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Effects of parent plant nutrition with different amounts of nitrogen and irrigation on seed vigor and some characteristics associated with hybrid 704 in kermanshah region

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ABSTRACT: To evaluate irrigation intervals and various nitrogen levels effect on germination, vigor and other characteristics of maize single cross 704 produced from mother line , an investigation at research station of agricultural and natural resources research centre- kermanshah region and central seed quality control, (SPCRI) Karaj, in year 2013 were conducted. The effect of irrigation intervals of 7, 9, 11 and 13 days as main object and pure nitrogen fertilizer uses amount 66, 99, 132 and 165 kg/ha as secondary ones factor under based on randomized complete design with 4 replication carried out. Results of data variance analyses indicated that germination percentages, velocity, mean germination time, number of normal seedling, root dry weight and seedlings length were under effects of treatments and revealed significant. Maximum seed germination and seedling vigor index was related to uses of 165 kg/ha nitrogen fertilizer with seven days irrigation intervals. Maximum electrical conductivity was related to seeds that were received 165 kg/ha nitrogen with 13 days irrigation intervals. Therefore, conclusion obtained is that uses of 165 kg/ha nitrogen fertilizer in mother plants with 7days irrigation intervals will produce seeds with higher vigor, germination characteristics and seedlings establishment.

Keywords: electrical conductivity, seed viability, seedling vigor, single cross 704.

INTRODUCTION

Environmental conditions affect seed quality during seed formation and also affect seedling establishment in the next growing season (Zakaria, 2009).Environmental conditions, especially the nitrogen content in the soil affect seed's nitrogen content and can increase or decrease yield and yield components. Nitrogen plays a key role in seed filling (Green 1984) and may increase dry matter due to increased light absorption through the leaves (Willhelm 1998). Nitrogen fertilizer increased seed protein content in wheat (Knowles, 1991), which is a good index for seed quality and vigor as applications of nitrogen fertilizer in wheat resulted in seeds with higher final germination percentages while the time that 50% of seeds germinated and mean germination time significantly decreased (Warraich, 2002). Furthermore, seeds which were produced with fertilizer applications of 120 kg/ha nitrogen had more vigor compared to applications of 0, 60 and 180 kg/ha in an electrical conductivity test. Research has shown that if mother plants undergo high temperature stress.; physiological disorders can develop in seeds along with delayed germination, a decrease of seedling growth and emergence and low yield in field (Matthews and Powel, 1987). Studies on sunflowers indicated that high germination in sunflower can be achieved from an application of 120 kg/ha nitrogen fertilizer (Sawan,1985). It has been reported that applications of 0, 66, 132 and 600 kg/ha nitrogen fertilizer had no effect on seed vigor and germination percentage (Osechas and Torres 2002). A high level application of nitrogen fertilizer in pea resulted in a decreased yield and low germination rate (Pollock 1972). Positive effect of nitrogen fertilizer application to the mother plant can be attributed to the effect of delaying the aging of seeds that allows for enough time to obtain the photosynthetic matters that results in more weight and higher quality (Pallars, 1987). Fast and uniform seedling establishment is essential to achieve this objective and this requires high quality seeds (Hadavizadeh and Raymond 1989). Seed quality is affected by several factors and seed germination, vigor and health are all considered as important determinants of seed quality (Perry, 1980). Seed vigor is an important factor as it affects seedling establishment, crop growth and ultimately seed yield. Each biotic or non-biotic factor that affects seed vigor and germination during seed development has a subsequent affect on production, especially under stress conditions (Zakaria, 2009). Seed vigor and germination have a direct influence on yield and seed quality is known to affect seedling emergence (Tekrony and Egli 1991). Seed lots with high vigor show higher rates of final emergence compared to seed lots with low vigor (Johnson and Wax, 1981). Experiments on wheat seeds with uniform size but different nitrogen concentrations have shown higher amounts of protein content, which may produce vigorous seedlings (Rahman and Goodman 1983).

Plants wherever they are, they grow and meet by many stresses that these stresses limit their chance of growing and survival (Kuchaki, 2003). Drought stress is the most common environmental stress that approximately limits production Planting in 25 percent of world agricultural fields (Hashemi Dezfuli, 1995). Water deficit can affect oilseed rape yield, but this effect depends on genotype, the stage of development and adaptability of plant to drought (Mendham and Salisbury., 1995). Breeders and farmers aim to get higher seedling establishment in crops, but some biotic and a biotic stresses reduce seedling establishment in field conditions (Yagmur and Kydan, 2008). Understanding of the ecological and evolutionary responses to environmental stresses is necessary in order to predict the viability of natural plant populations and the survival of species in a geographic area(Heschel and Rigions, 2005).

The drought stress is considered as one of the main factors that imposes crops yield. The effects of water deficit depend on several factors such as its intensity, duration, phonological phase of growth and genetic resistance capacity of plants. The water limitation affects plant growth and its productivity. The most typical symptom of water deficiencies in plants is a retarded growth due to inhibition of cell elongation by water limitation (Clua, 2006). In order to reduce resulted stress damage, selection of cultivars that have a good yield under drought stress conditions, is the main goal in improving racing programs. The sensitivity of subject intensifies when the sufficient water exists for beginning germination but growth of the new established young seedling meets the lack of water (Pouzet, 1995).

According to the experiments of greenhouse which has been done on Pea, it has been known that this plant during flowering stage and at beginning of the seed filling is sensitive to drought stress (Sharp, 1993). Drought stress in various stages of plant growth has a different influence (Blum, 1998). This research was performed in order to study the effect of irrigation intervals and different nitrogen rates on mother plant on germination and vigor characteristics of produced seeds of hybrid single cross 704.

MATERIALS AND METHODS

This research was conducted in order to study effect of irrigation and nitrogen levels on mother plants of hybrid corn of single cross 704 that were subjected to 4 irrigation frequencies: 7, 9, 11 and 13 days and 4 levels of nitrogen (ammonium nitrate) application: 66, 99, 132 and 165 kg/ha. The produced seeds were tested in central seed quality analysis laboratory of Seed and Plant Certification and Registration Institute (SPCRI).

Any experimental unit consisted of 100 seeds that they were by 4 replications (400 seeds all together) under the germination standard test.

In order to execute this test according to International Seed Testing association (ISTA), the seeds were planted between germination wetted papers and then were placed into the germinator in 25˚C for 7 days. In order to determine the indexes of Mean Time of Germination, Coefficient of Velocity of Germination, Mean Daily Germination, Daily Germination Speed by each day planted seeds were visited and written a number of germinated seeds and some indexes related to the above mentioned seed germination determined by equations below:

Mean Time of Germination (MTG) that is an index of germination rate and acceleration computed by equation 1:

(equation1): $MTG = \sum(nd) / \sum n$

At the end of the test also the number of the normal seedlings as the Final Germination Percentage (FGP) were counted and notes were taken and the obtained data for computation of the Mean Daily Germination (MDG) was used that is the index of Daily Germination Speed were obtained by the equation below:

(equation3): $MDG = FGP/d$

In this equation: FGP is the Final Germination Percentage and d is the number of days to reach to maximum final germination (Hunter et al., 1984).

Also in order to determine the seed vigour the number of 10 seedlings of each replication sampling by random and then by separating of the primary roots, shoots and the seedlings, their length, fresh weight and dry weight were determined (by placing them in germinator within a period of 24 hours in 75˚C temperature). Also seedling longitudinal vigour index (SVI1) and seedling weight vigour index (SVI2) relations were determined by equations below (Hunter et al., 1984). (equation5): SVI1= (primary shoot length + primary root length) × viability
(equation6): SVI1= dry weight seedling × viability

The Electrical Conductivity Test: For estimating seed vigor by electrical conductivity test, first 4 replications of 25 seeds from each treatment were placed in distilled water at 25ºc for 24 hours and then the electrical conductivity of a solute which seeds were soaked in was determined by EC meter.

$$EC\ (\mu s/cm) = \frac{\text{Electrical conductivity rate for each container}(\mu s)}{\text{Sample weight}(g)}$$

In the end, the obtained data by using the statistic software of MSTAT-C, the variance analysis was accomplished and the mean comparison was done by Duncan's method.

RESULTS AND DISCUSSION

The analysis of variance results showed that the effects of irrigation intervals and different nitrogen fertilizer level on electrical conductivity of produced seeds were significant at 1%level of probability (table1).The mean comparison results indicated that 13days irrigation treatment with 165 kg/ha fertilizer had the most amount of electrical conductivity and 165 kg/ha fertilizer with 9 days irrigation intervals had the lowest electrical conductivity .The irrigation intervals of 13 days and 165 kg/ha fertilizer caused drought stress on mother plant and finally resulted in EC increasing through cytoplasm membrane disruption and ions leakage to intercellular space and increase of cytoplasm substances concentration and sever reduction of cells water. According to investigation the electrical conductivity could have a significant positive correlation with seedling emergence in field (Ratajc Zack and duczmal, 1991). Hurch, (2002) reported that due to drought stress cells membrane of seeds become thin that will cause increase of electrolytes. This experiment is in agreement with above results and a significant difference observed between seed vigor and electrical conductivity, but seed weight is also effective. Electrical conductivity test is an index of seed substances leakage. When low vigor seeds are soaked in distilled water, excrete their substances, but excretion is lower in high vigor seeds, so there is a negative correlation between electrical conductivity and seed emergence ability (Levitt, 1980). Robert (1986) suggested that the amount of leakage reduces by plant transferring to normal condition and the damage would be recoverable. Pasbanelsan (2000) reported that electrolytes leakage from stresses is a reasonable criterion for stress tolerance. It could be suggested that due to stress, cell membrane of seeds becomes thin and will cause more leakage of electrolytes it seems that main detrimental effects of stress are occurred at water uptake stage of seed germination.

The results of variance analysis indicated that normal seedling percent was affected by irrigation intervals and nitrogen application rate and also the interaction of them (table 1). The mean comparison of normal seedlings revealed that 9 days irrigation treatment and all N-fertilizer levels resulted in the highest normal seedlings (table2)
The normal seedlings percent is one of the most.

Important seed quality criteria. Hampton (1992) reported that seeds which obtained more fertilizer and water at production stage resulted in increased seedling establishment and also increased yield in comparison with other treatments. Hamidi, (2005) investigated 3 irrigation frequencies of corn in field and laboratory and found that seeds with less irrigation interval produced more normal seed lines (percent) compared to the seeds which were obtained from mother plant with less water application. The statistical analysis of standard germination test and electrical conductivity tests indicated that all measured traits were affected by interaction of irrigation intervals and different levels of nitrogen. The interaction of drought stress and nitrogen fertilizer on final germination percent was significant at 1 percent level of probability (table1). Mean comparison of irrigation× nitrogen fertilizer interaction specified that the highest germination percent was related to 7 and 9 days irrigation treatments with mean of 100 percent at all levels of nitrogen fertilizer application. It could be suggested that because germination involves enzyme processes, so it could be affected by water stress (table 2). Drought stress in studied treatments caused un-properly availability of mother plant assimilation to seeds. Levitt, (1980) found that subjecting of mother plant to drought stress in maturity stage is a main reason of seeds physiological differences. This physiological disorder was related to delay of germination, reduction of radicle and seedling growth, poor emergence level and low performance of plant in field conditions. Bittman (1989) that reported the difference in final germination percent of seed could be result of amount of saved matters in endosperm and different seed size of genotypes. The processes which inhibit germination probably involve cell division and no transfer of nutrients. Germination involves several enzyme processes as catabolism and anabolism, so germination severely reacts to drought. It could be declared that confronting of mother plant to drought stress and disorder in photosynthesis resulted in seeds with lower germination percent compared to seeds which were obtained from normal irrigation condition.

The effect of drought stress on seedling fresh weight was significant (table 1). Also the effects of nitrogen fertilizer levels and the interaction of drought stress and N-fertilizer on seedling fresh weight and dry weight were significant at1% level of probability (table1). The mean comparisons of seeding fresh weight indicated that the highest seedlings fresh weight (8.81 gram)were obtained from 9 days irrigation intervals and 165 kg/ha nitrogen fertilizer and the highest seedlings dry weight (0.982 gram) were obtained from 7 days irrigation intervals and 132 kg/ha nitrogen fertilizer (table2). The seedling dry weight is an important index of seedling vigor and is used as a criterion for seedling vigor assessment (Hampton and Tekrony, 1995).

The results of seedling length mean comparisons indicated that the highest value (35.83cm) was related to 7 days irrigation interval and 132 kg/ha N-fertilizer. The seedling length is considered as a seedling vigor index and the correlation of seedling length and it's vigor has been distinguished in many plant species, so it is used as a criterion for assessment of seedling growth and vigor (Hampton and Tekrony,1995).Radicle and shoot lengths are indices of seedling development and seedling vigor. Their variations is analyzed as a seedling vigor index (Hampton and terrkony,1995). The mean squares results indicated that effects of irrigation intervals, nitrogen rates and the interaction of them were significant on radicle length at 1 percent level of probability (table1).According to mean comparisons the highest radical length (20.89 cm) was related at (7 days irrigation and 132 kg/ha nitrogen fertilizer and the lowest radicle length (16.88 cm) was related to (13 days irrigation and 66 kg/ha nitrogen fertilizer) (table2). Radicle length could be a good criterion for seed emergence ability, because if a seedling cant produce a vigorous root system, it's permanence will reduce significantly (Makawi,1999). There is a little information about root characteristics, performance and heritability. The main reason is lack of a precise method of measurement and also high error of sampling (Levitt,1980).

Table 1. The Analysis of Variance (Mean squares) of Standard test of Corn 704

Root dry weight	Seedling fresh weight	Root fresh weight	Seedling length	root Length	normal Seedling	Degree free	S.O.V
0.008 **	4.504 **	1.179 **	33.199 **	16.099 **	1998.512 **	3	Irrigation levels
0.003 **	0.273 ns	0.02 ns	9.556 **	5.69 **	17.699**	3	nitrogen
0.001 ns	0.378 ns	0.339 *	4.872 n.s	0.8762 **	1.928**	9	nitrogen× × Irrigation levels
0.001	0.533	0.159	3.59	0.73	0.509	48	Error
4.86	9.11	10.28	5.77	4.54	0.76		CV (%)

-Electrical conductivity	-Seedling vigor index weight	-Seedling vigor index length	Mean daily germination	Mean time germination	Final germination percent	-Seedling dry weight	Degree free	S.O.V
1119.333 **	2100.713 **	1782681 **	1.459 **	0.023 **	70.063 **	0.07 **	3	Irrigation levels
16.667 **	87.6 **	67813.29 ns	0.046 **	0.014 **	2.229 **	0.006 **	3	nitrogen
67.556 **	15.307 ns	45785.29 ns	0.016 ns	0.008 **	0.785 ns	0.002 **	9	nitrogen× × Irrigation levels
4.917	8.081	35372.09	0.01	0.0001	0.479	0.001	48	Error
4.79	3.51	6.08	0.71	0.64	0.70	3.58		CV (%)

n.s : Non Significant
** Significant at 1% level of probability
*Significant at 5% level of probabilit

Table 2. Interaction effect if Irrigation Intervals and Nitrogen Fertilizer on Measured traits in Standard test of Corn704

Seedling dry weight (gr)	Root dry weight (gr)	Seedling fresh weight (gr)	Root fresh weight (gr)	Seedling length (cm)	steam Length (cm)	root Length (cm)	normal Seedling	Nitrogen rate(kg/haa)	Irrigation levels(day)
0/8975 bcd	0.4900 bcd	8.435 abc	3/997 ab	32.13bcd	13.48 abc	18/49 cdef	93.69 d	66	7
0/9250 b	0.5025 abc	8.335abcd	3/767 abc	33.80 abc	13.42abc	20/02 ab	93.81d	99	
0/9825 a	0.5275 ab	8.592 ab	4/355 a	35.83 a	14.61 abc	20/89 a	94.94 c	132	
0/9175 bc	0.4825 bcd	8.493 abc	3/815 abc	32.78abcd	13.63 abc	19/29 bcde	94.50cd	165	

0/8132 ef	0.4900 bcd	8.233abcd	4/097 ab	32.17 bcd	12.71 c	18/59 cdef	98.25b	66	9
0/8725 cde	0.5050 abc	8.132abcd	4/130 ab	33.95 abc	14.42 abc	19/30 bcde	100.0a	99	
0/9250 b	0.5400 a	8.592 ab	4/345 a	33.53 abc	13.88abc	19/76 abc	100.0 a	132	
0/8875bcde	0.4700 cd	8.818 a	4/195 ab	34.58 ab	15.16ab	19/52 bcd	99.75a	165	
0/8175 fg	0.4700 cd	7.512 bcd	3/885 abc	33.72 abc	14.35 abc	18/18 defg	100.0a	66	11
0/8165 def	0.4800 bcd	7.870abcd	4/082 ab	33.00abcd	14.35 abc	18/66 bcdef	100.0a	99	
0/8475 ef	0.4750 cd	7.275 cd	3/255 c	34.28 ab	13.70 abc	19/56 bcd	100.0a	132	
0/8132 ef	0.4650 cd	8.342abcd	4/035 ab	32.80abcd	13.70 abc	19/05 bcde	100.0a	165	
0/7750 gh	0.4725 cd	7.495 bcd	3/608 bc	30.13 de	14.30abc	16/88 g	90.00 f	66	13
0/8025 fgh	0.4575 cd	7.495 bcd	3/695 abc	32.40bcd	15.26 a	17/95 efg	90.25ef	99	
0/7625 h	0.4475 d	7.405 bcd	3/597 bc	31.02cde	12.95 bc	17/64 fg	91.25 e	132	
0/7575 h	0.4400 d	7.170 d	3/99 c	29.13e	13.13 abc	17/06 g	90.50ef	165	

Seedling vigor index weight	-Seedling vigor index length	Mean day germination	Mean time germination	Final germination percent	-Electrical conductivity	Seedling dry weight (gr)	Nitrogen rate(kg/haa)	Irrigation levels(day)
89/29 bc	3361/ abc	14/29 a	3/075 de	100/0 a	41/75 ef	0/8975 bcd	66	7
91/01 bc	3522/ a	14/29 a	3/007 h	100/0 a	43/75 e	0/9250 b	99	
98/25 a	3276/ abcd	14/29 a	3/030 g	100/0 a	38/75 fg	0/9825 a	132	
91/53 bc	3208/ bcde	14/29 a	3/092 c	100/0 a	35/75 gh	0/9175 bc	165	
84/00 d	3393/ abc	14/29 a	3/000 h	100/0 a	42/75 e	0/8132 ef	66	9
87/25 cd	3349/ abc	14/29 a	3/010 h	100/0 a	41/75 ef	0/8725 cde	99	
92/50 b	3456/ ab	14/29 a	3/050 f	100/0 a	34/75 h	0/9250 b	132	
88/75 bc	3371/ abc	14/29 a	3/010 h	100/0 a	33/75 h	0/8875bcde	165	
73/57 ef	2968/ efg	13/82 cd	3/160 b	96/75 b	50/75 cd	0/8175 fg	66	11
76/72 e	3090/ cde	13/86 c	3/100 c	97/00 c	48/75 d	0/8165 def	99	
77/56 e	992/ def	14/07 b	3/043 fg	98/00 c	52/75 bc	0/8475 ef	132	
76/02 ef	2726/ fgh	13/89 c	3/033 g	97/25 cd	54/75 b	0/8132 ef	165	
66/07 f g	2761/ fgh	13/57 e	3/197 a	95 cd	55/75 ab	0/7750 gh	66	13
69/59 fg	2690/ gh	13/68 de	3/087 cd	95/75 de	49/75 cd	0/8025 fgh	99	
67/46 g	2578/ h	13/82 cd	3/070 e	96/75 e	55/75 ab	0/7625 h	132	
66/45 g	2736/ fgh	13/64 e	3/065 e	e95	58/75 a	0/7575 h	165	

Means within the same colum followed by the same latter are significantly different(0.05)using Duncan, s multiple range

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