c	68 c
CV %	4.2	3.9	2.7	3.4	2.7	4.1	2.7	2.5	2.5	2.7
No. groups	3	2	2	3	3	3	3	3	3	3

***G %: Germination %, FE % : Field emergence %, AA: Accelerated aging, SSAA: Saturated salt accelerated aging, CD: Controlled deterioration , BG: Brick gravel.**

Perusal of the results in Table (4), standard germination test, accelerated aging 24 h and salt saturated accelerated aging (24,72 h) ranked seed lots (6: 10) into two groups. Other tests divided onion seed lots (6: 10) into three groups. Three groups of lots were recorded by field emergence % as follow, lot 9 is in the first group, lot 6 in the second group and third group include three lots (7,8,10). Accelerated aging 48h and controlled deterioration tests provided the same classification of the lots (6:10) which was recorded by the field emergence in the second season.

Table 4. Comparison of onion seed lots using germination % and seed vigor tests in 2015/2016 season.

Test / Lot	F E %	G %	AA 24 h	AA 48 h	AA 72 h	SSAA 24 h	SSAA 48 h	SSAA 72 h	CD	BG
6	69 b	86 ab	74 a	68 b	62 b	77 a	73 a	66 a	70 b	70 a
7	64 c	83 b	69 b	62 c	58 c	69 b	65 c	61 b	65 c	62 c
8	65 c	84 b	70 b	64 c	61 bc	70 b	68 bc	61 b	67 c	66 b
9	73 a	89 a	77 a	71 a	68 a	77 a	72 ab	68 a	74 a	72 a
10	65 c	83 b	69 b	63 c	60 bc	70 b	67 c	61 b	67 c	65 b
CV %	2.7	4.8	2.7	2.7	3.4	3.4	4.8	4.8	2.7	2.7
No. groups	3	2	2	3	3	2	3	2	3	3

*** FE % : Field emergence %, G %: Germination %, AA: Accelerated aging, SSAA: Saturated salt accelerated aging, CD: Controlled deterioration , BG: Brick gravel.**

Simple linear regression for the germination %, controlled deterioration and field emergence tests are shown in Fig (1). Results in Fig (1) revealed that germination % and controlled deterioration as significantly contributing variables to variation in field emergence % . Coefficient of determination for the germination % and controlled deterioration were 85.5 and 84.2 %, respectively. The prediction equations for field emergence % were computed as follows:

Field emergence % = -18.5 + Germination %.

Field emergence%=- 7.7 + 1.1 Controlled deterioration.

Results in Fig. (2) revealed that brick gravel and accelerated aging (48 h) tests as significantly contributing variables to variation in field emergence %. The relative contribution for brick gravel and accelerated aging (48 h) tests of Fig. (2) towards field emergence % were 85.1 and 85.2 %, respectively. The prediction equation for field emergence % was computed as follows:

Field emergence % = 10.8 + 0.8 brick gravel.

Field emergence % = 12.2 +0.9 accelerated aging (48 h) .

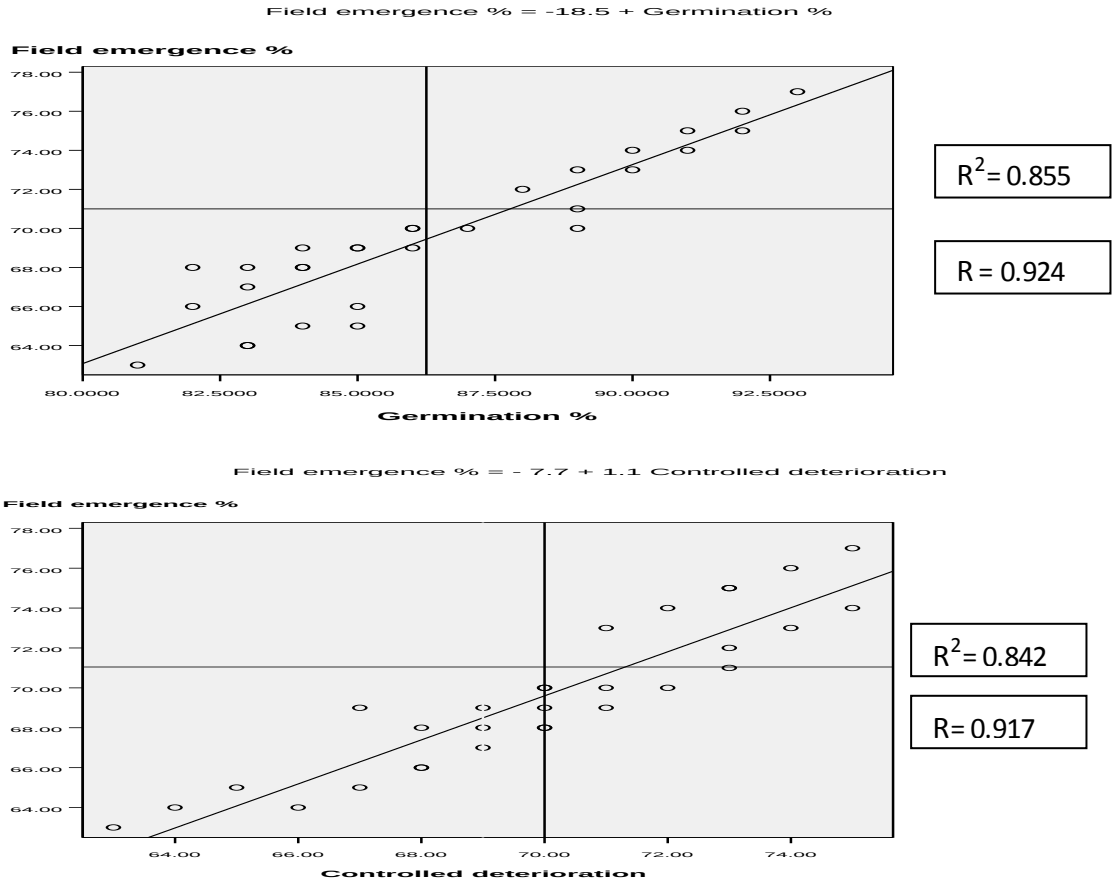

Fig. 1. Slope of linear relationship between field emergence and germination% ,controlled deterioration tests .

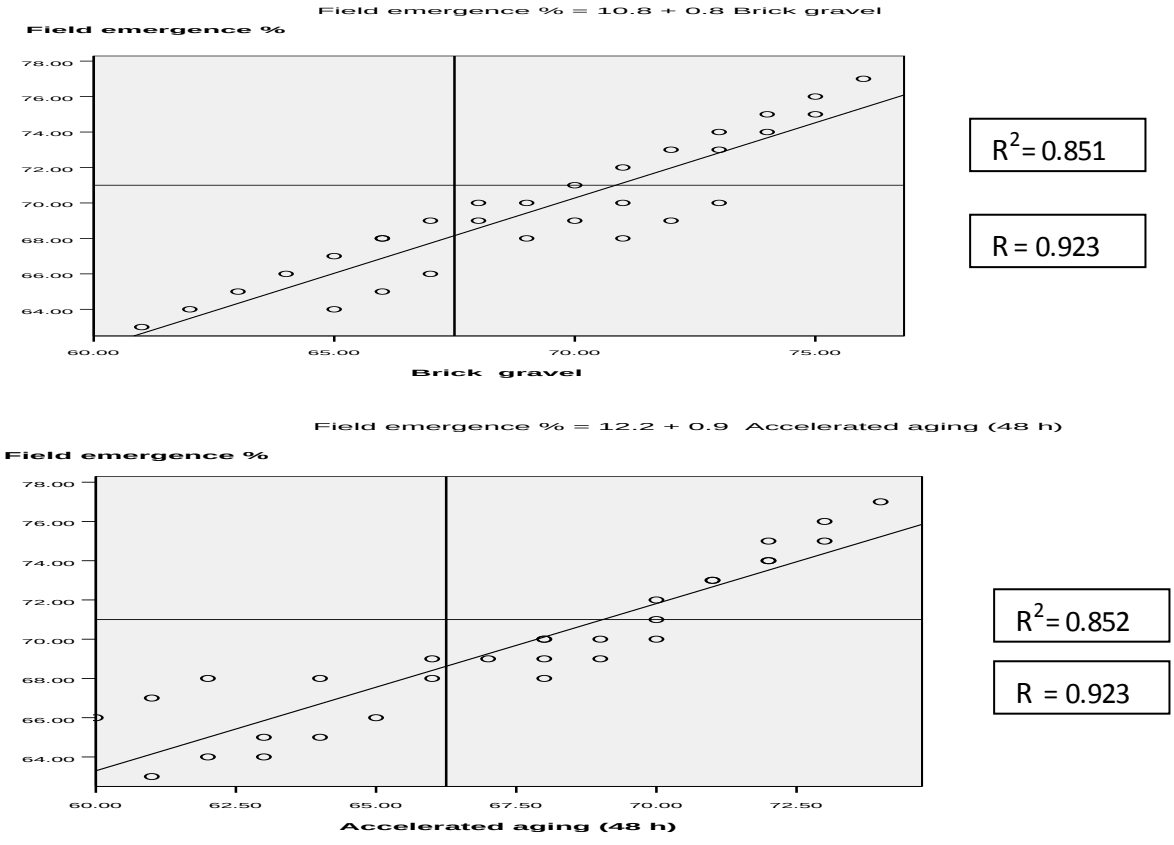

Fig. 2. Slope of linear relationship between field emergence and brick gravel, accelerated aging 48 h tests.

DISCUSSION

Standard germination doesn't always show seed lot potential performance, especially if field conditions are not optimal (Hampton & Tekrony, 1995). Seed vigor has a positive relationship with seedling emergence in the field. So, vigor tests evaluation based on predicting seed planting value is important in providing better results for classification the quality and for indicating planting value of seed lots than the standard germination test. Seed lots that do not differ in germination may differ in deterioration level and may differ substantially in field performance, thereby a test vigor is considered a powerful when identifies seed lots into more groups or levels (Kolasinska *et al*., 2000). The critical requirements of a vigor test include (i) it must better predict field performance value of seed lots than does traditional germination test (ii) it must provide a more sensitive index and accuracy of ranking seed lots than does standard germination test (Hampton & Tekrony, 1995).

Results in present study showed that accelerated aging (48 h), controlled deterioration, brick gravel tests recorded no significant differences with field emergence % in both seasons. Regarding to rank onion seed lots , accelerated aging (48 h) and controlled deterioration identified the same classification of field emergence %. Results showed that base on simple regression, standard germination test was good for predict onion seed performance in farm Fig. (1), but variance analysis show significant quantitative relationship between standard germination test and seed field performance. It seem that correlation coefficient and regression relations can't represent relationship between seed performance and seed vigour tests, because correlation coefficient and regression relations only to find parallelism of several variables but in seed studies we want to find quantitative relations between field emergence and other vigor tests. So, we demonstrate that using correlation coefficient and regression relations is not enough for prediction of seed field performance. Our results are agreement of many conducted studies in this field which proved that correlation coefficient and regression relations recorded unreal indicator for prediction seed performance in field (Naderidarbaghshahi and Bahari , 2012).

In conclusion, it could be stated that the prediction of field emergence of onion seed can be effectively done by using accelerated aging 48 h and the controlled deterioration tests. In order to standardize accelerated aging 48 h and the controlled deterioration test for vigour estimation of onion seed lots, the same controlled deterioration and accelerated aging 48 h conditions should be tested in different laboratories.

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كفاءة بعض اختبارات حيوية البذور في التنبؤ بالتكشف الحقلي لتقاوي البصل

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أجريت تجربتان معملية وحقلية بمعمل قسم بحوث تكنولوجيا البذور بالمنصورة و محطة بحوث تاج العز الزراعية خلال عامي ٢٠١٤ / ٢٠١٥ م و ٢٠١٥/ ٢٠١٦ م في تصميم تام العشوائية للتجربة المعملية و تصميم قطاعات الكاملة العشوائية للتجربة الحقلية في أربع مكررات بهدف تقييم كفاءة بعض اختبارات حيوية البذور [إختبار الشيخوخة لفترات (٢٤ ، ٤٨ و ٧٢ ساعة)، إختبار الشيخوخة ذات الملح المشبع (٢٤ ، ٤٨ و ٧٢ ساعة) ، إختبار التدهور المنتظم و إختبار الحصى] بالاضافة إلى اختبار نسبة الانبات بالمعمل في التنبؤ بالتكشف الحقلي وسلوك تقاوي البصل لصنف جيزة أحمر. ويمكن تلخيص أهم النتائج فيما يلي :- أظهرت النتائج عدم وجود فروق معنوية بين اختبار النسبة المئوية للتكشف الحقلي واختبارات (الشيخوخة لمدة ٤٨ ساعة ، التدهور المنتظم و اختبار الحصى) في كلا الموسمين. بينما اظهرت باقي الاختبارات تحت الدراسة فروقا معنوية بينها وبين اختبار النسبة المئوية للتكشف الحقلي في كلا الموسمين . سجل كلا من اختبار الشيخوخة لمدة ٤٨ ساعة و اختبار التدهور المنتظم تقسيما وترتيبا للوطات التقاوي مماثلا لنفس ترتيب اختبار النسبة المئوية للتكشف الحقلي . أظهر تحليل الانحدار البسيط أن اختبارت نسبة الانبات المعملي ، اختبار الشيخوخة لمدة ٤٨ ساعة و اختبار الحصى قد ساهمت بشكل معنوي في اختبار النسبة المئوية للتكشف الحقلي مما يعطي دلالة على ان تحليل الانحدار البسيط لا يمكن الاعتماد عليه في تقييم الاختبارات الخاصة بالتنبؤ حيث يعطي مؤشرا غير حقيقيا لعلاقة الاختبارات بالتكشف الحقلي . حيث يجب مراعاة الفروق والعلاقة الكمية بين نتائج اختبارات الحيوية ونتائج التكشف الحقلي . توصي هذه الدراسة استعمال اختبار الشيخوخة لمدة ٤٨ ساعة واختبار التدهور المنتظم للتنبؤ بالتكشف الحقلي لتقاوي البصل صنف جيزة أحمر . كما توصي هذه الدراسة بتكرار تقييم هذه الاختبارت الخاصة بالتنبؤ في اكثر من معمل للتوصل الى اعتماد اختبارات قياسية خاصة بالتكشف الحقلي لتقاوي البصل.