Online Journal of Animal and Feed Research
Volume 1, Issue 6: 249-254 (2011) ISSN 2228-7701

CORRELATION BETWEEN SEED TESTS AND FIELD EMERGENCE OF TWO MAIZE HYBRIDS (SC704 AND SC500)

A.A. ALILOO* and B. SHOKATI

[1]Department of Agronomy and Plant Breeding, Faculty of Agriculture, University of Maragheh, Maragheh, Iran

*Email: aliasghar.aliloo@gmail.com

ORIGINAL ARTICLE

ABSTRACT: *Early emergence and stand establishment of maize (Zea mays L.) are considered to be the most important yield-contributing factors. The influence of seed vigor on these factors is vital. Therefore, five laboratory tests and field experiment were conducted on basis of a randomized complete block design (RCBD) with five replications in 2011, to evaluate the correlation among the seed vigor tests and field emergence of two maize hybrids (SC704 and SC500). In laboratory tests, differences between two hybrids for cold test and electrical conductivity test were significant (P≤0.01). The leachates of hybrid SC500 was 35% higher than the leachates of hybrid SC704. However, high germination percentage was obtained by hybrid SC740 in cold test. A Statistically significant difference was found between hybrids in field emergence percentage (P≤0.05). The field emergence of hybrid SC704 and hybrid SC500 was 71% and 37%, respectively. The farm emergence percentage had the significant negative correlation (-0.71) with conductivity test, but positive correlation (0.79) with cold test. No significant correlation between the standard seed germination and the field emergence was detected. Therefore, the standard germination test was not a good indicator for field emergence percentage. However, cold and conductivity tests were the best predictor of field emergence than all the other laboratory tests.*

Keywords: *Field emergence, seed vigor, seed viability, zea mays L.*

INTRODUCTION

Maize (*Zea mays* L.) is one of the most useful emerging crops having wider adaptability under varied agro-climatic conditions (FAO, 2010). Globally, maize is known as queen of cereals because it has the highest genetic yield potential among the cereals (Guzobenli, 2010). It is cultivated on nearly 150 million hectares (ha) in about 160 countries having wider diversity of soil, climate, biodiversity and management practices that contributes 36% in the global grain production (FAO, 2010). In Iran, total maize cultivation area and its average production are 225390 ha and 7 ton/ha, respectively. Maize grain is used for the preparation of corn starch, corn syrup, corn oil dextrose, corn flakes, gluten, grain cake, lactic acid and acetone, which are used by various industries such as textile, foundry, fermentation and food industries (Hussain, 2009).

One of the main problems observed in the field is poor seedling establishment, which is influenced by seed quality, climatic conditions and field management practice (Zhu et al., 2010). Seed quality includes several attributes leading to near maximum germination capacity to produce seedlings, which emerge rapidly from the seedbed and continue to grow uniformly thereafter (McDonald, 2000). Sometimes standardized laboratory germination procedures are criticized as not predicting field performance very well (Fawad et al., 2002). These critics suggest using a variety of test conditions to find an optimum for each seed lot. Vigor testing is one possible solution (AOSA, 2009). Seed vigor tests, therefore, have been proposed to detect differences in potential seed lot performances.

Seed vigor is the sum total of those properties of the seed that determine the level of activity and performance of the seed during germination and seedling emergence (ISTA, 1987). Consequently, vigor tests such as growth test, conductivity test, cold test, accelerated aging test and brick grit test were developed to predict the field emergence of seed lots (Hempton and Tekrony, 1995). The growth tests principles are based on vigorous seeds grow at a faster rate than poor vigor seeds even under favorable environments (AOSA, 2009). Vigorous seeds rapidly germinate, metabolize and establish in the field. Therefore, any method used to determine the rapidity of seedling growth will give an indication of seed vigor level (AOSA, 2009). Conductivity test principles are based on weakening of cell membrane in poor vigor seeds causes leakage of water soluble compounds like sugars, amino

To cite this paper: Aliloo, A.A. and Shokati, B. 2011. Correlation between seed tests and field emergence of two maize hybrids (SC704 and SC500). *Online J. Anim. Feed Res.*, 1(6): 249-254.
Journal homepage: http://www.ojafr.ir

acids, electrolytes and etc. when immersed in water (AOSA, 2002). On the other hand fresh seeds having intact membrane leach less quantity of these chemical. The measurement of electrical conductivity of the leachate by a good and sensitive conductivity meter gives an accurate estimation of membrane permeability. The EC has been positively correlated with the emergence percentage of peas and broad beans (Panobianco et al., 2007). The cold test has been developed in USA to evaluate the seed vigor of maize. According to Wotza and Tekrony (2001) germination results obtained with applied cold test represent the most precise indicators of maize germination in the field. The test aims to differentiate between weak and vigorous seed lots by subjecting them to low temperatures prior to germination at optimum temperature. Accelerated ageing test has been developed for determining the storage potential of seed lots (Munamava et al., 2004). Studies of Leeks (2006) relating to seeds of Brassica (B. *rapa* × *campestris*, B. *campestris*, B. *napus*, B. *oleraceae* var. *alboglabra* L and B. *rapa* var. pekinensis) revealed that a high correlation between germination obtained by using accelerated aging and field emergence existed. The brick grit test is also known as the Hiltner test for detecting seed-borne Fusarium infection in cereals (Miloević et al., 2010).

The general strategy of determining seed vigor is to measure some aspects of seed deterioration or weaknesses, which is inversely proportional to seed vigor (Elias and Copeland, 1997). High vigor seed lots may improve crop yield in two ways: firstly, because the seedling emergence from the seedbed is rapid and uniform and the resultant plants are vigorous, and secondly because the percentage seedling emergence is high, the optimum plant population density can be achieved under a wide range of environmental conditions (Ghassemi-Golezani, 2008).

The objectives of this research were to predict field emergence of maize seed lots using several laboratory seed germination and seed vigor tests using correlation coefficients.

MATERIAL AND METHODS

The field and laboratory experiments were conducted in University of Maragheh, Iran to evaluation of relation between the seed vigor tests and field emergence of two maize hybrids (SC704 and SC500). All laboratory and field experiments were conducted on basis of Randomized Complete Block Design (RCBD) with five replications. The seeds with same size, weight and age were selected for eliminating of their effects on seed vigor. Seeds were disinfected by 1% Hypochlorite sodium for 10 minutes and then rinsed with distilled water three times before tests.

The following laboratory tests were conducted along the field experiment:

1. Conductivity test

A seed sample of 5 gram was weighted and surface sterilized with 0.1% Hypochlorite sodium for 10 minutes. The sample was washed thoroughly in distilled water. The clean seeds were immersed in 100 ml of water at 25±1°C temperature for 24 hours. After this the seeds were removed. The electrical conductivity of distilled water was measured in a beaker. The electrode was then cleaned with a tissue paper and conductance of the leachate was read. The electrode was thoroughly washed using a wash bottle and wiped with a clean tissue paper before reusing. To get the EC of leachate the reading of distilled water was subtracted from the sample reading. The reading was expressed as mmhos/cm/g of seed.

2. Cold test

After grinding and properly sieving the soil was filled in tray upto2 cm depth. Fifty seeds were placed over the sand and covered with another 2 cm thick layer of soil. The soil was compacted and enough water was added to make the soil about 70% of its water holding capacity. Water temperature should be l0°C after watering; the trays were covered with polythene bags and placed in the refrigerator maintained at 10°Ctemperature for one week. After one week the trays were removed and placed in the germinator at 25°C. The seedlings emerged after 4 days were counted.

3. Accelerated ageing test

One hundred seeds each in five replications were tied in a fine muslin cloth. The tied seeds were placed in jar on a wire mesh. The lower part of the jar was filled with water. There should not be a direct contact between water and the seeds. The jar was covered with the lid and sealed with paraffin wax to make it air tight. The jar was then placed in the accelerated aging chamber maintained at 45±2°C for 5 days. The jar was removed after this period and the seeds were cooled in a desiccator. The seeds were then tested in a normal germination test.

4. Brick grit test

In this test, seeds were planted on sand and covered with 3 cm of damp brick grit, then germinated in darkness at room temperature for 10 days. The percentage of normal seedlings from this test is considered to be an indication of the vigor level.

5. Laboratory germination, seedling growth and mean germination time (MGT):

To cite this paper: Aliloo, A.A. and Shokati, B. 2011. Correlation between seed tests and field emergence of two maize hybrids (SC704 and SC500). *Online J. Anim. Feed Res.*, 1(6): 249-254.
Journal homepage: http://www.ojafr.ir

Five replicates of 50 seeds were germinated between double layered rolled germination papers. The rolled paper with seeds was put into plastic bags to avoid moisture loss. Seeds were allowed to germinate at 20±1°C in the dark for 21 days. Germination was considered to have occurred when the radicles were 2 mm long. Germinated seeds were recorded every 24 h for 21 days. Mean germination time (MGT) was calculated to assess the rate of germination. $MGT = \sum(D * N)/\sum N$ R=1/MGT [eq. 1]

Where N is the number of seeds germinated on day, D is the number of days counted from the beginning of the test and is mean germination rate. The seedlings with short, thick and spiral formed hypocotyls and stunted primary root were considered as abnormally germinated. At the end of germination test (21 days), radicles and shoots were cut from the cotyledons and then dried in an oven at 75±2°C for 24 hours. The dried radicles and shoots were weighed to the nearest milligram and the mean radicle and shoot dry weight and consequently mean seedling dry weight were determined.

Field experiments

Field emergence evaluation studies using the same seed lots used in laboratory experiments were conducted at the Maragheh University Campus (37° 22' N, 46° 15' E, elevation 1275m) field station. Two maize hybrids with five replications were conducted using a randomized complete block design. The field was fallow during the previous year, and no plant residues were present. The field was tilled by shovel and seed bed was well prepared before planting. No chemical fertilizer was applied because the only seedling emergence was under consideration. Early season rainfalls were sufficient for the plant emergence. Each plot consisted of 10 rows of 20 seeds, planted 0.25 m apart and 0.04 m deep. Emergence (when green leaf could be seen inside coleoptiles) was recorded at 24±1 h intervals and continued until no further emergence occurred. In the notations used for field studies, G (germination) was replaced by E (emergence).

Correlations among measured laboratory germination parameters and emergence variables were calculated using PROC CORR procedure of SAS.

RESULTS

The T-test analysis of laboratory seed tests showed that there were no meaningful differences between two hybrids for MGT (mean germination test), BGT (brick grit test), AAT (accelerating aging test), GT (germination test) and other seedling growth parameters but the germination and emergence percentage of two hybrids for EC (electrical conductivity test) and CT (cold test) tests were significant (Table 1). According to Table 1, the leachates of hybrid SC500 was 182.4 (mmhos/cm/g of seed) that this value was 35 percentage more than the leachates for hybrid SC704.

We found a statistically significant difference between two hybrids in field emergence percentage (Table 1). The results showed that the field emergence of hybrid SC704 with 71 percentage was greater than those the hybrid SC500.

Table 1 - Means comparison of seed vigor tests, germination test and seedling parameters

H	MGT	EC	BGT	CT	AAT	FE	SL	SoL	RL	SG	RDW	SoDW	SeDW
704	2.143	119.30	0.800	0.272	0.736	0.712	18.15	6.70	11.45	0.952	0.4405	0.5248	0.9093
500	2.085	182.40	0.832	0.024	0.648	0.376	16.75	6.85	9.90	0.944	0.4869	0.3845	0.8714
LSD (5%)	0.105	13.161	0.098	0.0583	0.1620	0.2609	4.1418	1.0569	3.2539	0.0505	0.1519	0.1723	0.3232

MGT (mean germination test), EC (electrical conductivity), BGT (brick grit test), CT (cold test), AAT (accelerating aging test), FE (field emergence), SG (standa (seedling length), SoL (shoot length), RL (root length), RDW (root dry weight), SoDW (shoot dry weight), SeDW (seedling dry weigth).

Table 2 - Correlation coefficient between variables measured on seed lots and field emergence

	MGT	EC	BGT	CT	AAT	FE	SG
MGT	1	-0.58696	0.38217	0.55735	0.09297	0.67213 *	0.45228
EC	-0.58696	1	0.22921	-0.9026 **	-0.43717	-0.70922 *	-0.27305
BGT	0.38217	0.22921	1	-0.0754	0.23047	0.30464	0.09836
CT	0.55735	-0.9026 **	-0.07754	1	0.36321	0.78981 **	0.1627
AAT	0.09297	-0.43717	0.23047	0.36321	1	0.21028	-0.0047
FE	0.67213 *	-0.70922 *	0.30464	0.78981 **	0.21028	1	0.06181
SG	0.45228	-0.27305	0.09836	0.1627	-0.0047	0.06181	1
SL	0.15599	-0.25347	0.25347	0.40902	-0.08944	0.51244	-0.18322
SoL	-0.03759	0.21817	0.19546	0.04161	-0.39786	0.11207	0.13491
RL	0.20342	-0.23119	0.25235	0.49068	0.01119	0.59648	-0.26672
RDW	-0.07352	0.34435	0.46121	-0.06977	-0.05823	0.02376	-0.9651
SoDW	0.30503	-0.42341	0.18486	0.69932 *	0.11922	0.55335	0.16019
SeDW	0.15377	-0.09412	0.34227	0.40118	0.04558	0.35633	0.05224

*,**: Significant at p≤0.05 and p≤0.01, respectively. MGT(mean germination test), EC (electrical conductivity), BGT (brick grit test), CT(cold test), AAT(accelerating aging test), FE (field emergence), SG(standard germination), SL(seedling length), SoL(shoot length), RL(root length), RDW (root dry weight), SoDW (shoot dry weight), SeDW (seedling dry weigth).

To cite this paper: Aliloo, A.A. and Shokati, B. 2011. Correlation between seed tests and field emergence of two maize hybrids (SC704 and SC500). *Online J. Anim. Feed Res.*, 1(6): 249-254.
Journal homepage: http://www.ojafr.ir

The correlations among laboratory and field emergence tests are presented in Table 2. The correlations between MGT and other seed vigor tests were non-significant, But MGT test was significantly correlated ($P \leq 0.01$) with farm emergence percentage. The farm emergence percentage had significant negative correlation ($P \leq 0.05$) with EC test, but positive correlation with CT test. SG (viability percentage) had no significant correlation with farm emergence. Except for shoot dry weight that had significant positive correlation with CT test, the remaining seedling parameters were not significantly correlated to seed vigor tests and seed viability test (Table 2).

DISCUSSION

The standard germination tests were conducted under an optimal set of temperature and moisture conditions, which allowed for optimum seed germination with minimal stress (Fawad et al., 2002). However, the field emergence was measured under much more stressful conditions, which was reflected in a slower emergence and decreased crop stand (Garcia and Lasa, 1990). Therefore, reliance on the standard germination test cannot be correct to predict field emergence percentage. We found no significant correlation between the standard seed germination and field emergence (Table 1). The findings of the present study are consistent with those of Fawad et al. (2002) in subtropical corn hybrids and Tavakoli kakhki et al. (2006) in alfalfa, who found no significant correlation between the standard seed germination and field emergence. Some studies had reported strong correlations between the standard germination test and field emergence (Adebisi et al., 2003; Khan et al., 2010).

Regarding the results obtained by the cold test, among seed vigor and viability tests, cold test showed the highest significant positive correlation coefficient (0.79) with the field emergence (Table 2). Internationally, cold tests have gained wide acceptance for maize (*Zea mays* L.) and it was developed to evaluate the physiological potential of corn seeds, seeking to simulate adverse soil conditions (excessive water, low temperatures and presence of fungi in the soil) that frequently occur during the sowing season in the US Corn Belt. The efficiency of the cold test has been tested experimentally by several researchers as reported by Barros et al. (1999) and (AOSA, 2002; Damavandi et al., 2004).

Although in this study AAt and BGT tests had no significant correlations with the field emergence but there are some studies that show these tests could efficiently predict field emergence percentage. Fawad et al. (2002) reported that the accelerated aging test could detect differences among hybrids and showed the highest correlations (0.86 and 0.87, respectively) with the field emergence for the subtropical corn hybrids. Similar results have been reported for sweet corn (Wilson and Trawatha, 1991).

Significant negative correlations were found between the EC test and field emergence (Table 2). The high EC value is normally associated with the low seed quality. Ratajezak and Duczmal (1991) found that the electrical conductivity test was the best correlated with the field emergence than the other laboratory seed quality tests. Wang and Nan (2004) reported that electrical conductivity test was a good predictor of field emergence and showed a better correlation with the field emergence than the standard germination test. More ever Wilson et al. (1992) found that accelerating aging test and EC test could be used in field emergence prediction. Tavakoli kakhki et al. (2006) showed a significant correlation coefficient between EC and FE for alfalfa seed. They mentioned EC test had the highest correlation among laboratory tests with field emergence correlation coefficient. Rozrokh et al. (2002) also indicated that electrical conductivity and germination rate tests are suitable for evaluation seed vigor of chickpea (*Cicer arietinum* L.) in both laboratory and field experiments. The conductivity test correlated with the field emergence of dwarf French bean (Powell et al. 1986) and pea (Duczmal and Minicka, 1989). In cotrast, Yaklich and Kulik (1987) reported that field emergence and conductivity tests results were not consistently correlated.

One unanticipated finding was the positive correlation between MGT and FE (Table 2). Commonly there is an inverse relationship between MGT and seed germination rate [eq. 1]. ASOA (2002) considers germination rate as a good indicator of seed vigor. There are numerous studies that use seed germination rate to evaluate seed performance between non-treated and primed seeds (Farooq et al., 2006; Armin et al., 2010), but only a few studies have considered to compare germination rate of seed lot to predict the field emergence (Tavakoli et al., 2006). It is difficult to explain this result, but it might be related to differences between seed germination and seedling growth necessities. In the seed germination rate evaluation, only the time to radicle protrusion is considered as a parameter of germination rate. As a result, the use of seed germination rate in maize seeds as a vigor test might be mistaken.

CONCLUSION

When seed bed and environmental conditions are close to ideal, a field emergence will correlate well with germination and seed lot vigor is not an important factor. However, optimum field conditions are not often encountered in practice, and environmental stresses (e.g. low or high soil temperature, excess or low soil moisture) may lead to varying field performance depending on the vigor status of the seed lot. Usually, reach to entire suitable conditions for perfect seed lot performance is impossible and consequently heterogeneous emergence is the common events in the crop production. However, we need an easy method/or methods to detect the seed vigor variation. Several studies have been demonstrated that vigorous seeds generally show high stand establishment in variable field conditions. Therefore, the yield of crops that raised from high vigor seeds is high. The different performance of the tested hybrids may be related to the other aspects of seed vigor, i.e. genetic structure, possibly mechanical damage, seed filling conditions on mother plant and, etc. The results of experiments showed that conductivity test and cold test can be used to evaluate of maize seed lot performance in the field condition. As the EC test is a simple, low-cost and fast method so as a result, this test is preferable to the other seed vigor evaluating methods.

REFERENCES

Adebisi MA (2008). Relationships between seed testing traits, Field emergence and seed yield of Sesame (Sesamun Indicum L.) under different plant population environments. Asset Series A, 8: 194-204.

Association of Official Seed Analysts (AOSA) (2009). Seed Vigor Testing Handbook. Contribution No. 32 to the Handbook on Seed Testing.

Armin M, Asgharipour M and Razavi-Omrani M (2010). The Effect of Seed Priming on Germination and Seedling Growth of Watermelon (Citrullus Lanatus). Advances in Environmental Biology, 4: 501-505.

Association of Official Seed Analysts (AOSA) (2002). Seed vigor testing handbook. Lincoln, 105p. (Contribution, 32).

Barros SRB, Dias MCLL, Cicero SM and Krzyzanowski FC (1999). Cold test. chap.5, p. 1-15. In: Krzyzanowski, F.C., Vieira, R.D., França Neto, J.B., eds. Seed vigor: concepts and tests. ABRATES, Londrina, PR, Brazil. (in Portuguese).

Damavandi A, Latifi N and Dashtban AR (2008). Evaluation of seed vigour tests and it's field efficiency in Forage Sorghum (Sorghum bicolor L.). Journal of Agricultural Science and Natural Resource, 14: 1-7.

Duczmal KW and Minicka L (1989). Further studies on pea seed quality and seedling emergence in the field. Acta Horticulturae, 253: 239–246.

Elias SG and Copeland LO (1997). Evaluation of seed vigor tests for canola. Seed Technology, 19: 78-87.

FAO (2010). FAOSTAT. Food and Agriculture organization of the united nations, Rome, Italy.

Farooq M, Shahzad MA, Basra H and Tariq M (2006). Germination and Early Seedling Growth As Affected By Pre- Sowing Ethanol Seed Treatments In Fine Rice. International Journal of Agriculture and Biology, 8: 19-22.

Fawad SS, Clarence EW and Edgar RC (2002). Seed Vigor Testing of Subtropical Corn Hybrids. Research Report, 23: 1-5.

Garcia A and Lasa JM (1990). Seed vigour tests for predicting field emergence of maize under severe conditions. An. Aula Dei, 19: 279-291.

Ghassemi-Golezani K, Aliloo AA, Valizadeh M and Moghaddam M (2008). Effects of different priming techniques on seed invigoration and seedling establishment of Lentil (lens culinaris Medik). Journal of Food, Agriculture and Environment, 6: 222-226.

Guzobenli H (2010). Seed vigor of maize grown on the contaminated soil by cadmium. Asian journal of plant sciences, 9: 168-171.

Hempton JG and Tekrony DM (1995). Handbook of vigour test methods, 3rd edition, International Seed Testing Association.

Hussain I (2009). Genetics of drought tolerance in Maize (Zea mays L.). A thesis submitted in partial fulfilment of the requirements for the degree of PhD. Department of plant breeding and Genetics University of agriculture, Faisalabad, Pakistan.

International Seed Testing Association (ISTA) (1987). Handbook of Vigor Test Methods. 2nd ed., International Seed Testing Association, Zurich, Switzerlan.

Khan AM, Shah P, Mohd F, Khan H, Perveen AS, Nigar S, Khalil SK and Zubair M (2010). Vigor tests used to rank seed lot quality and predict field emergence in wheat. Pakistan Journal of Botany, 42: 3147-3155.

Leeks CRF (2006). Determining seed vigour in selected Brassica species, Master thesis, Lincoln University.

Maiti RK and carrillogutierrez, MDEJ (1989). Effect of plating depth on seedling emergence and vigor in sorghum (sorghum bicolor L.). Seed science and technology, 17: 83-90.

McDonald MB (2000). Seed priming. In Seed technology and its biological Basis, Eds., Black, M and J.D. Bewley. Sheffield Academic Press. England, Pp 287-325.

Miloević M, Vujaković M and Karagić Đ (2010). Vigour tests as indicators of seed viability. Genetika, 42: 103-118.

Munamava MR, Goggi AS and Pollak L (2004). Seed Quality of Maize Inbred Lines with Different Composition and Genetic Backgrounds. Crop Science, 44: 542–548.

Panobianco M, Vieira RD and Perecin D (2007). Electrical conductivity as an indicator of pea seed aging of stored at different temperatures. Scientia Agricola, 64: 119-124,

Powell AA, Oliveira ADM and Matthews S (1986). Seed vigour cultivars of dwarf French bean (Phaseolis vulgaris). Journal of Agricultural Science, 106:419–425.

Ratajczak K and Duczmal KW (1991). Seed vigor estimation by the conductometeric test, Katedra Nasiennictwa I Szkolkarstwa Orgodniczego, AR, Poznan, Poland Biuletyn-Instytutu-Hodowali-i-Aklimatyzacji-Rozlin, 180: 181-188.

Rozrokh M, Ghasemi Golozani K and Javanshir A (2002). Relation between seed vigour and field performance in chickpea (Cicer arietinum L.). Tehran, Journal of Agriculture Research Seed and Plant Improvement Institute, 18(2): 156-162.

Tavakoli HR, Beheshti A and Nasiri-Mahallati M (2005). Evaluation of seed vigor tests for determining alfalfa seed quality. Iranian Agricultural Research Journal, 3: 25-34.

Wang YR, Yu L, Nan ZB and Liu YL (2004). Seed Physiology, Production and Technology. Vigor Tests Used to Rank Seed Lot Quality and Predict Field Emergence in Four Forage Species. Crop science, 44: 535–541.

Wilson DO, Alleyne JC, Shafii B and Krishna–Mohan S (1992). Combining vigor test results for prediction of final stand of shrunken –2 sweet corn seed. Crop Science, 32: 1496 – 1502 .

Wilson DO and Trawatha SE (1991). Physiological maturity and vigor in production of Florida Staysweet Shrunken-2 Sweet Corn Seed. Crop Science, 31: 1640-1647.

Woltz J and Tekorny D (2001). Accelerated aging test for corn seed. Seed technology, 23: 21-34.

Yaklich RW and Kulik MM (1979). Evaluation of vigor tests in with field emergence over this temperature range. soybean seeds: Relationship of the standard germination test, seed ling classification, seedling length, and tetrazolium staining to field performance. Crop Science, 19: 247–252.

Zhu S, Hong D, Yao J, Zhang X and Luo T (2010). Improving germination, seedling establishment and biochemical characters of aged hybrid rice seed by priming with KNO3 + PVA. African Journal of Agricultural Research, 5: 78-83.

To cite this paper: Aliloo, A.A. and Shokati, B. 2011. Correlation between seed tests and field emergence of two maize hybrids (SC704 and SC500). *Online J. Anim. Feed Res.*, 1(6): 249-254.
Journal homepage: http://www.ojafr.ir