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Research Article

Effect of Planting Date on Germination Indices of Erflor cultivar of Sunflower Seeds

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Abstract

An experiment was performed to test the sensitivity of seed production and climatic conditions effect on mother plant. The seeds from different planting dates in field experiment were studied randomly in 2013 during four replications at the laboratory of Agriculture Faculty of Islamic Azad University, Khoy Branch. The results showed that the effect of sowing date on shoot length and dry weight, root germination, mean germination time, germination average, germination and mean germination were significant. Based on the results of the experiment, seeds from the first to third sowing dates had the best germination time and the average germination time for the best seedlings due to the highest length and stem and rootstock weight. In general, it became clear that the delay in planting the mother plant decreases seed quality. MGT indices showed a significant negative correlation with GR. Also, MDE increased the length and weight of the stem.

Key words: Sunflower, Erflor, germination, planting date.

Introduction

The value and nutrition importance of the oilseed plants has a special place in terms of calories and energy needed by man and livestock among the crops, which is one of the most valuable agricultural products (Baradaran Nassiri et al., 2010). Achieving high yield in arable crops such as sunflower, depends on the use of seed of optimal quality in terms of seed germination and vigourity. High seed quality is essential to ensure proper planting. Therefore, the used seed's vigour must be high. Seed vigour is a sum of seed characteristics that determines seed potential for fast and uniform emergence of plantlets under a wide range of farm conditions (McDonald, 1980). The plantlets are affected by environmental conditions during seed development (Delouch, 1980), such as the frequency of dryness and humidity, high temperatures, high humidity and rainfall (Castillo et al., 1994) and genetic factors (Gusta et al., 2003). Planting dates is the first pivotal point in crop management decisions, Especially in the areas with environmental constraints such as early or late winter and extreme heat in the middle of summer (Khajehpour, 2008). Planting date is the most important factor that often affects germination characteristics, seedling establishment, greenfield and yield (Miri et al., 2010). In studies conducted by Adam et al. (1989) on soybeans, the seeds produced in early sowing date (April 30th) have lower seed quality than those of the later planting dates (May 15 and 30). They stated that relative humidity and high temperature during seed filling, have probably reduced seed quality at these planting dates in the early sowing date. Fancaneto (1993) in research on the effect of seed shrinkage caused by heat and drought stresses during seed filling on soybean seed quality explained that the increase in shrinkage reduced the germination percentage and the final results showed that seeds with more than 50 shrinkage percentage is not suitable for planting. The research results of Nabavi (2005), Armanpisheh (2009) and Hunter et al., (1984) showed that as long as necessary for germination, the percentage of final germination and average daily germination

decreases. High-quality seeds also have higher average daily germination than low-quality seeds. Khawari et al. (2008) stated that the amount of seed vigor is reduced in delayed crops and therefore delayed planting reduces seed quality, which is probably due to the development and ripening of seeds in adverse environmental conditions. Nasrollahzadeh et al. (2013) reported a significant difference in terms of 1000 grain weight between the stages after the emergence of Agropyron cristaumi agronomic spike and the highest 1000 grain weight occurred 63 days after 50% flowering and the maximum seed yield in 63 days was equal to 50%. Experimental results of Khawari and et al., (2008) showed that the amount of electrical conductivity, germination percentage of 43259 cotton plant and germination percentage and seedling length of Sai Akra cultivar had a significant difference between harvesting dates. In general, the seed quality of cotton cultivars was reduced with delay in harvesting. Early harvesting increases the number of immature seeds that have germination percentage and lower vegetative ability.

The purpose of this study was to investigate the effect of changes in environmental conditions on cotton mother plant due to the planting date on the seed vigour and the quality of the seeds produced from it, regarding the importance of planting date and its effect on seedling and seed germination.

Materials and Methods

In order to evaluate the effects of maturity of the seeds on germination indices of sunflower seeds of Erflor cultivar, a completely randomized experiment was conducted with four replications in 2013 in Agriculture Laboratory, Faculty of Agriculture, Islamic Azad University, Khoy Branch.

The seeds used in this experiment were the result of a sampling of another research carried out by the implementer of the project in 2012. In this research, the cultivar Euphorbia had been planted in eight planting dates (9, 19, 29, May 7, 16, 25 June and 3, 12 July). The seeds were tested for laboratory comparisons by observing the principles of germination of sunflower, as described by ISTA (ISTA 2008). So that the seeds were cultured in Petri dishes with a diameter of 90 and a thickness of 15 mm, and in each petri (experimental unit), 25 seeds were placed. The culture medium contained a Watten No. 1 filter paper. Prior to planting, the filter paper was disinfected in 180 °C for 1 to 2 hours. In order to disinfect the seeds, they were placed in a 0.25% hypochlorite solution for 5 minutes and immediately rinsed 2-3 times with distilled water. After the addition of distilled water (in the absence of excess water in Petra), the containers were tapped and placed in a growth chamber in dark conditions, with a temperature of 20-25 °C and a humidity of 80% for 72 hours. Germinated seeds were counted daily at 9:00 AM. At the end, the total number of normal seed buds (seedlings produced) was counted and recorded and the obtained data were considered as the final germination percentage. Then, normal and abnormal seedlings appeared, and 10 normal seedlings were selected, and the length of the seedling was determined. Seedlings with thick, spiral, short, and bad stems were considered as abnormal buds. Then seedling were oven dried in a temperature of 75 °C for 48 hours and finally weighed and calculated.

The average germination time is an indicator of the acceleration rate of germination and is calculated by the following equation (Ellis et al, 1995).

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

Where ''n'' is the number of seeds germinated in d days; d is the number of days and : $\varepsilon(n)$ is the total number of seeds has germinated.

GR= (number of germinated seeds/first counting) + (number of germinated seeds/ second counting)+…+ (number of germinated seeds/last counting).

Germination rate

The average germination time was calculated according to the following formula. In this formula, N_i stands for the number of freshly germinated seeds in day T_i.

$$MGT = \sum TiNi \,/\, \sum Ni$$

Statistical software of MSTATC was used to variance analyze and compare the average measured characteristics. Average comparison was performed using Duncan's multiple range test method at 5% level.

Results and Discussion

Stem length and weight

Seedling length is considered as a seedling vigour criterion, and in many species, the correlation between seedling length and its vigour has been verified (Hampton and Tekrony, 1995). In this

research the effect of sowing date on stem length and weight was significant at 1% level (Table 1). The stem length was maximum at first planting date and during the fourth planting the shortest shootlets appeared (Table 2). Probably, the favorable conditions for the seed treatment period in the first planting were due to the increase in the growth of the stems. Obviously, the prevailing conditions during the grain filling period and the formation of the seed embryo are very determinative and in a plant such as sunflower, which has an epiglizal green leaf morphology, the length of the stem may be highly determinative. This feature is much more important, especially when the physical structure of the soil is undesirable and the depth of planting is asymmetric.

Table 1. Variance analysis of germination indices in sunflower seed during variuos plantation dates

SV	FD	Average Squares							
		Stem Length	Stem Weight	Root Length	Root Weight	Average Germination Time	Average Germination Day	Germination Rate	Mean of Germination Time
Repetition	3	0.001	0.145	0.001	1.01	3.49	0.80	3.26	0.98
Date of Harvest	7	0.058**	0.012**	1.087*	0.002*	31.29**	41.79**	152.39**	25.59**
Error	21	0.219	0.001	0.459	0.001	6.07	2.00	1.58	2.67
CV (%)		18.02	14.62	15.26	13.90	33.11	16.58	8.24	17.8

*,** Respectively Significant at a level of %5 and %1.

Table 2. Comparison of average sunflower germination indexes at different sowing dates

Plantation Date	Stem Length (cm)	Stem Weight (gr)	Root Length (cm)	Root Weight (gr)	Average Germination time	Average Germination day	Germination Rate	Mean of Germination Time
First	2.17^{a}	0.25^{a}	3.64^{a}	0.035^{a}	5.78^{bc}	9.58^{b}	17.42^{c}	4.87^{c}
Second	1.58^{bc}	0.16^{b}	2.38^{b}	0.03^{a}	5.19^{c}	11.21^{ab}	20.50^{ab}	5.57^{c}
Third	1.72^{b}	0.07^{f}	2.91^{b}	0.01^{b}	5.08^{c}	12.38^{a}	21.87^{a}	5.70^{c}
Fourth	1.17^{c}	0.11^{d}	2.36^{b}	0.03^{a}	5.93^{bc}	12.37^{a}	19.12^{bc}	11.02^{a}
Fifth	1.56^{bc}	0.13^{c}	2.73^{ab}	0.03^{a}	5.98^{bc}	5.62^{cd}	19.08^{bc}	10.50^{a}
Sixth	1.84^{ab}	0.13^{cd}	2.35^{b}	0.02^{ab}	8.71^{b}	4.75^{d}	8.72^{d}	10.12^{a}
Seventh	1.57^{bc}	0.09^{e}	2.86^{ab}	0.02^{ab}	12.75^{a}	5.29^{d}	6.54^{d}	8.68^{ab}
Eighth	1.86^{ab}	0.14^{c}	1.91^{b}	0.03^{a}	10.12^{ab}	7.08^{c}	8.75^{d}	6.15^{bc}

The numbers of each column with the common denominator based on the Duncan multiscope test are not significantly different at 5% probability level.

The weight of one hundred seeds in the first planting date can be considered as an important factor, as Luis et al., (1989) stated that the thicker acne of the sunflower was swollen at a higher rate but delayed at the onset of germination compared to the smaller seeds. In this experiment, the maximum weight of 100 seeds was obtained on the third planting dates. Farooq et al. (2006) stated that increasing seed weight provides more food for fetal growth.

The maximum stem weight was obtained at the first sowing date, but the lightest stems were grown at the seventh planting date (Table 2). According to Stiner et al. (1989), seedling dry weight is one of the best seed rate criteria to predict the emergence of wheat seedlings in the field. Accordingly, it can be predicted that the seeds from the first to third planting dates, with a weighing 100 seeds and shoots, would be more suitable potentially to grow on the field. The higher seed weight resulted in the formation of more normal seedlings with higher dry weight and delayed planting followed by a reduction in 1000 seed weight, normal seedling percentage and dry weight of normal seedlings (Nikoobin et al., 2009). Reducing the percentage of normal seedlings because of 1000 seed weight loss can be due to the reduction of seed straw, which occurs due to environmental stresses during the period of seed filling (Yaklich, 1984).

Length and root weight

The effect of harvest time on these two traits was significant at 95% (Table 1). The highest root length and weight were obtained in the first planting date. Root length was less than the other treatments on the 6th day. However, the root length did not change a lot (Table 2). The process of decrease and increase in root length and weight characteristic was largely similar to shoot length and weight. Perhaps the reason for this difference in the behavior of root compared to the stem is that subterranean organs are less susceptible to environmental changes. Gay et al. (1991) stated that the optimum temperature for sunflower seeds is 25 ^{o}C, and in cool temperatures, the growth of hypocotyl is limited to roots.

In Jahandideh et al. (2005) experiment, chickpea planting date had a significant effect on seedling percentage and root length. Therefore, the root length of the seeds from the second planting date was greater than the other planting dates. Hashemi et al. (2009) showed that the effect of seed harvesting time on canola germination, germination rate, seedling dry weight and root dry weight was significant and higher in fifth harvesting than other harvesting times. So early harvesting resulted in reduced germination, seedling dry weight and root crop.

Average germination time

The effect of sowing date on average germination of sunflower seeds was significant at 1% level (Table 1). The average germination time at the seventh planting date was the maximum (12.75) and at the third planting date was the least (5.08). (Table 2). Correlation coefficiency showed that there is a positive and significant correlation between germination average and germination percentage as well as root weight. In the research that was performed by Armanpisheh (2009) and Hunter et al. (1984) it was concluded that the more the duration of germination increases, the more the percentage of ultimate germination and average germination daily decreases. They also stated that in high quality seeds, the average daily germination rate is higher than in low quality seeds.

Average germination day

In fact, the average germination is daily. This index was also heavily influenced by planting dates (Table 1). The maximum mean germination index (12,38) occurred on the third and fourth dates of planting. This indicated a close relationship with grain weight. The minimum average daily germination (4.75) occurred at the fifth to seventh sowing dates. Meteorological data in the mentioned sowing dates indicated that flowering time of the plants coincided with decrease of relative humidity and high temperature of the environment (13 to 28 July in the year of experiment). The flowering date of the 8th planting date was August 8, which was reduced by the severity of heat, especially during the grain filling period.

Jahandideh et al. (2005) showed that drought stress reduces the average germination day and seed vigour in chickpea only at the beginning of flowering stage, and when the drought stress of the season occurs late due to the appropriate selection date of the planting, it will not affects the germination indices of harvested seeds. Hashemi et al. (2009) also emphasized the effect of canola harvesting time on germination percentage and average germination days, and stated that later harvesting of seedlings leads to an increase in the numerical value of these indices. Gurusamy (1999) reported that the delay in harvesting of seeds reduced the average germination day and the rate of germination and caused the burnout of the seeds before harvesting.

Germination rate

The germination rate was influenced 99 percent by the dates of the sunflower plantation (Table 1). The maximum germination rate was in the third planting date (21.9) and the minimum rate was in the seventh planting date (6.5). Jahandideh et al. (2005) showed that the planting date of chickpeas is effective on seed germination rate and the best germination index can be obtained from the first planting date. They concluded that plants which were under drought stress at the beginning of flowering had less germination. In this regard, Heatherly (1993) observed a significant decrease in germination of soybeans seedlings due to the drought stress. Ghasemi Firoozabadi et al. (2011) acknowledged the influence of harvesting time of rangeland plant seeds on the effective germination index and they announced the best time of sowing as May 21 for rangelands of Yazd province in Iran. Also the correlation between germination rate and germination duration was significantly negative (0.62). The same results have been reported by Nasrollahzadeh (2013) about corn. Reducing the amount of germination in the final dates led to an increase in the duration of germination. Siddque and Goodwin (1980) reported that high temperatures during soybean seeding reduced the number of normal seedlings.

Average germination time

The effect of planting date on average germination was significant at 1% probability level (Table 1). The duration of germination in the first to third planting dates is less than the other planting dates, which means, the seed yields a germination process in a shorter period of time. But it was the highest on the fourth to sixth dates (Table 2). Therefore, seeds from early crops germinate in shorter periods and can quickly grow green and close the canopy. Likely, while providing a fast shade, it prevents the evaporation of water from the surface of the soil, and maximizes its solar energy, and also prevents the growth and development of weeds.

Abadikhah (2012) reported the average germination time for sesame seeds. The highest amount obtained shows the number of germinated plants per day for germination until that day, so the minimum of this index was obtained in control treatment. Takasi et al. (2012) emphasized that the alfalfa extract increased the average germination time of alfalfa weeds, thus reduced their germination speed, and the increase in duration, reduced the germination rate of weed seeds. Early seed harvest increases the number of immature seeds with a low germination percentage (Kaboli and Sadeghi, 2002). The mean germination time showed a negative and significant correlation of 0.62 with germination. It thus becomes apparent that the relationship between these two indicators is not consistent and acts in the opposite directions. Khajeh Hosseini et al. (2011) reported that higher MGT dormancy genotypes (slower germination) had less uniform seedling length, therefore, they concluded that this index can be used to evaluate corn seed vigour.

Overall outcomes

All of the germination indices in this experiment showed a significant correlation with the planting date of the mother plant. It seems that in this regard, the dominant climatic conditions during the flowering and filling of seeds has been effective on the quality of the obtained seeds. The variation in 1000 seed weight also verifies this claim. From the qualitative point of view, the best seeds were obtained from the third planting date. In this treatment, MDG and GR were maximum and MTG and MGT were minimum. The third plant (in May 19th) flowering was on June 18th and its growth period was 96 days. Poor quality seeds were obtained from crops 6 and 7. Flowering dates of these treatments were 12 and 18 July respectively (which coincides with peak heat and relative humidity). Therefore, based on the results of one year, it is recommended to benefit from early planting in the Khoy region to produce desirable sunflower seeds.

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