The effect of sowing season on seeds germination characteristics of 12 cultivars of spring rapeseed

Lotfifar Omid[1], Akbari GH.Ali[1], Sadatnouri Ahmad[1], Shirani Rad Amirhosein[2], Mottaghi Samaneh[1], Mottaghi Leila [3]

[1] Department of agriculture science, University of Tehran. Tehran- Iran Email: olotfifar@ut.ac.ir
[2] Plant and seed breeding institute. Karaj- Iran
[3] Former biotechnology Graduate student

Abstract

For studying the effect of sowing season on seeds germination characteristics of 12 high-yield cultivars of spring rapeseed, the experiment was performed in 2004-2005 in the research field and laboratory of Tehran University. The experimental design used for this study was factorial in the form of randomized completed design with four replications. Treatments were consisted of first factor in two levels 1-seeds were obtained from autumnal sowing (date of sowing: 6 October) and 2-seeds were obtained from spring sowing (date of sowing: 2 March). Second factor was 12 cultivars of spring rapeseed. According to the results, seed weight, oil percentage, seed vitality, length of radicles and plumules, seedling dry weight, the number of normal and abnormal seedlings with the 0.0001 probability level and the average of daily germination, mean of time of germination, and seedling vigor index with 0.05 probability level were affected by sowing season. Based on mean comparison, seedlings which were obtained from seeds of autumnal sowing, in consequence of having the higher oil and seed weight, have higher metabolism than spring sowing. Also in this treatment, length of radicles, seed vitality index and daily reduction of seedling weight due to respiration was higher. Seeds of autumnal sowing in consequence of higher reserves materials and higher received GDD during the ripening stage and being complete of ripening stage showed the higher vitality and greater normal seedlings. Length of plumules due to negative correlation with oil percentage(R=0.36) and seed weight(R=0.40) and the number of abnormal seedlings due to faster ripening were higher in spring treatment. Weight of thousand of seeds, oil percentage, seedling dry weight, length of radicles and plumules and seed vitality with 0.001probability and germination rate with 0.01probability level was affected by kind of cultivar. RG405/03 cultivar in consequence of higher received GDD during seed loading stage produced the higher seed weight that it causes higher metabolism during primary growth and then generated taller seedlings and radicles, higher respiration and vitality seed. AMICA and KIMBERLY cultivars due to low seed weight had the lowest vitality, length of radicles and seedling, number of normal seedlings, seedling vigor index, daily respiration and the highest length of plumules. Interaction effect of treatments in consequence of not existing significant effect on the seed weight did not influence on many characters.

Key words: Rapeseed, Sowing season, Germination, Vitality

Introduction

Seed quality is very important in agricultural crops products and as a reproduce organ of plants and the most important factor of production, and optimum yield of these plants is impressed by this parameter (Fox 2001 and Johnson 2001). The bad seed does not achieve success in agriculture. Small and injured seeds with non-equilibrium nutritious produce faint seedlings in the farm, which are very sensitive to the diseases, have high mortality and low yield (Hunter. et al. 1994). Genetic characterization, vitality, strength of germination, power, humidity amount, storing quality and age of seeds are used to determine the seed quality (Fox 2001). The simplest method is vitality determination in vitro system to estimate the seed quality. Seeds, which have good vitality, germinate 90-100% in vitro germinated ones, are 90-85% in the field, which are cultivated well. Any decrease in germination percentage is lead to the decrease in green percentage in the field severely (Magurie 1962). Environmental factors have some effects on the seeds vitality such as soil, the weather, and sowing process in growing period of the mother plant from sowing to the harvest and the period of time after it (Perry and harison), which the weather conditions are especially very important in the seed filling and ripening period such as temperature, relative humidity and raining (Wood et.al 1980). Spring cultivars of rapeseed sowed autumnally according to the relative resistance to the coldness, in addition of spring sowing. Plants, which are gained with these, tow sowing dates pass each of the morphological stages in different times of the year and naturally the plant in spring sowing enter to the flowering stage later than autumnal one and at last enter to the complete ripening stage later. Seed filling stage in warm days of the late spring and the beginning of the summer, cause physiological disorders in seeds in addition of reduction of seed quality and quantity according to the oil, and then delay in seed germination and reduction of seedling growth have negative effect on the final yield (Perry and Harrison 1997). Angadi et al., analyzed heat affect on the features of some rapeseed genotypes. According to the result of the standard germination test, high temperature in flowering and poding stages cause reduction of seed quality and quantity. This test determined that seed germination characters of the plants that were influenced by heat in flowering stage showed more damage than the plants, which face to heat stress in poding stage (Angady et. al 1999). Seeds of the rapeseed spring sowing to the seeds of autumnal produce smaller seeds with lower seed weight (1000) and storage substances especially oil. Chiza et al. expressed about the test on the Sinapus indicus that the size of seed and complete ripening affect on the vitality on seed. Seeds, which have higher weight, have higher vitality and leak lower in electrical conduct test (Devi et. al 2003). Purpose of this test

is study of the effect of sowing season on seeds germination characteristics of 12 high crop cultivars of spring rapeseed, determination of the correlation between effective features on seed germination and determination of the relation between seed respiratory and other measured characteristics.

Materials and methods

In order to the effect of sowing season on seed germination of the high crop cultivars of spring rapeseed, a test was done and experimental design used for this study was factorial in the form of randomized complete design with 4 replications which consisted of: RGS003, AMICA, OPTION500, HYULA401, HYULA330, HYULA308, KIMBERLY, ORS3150-3006, RG405/02, RG4403, RG405/03, PP401. Cultivars planted in farm in 2004. Sowing season consisted of autumnal sowing (sowing date was 5 October) and spring sowing (sowing date was) when ripening stage was completed, harvest was done and after seed cleaning, they were transferred to laboratory for performing germination tests.

To determine vitality and some related characteristics, the seeds with favorite humidity have exposed to standard germination test according to the standards of International Seed Test Association (ISTA)(Anonymous 2001). For this purpose, 400 seeds (100 numbers in four replications) selected randomize. Then they were weigh and set on germination paper in the closed plastic dishes and exposed to 20-30 degree of centigrade temperature in germinator for seven days.

The numbers of germinated seeds were counted daily and some characteristics such as mean of daily germination that is the index of daily germination speed and the mean time of germination that is the index of germination speed were calculated using the formula of International Seed Test Association (ISTA) (Hunter et. al 1984). Daily germination speed that is opposite of the mean of daily germination were counted, too (Copeland 1976). At the end of test performing, final vitality (the number of germinated seeds in 7^{th} day) were determined. In addition, the numbers of normal and abnormal seedlings were become clear on the base of standards of International Seed Test Association (Anonymous 2003). To determine the seedling vigor, 30 normal seedlings from every replication were selected and scaled ruler by centimeter and exact weighting machine by gram, respectively measured the length of seedlings and the fresh weight of it.

After drying the seedling in 75 degree of centigrade for 24 hours in oven, exact weighting machine were used to measure seedling dry weight. Also, the relation of [vitality*seedling dry weight] and [vitality* mean of total length of seedling/100] were used to determine seedling vigor index and seed vitality index, respectively (Aabdul-Baki and Anderson 1973). in this test, in addition of related indexes that is common in more seed germination tests that mentioned above, the other index was used that called " seedling weight reduction during germination". it is the percentage of seed weight that become lost during seed germination. Following formula was used to count it:

Seed weight reduction percent= [(seed dry weight –seedling dry eight)]*100/ seed dry weight

After normality test, obtained data were analyzed by SAS(ver. 6,12) software and Duncan method was used to compare the means.

Result and Discussion

Seed weight (1000), seed vitality, length of radicle, seed weight reduction during germination, seedling vigor index and number of normal seedling at.001, number of abnormal seedling at 0.01 and the mean time of germination and the mean of daily germination at 0.05 level was affected by sowing season(table1,2). The effect of cultivar was significant on seed weight, length of radicle, length of plumule, seed weight reduction during germination and seedling vigor index of 0.001 levels and the mean time of germination and the mean of daily germination at 0.05 levels (table).

The interaction was significant on the length of plumule, and seedling vigor index at 0.001, seed vitality, the mean time for germination at 0.01 and the length of radicle at 0.05 levels (table).

The seed weight was higher in autumnal sowing (3.384gr) than spring sowing (2.819 gr). The reason of this difference was higher rate of photosynthesis due the higher photosynthetic area (higher leaf area) during the growth period and greater time for seed filling in sowing autumnal with attention to high and positive correlation between seed weight and time of seed filling stage(r=0.067). RG405/02(3.49 gr) and HYOLA401 (3.45 gr) cultivars had higher mean of seed weight between cultivars and AMICA (2.74 gr) and HYOLA308 (2.85 gr) cultivars had the less seed weight. According to the result of other research, in the spring sowing, vegetative stage have been shorter the plant have had less time for leaf product and it cause to decrease the photosynthesis. It has happened due to necessary additional temperature for entering to reproductive stage have provided in the shorter time (20). In addition, AMICA and HYOLLA308 have had the less time for seed filling stage in autumnal and spring sowing, reproductively.

On the base of results, vitality of seeds that obtained of autumnal sowing (98.35%) was higher than spring sowing (96.60%). According to significant and positive correlation between seed weight and vitality (r=0.46) and time of seed filling (r=0.67), higher vitality of seed obtained of autumnal sowing was attributed higher seed weight and more completed ripening of seed. RG4403 (99.25%) and RG405/02 (99.25 %) have had the greatest seed vitality between cultivars.

Mention that these two cultivars had higher period of seed filling in average. KIMBERY cultivar (94.88%) had the lowest vitality. After study of the interaction, RG4403 (100%) and HYOLA308 (99.5%) cultivars in autumnal sowing and KIMBERY (92%) cultivar in spring sowing had the lowest vitality. Green et al., found that the plants of early sowing date produced seeds with low vegetative strength because of existing in a dry weather in seed filling time (Green et. al 1965 and 1966).

Although the seed of autumnal sowing (9.84 cm) could produce longer radicle than the seed of spring sowing (9.06 cm), plumule length of the spring sowing seed (5.89 cm) was more than autumnal sowing (5.31 cm). Among the cultivars,

RG405/02 cultivar (10.96 cm) had the highest and AMICA (5.08cm) and KIMBERLY (8.04cm) had the lowest length of radicle. The higher lengths of plumule belong to the AMICA (6.20 cm) and the lowest one was for pp401 cultivar (4.94 cm). In the study of interaction effect, RG405/02 (11.45 cm) RG4403 (11.36 cm) cultivars produced the longest radicle in autumnal sowing and AMICA cultivar (7.35 cm) produced the lowest one. In spring sowing, RGS003 (7.05 cm) and AMICA (7.1 cm) cultivars had the highest plumule and HYOLLA401 cultivar (4.86 cm in autumnal sowing had the lowest one. It is recognized that the radicle growth can bee good factor for the seed growth strength measuring, because if the seedling could produce the strong root system, its survival is reduced (Wood et. al 1980).

Seed of autumnal sowing in average could produce higher seedling vigor index (0.246) than the spring sowing ones (0.123). Among these cultivars RG405/02 (0.265) and HYOLLA401 (0.265) cultivar had the highest and KIMBERLY cultivar (0.205) had the lowest seedling vigor index. HYOLLA 401cultivars from autumnal sowing (0.284) had the highest and AMICA cultivar from spring sowing (0.185) had the lowest seedling vigor index. High and positive correlation of this traits with seed weight (r=0.61), time of seed filling stage (r=0.41) and vitality (r=0.35) can explain being high in relation with seed of the cultivated plant in autumn.

According to the results, the number of normal seedling of the autumnal sowing seeds (92.75) was more than spring sowing ones (88.6). Cultivars are categorized in three groups according to this trait. Number of normal seedlings in P401 cultivar from autumnal sowing (95.5) was the highest and AMICA cultivar from spring sowing was the lowest (80.75). Among measured traits, number of normal seedling showed positive correlation with seed weight (r=0.31), time of seed filling period(r=0.61), oil percentage (r=0.36) and vitality (r=0.49), and negative correlation with the number of abnormal seedling traits (r=-0.89).

The number of abnormal seedling from spring sowing (8/0) was more than autumnal sowing (5.6), but the cultivars were categorized in one group according to these traits. Different between the seed of 2 sowing season are caused by immaturity of same of the spring sowing seed and the short time of sowing season and interaction between time of seed filling and ripening and high temperature of the June.

The mean time of germination index for both of sowing season, set in the same statistical group, but cultivar divided into 32 groups that AMICA (1.5) and RG405/02 (1.14) had the highest and lowest mean time of germination respectively. The mean of daily germination of seed that obtained of autumnal sowing (36.35) was higher than spring sowing (29.8). HYOLLA401 (47.02) had the highest and ORS150-3006 (25.24) had the lowest mean of daily germination. HUOLLA308 seeds obtained of autumnal sowing (46.5) had the highest and KIMBERLY seeds obtained of spring sowing had the lowest mean of daily germination.

On the baser of result, this index had the positive and significant correlation (r=0.65) with vitality and vitality seedling index. Hanter and et al.,(2001) said that the mean of daily germination have been correlation with the standard of germination speed and vitality.

The seed weight reduction during germination in seed obtained of autumnal sowing (28.61%) was higher than spring sowing (24.25%). It seems, the higher metabolism of seed of autumnal sowing (with greater respiration) due to being greater storage substance and differing their kind of compound, has caused to produce storage seedling with taller radicle and seedling and higher growth speed. RG405/02 (35%) had the highest and Amica (20.47) had lowest rate of this traits between cultivars. RG405/02 obtained of autumnal sowing (37%) and AMICA obtained of spring sowing (18.7%) had the highest and lowest rate of seed weight reduction, respectively. The positive and high significant correlation between this index with seed weight (r=0.68), vitality(r=0.35) and seedling vigor index (r=0.79) show that the trait can use to determine the seed germination ability as an index with other mentioned factor.

Table: Analysis of variance

Source of variance	d.f	MEAN SQUARE									
		Seed weight	Normal embryo	Abnormal embryo	Mean daily germination	Vitality	Sidling vitality index	Radicle length	Plomule length	Weigh t reduce	Mean time to germination
Sowing season(A)	1	7.64**	412.5***	4.45 **	1027/91*	0.192***	0.027 ***	14.88 ***	8.05***	6/00 **	0.24 n.s
Cultivar (B)	11	0.425 ***	21.24 n.s	2.27 n.s	374.354*	0.036***	0.003 ***	5.77 ***	1.607** *	3.02** *	0.23 n.s
A*B	11	0.082 n.s	26.28 n.s	3.88 n.s	267.599 n.s	0.022**	0.002 ***	2.36 *	1.101** *	3.32 n.s	0.30*
Error	72	7.30	28.45	37.034	165.235	0.008	0.00058	0.99	0.22	1.01	0.12

References

Abdul-Baki, A. A., Anderson, J.D. 1973. Vitality determination in soybean multiple criteria. Crop Science 13:630-638.

Anonymous, 2001. Year Book, Production. Vol. 54, F. A. O. Rome, Italy.

Anonymous, 2003. Handbook for Seedling Evaluation (3rd.Ed.). International Seed Testing Association (ISTA), Zurich, Switzerland.

Copeland, L. O. 1976. Principles of seed science and technology. Burgess Publishing Co. Minnesota. U.S.A. 369 P.

Devi, L. Chitra, Kant, K. Dadlani, M. 2003 .Effect of size grading and ageing on sinapine leakage, electrical conductivity and germination percentage in the seed of mustard(Brassica juncea L.) Seed Science and Technology, Volume 31, Number 2, pp. 505-509.

Fox, MJ. 2001. Soybean seed quality. By Bob Byrnes. The ISTA News Bulletin. WEB, ISTAA, Zurich .

Genter, C. F., and G. D. Jones. 1970. Planting date and growing season effect and interactions on Growth and yield of maize. Agronomy Journal, 62: 7601-761.

Green, D.E., E. L. Pinnel, L.E. Cavana, and L. F.Williams. 1965. Effect of planting date and maturity date on Soybean seed quality. Agronomy Journal.

57:165-168.
Green, D.E., L. E. Cavana, and E. L. Pinnel. 1966. Effect of seed moisture content, filed weathering, and combine cylinder rspeed on Soybean seed quality. Crop Science6`:630-638.
Hunter, E. A., Glasbey, C.A., and Naylor, R. E. L.1984. The analyses of data from germination tests. Journal of Agricultural Science, Cambridge 102: 207-213.
Johnson, C. 2001. Soybean seed quality a concern in 2001. Crop season. Ag answer writer, Agricultural communication service, Produce University.
Magurie, J. D. 1962. Speed of germination, aid in selection and evaluation for seedling emergence and vitality. Crop Science 2: 176-177
Perry, D.D. and J. G. Harison. 1997. Effect of seed deterioration and seed bed environment on emergence and yield of spring – sown Barley. Annals of Applied Biology. 86(3): 291-300.
Pollock, B.M. and E.E.Ross. 1972. Seed and Seedling vigour. Kozlowski, T.T. (ed). Seed Biology, Academic press. Singletary, G. W., R. Banisadr and P. L Keeling, 1994. Heat stress during filling in maize: Effect on carbohydrate storage and metabolism. Australian Journal Of Plant P hysiology, 21: 829-841
Wood, D. W, Scoot. r. k and P. C. Longden.1980. The effect of mother plant temperature on seed quality in sugar beet (beta vulgaris). In Hebbelethwaite. PD(ED). Seed production. Lomdon. Boston. Butterworth. PP: 257-270.