Journal of Novel Applied Sciences
Available online at www.jnasci.org
©2013 JNAS Journal-2013-2-12/678-682
ISSN 2322-5149 ©2013 JNAS

Do correlation coefficient and regression models able to describe relationship between laboratory seed vigour tests and field seed emergence of crops

Mohammadreza Naderidarbaghshahi

Assisstant Professor of Agronomy, Department of Agronomy and plant Breeding, Khorasgan Branch, Islamic Azad University, Isfahan, Iran

***Corresponding author*:** Mohammadreza Naderidarbaghshahi

ABSTRACT: The objective of the present study was to determine "do correlation and regression models able to describe relationship between laboratory seed vigour tests and field seed emergence of crops". So some Iran important crop included corn, wheat, barley, sorghum, alfalfa, Iranian clover, safflower, rapeseed, dry pea, mungbean, white bean, broad bean, suger beet, sunflower and cotton stored one year and then several vigor test take on them and simultaneous they sowing in farm and germination percentage in labetorary and emergence percentage in farm recorded then means of seed germination and seed emergence were comparsion by analys variance and simultaneous correlation coefficient and simple and multiple regression relations were determine. Base on my finding, correlation coefficient and regression relations can not describe relationship between seed laberatiry results and seed emergence in farm, because correlation coefficient and regression relations only to find isotropy of several variables but in seed studies we want to find quantitative relations these variables, so we will report that we must not recommend use of correlation coefficient and regression relations in study of relationships between seed performance and vigour tests.

***Keywords*:** Corrolation, Mean comparison, Regression relationship, Seed performance, Seed vigour tests.

INTRODUCTION

Seed quality tests should relate to field emergence. Many researchers have reported significant correlation coefficients between field emergence and standard laboratory germination tests, but they have also reported inconsistencies and difficulties with the prediction of field emergence. Standard laboratory germination tests describe the percentage of normal seedlings under optimal conditions specified by the International Seed Testing Association (ISTA, 2008). This test, commonly used to evaluate seed quality, is able to predict field emergence provided the conditions for emergence are favorable. Many authors found laboratory germination tests to correlate well with field emergence like accelerated aging test for peas (Hampton and Tekrony, 1995), seed conductivity test for safflower (Khawari 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. But there is no a reliable test yet for identifying seed power of all plant species. High quality seed is an essential factor to ensure good crop establishment. The seed must be viable and possess physiological traits that allow rapid germination and seedling stablishment. Important aspects of a good seed are strong vigor, steady germination and good and fast establishment in farm under a wide range of environmental conditions that called seed field performance (Lopez-Canstaneda et al., 1996; Soltani et al., 2002; Latifi et al., 2004). Then, nowadays, studying the relationship between various laboratory tests and farm performance is one of the most important researches in seed technology science (Van Gastel and Pagaotta, 1996). Since a single test does not necessarily measure all aspects of seed vigour,

several tests have been suggested (Hampton and Coolbear, 1990). For many crops, one of the main problems observed in the field is poor stand establishment, which can be influenced by seed quality, adverse climatic conditions, and poor field management (Maiti and Carrillo Gutierrez, 1989). Nowadays most researchers use to correlation coefficient and regression relations for determine relationship of seed vigour and field seed emergence. For example Bolek, (2010) reported base on regression relation mixed of standard seed germination at 180C and 30^{0C} could had the best predict of seed cotton emergence in farm. In Qasim et al, (2010) study Laboratory tests and field emergence of cheakpea were compared with simple regression. In view of the above considerations, the objective of this study was to comparison two methods means comparison and regression relations for association between laboratory seed quality tests and seedling field emergence in some important crop in iran .

MATERIALS AND METHODS

In order to comparison the correlation, simple and multiple regression models relationship between some seed vigour tests and field seed performance of some Iran important crop with means comparison of these vigour tests and seed emergence this study was conducted in two in vivo and in vitro parts. In vivo part was done in research farm of Islamic Azad University (Khorasgan Branch) located in east of Isfahan (10 km). The farm has a soil with silty loam texture. Electrical conductivity and organic matter of soil were 3.5 and 0.8 %, respectively(Table 1).

Table 1. Some soil physicochemichal traits of experimental site.

Texture	Total N (%)	K available (Ppm)	P available (ppm)	O.m (%)	pH	EC ds/m	Soil Depth (cm)
SL	0.09	280	17.5	0.8	7.8	3.5	0-40

Method of research

A lot of certified seeds of corn(*Zea mays* L.), wheat(*Triticum aestivum* L.), barley(*Hordeum vulgar* L), sorghum(*Sorghume bicolor* L), alfalfa(*Medicago sativa* L., Iranian clover(Trifolium resupinatum L.), safflower(*Carthamus tinctrius* L.), rapeseed(*Brassica nupus* L.), dry pea(*Cicer arietinum* L.), mung bean(*Vigna radiate* L.), white bean(*Phaseolus sp* .), broad bean(*Vicia faba* L.), suger beet(*Beta vulgaris* L.), sunflower(*Heliantus annuus* L.) and cotton(*Gossypium hirsutum* L.) produced in 2011 were prepared and after standard germination test, were kept under unfavorable condition (30°c and 30% relative humidity) for one year. After that following tests were done on all seeds: standard germination test, cold test, cool test, accelerated aging test, tetrazolium test, deterioration test and osmotic stress at -0.2, -0.4, -0.6, -0.8, -1 by PEG 6000. Means comparison between total tests were done base on Dancan multiple range at 5% with Mstat-c progrom.Corrolation coefficient, multiple and simple regression between vigour seed tests and seed emergence in farm for total crops were determine using S.A.S program.. All tests of this study were done according to international seed testing association (ISTA) rules, (2008).

Field tests

Field experiments were conducted at farm to compare field emergence with laboratory test results. Sowing was done according to regional mores. In this study, environmental condition of seed tests in laboratory and soil condition in farm hypothesized as different treatments and analyzed and according means comparison results quantitative relation between seed vigor and seed emergence were determine.

RESULTS AND DISCUSSION

Results

Correlation coefficient

According results of correlation coefficient, from total laboratory tests, standard germination test($r=0.75^{**}$), acceleration aging test($r=0.64^{*}$), hiltner test($r=0.59^{*}$) and cold test($r=0.65^{*}$) had a significantly correlation with field seed emergence(Table 2).

Table 2. Correlation coefficient between seed emergence and seed germination of crops

Tests	Seed emergence in farm
Seed emergence in farm	1
Standard germination test	0.75**
Tetrazolium test	0.21
Accelerated Aging Test	0.64*
Deterioration test	0.27
Hiltner test	0.59*
Cold Test	0.65*
Cool Test	0.48
Stress Osmotic Test -0.2	0.49
Stress Osmotic Test -0.4	0.48
Stress Osmotic Test -0.6	0.47
Stress Osmotic Test -0.8	0.44
Stress Osmotic Test -1	0.09

+ * and **: significant at the 5% and 1% probability levels, respectively.

Simple regression models

Base on results of simple regression relations, some tests include Standard germination test (0.56**), hiltner test(0.35*), cold test(0.42**) had a linear relation with seed field emergence(Table 3). In my study all of another vigor tests could not significantly describe seed emergence in farm(Table 3).

Table 3. Models of simple regression of relationship seed performance and seed vigour

seed method(x)	R^2	Model
Standard germination test	0.56**	Y = -45.387 +1.359x
Tetrazolium test	0.04ns	Y = 25.136 + 0.368x
Accelerated Aging Test	0.04ns	Y = 25.136 + 0.368x
Deterioration test	0.07ns	Y = 51.425 + 0.519x
Hiltner test	0.35*	Y = 33.55 + 0.496x
Cold Test	0.42**	Y = 33.53 + 0.638x
Cool Test	0.24ns	Y = 39.082 + 0.465x
Stress Osmotic Test -0.2	0.24ns	Y = 47.058 + 0.556x
Stress Osmotic Test -0.4	0.23ns	Y = 47.948 + 0.488x
Stress Osmotic Test -0.6	0.22ns	Y = 49.32+ 0.414x
Stress Osmotic Test -0.8	0.19ns	Y = 52.287 + 0.551x
Stress Osmotic Test -1	0.01ns	Y = 56.583 + 0.152x

* and ** significant at the 5% and 1% probability levels, respectively.
Where Y is seed emergence percentage in farm

Multiple regression model

Base on linear stepwise multiple regression, from total vigour test only standard germination test and acceleration aging test could enter of model and they could significantly describe 72 percent of seed emergence in farm(Table4).

Means comparison for quantitative relationship between seed emergence and seed vigour tests

Table 4. Results of stepwise linear multiple regression relationship between seed vigour tests and seed performance

Stages	Entered variable	Partial coefficient	Total coefficient
1	standard germination test	0.56**	0.56**
2	Acceleration aging test	0.16*	0.72**
Model		$Y = - 32.48 + 1.058 X_1 + 0.517X_2$	

* and ** are significantly at 1 and 5 percent respectivly.

Base on means comparison results, there are different between crop about suitable vigour test that to describe quantitative relationship between seed vigor and seed emergence. In our study the best seed vigour test for bean, sunflower, alfalfa, barley, cotton, mung bean and broad bean was standard germination test, but the best vigour test for colza was acceleration test and for wheat, safflower and sorghum, hiltner test and for sugar beet, hitner and cold test, for pea cool test, for corn cold test and for clover, osmotic stress test were the best vigour tests that could explanatory relationship between seed vigour and seed emergence in farm. Mean comparison results

showed that however some seeds had high viability according to tetrazolium test, but germination percentage of these seeds in farm was very low(Tables 5,6,7) It seems that bad saving conditions have caused the seeds to lose their food reservoirs and in spite of having high viability according to tetrazolium test, could not germinate under non appropriate conditions of farm.

Table 5. Mean comparison for effect of environmental condition on germination and seed emergence of Cotton, Colza, Sunflower, Sugar beet

Treatment	Germination and Emergence %				
	Cotton	Colza	Sunflower	Safflower	Sugar beet
Standard germination test	91.50a	63.75b	75.75 b	89.50 ab	86.75a
Accelerated Aging Test	63.75b	3.25ef	50.21 def	7.50 g	3.25c
Deterioration test	13.70de	7.00def	42.23 ef	20.00 f	2.00c
Hiltner test	88.00a	11.75d	13.25 g	73.00 c	67.50b
Cold Test	21.25d	10.00de	53.75 cde	81.25 bc	64.50b
Cool Test	44.25c	35.00c	36.50 f	40.00 e	83.00ab
0.2 - tress Osmotic Test	9.25def	0.01g	48.75 def	72.50 c	0.01c
0.4 - Stress Osmotic Test	13.00de	0.01g	67.25 bc	54.75 d	0.01c
0.6 - Stress Osmotic Test	8.50ef	0.01g	60.50 cd	58.75 d	0.01c
0.8 - Stress Osmotic Test	0.01f	0.01g	40.25 ef	0.01 g	0.01c
1 -Stress Osmotic Test	0.01f	0.01g	0.01 g	0.01 g	0.01c
Tetrazolium test	96.25a	100.00a	93.25 a	99.10 a	93.25a
Seed Emergence in farm	86.57a	3.50ef	78.75 b	75.21 c	68.25b
LSD	11.45	6.82	13.53	11.36	17.26

Means in each column, followed by similar letter(s) are not significantly different at the 5% probability level- Using Dancan test

Table 6. Mean comparison for effect of environmental condition on germination and seed emergence of Wheat, Corn, Barley, Sorghum, Alfalfa

Treatment	Germination and Emergence %				
	Wheat	Corn	Barley	Sorghum	Alfalfa
Standard germination test	50.00b	77.50 b	75.75 b	54.75 b	57.00 b
Accelerated Aging Test	1.26 e	6.25 e	26.25 def	27.50 def	0.01 g
Deterioration test	1.23 e	5.01 e	0.01 f	30.00 cdef	0.01 g
Hiltner test	17.50 cd	13.00 d	75.00 ab	34.50 cd	23.75 d
Cold Test	0.01 e	54.20 c	26.00 cd	46.25 bc	13.00 f
Cool Test	4.92 e	3.78 ef	68.75 ab	28.25 cdef	35.00 c
0.2 - Stress Osmotic Test	3.25 e	11.00 de	38.75 c	14.20 fg	17.75 ef
0.4 - Stress Osmotic Test	0.01 e	10.50 de	17.00 de	15.50 efg	1.50 g
0.6 - Stress Osmotic Test	0.01 e	6.00 e	11.25 ef	32.75 cde	0.01 g
0.8 - Stress Osmotic Test	0.01 e	0.06 f	8.65 ef	13.75 fg	0.01 g
1 -Stress Osmotic Test	12.9 d	0.01 f	60.75 b	0.01 g	0.01 g
Tetrazolium test	67.50 a	90.50 a	72.50 ab	91.25 a	69.50 a
Seed Emergence in farm	23.00 c	58.52 c	69.25 ab	36.25 cd	53.88 b
LSD	7.36	6.66	12.92	16.11	13.53

Means, in each column, followed by similar letter(s) are not significantly different at the 5% probability level- Using Dancan test

Table 7. Mean comparison for effect of environmental condition on germination and seed emergence of Broad bean, mung bean, Dry pea, Bean, clover

Treatment	Germination and Emergence %				
	Broad bean	Mung bean	Dry pea	Bean	Clover
Standard germination test	80.50 b	99.25 a	80.00 b	57.50 ab	80.00 b
Accelerated Aging Test	28.75 e	51.25 c	0.01 d	23.75 cd	0.01 f
Deterioration test	28.85 e	5.12 d	0.01 d	18.50 de	0.01 f
Hiltner test	54.85d	94.50 a	81.75 b	17.55 def	55.00 c
Cold Test	65.75 c	68.75 b	14.25 d	35.00 c	8.75 ef
Cool Test	88.25 b	42.50 c	60.25 c	5.25 fg	13.75 e
0.2 - Stress Osmotic Test	0.01 f	91.75 a	5.13 d	6.75 efg	28.00 d
0.4 - Stress Osmotic Test	0.01 f	73.75 b	0.01 d	9.75 efg	28.50 d
0.6 - Stress Osmotic Test	0.01 f	78.75 b	0.01 d	6.25 efg	14.00 e
0.8 - Stress Osmotic Test	0.01 f	73.00 b	0.01 d	3.75 g	0.25 f
1 -Stress Osmotic Test	0.01 f	7.87 d	0.01 d	2.75 g	0.01 f
Tetrazolium test	100.00 a	97.75 a	95.00 a	66.25 a	95.25 a
Seed Emergence in farm	78.75 b	93.50 a	57.50 c	51.25 b	26.88 d
LSD	9.1	9.33	12.58	11.54	11.36

Means, in each column, followed by similar letter(s) are not significantly different at the 5% probability level- Using Dancan test

Discussion

Base on our results, there are different between crop about suitable vigour test that to describe relationship between seed vigor and seed performance. In our study the best seed vigour test for bean, sunflower, alfalfa, barley, cotton, mungbean and broad bean was standard germination test, but the best vigour test for colza was acceleration test and for wheat, safflower and sorghum, hiltner test and for sugar beet, hitner and cold test, for pea cool test, for corn cold test and for clover, osmotic stress test were the best vigour tests that could explanatory relationship between seed vigour and seed performance in farm. Results showed that base on simple and multiple regression and correlation coefficient, standard germination test, acceleration aging test, hiltner test and cold test, had the best seed test for seed vigour test and seed emergence relationship for total crops, but base on means comparison results, for a some crops, there were no any relationship between seed performance and some of these tests that the reason is contrary to some reports. It seem that correlation coefficient and regression relations can't represent relationship between seed emergence and seed vigour tests because correlation coefficient and regression relations only to find isotropy of several variables but in seed studys we want to find quantitative relations these variables, so we will report that we must not use of correlation coefficient and regression relations in relationship between seed performance and vigour test experiments.Our results to reject results of many conducted studies in this field which are based on correlation coefficient and regression (Makkawi et al.1999; Wang and Nan, 1996; Pourhaadian and Khaajepour, 2010). Bolek, (2010) reported base on regression relation mixed of standard seed germination at 180C and 300C could had the best predict of seed cotton emergence in farm. In Alillo and Shokati, (2011) study the corn farm emergence percentage had the significant negative correlation (-0.71) with conductivity test, but positive correlation (0.79) with cold test. In Qasim et al, (2010) study the simple regression showed that cold germination and standard germination tests were the best predictor of field emergence than all the other laboratory tests used because higher positive correlation coefficients were found in the standard germination test.

CONCULSION

According to results of this study, tests which show the relationship between germination and seed emergence in farm are different for various crops . Also we don't recommend using simple and multiple regression models and correlation coefficients for predicting seed crops emergence in farm.

REFERENCES

Aliloo AA and Shokat B. 2011. Correlation between seed tests and seed performance of two maize hybrid (SC704 and SC500) . Online J of Animal and Feed Res 1 (6): 249-254.

Bolek YA. 2010. Predicting cotton seedling emergence for cold Tolerance(*Gossypium hirsutum* L.). Not Bot Hort Agrobot Cluj 38 (1) : 134-138

Hampton JG and Coolbear P. 1990. Potential versus actual seed performance - Can Vigour testing provide an answer? Seed Sci and Techno 18:215-228.

Hampton JG and TeKrony DM. 1995. Handbook of vigor test methods (3rd ed.). International Seed Testing Association (ISTA). Zurich, Switzerland.

International Seed Testing Association. 2008. International ruls for seed testing. Seed Sci and Technol 13: 356-513.

Latifi N, Soltani A and Spanner D. 2004. Effect of temperature on germinationdcomponents in Canola (*Brassica napus* L.) cultivars. Iranian j Agri Sci 35(2):313-321.

Lopez–Castaneda C, Richards RA, Farquhar DG and Williamson RE. 1996. Seed and seeding characteristics contributing to variation in early vigour among temperate cereals Crop Sci. 36:1257-1266

Maiti RK, De J and Carrillo Gutierrez M. 1989. Effect of planting depth on seedling emergence and vigour in sorghum (*Sorghum bicolor* [L.] Moench). Seed Sci and Technol 17:83-90.

Makkawi M, El Balla M, Bishaw Z and Van Gastel AJG. 1999. The relationship between seed vigor tests and field emergence in lentil. Seed Sci Technol 27: 657-668.

Noli E, Casarini G, Urso G and Conti S. 2008. Suitability of three vigour test procedures to predict field performance of early sown maize seed. Seed Sci Technol 36: 168-176

Porhadian H and Khajepour MR. 2010. Relationship between germination test and field emergence of wheat. Asian J of Applied Sci 34: 160-176.

Van Gastel AJ and Pagnotta MA. 1996. Seed Science and Technology . ICARDA, Aleppo, Syria.