ABSTRACT

One of the agricultural characteristics of seed is its growth power, seed vigor, rapid ability of seedling, and the degree of seed tolerance determine a range of various environmental factors. The effect of seed vigor on the growth of plant and its performance may arise as well. This experiment was performed in agricultural (physiology) laboratory of Islamic Azad University, shushtar branch, in 2011. In this experiment, treatments were new hybrid seeds of corn at 10 levels from V1 to V10 and hybrid SC 704 as control hybrid (V0). In this study complete randomized design of four replications was used. Evaluated characteristics included mean daily germination, daily germination speed, seedling vigor index, primary root length, and seedling length. The obtained data were entered into the tables of computer programs like Excel spread sheet after summarization and classification. Variance analysis of row data was performed by SAS statistical programs and mean analysis was done by LSD test. Statistical analysis made it clear that all the characters evaluated in laboratory were affected by hybrid type. The comparison of means showed that hybrids were different in terms of all the characters evaluated in this experiment. Moreover, the results clarified that some of the studied hybrids were, in terms of evaluated indices, superior to hybrid SC704 which was the prevalent hybrid in the region so that, as to the characteristic of mean daily germination, hybrid PL 774 with an average of 16 sprouts appeared per day and hybrid PL710 with a mean of 8.25 sprouts daily had the most and the least germination respectively. Hybrid PL710 with a mean of 0.122 and hybrid PL774 with a mean of 0.063 had the most and the least daily germination speed respectively. Hybrid PL774 with an average of 7340 and hybrid PL710 with an average of 3365 were most and the least in term of seedling vigor index. Also, as to primary root length, hybrid PL 774 had the most primary root length with a mean of 23.05 mm and hybrid PL 710 had the least primary root length with a mean of 14.77 mm. the most seedling length was allocated to hybrid PL774 with 50.35 mm average and the least seedling length was allocated to hybrid PL 710 with an average of 23.47 mm. Since in most cases the results obtained in laboratory conditions can predict and suggest the results obtained in field conditions, it is expected that these hybrids can also preserve their superiority in field conditions in the region.

Key words: mean daily germination, daily germination speed, seedling vigor index, primary root length, seedling length.

Introduction

Seed is the most important agricultural resource. The effects on the other sources like fertilizers, irrigation water and herbicides in forming and fertilizing the agricultural plants are determined by this resource. By considering that the seed is the marginal product of the plant reform programs and it could be said that the success of a program specifies the time it's seed is in the hand of farmers and is used by them, every type of abnormality in germination and it's sprouting vigor affects the plant establishment and wastes away the difficulties that the reformers and producers confront. Despite the advance obtained in technology and agronomy management, seed, germination, and desirable establishment of resultant seedlings have still a key importance in agriculture such that success or failure...
in production depends on quick and complete germination of seeds and production of strong seedlings. The most establishment of seedling is achieved when seed is able to overcome undesirable conditions and exhibit a proper response. Undoubtedly, such a response is variable depending on the kind of genotype and environment. Environmental conditions of seeds bed usually cause seed to face various tensions such as dryness, temperature, water or soil salinity and many other animate or inanimate tensions [13] from the beginning of planting till the stage of emerging on the surface of the soil.

The concentration of seed production of some agricultural plants in especial regions is a convincing cause for the environmental factors to affect seed quality and its growth [9]. The centricity of some especial regions for the production of some products is a convincing reason for the effect of the environment on the growth and quality of the seed [19]. Studying and investigating the effect of cultivation date on the quality of soybean seed, Green, et al [12] found that the soybeans produced because of the early cultivation, due to placement in a hot and dry weather, produced seeds with low growth vigor. Also, Perry and Harrison [20] in their investigations found that exposing the mother plants to high temperatures during maturation and desiccation of premature seeds in high temperatures is the principal factor for physiological differences in the seeds. The emergence of this physiological disorder has been related to the delay in germination, decrease in the growth of seedling and plant, low green level, and low yield of the plant in field conditions. The effective factors on the seed quality could be issues like temperature, humidity, soil fertility, nutrition of mother plant, pathogenic factors and the environmental factors after maturation and before harvesting, the drying and storage method of seed. In spite of the technological developments and the agricultural management of the seed, the optimal germination and placement of the produced seedlings have a key rule in agriculture, so that the success or failure in the production is dependent on the full and fast seed germination and the production of vigorous seedlings. The most seedling establishment is achieved when the seed could overcome the undesirable environmental conditions and shows a proper reaction from itself. Certainly this reaction is variable according to the genotype and environment. The environmental conditions of the seedbed usually will cause the seed to confront various tensions like dryness, low temperature, soil or water salinity and many live and dead stresses [13]. It seems that producing and introducing high-yield figures requiring low irrigation and also early – yielding figures among agricultural crops is one of the effective strategies that when integrated with other water-deficit management methods can minimize the effect of this phenomenon [2,1,28].

The standard germination tests are the most common tests to determine the germination capacity of the seed. Everyone believes that germination and germination capacity of the seed are the same [22]. One of the primary tests which is commonly used to determine the seed quality is the standard germination test. This test is used to investigate the seed quality in optimal conditions (ISTA, 1987). But its results hardly reveal that how the seeds are established in the field, and more the field condition standards are away from the optimal conditions, more difference is between the laboratory results and the seed establishment in the field [13,23]. The germination percentage includes the combination of strong and weak seedlings, while a weak seedling hardly could be established in a field in stressful environment. Because of humidity and temperature, the germination test could be done under optimum conditions, while the environmental conditions are hardly according to the abovementioned conditions [10]. Establishing an infirm seed mass could be different in different environmental conditions. This reveals the cooperative interaction between the seed mass and the environmental conditions, including the seed bed [21,29]. In order to determine the seed vigor in the laboratory conditions, different tests are used. These tests include those which evaluate the seedling growth and chemical and stress test [26]. However, using the measure of seedling growth and other tests of seed vigor to evaluate the seedling vigor in different seed masses could be an effective solution to evaluate the establishment of the seed in the field [24]. In dry zones or in low soil temperature, the seedling vigor and it's establishment method is very important. In this regard, the results obtained by Cisse and Ejeta [7] showed that there is a considerable relationship between measuring the height of Sorghum seedling in the field and sprouting in greenhouse and growth room. So, the seed vigor tests provide a better measure for establishing or sprouting of the seed in the field in comparison to the germination test. The test which has been done relating to the alfalfa seedling [16] showed that the correlation between the seedling height and establishment has been a positive and considerable one, so measuring the seedling height is better in interpreting field demonstration than the germination time. Also the tests which have been performed on soybean showed that there is an appropriate relationship between laboratory tests and establishing the seedling in the field, but the significance of these tests was variable in predicting the greening of the field and these variables may be due to the environmental conditions of the field [25].

The standard germination test is done under optimal conditions, so when the field conditions are nearly optimal in cultivation time, it's results have an appropriate correlation with sprouting in the field, but these are usually better than those of sprouting in the field [27]. Castillo, et al [5] showed that the
results of the standard germination test haven't any correlation with the amount of the emergence of pea seedlings. [21] observed no correlation between the standard germination test and the emergence of pea seedlings. Hegarty [14], Baalbaki and Copeland [3] found out that the standard germination test helps to estimate the amount of pea and wheat seedlings. Also, Tekrony and Egli [25] observed that the marginal germination percentage of soybean seeds only in optimal field conditions has a correlation with the emergence of seedlings in the field, while Burris, et al [4] reported that the number of the sprouting seeds 4 days after the standard germination test (in primary counting) is the optimal laboratory measure for the estimation of seedling emergence in the soybean field. Some measurable standards could be utilized successfully during the standard germination test including the number of normal and abnormal seedlings that are used to classify the seedling vigor and also measuring the seedling, primary root and peduncle [30].

The standard germination test which has been verified internationally is very simple and economical. Studies on lentil [18], soy bean [27], corn [26] and pea [21] show that the germination test only has a correlation with the seedling emergence in optimal conditions of the field. However, most of sugar-beet seed companies were forced to accept the standard germination test as a germination index. The present study tries to seek a suitable solution to determine the best hybrid figure of corn to be cultivated in the fields of Khuzestan Province in order to be able to increase, based on obtained results, the performance of the fields of the province.

Materials and Methods

This experiment was performed in agricultural (physiology) laboratory of Islamic Azad University, shushtar branch, in 2011. In this experiment, treatments were new hybrid seeds of corn at 10 levels from V1 to V10 and hybrid SC704 that was used as control hybrid (V0). In this study complete randomized design of four replications was used. 4,100-seed iterations have been tried out on each sample to determine the germination capacity. The samples were located in plastic boxes which their dimensions were 26×9×38 centimeters and situated in the culture room by 76-86 humidity percentages and 25ºc temperature and iterations have been checked and the amount of the daily sprouting seeds was determined. After 7 days, the number of normal and abnormal seedlings and rotten seeds were determined and 10 seedlings were selected randomly and the related measurements on the length and dry weight of the seedling and primary root were applied. The obtained data were used in order to calculate some indices of germination capacity and seed vigor.

The mean daily germination which is an index of daily germination speed is determined from this equation (Hunter, et. al, 1984):

\[ \text{MDG} = \frac{\text{FGP}}{d} \]

In this equation, FGP is the percentage of marginal germination speed(the germination capacity) and "d" is the number of days before the maximum marginal germination (the duration of experiment).

Daily Germination Speed (DGS):

This index is in contrast with the mean daily germination and is calculated by this formula (Maguire, 1962).

\[ \text{MDS} = \frac{1}{\text{MDG}} \]

The Seedling Vigor Index (SVI):

After determining the normal and abnormal seedlings, 10 seedlings were selected randomly from each mass and after measuring the seedling length, the primary leaves and roots were measured by a ruler (on the basis of centimeter) and the wet and dry weight of the seedling was determined by means of a torsion balance (on the basis of gram) and it was done after drying it in the oven by 75ºc in 48 hours). Using these recent data, two seedling vigor indices were determined from this equation:

\[ \text{SVI}_1 = \text{The germination capacity} \times (\text{the mean primary root length} + \text{The mean peduncle length}) \]

\[ \text{SVI}_2 = \text{The germination capacity} \times \text{The dry weight of the seedling} \]

In the beginning of seedling formation, in order to determine the The mean daily germination (MDG), Daily Germination Speed (DGS), The Seedling Vigor Index (SVI), Primary root length and Seedling length and the way of seedling establishment. All the data were registered and maintained for statistical analysis. The obtained data were entered into the tables of computer programs like Excel Spread Sheet after summarization and classification. The variance analysis of row data was made by SAS statistical programs and the mean analysis was done by LSD test.

Result and Discussion

The Mean Daily Germination:

Statistical analysis made it clear that all the characters evaluated in laboratory were affected by hybrid type (table 1). The comparison of means showed that hybrids were different in terms of all the characters evaluated in this experiment. Moreover, the results clarified that some of the studied hybrids
were, in terms of evaluated indices, superior to hybrid SC704 which was the prevalent hybrid in the region. The results from variance analysis of hybrid type of the characteristic of mean daily germination using standard germination test in laboratory conditions are presented in Table 1. From these results it can be deduced that the hybrids studied in this experiment in terms of mean daily germination characteristic were meaning fully different at the 1%-percent probability level statistically. As indicated in Figure 1, hybrid PL774 with a mean of 16 sprouts emerged per day was in the first place, hybrids PL706 and PL711 with 13.50 and 13.25 sprouts daily had the second and the third places respectively, hybrid PL710 with an average of 8.25 was in the lowest place, and control hybrid (SC704) had the fifth place.

Germination stage is of the most important stages of plant growth so that this stage determines endurance, establishment and final performance of agricultural plants [8]. Germination stage is vitally important due to its importance in determining final density of the bush in surface area unit. Adequate density of the bush is obtained when planted seeds are germinated completely [3]. The evenness of germination, in effect, displays the length of linear phase in cumulative percentage curve of germination versus time. The shorter the length of this stage, it signifies the simultaneous germination of seeds. Conversely, if this stage gets long, it denotes that seeds have not germinated simultaneously; rather their germinations have taken place in longer period of time. Uneven germination in a longer duration in creases the possibility of the attack of terricolous diseases on seedlings’ seeds, decreasing the complete establishment of seedlings [15].

**Daily Germination Speed:**

The results obtained from variance analysis of characteristic daily germination speed indicated that, in terms of the mentioned characteristic, there was statistically a meaningful difference among the studied hybrids at the 1%-probability level. Figure (2) presents the comparison of means of daily germination speed characteristic of different hybrids. As shown in Figure 1, hybrid PL 710 with an average of 0.122 and hybrid PL 774 with a mean of 0.063 had the most and the least rate respectively in term of daily germination speed characteristic and hybrid SC704 with a mean of 0.083 was in the sixth place among these treatments so that it was less than the total average of treatments (0.090). The results obtained from this experiment were in consistence with those obtained Enayatgholizadeh et al., [11].

**Seedling Vigor Index:**

From the table of variance analysis it can be inferred there is statistically a meaningful difference at the 1%-probability level among the hybrids that were tested in terms of the characteristic of seedling vigor index (Table 1). As it is indicated in Figure w, hybrid PL774 with a mean of 7340 and hybrid PL710 a mean of 3365 were the highest and the lowest respectively in seedling vigor index characteristic, and hybrid SC704 with average 4375 that was less than the total mean (4761) was in the sixth place. Castro et al., [6] observed that different hybrids of corn were meaningfully different in terms of the degree of the emergence of seedling in field.

**Primary root length:**

The results obtained from variance analysis of primary root length are presented in Table 1. From this table it can be deduced that there is statistically a meaningful difference at the 1%-probability level among various hybrids in terms of primary root length. Out of the studied treatments, hybrid PL 774 with a mean of 23.05 mm and hybrid PL 710 with an average of 14.77 mm had the most and the least primary root length, and hybrid SC 704 with average 17.20 was in the sixth place (Figure 4).

**Seedling length:**

The results obtained from variance analysis of seedling length are presented in Table 1. These results indicate that there is statistically a meaningful difference at the 1%-probability level among tested treatments in terms of seedling length. As indicated in Figure 5, various hybrids have different seedling lengths and the most seedling length was allocated to hybrid PL774 with a mean of 50.35 mm, where as the least seedling length belonged to hybrid PL 710 with an average of 23.47 mm. Hybrid SC704 with average 28.85 mm was less than the total mean of treatments (32.24 mm) and was in the sixth place.

**Conclusion:**

One of the agricultural characteristic of seed is its growth power. Seed vigor, rapid ability of seedling, and the degree of seed tolerance determine a range of various environmental factors. The effect of seed vigor on the growth of plant and its performance may arise as well. The results obtained from this experiment indicated that the studied hybrids can influence the characteristics evaluated in standard germination test and exhibit certain differences. This experiment also indicated that five hybrids of can used in this study were significantly superior to hybrid SC 704 (the prevalent hybrid in the region) in terms of the evaluated characteristics. Since in most cases the results obtained in laboratory conditions can predict and suggest the results obtained field conditions, it is expected that these hybrids can also preserve their superiority in field conditions in the region.
Table 1: Analysis of variance (mean squares) Standard Germination Test and seedling characters in laboratory conditions

<table>
<thead>
<tr>
<th>S. O. V</th>
<th>df</th>
<th>Standard Germination Test</th>
<th>Mean germination</th>
<th>Daily</th>
<th>germination</th>
<th>Seedling Index</th>
<th>Vigor</th>
<th>Primary</th>
<th>root</th>
<th>Seedling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>daily speed</td>
<td></td>
<td>daily</td>
<td></td>
<td></td>
<td>length</td>
<td></td>
<td>length</td>
</tr>
<tr>
<td>Hybrids</td>
<td>10</td>
<td>20.30454**</td>
<td>0.00127**</td>
<td>62.48632.19**</td>
<td>30.14264**</td>
<td>294.02740**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>33</td>
<td>0.09509</td>
<td>0.00006</td>
<td></td>
<td>11685.39</td>
<td>0.28462</td>
<td>1.30651</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>CV(%)</td>
<td>7.02</td>
<td>8.40</td>
<td>2.27</td>
<td>2.99</td>
<td>3.54</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

ns: non significant, * , ** : respectively significant (p ≤ 0.05) and highly significant (p ≤ 0.01)

Fig. 1: Effect hybrids on mean daily germination in laboratory conditions using standard germination test

Fig. 2: Effect hybrids on daily germination speed in laboratory conditions using standard germination test

Fig. 3: Effect hybrids on seedling vigor index in laboratory conditions using standard germination test
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