INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 12, p. 512-517, 2014

RESEARCH PAPER OPEN ACCESS

Effect of planting date on yield and germination indices of different shapes of hybrid maize seeds (*Zea mays* L. Cv. single cross 704)

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Key words: Standard germination, mean time to germination (MTG), seedling vigor index length and radicle emergence.

http://dx.doi.org/10.12692/ijb/5.12.512-517 Article published on December 27, 2014

Abstract

Maize (*Zea Mays* L.) is the third most important crop after wheat and rice and is grown in more countries than any other crop in the world. This experiment was conducted to study of germination reactions of different shapes of hybrid maize (*Zea mays* L. Cv. Single Cross 704) to planting date and effect of planting date on yield and yield components. The study was carried out in 2012 at the seed and plant certification and registration institute in Karaj- Iran. The experiment in field was conducted in a randomized complete block designs with four replications. Also the experiment in laboratory was carried out in a factorial experiments based on completely randomized designs. The ration of maternal lines to paternal lines was 4:2, so that B73cms was used as the maternal line and Mo17 was used as the paternal line Treatments were included planting date (T1: 2 May., T2: 12 May., T3:28 May) and seed size (round, medium and flat).For separation and grading of round, flat and medium seeds respectively oblong (5.5 mm), round (7 mm) and round (6-6.25mm) sieves were used. Traits were studied including: yield and yield components, standard germination, Mean time to germination (MTG), Seedling vigor index length and Radicle emergence. Results showed that sowing date significantly effected on the number of seeds on rows, weight of 1000 seeds and yield. Main comparison indicated that with delay of planting date, normal seedling percentage and Seedling vigor length index and radical emergence were decreased and mean time to germination was increased.

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Introduction

Corn (*Zea mays* L.) is one of the most important cereal crops grown principally during the summer in Iran. (Dahmardeh and Dahmardeh, 2010). The seed yield of corn consists of different proportional contributions of the effective factor in all growth stages from emergence to maturity (Yakup and Canavar, 2014).In order to minimize negative effect of some abiotic and biotic stress on plant, sowing date can play a major role in determining the seed yield, quality, seed germination and understanding whole phonological stages in many regions(Yakup and Canavar, 2014). Shunway *et al.*,(1992) explained that delay in sowing reduces quality performance and performance components of maize. Early and intermediate sowings tend to best utilize solar radiation for grain production (Otegui *et al.*, 1995). Temperature is a major environmental agent that determines the rate of plant growth and development. Corn development is primarily driven by temperature, with air temperature being theoretical to enhance maize development from emergence to physiological maturity (Cuttorth and Shaykewich, 1990).

Muchow(1990) showed that seed growth may be directly influenced by air temperature. Different sowing dates might cause different environmental conditions from emergence to seed filling.

Materials and methods

The study was carried out in 2013 at the seed and plant certification and registration institute in Karaj-Iran. The geographical coordinates is 35 degrees 48 north latitude and 50 degrees 58 minutes east longitude. The soil type was a silty clay with a pH of 7.8 and 0.8% organic matter. The land was plowed and disked before planting. Fertilizer was applied according to the soil test recommendation. The experiment in field was conducted in a randomized complete block designs with four replications. The experiment in laboratory was carried out in a factorial experiments based on completely randomized designs as well . The ration of maternal lines to paternal lines was 4:2, so that B73cms was used as the maternal line and Mo17 was used as the paternal line. The spacing between stacks was 75cm and the space between seeds in every planting row of paternal lines was 10cm, while , of the maternal lines was 18cm. Treatments were included planting date (T1: 2th May., T2: 12th May., T3:28th May) and seed size(round, medium and flat). For separation and grading of round, flat and medium seeds respectively oblong (5.5 mm), round (7 mm) and round (6-6.25mm) sieves were used. In order to ensure precise separation of the seeds, this work was done two times manually with related screens.

Standard germination test

Standard germination test was conducted for all samples according to the between paper (BP) method of the ISTA rules (ISTA, 2008). Four hundred seeds were randomly chosen from various flat, round and medium and under sieve seeds and were placed on moist germination paper (containing 4 sheets of germination paper and 1 sheet of paper towel) equidistant apart. Paper towels were rolled up and placed individually in plastic bags. The bags were sealed with an elastic band. They were incubated in an upright position at 25 ± 1°C. Percentage germination was determined after seven days and rating for normal/abnormal seedlings was done at eleven days. Seeds were visually assessed according to the ISTA rules (ISTA, 2008). Results were presented as the percentage seedlings that had germinated at the end of the test period. Finally ten normal seedlings were selected randomly and seedling, root and shoot length and dry and fresh weight were calculated. In order to evaluate germination time and speed, germination papers were checked daily and number of germinated seeds were recorded. By daily counting of germinated seeds, seed germination and seedling vigor indices was calculated as following:

Mean time to germination (MTG)

Mean time to germination is an index of seed germination speed and velocity (Ellis and Roberts, 1981), and calculated by:

$$MTG = \frac{\Sigma (nd)}{\Sigma n}$$

n = number of germinated seed during d days
d = number of days
Σn = total number of germinated seeds
Seedling vigor index length (SVIL)=LP*nor
LP: length of seedling; 10 seedlings of each treatment and replication were selected and length measurements were taken nor; number of normal seedlings (Ellis and Roberts, 1981).

Radicle emergence

Radicle emergence test was conducted for all samples according to the between paper (BP) method of the ISTA rules (ISTA, 2008). Four hundred seeds were randomly chosen from various flat, round and medium and under sieve seeds and were placed on moist germination paper (containing 4 sheets of germination paper and 1 sheet of paper towel) equidistant apart. They were incubated in an upright position at 20 ± 1°C for 66 hours. After 66 hours the number of seedlings that having 2 mm of radicle, were counted(Matthews *et al.*,2011).

Statistical analysis

Analysis of variance was conducted using SAS version9 software, and means were compared by LSD multiple range test at 1% and 5% probability levels.

The objective of this research was to distinguish germination reactions of different shapes of hybrid maize (*Zea mays* L. Cv. Single Cross 704) to planting date and effect of planting date on yield and yield components.

Results and discussions

The results of the analysis variance showed (Table 1) sowing date significantly effected on the number of seeds on rows, weight of 1000 seeds and yield.

Table 1. Mean square of yield components of corn seed in three planting dates in Karaj.

S.O.V	DF	The number of rows	The number of seeds on rows	Weight of 1000 seeds	Yield
Replication	3	0.173 ns	16.804*	233.252**	963262.11 ns
Planting date	2	1.24 ns	8.404**	256.202**	5168520.78**
Error	6	0.773	0.604	8.486	177158.28
CV		4.727	2.47	1.129	10.089

* and ** Significant at 5% and 1% levels, respectively. Ns Non-significant.

It was revealed that maximum of the number of seeds on rows and yield were seen in 2th May sowing date, but the peak of weight of 1000 seeds was seen in 12th May sowing date(Table2).

This result could be due to early sowing which caused the better growth and development of crop as Kolawole *et al.*(2009)reported .According to his report, good photosynthates accumulates in leaves and it transfers to economic part**s** such as grains, cobs etc.

Table 2. Mean comparison of yield components of corn seed in three planting dates in Karaj.

Treat	The number of seeds on rows	Weight of 1000 seeds	Yield
2th May	33.266 a	250.983 b	5177.3 a
12th May	31.0 b	268.433 a	4651.3 a
28th May	30.0 b	254.433 b	2687.0 b
LSD5%	1.76	6.603	954.17

Means, in each column, followed by similar letter are not significantly different at the 5% probability level- using LSD.

Analysis of variances illustrated that the size of seeds and the date of planting had a significant affects on percentage of normal seedling and the planting date had a noticeable effect on radical emergence as well (Table3). Evidently, the interaction of these aforementioned factors on germination mean time,

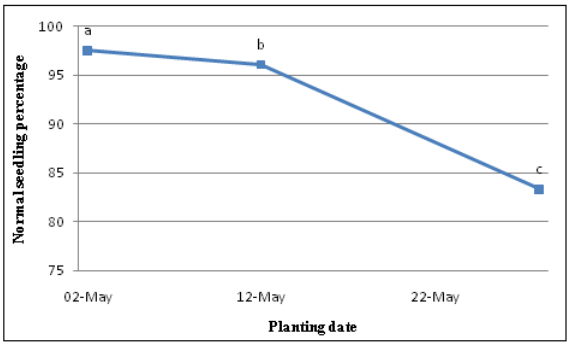
seedling vigor length index and seedling vigor weight index, were considerable (Table 3). Main comparison indicated that with delay of planting date, normal seedling percentage decreased while the highest normal seedling percentage was in the first plating date(2th May with 98%) and the lowest one was in the thirst planting date(28th May with 84%) (shape 1).

Table 3. Mean square of some germination indexes of corn seed in three planting dates and three seed sizes.

S.O.V	Normal seedling percentage	Mean time to germination	Seedling vigor length index	Seedling vigor weight index	Radicle emergence percentage
seed size	16.44**	0.21**	77629.48**	1.459**	9.333ns
Planting date	551.44**	0.74**	523848.03**	12.537**	236.333**
seed size × Planting date	0.722ns	0.08**	14134.64**	1.954**	5.833ns
Error	1.74	0.012	3914.444	0.079	6.518

* and ** Significant at 5% and 1% levels, respectively. Ns Non-significant.

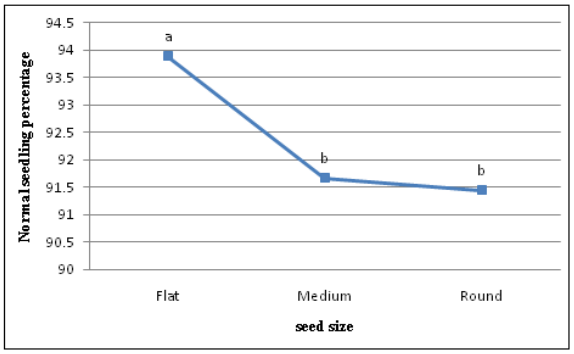
Mean comparison of main effect of seed size on normal seedling percentage showed that there was the highest normal seedling percentage in flat size (about 94%) and there was not any significant effect between medium and round sizes (shape 1).



Shape 1. Effect of planting date on normal seedling percentage

Mean comparison of interaction of planting date and seed size showed that there was not significant effect on mean time to germination among sizes in the first planting date (shape 3). At the second planting date (12-May) there was not considerable effect between flat and medium sizes but there were substantial effects between flat and medium with round, as the highest mean time to germination was in round size. At the third planting date, there were significant effect among sizes and the highest mean time to germination in flat size and lowest one was seen in medium sizes According to shape- 3 with delay of planting date, mean time to germination increased and climbing in round size was more than others.

Mean comparison of the effect of planting date on radicle emergence percentage indicated(Shape 4) that there were not a great deal of differences between the first and the second planting dates(2th May and 28th May),although the lowest rate was seen in the thirst planting date(28th May).



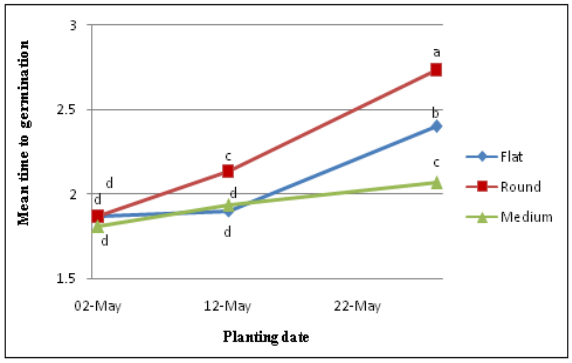
Shape 2. Effect of seed size on normal seedling percentage

Mean comparison of interaction of planting date and seed size indicated with delay of planting date Seedling vigor length index decreased .there were not significant effect between second and third planting dates in all seed sizes and Seedling vigor length index in flat size was more than round and medium sizes (Shape5).

Discussions

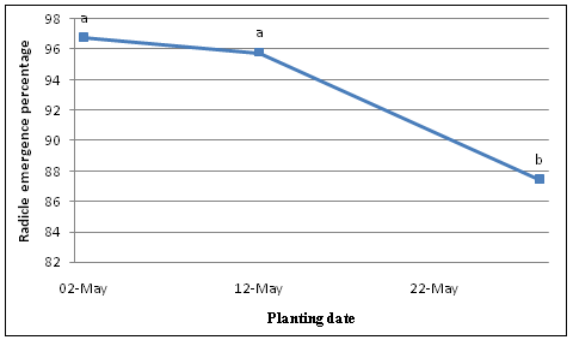
At least four strategies can be employed to maintain yields of vigorous seed: 1) sound agronomic management in seed production fields will minimize the severity of stress when it occurs;2) seed production areas are spread over wide geographic regions to minimize the risk of locally unfavorable growing conditions;3) many seed production areas

are capable of being irrigated; and finally, 4) new cultivars are continually being developed with improved stability, the ability of maintain seed yield and quality in variable production environments(Basra, 2002).



Shape 3. Effect of planting date and seed size on mean time to germination

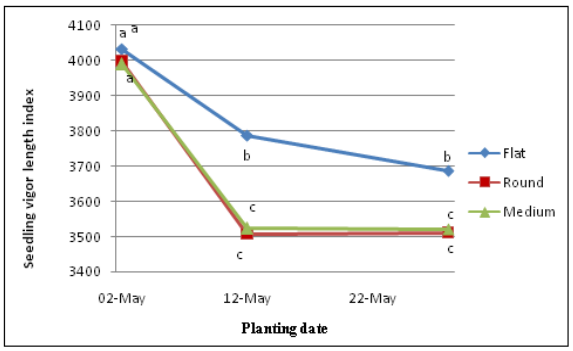
Mrdja *et al.*, (2012)Explained that seed quality depends on environmental conditions during growth season and occurring of unfavorite conditions during growth season ,even for short period, can cause to reducing of yield and changing of seed components and finally seed quality would be decreased.



Shape 4. Effect of planting date on radical emergence percentage

Also Akram ghaderi *et al.*, (2005) reported that seed producers could improve seed quality with changing of planting date.

Wych, 1988 showed that planting date in each location was determined by considering of high and low temperature risks, also he proved that early sowing caused to increasing of yield and seed quality.
One of the unique aspects of seeds on a corn ear is their dramatic difference in size and shape due largely to their position on the ear. Large round seeds are often found at the base of the ear and small rounds at the tip. About 75% of the seeds in between these round types are flattened as a result of their tightly packed position. These flats typically ranged in size from small to large(Beck, 2004).



Shape 5. Effect of planting date and seed size on Seedling vigor length index.

Roy *et al.*, (1996) studied on rice(*Oryza sativa*) and showed that rate of germination in small seeds were higher than large seeds. Vice versa Al-Niemi *et al.*, 1992 reported that large seeds have better germination and establishment and can produce uniform seedlings.

Aman and Ikram,(2001) reported that seed size could be effective on seed vigor by providing of more stored nutrition.

summary

The present study on the effect of planting date on yield and seed quality of different seed sizes of corn (*Zea mays* L. Cv. Single Cross 704) has indicated that planting date can influence on yield .delayed planting reduced grain yield and seed vigor and this reducing in round seeds were more than flat and medium seeds.

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