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ORIGINAL ARTICLE

Effect of Cold Stress on Germination and Growth of Wheat Cultivars

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Roghayyeh Zabihi-e-Mahmoodabad, Shahzad Jamaati-e-Somarin, Majid Khayatnezhad, Roza Gholamin: Effect of cold stress on germination and growth of wheat cultivars

ABSTRACT

This laboratory experiment was carried out in the Agricultural College of the Mohaghegh Ardabili University in 2010. It was conducted by factorial design with two factor and three replications, content 30 grain to per replication. Factor A include three temperature levels (2, 3 and 5° C) and factor B, include five wheat cultivars (Gaspard, MV17, Sardary, Cascogen and Bezostaya) were used in this experiment. Result showed that velocity of seed was lowest in the 2° C and Gaspard, Sardary, Cascogen and Bezostaya have highest velocity of seed, respectively. Therefore, greatest, seed velocities belong to Bezostaya cultivar in the 5° C temperature. Lowest, seed velocity related to MV17 in the 2° C temperature. For the number of roots, Cascogen cultivar with greatest and Gaspard cultivar with lowest of number roots were determined. Sardary cultivar has highest coleoptiles length. In the final result, Bezostaya cultivar was arranged in the first and highest level, between five cultivar, for cold stress characteristics and Sardary cultivar was showed second level, significantly in comparison of the another cultivars.

Key word: Cold stress, Seedling, Germination and Wheat.

Introduction

A stress affects practically every aspect of plant growth and metabolism. Plant responses to stress depend upon various factors such as duration and degree of stress, growth stage and time of stress exposure [1]. Due to their sedentary mode of life, plants resort to many adaptive strategies in response to different stresses such as high salt, dehydration, cold and heat, which ultimately affect the plant growth and productivity [2]. Against these stresses, plants adapt themselves by different mechanisms including change in morphological and developmental pattern as well as physiological and biochemical responses [3].

Wheat at different stages of growth temperature ranges and generally require heat and cold on the relative strength of their shows, usually at about 4° C to start germination of wheat resistance against cold, but relatively high and autumn races that are planted in cold areas, can be so cold -35° C, but must tolerate moderate frost tolerance in wheat, about 10 to -17 degrees. Wheat resistance against cold ancestry to different stages of its growth to changes in the early stages of growth is higher sensitivity [4]. Wheat is one of the most important cereal crops of the world. In most areas of the world, wheat is a principal food. In Pakistan, wheat is a staple food and thus occupies central position in farming and agriculture policies. It contributes 13.8% value added to agriculture and 3.4% to GDP. During 2003-04 wheat was cultivated on an area of 8176 thousand hectares, showing 1.8% increase over the previous year with the production of 19767 thousand tones which was 3.0% higher than the previous year [5].

Large areas of land under tomato production are established by sowing seed directly into the field instead of transplanting [6]. A primary task in

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breeding for stress tolerance is the identification and genetic characterization of useful germplasm. Appropriate time for sowing wheat, depending on the area conditions will change and more to soil temperature is about [7]. Wheat seeds germinated well in the state produces temperatures of more than 4° C, the temperature of whatever are more than 4, the budding is done sooner. But when the temperature is very high level of seed germination will be lost. Minimum temperatures for bud production, and near zero in mid winter wheat was about 2 degrees and the best and most suitable 8 to 10 and maximum 20 to 22° C is [4] germination stage is sensitive to soil temperature because the absorption seed needs water by enzymatic activity or is breathing [8]. Germination and growth before emergence normally is controlled by soil temperature [9] According to Macduff and Wild [10] root temperature on root growth, root number and length of barley and turnip effective. Range 3 to 9° C turnip root length with increasing temperature increases. Barley root length with increasing temperature in the thermal range of 3 to 25° C after 20 days increased 27 times. Abbasal-Ani and Hay [11] reported that seedling root systems of barley, oats, rye and wheat at low temperature (5° C) shorter at high temperatures (15 and 25° C) is also fast Davidson [12] has reported that the temperature on the growth allocation between shoots and roots affects.

Seed germination and vigor are prerequisites for the success of stand establishment of crop plants. Under stress conditions of different regions, low moisture and cold stress are limiting factor during germination. The rate and degree of seedling establishment are extremely important factors in determining both yield and time of maturity [13].

Seed germination is major problem of wheat (*Triticum aestivum* L.) production. It is influenced by many environmental factors, but the availability of soil moisture has a major effect on germination and subsequent emergence. Besides the reduction in total germination, comparatively low soil moisture availability results in delayed emergence, a criterion of particular importance in the vigor and subsequent yielding ability of many crops [14]. The rate of decline was found to be obvious, varying with crop species and cultivars [15]. Rate and seasonal distribution of precipitation, temperature and soil conditions are the main factors affecting yield and yield components of sesame in ari, semi–arid and cold areas [16].

The aim of this study was study of cold stress effect on germination and seedling growth, between five wheat cultivars for selection of best cultivar for planting in cold stress conditions.

Materials and methods

Experiment in 2010 in the Faculty of Agriculture University researcher Ardabil two factor factorial with three replications and 30 seeds in each replication were performed. The first factor was levels of temperature (2, 3 and 5 ° C) and the second factor cultivars (Gaspard, MV17, Sardary, Cascogen and Bezostaya). Germination test and seedling growth in Petri dishes 9 cm long with a filter paper and the following one in the seeds were conducted. In order to disinfect seeds of two fungicides Benomyl was used in thousands. For applying different temperature of germination chamber model Axyos were used. After 24 h germinated seeds counted and this practice continued for 20 days in this period often took seed germination. Last day of root length, shoot length and coleoptiles length with ruler was measured.

Number of roots was counted and the germination rate of the given ratio of the total number of seeds germinated to the total obtained by multiplying the number of seeds germinated on day (I) was estimated. For data analysis of SAS software was used. Comparison of means with LSD test at the 5 percent level of probability was performed.

Results:

Germination Rate:

Comparison of means (Table 2) and variance analysis table (Table 1) showed germination wheat cultivars under the influence of treatment temperature was applied temperature, so that the lowest rate of germination in the treatments at 2° C achieved. Between cultivars of germination rate significant difference was observed in five percent level probability (Table 1). Differences was observed between cultivars in terms of germination rate, thus cultivars Gaspard, Sardary, Cascogen and Bezostaya had the highest germination rate and MV17 cultivar obtained in the category (Table 2).

Stem Length:

Results showed that among the studied cultivars of stem length, there is no significant difference. ANOVA table (Table 1) and comparison of means (Table 2) showed stem length affected by treatment temperature is studied. Thus the treatment of temperature 5° C has highest and treatment of the temperature 2° C has lowest stem length.

Root length:

ANOVA table showed that root length under the influence of thermal treatments is applied (Table 1). Thus the temperatures of 3 and 5° C maximum and temperature of 2° C lowest root length were observed. Between cultivars were not observed significant differences for root lengths (Table 1).

Number of Root:

Results of variance analysis and comparison between the cultivars showed the number of roots is significantly different so that the Cascogen and Gaspard cultivars were obtained the highest and lowest number of roots, respectively. Also it was observed that with decreasing temperature, root number was significantly reduced (Table 1). So that the thermal treatment of 2 and 5° C, respectively lowest and highest number of roots were observed.

Coleoptiles Length:

The results showed a difference in length of coleoptiles was significant in 5 percent probability level (Table 1).

Comparison of means (Table 2) showed that Sardari cultivar having the highest level during the first and cultivars coleoptiles Gaspard, Bezostaya and Cascogen jointly received the lowest level.

MV17 cultivar after of Sardari cultivar was the second level.

Table 1: Analyses of variances of cultivar and cold stress on measured traits.

Sources of variation	Ms					
	Df	Number of root	Root length	Coleoptiles length	Stem length	Germination rate
Cold Stress	2	1.531*	87.424*	7.506*	182.957*	23.115*
Cultivar	4	0.531*	3.415	4.265*	2.053	51.463*
Cultivar × Stress	8	0.098	1.020	0.544	1.576	13.568
Error	30	0.095	2.345	0.530	1.113	23.784

* And **, significant in 5 and 1%.

Table 2: Mean comparisons of traits associated with germination and seedling growth of wheat varieties.

Treatments		Number of root	Root length	Coleoptiles length	Stem length	Germination rate
	Gaspard	2.727(b)	5.517(a)	3.183(b)	2.417(a)	30.41(a)
Cultivars	MV17	3.120(ab)	5.540(a)	3.814(ab)	2.908(a)	25.19(b)
	Sardari	2.886(ab)	7.017(a)	4.881(a)	3.118(a)	29.39(a)
	Cascogen	3.434(a)	5.819(a)	3.409(b)	3.304(a)	30.97(a)
	Bezostaya1	2.911(ab)	6.080(a)	3.328(b)	3.762(a)	30.71(a)
Temperature (° C)	2	1.94(c)	5.82(c)	3.14(c)	2.36(c)	24.22(c)
	3	2.74(b)	6.94(ab)	3.89(b)	2.96(b)	29.41(ab)
	5	3.36(a)	7.43(a)	4.96(a)	3.74(a)	30.46(a)

*Similar letters in each row, don't have significant differences

Discussion:

In general it was found that the lowest emergence of traits is the lowest temperature (2° C) among the studied temperatures. And according to cultivars studied and the results it was found that at low temperatures, Bezostaya cultivar in the first rank, and then Sardari cultivar, has had a more normal growth than other cultivars Foolad and Lin [17] showed that there were significant differences among cultivars respecting germination index. In many crop plants, seed germination and early seedling growth are the stages most sensitive to environmental stresses [18,19]. In the cultivated plants, chilling temperatures in the range of 0-12° C (cold stress) in the germination significantly delay the onset, reduce the rate and increase the dispersion of seed germination events [19,20,21]. The presence of environmental stress, such as cold, restricts establishment of direct-seeded crops. Poor seed germination may result in uneven stand establishment and poor crop performance [19]. Most commercial cultivars of some plants are highly sensitive to cold stress during seed germination; however, genetic variation exists within the cultivated plant and related wild species [19,20,21,22]. Adaptation to all these stresses is associated with metabolic adjustments that lead to the modulation of different enzymes [23,24, 25]. Among these enzymes are phosphatases, which are believed to be important for many physiological processes, including regulation of soluble phosphorous (Pi) [24]. Phosphateases are traditionally classified as being acid and alkaline depending on their optimum pH for enzyme activity, above and below pH 7.0 [26]. Free soluble phosphate reserves plays vital role in energy transfer, metabolic regulation, and important structural constituent of biomolecules like phytin bodies in the ungerminated seeds, protein and nucleotide phosphorylation [25,27].

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