A comparison of maize commercial varieties in terms of grain yield and its components

Zohrab Gorgani, Ezzat Karami*

Agronomy and Plant Breeding Department, College of Agriculture and Natural Resources, Sanandaj Branch, Islamic Azad University, Sanandaj, Iran

Key words: Cluster, comparison, corn, cultivar, grain.

http://dx.doi.org/10.12692/ijb/6.5.298-307 Article published on March 14, 2015

Abstract

The experiment carried out in order to comparison of maize commercial cultivars grain yield and its components in Kamyaran region, Kurdistan province of Iran, during the 2013 cropping season. The fourteen commercial cultivars of maize evaluated as Randomize Complete Block Design (RCBD) with three replications. Days to maturity, days to harvest, grains rows cob⁻¹, grains row⁻¹, 100-grain weight (gr), grain moisture content (%), grain yield mean per five plants (gr) and grain yield hectare⁻¹(t/h) were measured. Analysis of variance results showed studied cultivars were deferent significantly for all measured traits at the level of 1%. That indicated genetic variation among studied cultivars. According to Duncan’s mean comparison results at 5% level the highest value of measured traits were belonged to 89May70 and Hido cultivars. These cultivars produced higher grain yield hectare⁻¹ with the value of 11.4 and 10.1 (t ha⁻¹), respectively, and showed significant deference than KSC 704 traditional cultivar with the value of 8.7(t ha⁻¹). The Cantabris cultivar accounted for lowest amount of grain yield hectare⁻¹ (5.4 t ha⁻¹). The cluster analysis classified studied cultivars into four separate clusters. Two hopeful cultivars of 89May70 and Hido classified into two separate clusters. Therefore, we could be using from these cultivars in breeding programs for release of the cultivars with highest hetrosis vigor and grain yield.

*Corresponding Author: Ezzat Karami ☉ ezzatut81@yahoo.com
Introduction

Maize (Zea mays L.) is the most important grain crop in the world and is produced under diverse environments. Successful maize production depends on the correct application of production inputs that will sustain the environment as well as agricultural production. These inputs are, inter alia, adapted cultivars, plant production, soil tillage, fertilization, weed, insect and disease control, harvesting, marketing and financial resources. Cultivar choice, if correctly planned, can make a great contribution to risk reduction and should constitute an important part of production planning. Cultivars differ from one another with regard to a variety of characteristics. Therefore, every cultivar has its own adaptability and yield potential. These differences among cultivars leave a producer with alternatives that can be utilized fully. The producer should, however, first verify the reaction of new or foreign cultivars before abandoning proven cultivars. As a result of a wide diversity of conditions under which maize is produced in the world, it is essential that cultivars that are eventually planted should be adapted to specific production conditions. Cultivars with wide adaptability can be used to stabilize yields under variable weather conditions of the world. Together with adaptability, stability of cultivars should also be considered. Greater stability of a cultivar, leads to predict ability of yield reaction at a specific potential (Siadat et al., 2013). The Success of crop breeding programs primarily depends on the availability of plant genetic variation. Moreover genetic diversity is a key element of sustainable agriculture and genetic diversity should always be considered in agricultural systems through learning from nature (Bagheri et al., 1996). Management and the proper use of the local varieties diversity and wild relatives are very important in implementation of effective breeding programs. The first step in plant breeding programs is exact identification of the plant germplasm structure, which this issue would make possible regular and accurate sampling of germplasm for breeding and conservation objectives (Hajjar and Hodgkin, 2007; Hawkes, 1977; Hayward et al., 1993). The inform of genetic distance among individuals or populations and knowledge of kinship relations varieties used in breeding programs provide the possibility of germplasms organizing, effectively sampling of genotypes and better utilization of diversity (Sharma et al., 1996). The genetic diversity is a key to crop improvement (Welsh, 1981). The search for superior genotypes regarding yielding ability, disease and pest resistance, stress tolerance or better nutritional quality is very hard, competitive and expensive. This is why breeders tend to concentrate to adapted and improved materials, avoiding wild parents, landraces and exotics, available in germplasm banks which would require long time, high financial support besides the difficulty to identify potentially useful genes. Evidently, there is a gap between available genetic resources and breeding program activities. While germplasm banks try to preserve as much as possible genetic variability to be used by breeders, breeding programs do not explore efficiently the available diversity, relying almost exclusively on their working collection. One of the consequences of the massive use of uniform commercial varieties in maize production is loss of its genetic variability. Only about 5% of maize germplasm is in commercial use (Caliskan, 2012). Genetic improvement in traits of economic importance along with maintaining sufficient amount of variability is always the desired objective in maize breeding programs (Hallauer, 1973). Grzesiak (2001) observed considerable genotypic variability among various maize genotypes for different traits. Bernardo (1995) and Ihsan et al. (2005) also reported significant genetic differences for morphological parameter in maize genotypes. Olakajo and Iken (2001) reported that maize varieties produce significantly different yields at different locations. Olaoye (2009) emphasized the need to evaluate maize varieties in various agro-ecological zones for their adaptation, yield potential and disease reactions so as to release suitable varieties for cultivation on farmers’ fields. It is, therefore, imperative to understand the relationship among yield testing locations for better adaptation of germplasm to different production environments (Trethowan et al., 2001). The present study was conducted to evaluate the performance of fourteen...
maize genotypes under the agro climatic condition of Kamyaran region and assess the magnitude of diversity among them. The objective was to search for maize genotype(s) with improved yield along with other desirable traits.

Material and method

Plant Material

The fourteen maize varieties (Biaris, Cantabris, Chillan, Dehghan, Eldora, Es.sensor, Es.solito, Fager, Hido, KSC704, 89May70, Macari, Tuono and Triumfo) were evaluated for various yield parameters. The seed of studied cultivars were provided from Seed and Plant Improvement Institute, Karaj, Iran.

Geographical Coordinates and Soil Characteristics of Experiments Site

The experiment was conducted at the Haibt Abad Research Farm, Kamyaran, Kurdistan province, Iran (The North Latitude: 34˚ 47′ 32.6″; the East Longitude: 46˚ 52′ 29″ and 1435 meters high from sea level) during summer 2013. The experimental area has a heavy soil structure with clay-silt soil at 0-20 cm depth and clay-loamy structure at 20-40 cm depth. It was laid out in a randomized complete block design (RCBD) with 3 replications.

Farming Operations

Sowing was done on a well prepared soil on 3rd week of May. The net plot size was 10m × 2.1m with 3 rows 10 m length and spacing 70 cm between rows and 20 cm between plants (Turgut, 2000). Two seeds were planted in each hill and then thinned to one plant to have a final plant density of 71420 plants ha⁻¹. Nitrogen and Phosphorous were applied 150:50 kg ha⁻¹ as Urea and Super Phosphate triple. All P and 33% of N were applied at planting time, whereas the residual amount of N was top dressed one month after sowing. The irrigation was done immediately after sowing then to determine the exact irrigation frequency based on the maize water requirement was implanted two tensio-metre 60cm and 90 cm from Jet-Phil American company in depth of 22 cm (roots) and 35 cm (under root). Thus, moisture requirement of experimental field was estimated to be accurate and timely. Control of weeds using 2,4-D poison to 5.1 liters per 300 liters of water per hectare rate was used. Harvest was done at the end of the milk stage of seed for each variety. All agronomic practices were provided at par to all treatments.

Traits Measurement

Observations and measurements were done for eight characters such as days to maturity, days to harvest, grains rows cob⁻¹, grains row⁻¹, 100-grain weight (gr), grain moisture content (%), grain yield average per five plants (gr) and grain yield hectare⁻¹ (t h⁻¹) on five normal plants that were harvested from middle row of the each plot. Grain yield (kg ha⁻¹) was calculated for the entire plot, converted into yield ha⁻¹ and it was adjusted to 14% grain moisture using the formula prescribed by Taran et al. (1998).

Statistical Analysis:

Analyses of variance and Duncan’s Multiple Range Test (LSR) at 5% probability level were done by SAS 9.2 software (2014) and Ward’s cluster analysis was done by SPSS17 software (2008).

Result and discussion

Analysis of variance (Table 1) showed that studied cultivars for all traits were significant differences in the level of 1%. The results of the means comparison of Duncan at 5% also showed significant differences among the studied cultivars (Table 2). This represents difference and genetic diversity of commercial cultivars that can be use this potential in order to select the best and most consistent cultivar with the climate of the region and growing season duration. Can also selecting the suitable varieties to the cross in breeding programs and use them to improve the yield of maize. Similar results were reported by Ahmed et al. (2000) and Souza et al. (2002) who evaluated and identified high yielding maize varieties among different genotypes tested.

Days to Maturity

Iranian varieties of Fajer and Deghan with 125 and 120 days to maturity, respectively, were the earliest cultivars. But foreign cultivars Biaris (138 days),
Cantabris (137.7 days), Chillan (137.3 days), Eldora (141 days), Macari (137 days) and Hido (139.7 days) as the latest cultivars by Duncan’s grouping were grouped in the same group. Since these cultivars are late and the growing period of them lasts longer than 4.5 months therefore should in the beginning of the growing season (April) are cultivated as soon, Otherwise, due to down-temperature at the end of the growing season the thermal coeffici

Table 1. Variance analyses of randomize complete block design for yield and yield components in maize.

<table>
<thead>
<tr>
<th>S.O.V</th>
<th>df</th>
<th>Days to Maturity</th>
<th>Days to Harvest</th>
<th>Moisture Content</th>
<th>100-Grain Weight</th>
<th>Grains Rows Cob-1</th>
<th>Grains Row-1</th>
<th>Grain Yield per 5 plant</th>
<th>Grain Yield / hectare</th>
<th>CV%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block</td>
<td>2</td>
<td>14.2</td>
<td>6.45</td>
<td>6.365</td>
<td>28.67</td>
<td>1.8</td>
<td>23.87</td>
<td>0.148</td>
<td>0.00018</td>
<td></td>
</tr>
<tr>
<td>Varieties</td>
<td>13</td>
<td>120.1</td>
<td>89.47</td>
<td>91.1</td>
<td>79.87</td>
<td>4.6</td>
<td>23.67</td>
<td>0.366</td>
<td>7.25</td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>26</td>
<td>5.16</td>
<td>5.37</td>
<td>11.76</td>
<td>12.12</td>
<td>0.986</td>
<td>8.19</td>
<td>0.125</td>
<td>0.0016</td>
<td></td>
</tr>
<tr>
<td>CV%</td>
<td></td>
<td>10.7</td>
<td>11.4</td>
<td>15.17</td>
<td>11.61</td>
<td>6.42</td>
<td>8.03</td>
<td>20</td>
<td>7.5</td>
<td></td>
</tr>
</tbody>
</table>

**Days to Harvest:**
In terms of days to harvest the studied cultivars by Duncan’s grouping were grouped in two classes, so that the cultivars of Biaris, Cantabris, Chillan, Eldora, Macari and Hido as the more late cultivars were placed at the same class. Also the cultivars of Dehghan, Fajer, 89May70 Tuono, Triumfo, Es-Solito, Es-Sensor and KSC704 with the fewer days to harvest average as a range of medium and early varieties were placed in a common class. Nevertheless, the Eldora cultivar with an average 149.3 days to harvest and the Tuono cultivar with an average 135 days to harvest accounted for least and most number of days to harvest, respectively, and were identified as late and early cultivars in this experiment. Lari et al. (2006) To study effect of planting date on maize varieties in three consecutive years (2004, 2005 and 2006) showed that early planting date due to the long period of growth and more biomass than other planting dates was produced significantly further grain yield at the level of 5%. Whatever planting dates went toward the cold season was reduced the crop yield and varieties in terms of yield components showed significant difference (at 1% level) which represents diversity in potential of their production.

**Grains Rows per Cob**
Studied cultivars were different significantly because of grains rows cob-1 that indicating cultivars genetic variation and primary germplasm difference which were derived from. Since, the grains rows cob-1 is considered as a major component of yield and the influence of genetic in maize, therefore the cultivars with higher grains rows cob-1 can produce more grain yield. This trait as one of the effective components of yield can be used a criterion to identify varieties with high yield in corn. Duncan’s grouping on this trait placed the studied cultivars in variety groups. Es-Sensor varieties with an average of 33.17 and the Iranian cultivar of Dehghan with an average of 22.14 allocated highest and lowest number of grains rows cob-1, respectively. Also, Macari, Eldora, Contabris and Hido varieties produced high grains rows cob-1.

**Grains per Row**
Cultivars of KSC704 and Triumfo with 39.3 and 39.5,
respectively, accounted for a maximum number of grains row\(^{-1}\) and without a significant difference were placed in the first group. The range of this trait in the studied cultivars was different from 31.5 for Hido cultivar up to 39.5 for the Triumfo cultivar. KSC704 cultivars with the highest number of grains row\(^{-1}\) has produced approximately 9 tons of grain yield per hectare which in terms of ranking in comparison of other cultivars were placed third rank. However, 89May70 and Hido cultivars with a 11.5 and 10( t h\(^{-1}\)) produced the highest grain yield per hectare but in terms of grains row\(^{-1}\) with 36 and 31.5, respectively, among studied cultivars were placed in the middle and lower ranks. Considering to the Hido cultivar has been place in the first rank for the most influential characters seems to be short of cob length and reducing the number of grains row\(^{-1}\), as weak point of this cultivars is the main factor, placing it in the second rank in terms of grain yield, otherwise, would be expected was placed in the first rank. Here one can easily understand to the importance of this trait as one of the most influential components on grain yield in maize. Khalili et al. (2013) were investigated yield and its components of four corn cultivars under both normal and drought stress (as irrigation interruption) and reported that KSC720 cultivars has to be the highest traits such as grain yield, grains rows cob\(^{-1}\), grains row\(^{-1}\) and100-grain weight. Zaman Khan et al. (2011) reported that maize varieties had significant difference in terms of grains row\(^{-1}\).

<p>| Table 2. The means comparison of maize varieties using Duncan’s multiple range tests at the level of 5%. |</p>
<table>
<thead>
<tr>
<th>Varieties</th>
<th>Days to Maturity</th>
<th>Days to Harvest</th>
<th>Moisture Content</th>
<th>100-Grain Weight(g)</th>
<th>Grains Rows Cob</th>
<th>Grains Row(^{-1})</th>
<th>Grain Yield /5 plants(gr)</th>
<th>Grain yield / hec tare(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehghan</td>
<td>120.33e</td>
<td>137.7b</td>
<td>18.57defg</td>
<td>23f</td>
<td>14.22ed</td>
<td>34.22abcd</td>
<td>1.49cd</td>
<td>6.64i</td>
</tr>
<tr>
<td>FAJER</td>
<td>125d</td>
<td>138b</td>
<td>15.93fg</td>
<td>25.3ef</td>
<td>16.57ab</td>
<td>37.45abc</td>
<td>1.6ed</td>
<td>7.12h</td>
</tr>
<tr>
<td>ES-SENSOR</td>
<td>132b</td>
<td>139b</td>
<td>16.97efg</td>
<td>25.67ef</td>
<td>17.33ca</td>
<td>32.22ed</td>
<td>1.82bed</td>
<td>8.08e</td>
</tr>
<tr>
<td>ES-SOLITO</td>
<td>129.7bc</td>
<td>139b</td>
<td>23.73bed</td>
<td>30ede</td>
<td>14.57cd</td>
<td>33.66bed</td>
<td>1.45cd</td>
<td>6.48j</td>
</tr>
<tr>
<td>TRIUMFO</td>
<td>127cd</td>
<td>136b</td>
<td>23.17dce</td>
<td>30.67bcde</td>
<td>15.89abc</td>
<td>39.55a</td>
<td>1.67bed</td>
<td>7.4g</td>
</tr>
<tr>
<td>TUONO</td>
<td>126.3cd</td>
<td>135b</td>
<td>17.33defg</td>
<td>23f</td>
<td>13.33rd</td>
<td>38.78ab</td>
<td>1.42ed</td>
<td>6.3k</td>
</tr>
<tr>
<td>89 MAY 70</td>
<td>128.3bcd</td>
<td>137.7b</td>
<td>31.17a</td>
<td>35.67abc</td>
<td>14.44cd</td>
<td>36abc</td>
<td>2.56a</td>
<td>11.4a</td>
</tr>
<tr>
<td>KSC 704</td>
<td>129.3bc</td>
<td>137b</td>
<td>29.9abc</td>
<td>33.33abcd</td>
<td>14.44cd</td>
<td>39.33a</td>
<td>1.99abc</td>
<td>8.87c</td>
</tr>
<tr>
<td>BIARIS</td>
<td>138a</td>
<td>148.3a</td>
<td>21.33def</td>
<td>26.67ef</td>
<td>14.67bc</td>
<td>32.33cd</td>
<td>1.81bcd</td>
<td>8.15d</td>
</tr>
<tr>
<td>CANTABRIS</td>
<td>137.7a</td>
<td>147a</td>
<td>14.37g</td>
<td>28def</td>
<td>17.22a</td>
<td>33.33bcd</td>
<td>1.21d</td>
<td>5.4l</td>
</tr>
<tr>
<td>CHILLAN</td>
<td>137.3a</td>
<td>147.7a</td>
<td>26.03abc</td>
<td>28.33def</td>
<td>15.11bc</td>
<td>34.77abc</td>
<td>1.74bed</td>
<td>7.75f</td>
</tr>
<tr>
<td>ELDORA</td>
<td>140.7a</td>
<td>149.3a</td>
<td>22.5cde</td>
<td>39a</td>
<td>16.45ab</td>
<td>37.77abc</td>
<td>1.73bed</td>
<td>7.72f</td>
</tr>
<tr>
<td>MACARI</td>
<td>139.7a</td>
<td>145.3a</td>
<td>25.2abc</td>
<td>34abcd</td>
<td>16.56ab</td>
<td>37.77abc</td>
<td>1.83bcd</td>
<td>8.12de</td>
</tr>
<tr>
<td>HIDO</td>
<td>139.7a</td>
<td>148.7a</td>
<td>39.23a</td>
<td>37ab</td>
<td>15.56abc</td>
<td>31.55d</td>
<td>2.27ab</td>
<td>10.1b</td>
</tr>
</tbody>
</table>

The varieties with same letter have not significant difference.

**Grain Moisture Content**

Since, the agricultural researchers strive to select the varieties that have low moisture content during the harvest, thereby, low cost and time for drying grains and guaranteed optimal storage and high quality seeds. The results of this experiment showed Cantabris and 89May70 foreign varieties with an average of 14.3 and 31.17 accounted lowest and highest of moisture content, respectively. Iranian corn varieties of Fajer and Dehghan, with 15.9 and 18.5 accounted low levels of grain moisture content, respectively. It is remarkable that the amount of grain moisture content in the 89 May 70 was more than twice the amount of grain moisture content in the
Cantabris. Meanwhile, the cultivars of 89May70 and Hido with no significant difference accounted the maximum moisture content of grain also produced the highest grain yield per hectare. With this interpretation can be concluded the moisture content during the harvest is a genetic characteristic then could be produced varieties with high yield and low levels of grain moisture content during the harvest by suitable breeding programs.

**Table 3.** The means of traits for clusters separately.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Varieties</th>
<th>Days to Maturity</th>
<th>Days to Harvest</th>
<th>Moisture Content</th>
<th>100-Grain Weight</th>
<th>Grains Row-1 Cob-1</th>
<th>Grains Row-1</th>
<th>Grain Yield per 5 plant</th>
<th>Grain Yield / hectare(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>89May70 KSC 704 ES</td>
<td>128.6</td>
<td>137.5</td>
<td>27</td>
<td>32.4</td>
<td>14.85</td>
<td>37.2</td>
<td>1.92</td>
<td>8.54</td>
</tr>
<tr>
<td></td>
<td>Solito Triumfo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>Fajer Tuono Dehghan</td>
<td>132.8</td>
<td>137</td>
<td>17.3</td>
<td>32.8</td>
<td>14.7</td>
<td>36.8</td>
<td>1.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Third</td>
<td>Eldora Macari Hido</td>
<td>139.03</td>
<td>148</td>
<td>26</td>
<td>36.7</td>
<td>16.2</td>
<td>35.7</td>
<td>1.94</td>
<td>8.7</td>
</tr>
<tr>
<td>Fourth</td>
<td>Biaris Chillan ES</td>
<td>136.2</td>
<td>145.5</td>
<td>19.7</td>
<td>27.2</td>
<td>16.08</td>
<td>33.2</td>
<td>1.65</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>Sensor Cantabris</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**100-Grain Weight**

Highly significant differences among cultivars for 100-grain weight as one of the other effective components of grain yield with monogenic inheritance is indicated the genetic diversity of cultivars, it allows that we can select the desired cultivar in relation to this attribute depends on the purpose of cultivation. Duncan’s Mean comparison at the 0.05 level (Table 2) showed the differences between cultivars for 100-grain weight and placed studied cultivars in different classes. The variation range of this attribute was different from 23 to 39 g for studied varieties. Eldora and Hido varieties with 39 and 37g had the highest 100-grain weight. These varieties, (especially the Hido) produced a high grain yield. Iranian varieties of Dehghan and foreign varieties of Tuono with 23 g accounted for the lowest 100-grain weight. These varieties compared to other studied cultivars produced lower grain yield per hectare, too. Estakher (2003) to investigate the grain yield and yield components and the study their correlation in foreign and domestic corn hybrids found that hybrids were significant differences in terms of traits such as plant height and ear height, number of grains rows cob-1 and grains row-1, seed depth, 100-seed weight, percentage of cob ear, grain yield and days to maturity.

**Grain Yield per 5 Plants:**

Average grain yield in 5 plants was different from 1.2 g to 2.56 g. The highest and lowest grain yield per 5 plants belonged to 89May70 and Cantabris varieties, respectively. This issue is very important that average grain yield per 5 plants for 89May70 cultivar is more than twice the Cantabris cultivar. Although 89May70 variety had the highest grain yield per 5 plants (2.56 g), but compared to the Hido and KSC704 cultivars with the value of 2.27 g and 1.99 g was not significant difference. Iranian cultivars of Dehghan and Fajer with the average of grain yield per 5 plants (1.49 g) and (1.6 g), respectively, were not significantly different and placed in the same class. The average of grain yield per 5 plants for Iranian varieties compared to 89May70 foreign cultivar was approximately half. Because of considerable cultivated area of corn in Iran, the situations of Iranian cultivars are not satisfactory. TamadonRastgare (2005) by performing researches reported that maize cultivars have significant differences for grain yield and yield components that indicate different potential of maize varieties for seed production.
**Grain Yield per Hectare**

When the purpose of the experiment is comparing commercial cultivars under the climatic conditions of a particular area to identify and introduce optimal cultivar, the most important and reliable attribute to judge about studied cultivars is grain yield per hectare. This attribute is outcome of the all traits that influenced directly or indirectly and defined as the ultimate goal of farming in grain crop products. Therefore, it can be used as very good criterion for judging and selection of promising and optimal cultivars. The results of this experiment Implies to the genetic diversity of cultivars in terms of this trait. Genetic diversity among studied cultivars have particularly importance, because it's possible the choice optimal genotypes to fit condition of the cultivation area for researchers and agricultural specialists. Also, existence differences and demonstrated genetic diversity among commercial varieties allows the plant breeders that could be select complementary cultivars for the cross in order to achieve the superior objectives, So that researchers can breeding and release the cultivars that have most desirable traits to produce a greater grain yield. The highest grain yield per hectare (11.4 t ha⁻¹) in the present experiment was belonged to 89May70 cultivar that placed in group A with a significant distance than traditional cultivar of KSC 704 (8.8 t ha⁻¹). Hido (10.1 t ha⁻¹) and KSC 704 (8.8 t ha⁻¹) cultivars were ranked second and third groups, respectively. According to the results of this study and significant difference of 89May70 and Hido cultivars withKSC704, can be repeated trial and after ensure of result in the following years is promote and recommended 89 May70 cultivar as an alternative to the KSC704 in Kamyaran region. The cultivar of Cantabris with 4.5 t ha⁻¹ had the lowest value of the grain yield. However, it was accounted for the highest number of grains rows cob⁻¹. Small grains (100-grains weight down) and bald cobs in Cantabris cultivar was caused that it to be recognized in the last rank as the weakest cultivars in relation to grain yield per hectare (as the main criteria for selecting varieties). Iranian cultivars of Fajer and Dehghan with the value of 7.12 and 6.6 t ha⁻¹, respectively, had a significant difference. Hussein et al. (2011) in a similar experiment were studied fourteen varieties of corn for grain yield and stated that the corn varieties were significantly different in terms of the number of days to flowering, days to tasseling, days to maturity, plant height and grain yield. Considering to the high performance foreign varieties of 89May70 and Hido it seems now, Iranian varieties are not able to compete with foreign high performance varieties. The grain yield of Es-Sensor, Biaris and Macari Varieties were higher 8 t ha⁻¹ that indicated high genetic value of these genotypes. Ashoftehbirgy et al. (2011) reported significant differences among hybrids of corn, different years and dates of planting. So that the highest grain yield obtained from EXP1 hybrid and
the lowest grain yield was belonged to OSSK602 and DC370. McCutcheon et al. (2001) and Akbar et al. (2009) also reported significant differences among maize cultivars for grain yield.

**Cluster Analysis**

Cluster analysis to classify 14 commercial varieties of corn was performed by Ward’s method on the measured traits (Figure 1). The 89May70, KSC 704, Es-Solito and Triumfo cultivars were placed in the first cluster. Also, two subgroups formed within first cluster, so that cultivars of 89May70 and KSC704 in the first subgroup and Es-Solito and Triumfo were placed in the second subgroup. Iranian varieties of Fajer and Dehghan with the Tuono cultivar were placed in the second cluster that indicated the genetic affinity and the same genetic pedigree of these cultivars. Very late varieties of Eldora, Macari and Hido that in terms of measured traits were very close and similar were placed third cluster. Also, the third cluster was divided into two subgroups so that, the Eldora and Macari cultivars in the first subgroups and the Hido cultivar were classified in the second subgroups. The fourth cluster was in its placed Biaris, Chillan, Cantabris and Es- Sensor cultivars and it was divided into two subgroups similar to the first and third cluster. The Biaris and Chillan cultivars in the first subgroups and the Cantabris and Es- Sensor cultivars were grouped in the second subgroups. The cultivars are located in a cluster and in a sub-group particularly, have a Maximum genetic affinity with each other and is possible are originated from a same germplasm and have the same genetic pedigree. But the cultivars are classified in separate clusters have not genetic relationships and more likely carriers of different genes to control the traits. Therefore, if we want to select cultivars with complementary characteristics for crossing blocks in plant breeding programs, should be used varieties that are classified in separate and distant clusters. With this interpretation and based on results of the present study can be concluded cross of the Hido and 89May70 cultivars is Promising to release of new hybrid varieties with high heterosis vigor and high grain yield. In order to better interpret the clusters the means of measured traits were calculated for the cultivars within each cluster (Table 3). The classified cultivars within third cluster (Eldora, Macari and Hido) are accounted for the highest value of days to maturity, 100-grain yield, grains rows cob-1 and grain yield per hectare. The first cluster varieties (89May70, KSC704, Es-Solito and Triumfo) were close to the third cluster varieties (Eldora, Macari and Hido) in terms of grain yield and yield components. The second cluster varieties (Fajer, Dehghan and Tuono) were similar to fourth cluster varieties (Biaris, Chillan, Cantabris and Es- Sensor) for all measured traits (Table 3).

**Abbreviation**

Grains rows cob-1: Grains rows per cob; Grains row-1: Grains per row; Grain yield hectare-1: Grain yield per hectare; LSR: Least significant ranges; RCBD: Randomize complete block design.

**References**


http://dx.doi.org/10.2135/cropsci1995.0011183X003
500010026x.

http://dx.doi.org/10.5772/2639.


http://dx.doi.org/10.1007/s10681-007-9363-0.

http://dx.doi.org/10.2135/cropsci1973.0011183X001
300030001x.

http://dx.doi.org/10.1007/BF00021686.


http://dx.doi.org/10.4314/as.v8i2.51107.

Sharma SK, Knox MR, Ellis TH. 1996. AFLP analysis of the diversity and phylogeny of Lens and its comparison with RAPD analysis. Theoretical Applied Genetic 93, 751-758.  
http://dx.doi.org/10.1007/BF00224072.


Souza FRSD, Rebeiro RHE, Veloso CAC, Correa LA, Souza FRS. 2002. Yielding and
phenotypic stability of corn cultivars in three municipal districts of Para State, Brazil. Pesquisa-Agrepercúria-Brasileia 37, 1269-1274.


