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Application of Zeolite in Drought Stress on Vigority of Canola Seed (Zarfam Cultivar)

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Abstract: The laboratory experiment was done on the Factory of based on a Randomized complete Block Design whit four replication in 2008 to study the effects of the usage of the Zeolite and the different levels of the irrigation on the germination and the vigority of the rape seed cultivars. The factors included three levels of the Zeolite (0, 10, 20 tones in the hectare) and three levels of the irrigation (the irrigation after 80,120,160 millimeter evaporation from class A pan) based on the factorial on the rape cultivar of Zarfam.the used seeds were produced based on the levels of the Zeolite and the drought stress and they were stored in the storage for two months. the studied seeds were determined based on the three common test including the standard germination test, accelerate ageint test and cold test. In each three test, in the condition of the drought stress, the usage of the Zeolite caused two increases significantly some characters. The comparison of the means showed that the different levels of the Zeolite have the significant effect on the ratio of the root to the shoot, the length of the shoot, the length of the root, the dry weight, FGP. The different levels of the irrigation also have the significant effect on these characters. Also, by using the Zeolite, we can reduce the unfavorable effects of the drought stress on the characters like the abnormal seedling and the usage of the more a month of the Zeolite (20 tones in hectare) increase the dry weight of FGP significantly.

Key words: Canola · Zeolite · Seed germination · Vigor test · Drought stress

INTRODUCTION

Zeolites comprise the great family of the minerals of Alominosilicate and its properties are the property of the fertility of the soil, the storage of the temperature and the storage of the water [1]. Drought conditions occur ubiquitously during the growing season of many plants and in the case of crops, it could have a profound negative effect on crop productivity [2]. Limited water supplies may make it impossible to grow traditional annual crops, such as corn, winter canola and beans. Less irrigation had negative effects on winter rapeseed yield and quality [3].

By using the Zeolite, we can preserve the moisture of the soil for long-term and get available to the plant, so the usage of the Zeolite can modify the effects of drought stress in the agricultural plant [4].

Seed quality was affected by different parameters such as environmental factors, genetic, moisture and fertility of soil [5]. Seed germination is an important stage in the life history of plants, affecting seedling development, survival and population dynamics. Germination, seed and seedling vigor are affected by many factors, including stresses, seeding practices, Genetic [6].

The standard germination test is a seed viability test in best situation for germination and showed speeds of germination only [7]. For these reasons used the other laboratory test such as the accelerated ageint test (seeds are under high temperature and relative humidity) and the cold test (seeds are under cool condition), subject seeds to stress as means of determining their suitability for planting. We conducted a study in 2008 in which 3 vigor testes were evaluated to determine their vigor and germination canola (*Brassica napus L.*) seeds.

The laboratory experiment was conducted in physiology laboratory of the Pardise of Aboreihan of the University of Tehran for investigation of seed vigor and germination of canola.

The major aims of this study were related to the usage of the Zeolite in the condition of drought stress. This amount of the water was used to initiate the spring

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plantation and to determine the under drought stress. In this study, one cultivar of the autumn canola was used in Iran as Zarfam (Iran is the origin of the cultivar of Zarfam). In this experiment, determining the vigor of the seed from the different levels of the usage along with the control irrigation, the medium stress and the intense stress of the dryness was considered in the period of the growth of canola.

MATERIALS AND METHODS

Laboratory Experiment and Seed Quality Determination: To study the effect of the usage of the Zeolite in the different regimes of the moisture on the qualititave properties and the technological properties of the seeds of the autumn cultivars, one experiment was performed in the lab of the physiology on the seed of pardise of Aboreihan of the university of Tehran in the area of pakdasht in 2007-2008. In this experiment, the seeds of one cultivar of the autumn canola (Zarfam). Were employed under the influence of three levels of the Zeolite (A) (a1 in zero ton in hectares, a2 in 10 tons in hectares, a3 in 20 tons in hectares) and three levels of the regimes of the moisture of irrigation (B) (after 80 millimeter (control or normal (b1), 120 millimeter (the medium stress (b2) and 160 millimeter (intensee stress (b3)) evaporation from class A pan.

The standard germination test [7] was conducted on four groups of 100 seeds of each cultivar at 20±2°C for 7 days on moistened blotter papers. Only normal seedlings were counted and then thirty plants from each box were randomly chosen and tagged for subsequent sampling.

The cold test [8] was performed on four groups of 100 seeds of each cultivar by exposing the samples to 5°C for 5 days on moistened blotter papers and then transferred to 20±2°C for 5 days. The mean time germination and daily germination speed of normal seedlings were recorded. Thirty plants from each box were randomly chosen and tagged for subsequent sampling.

The accelerated ageint test was conducted by ageint seeds at 42°C for 48 hours [9] using the wire-mesh tray method [10]. A single layer of seeds from each sampling date of each cultivar was placed on 10 × 10 × 3 cm copper wire mesh tray inside a 11 × 11 × 3.5 cm plastic box containing 2 cm water (about 100 mL) above the bottom of the box. Following incubation, the seeds were germinated at 22°C for 7 days as described above. The percent of normal seedlings was recorded and in 7th day, abnormal seedling recorded and then thirty plants from each box were randomly chosen and tagged for subsequent sampling. Lengths of whole plant and roots samples measured and then were dried in oven at 70°C for 24 h for measuring seedling dry weight.

Experimental Design and Statistical Analyses: All data were subjected to analysis of variance (ANOVA) appropriate to a factorial form on Randomized Complete Blocks Design with four replication. The studied factor were Zeolite at 3 levels (0, 10, 20 tons in hectare), the different regimes of the moisture at 3 levels (the irrigation after 80, 120, 160 millimeter evaporation from class A pan) and one cultivar of the autumn canola (Zarfam).

All data were analyzed with SAS (version 9.1) and the treatment means were tested by Duncan Multiple Range (DMR) and drawing figures with Excel 2007.

RESULTS AND DISCUSSION

Seedlings Dry Weight (g): In the tests of the germination and the accelerated ageint test, the usage of Zeolite were significant (Tables 1,5) on dry weight seedling (p<0.01). Also, the different levels of irrigation were significant at the standard germination test, accelerated ageint test and the cold test (Tables 1,5) on dry weight seedling (p<0.01). Therefore by using the levels higher than the Zeolite (20 tons in the hectare), the highest dry weight seedling was occurred (Table 6). In cold test, the usage of the different levels of the Zeolite was significant at the 0.05 level of probably on the dry weight seedling (Table 3). In the accelerated ageint test, the irrigation after 80 millimeter evaporation from class A pan caused the most dry weight seedling (data don't show). That this result was correlated with the conclusions from the researches of Perz and et al. [11] that stated that the seeds with the high quality make the seedlings much more than the unqualified seeds. Dry weight of the seedling is one of the best criterions of the power of the seed to forecast the value of the appearance of the seedlings of wheat in the field [12]. Performing Accelerated ageint test, by increasing the age of the seed, the dry weight of the seedling and the power of the growth of the seedling will be reduced [13].

Root Height: Analysis of variance (Tables 1, 3 and 5) showed that in all of the tests, interaction of Zeolite and irrigation were significant on root height (p<0.05). In the standard germination test and the accelerated accelerated ageint test, the level upper than the Zeolite (20 tons in the hectare) and the normal irrigation (irrigation after 80 millimeter evaporation from class a pan). Produced the lengthiest root (Tables 2, 6).

Table 1: Source of variance of traits affected by Zeolite and irrigation under standard germination test condition

		Mean square					
S.O.V	df	Seedling dry weight	Root height	Shoot height	Abnormal seedling	Root/Shoot	Finally germination (%)
Rep	3	0.000003 ^{ns}	0.003^{ns}	0.03 ^{ns}	0.67 ^{ns}	0.001 ^{ns}	3.14 ^{ns}
Zeolite	2	0.0001**	7.429**	0.97**	22.75**	0.059**	71.86**
Irrigation	2	0.001**	23.249**	5.35**	232.75**	0.067**	269.69**
Irrigation × Zeolite	4	0.000006 ^{ns}	0.935**	0.13**	12.50**	0.014**	19.82**
Error	24	0.00001	0.023	0.02	1.96	0.001	1.41
CV		3.63	1.75	2.15	13.99	2.5	1.26

**Significant at the 0.01 level of probably, *Significant at the 0.05 level of probably, ns: No signifcant

Table 2: Interaction of traits measurements for Zeolite and irrigation under standard germination test

	Root height	Shoot height	Abnormal seedling	Root/Shoo	Finally germination (%)
a1×b1	9.88 c	6.68 a	4.5 e	1.47818 b	98.75 a
a1×b2	7.31 g	5.41 d	14.75 ab	1.35195 c	89 e
a1×b3	6.37 h	5.05 e	15.5 a	1.26184 d	85.25 f
a2×b1	10.15 b	6.81 a	5.25 e	1.48873 b	98.75 a
a2×b2	8.24 e	5.99 cb	9.75 d	1.37433 c	94 c
a2×b3	7.85 f	5.59 d	13 bc	1.40347 c	92 d
a3×b1	10.55 a	6.83 a	5.5 e	1.54502 a	99 a
a3×b2	9.59 d	6.12 b	9.5 d	1.56592 a	96.5 b
a3×b3	8.13 e	5.81 c	12.25 c	1.39925 c	91 d

Mean followed by the same letter(s) in each column are not significantly different (Duncan multiple rang 5%)

Table 3: Source of variance of traits affected by Zeolite and irrigation under Cold test condition

		Mean square					
S.O.V	df	Seedling dry weigh	Root height	Shoot height	Abnormal seedling	Root/Shoot	Finally germination (%)
Rep	3	0.0001 ^{ns}	0.017^{ns}	0.028 ^{ns}	5.287 ^{ns}	0.004 ^{ns}	4.250^{ns}
Zeolite	2	0.0005*	1.541**	2.729**	46.861 $^{\times\times}$	0.136**	63.583$^{\times\times}$
Irrigation	2	0.003**	15.464**	4.643**	263.361**	0.025^{ns}	325.75**
Irrigation × Zeolite	4	0.0002^{ns}	0.696*	0.654**	10.361**	0.051*	16.458*
Error	24	0.0001	0.107	0.043	1.495	0.012	5.562
CV		13.856	3.8554	3.7579	12.471	7.260	2.5068

**Significant at the 0.01 level of probably, *Significant at the 0.05 level of probably, ns: No signifcant

Table 4: Interaction of traits measurements for Zeolite and irrigation under Cold test

	Root height	Shoot height	Abnormal seedling	Root/Shoo	Finally germination (%)
a1×b1	9.7750 a	6.1575 ab	5.0000 e	1.58757 b	99.500 a
a1×b2	7.8175 c	4.8675 f	14.500 b	1.60657 b	90.500 b
a1×b3	7.0775 d	3.9950 g	16.50 a	1.79096 a	85.750 c
a2×b1	9.7650 a	6.1600 ab	4.75 e	1.58520 b	99.750 a
a2×b2	7.6725 c	5.7750 cd	9.50 d	1.33347 c	91.500 b
a2×b3	7.7725 c	5.3800 e	13.50 bc	1.44638 bc	90.250 b
a3×b1	9.8100 a	6.2825a	4.50 e	1.5620 b	100.00 a
a3×b2	8.9925 b	5.8625 cb	8.00 d	1.53383 b	97.00 a
a3×b3	7.9400 c	5.5025 de	12.00 c	1.44405 bc	92.500 b

Mean followed by the same letter(s) in each column are not significantly different (Duncan multiple rang 5 %)

Table 5: Source of variance of traits affected by Zeolite and irrigation under Accelerate ageint test

		Mean square					
S.O.V	df	Seedling dry weigh	Root height	Shoot height	Abnormal seedling	Root/Shoot	Finally germination (%)
Rep	3	0.000001^{ns}	0.204^{ns}	0.183^{ns}	7.953^{ns}	0.116^{ns}	6.694^{ns}
Zeolite	2	0.0005^{**}	17.276^{**}	2.588^{**}	114.694^{**}	0.029^{ns}	295.75^{**}
Irrigation	2	0.001^{**}	59.672^{**}	2.451^{**}	364.694^{**}	1.045^{*}	527.250^{**}
Irrigation × Zeolite	4	0.0001^{*}	4.810^{**}	0.738^{**}	21.694^{*}	0.157^{ns}	73.750^{**}
Error	24	0.00003	0.089	0.087	7.537	0.058	14.986
CV		6.09	3.54	8.11	17.01	10.43	4.17

**Significant at the 0.01 level of probably, *Significant at the 0.05 level of probably, ns: No signifcant

Table 6: Interaction of traits measurements for Zeolite and irrigation under Accelerate ageint test

	Seedling dry weigh	Root height	Shoot height	Abnormal seedling	Finally germination (%)
a1×b1	0.108 a	10.85 a	4.12 a	10.50 e	99.00 a
a1×b2	0.079 ef	5.77 f	2.96 c	23.00 ab	86.25 d
a1×b3	0.075 f	4.79 g	2.28 d	25.00 a	76.00 e
a2×b1	0.109 a	10.78 a	4.13 a	10.00 e	99.75 a
a2×b2	0.09 bc	8.68 c	3.72 ab	17.00 cd	94.50 abc
a2×b3	0.085 de	6.76 e	3.50 b	19.50 bc	90.25 cd
a3×b1	0.108 a	10.86 a	4.11 a	9.500 e	99.75 a
a3×b2	0.100 ab	9.94 b	4.04 a	13.25 de	96.75 ab
a3×b3	0.089 cd	7.67 d	3.90 ab	17.50 c	92.50 bc

Mean followed by the same letter(s) in each column are not significantly different (Duncan multiple rang 5 %)

These conclusions didn't correlate with the results of khalaj [14] that stated that in the test of the accelerated ageint test, stopping the irrigation after the period of producing silique produces the lengthiest root Hashemi Dezfoli and Agha Ali Khani [15]. Stated that the growth of the root can be a good criterion to calculate the power of growing the seed, because if the seedlings can not make one strong system of root, so their possibility for the survival will be decreased significantly.

Also, Machado *et al*. [16] in their experiment on bean, considered the decrease of the length of the root and the dry weight of the seedling caused by the effects of decreasing the power of the seed because of the accelerated ageint test and weariness that doesn't correlate with the results from this search.

Shoot Height: In all of the tests, analysis of variance showed (Tables 1, 3, 5) that interaction of Zeolite × irrigation were significant on shoot height (p<0.01). In the standard germination test, the usage of the higher level of the Zeolite (20 tons in hectares) and the normal irrigation (irrigation after 80 millimeter evaporation from class A pan) produced the lengthiest shoot (Table 2). But in the condition of non using of Zeolite and the intense drought stress (irrigation after 160 millimeter evaporation from class a pan), the least length of the shoot was observed (Table 6). Along the researches by Abba and Lovato [17], they concluded that the length of the shoot is one important measure to forecast after appearing the seedling in the field and the existing differences among the seed masses. Mendoka *et al.* [16] in the year of studing the seeds of cabbage noticed the test of the accelerated accelerated ageint test by affecting on the value of the germination and the length of the shoot of cabbage can be used to determine the level of the power of the growth in the seed of cabbage.

Abnormal Seedlings: In all of the tests, the interaction of Zeolite × irrigation showed (Tables 1, 3, 5) the significant effect on number of abnormal seedlings (p<0.01). In accelerate ageint test, in the condition of non using the Zeolite and the intense drought stress (a1b3), the most abnormal seedlings were observed (data don't show).

Woodstock [18] reported that some of the measurable reiterions alongside of performing the standard test including the number of the normal and abnormal seedlings can be used to estimate the power of the seedling successfully. Generally, by increasing the level of accelerate, the number of the abnormal seedlings will be increased. This has been observed in the studies of Ghasemi *et al.* [19] and Machado and *et al.* [16] on the seed of wheat (*Triticum aestivium L.*) and bean Faseolus (*Vulgar L.*).

Root/Shoot: In accelerate ageint test, the interaction effect between the different levels of Zeolite and irrigation on the ratio of the root to the shoot didn't observe (Table 5). But in the standard germination test, the interaction effect of the Zeolite × irrigation showed (Table 1) the significant effect (p<0.01) and at the cold test, showed (Table 3) the significant effect (p<0.05). Khalaj [14] stated that the ratio of the root to the root is one of the best criterions of the power of the seed to forecast the value of appearing the seedlings of canola in the field. In the standard germination test, in the condition of non using the Zeolite and the intense drought stress (a1b3), the least ratio of the root to the shoot was shown (Table 2), but in the test of the accelerated test in the condition of the normal irrigation (b1), the most ratio of the root to the shoot is observed (data don't show). That these results didn't correlate with the results of Abba and Lovato [17] and Ellis *et al.* [20] that they showed the increasing of the ratio of the root to the shoot at the standard germination test.

Final Germination Percentage: In all of the tests, the interaction effect of the Zeolite × irrigation showed (Tables 1, 3, 5) the significant effect on final germination percentage (p<0.01). at accelerated ageint test in the condition of non using the Zeolite and the intense drought stress (a1b3), the least final germination percantage was observed (Table 6). But in every of 3 tests, in the condition of non using the Zeolite and the intense drought stress (a1b3), the most the final germination percentage was observed (Tables 2, 4, 6). In this study, the non using the Zeolite in the condition of drought stress causes to decrease of final germination percentage (FGP) that this specifity in the condition of drought stress with the usage of the Zeolite specially with the usage of Zeolite showed the least decrease.

Also, among these three tests, cold test had the most final germination percentage and this conclusion correlates with the result of Tys and Jankowski [21], Stankova and Stankova [22] and they reported that the condition of the experiment of the cold test is like the stress of the cold test and stimulate the germination of the seeds.

CONCLUSION

The result of the present studies showed that the produced seeds under drought stress and without the Zeolite have the shorter root, the less dry weight, less final percent of the germination and more abnormal seedlings. And these parameters cause to decrease the and the power of growing the productive seeds. So this shows that in the condition of drought stress and non using the Zeolite, we will confront with the decrease of the length of the root and also the decrease of the ratio of the root to the shoot, so these plants show the less ability in the tolerance of drought stress. But in the produced seed under the medium and intense drought stress that the different values of the Zeolite were used to produce them, they showed the decrease of the quality and the quantity of the productive seeds and we don't recommend drought stress without the usage of the Zeolite and also we recommend that in the areas that we confront with drought stress because of the shortage of the sources of water, we can modulate the undesirable effects of drought stress by using the different levels of the Zeolite.

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