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Original Article

Effect of Drought Stress and Zn Fertilizer on Some Root Characteristics of Chickpea Cultivars

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ABSTRACT

Objective: Drought stress is most important factor which reduce root and shoot growth in crops. This study was performed in order to evaluate the effects of drought stress and Zn fertilizer on root traits of four cultivars of chickpea. **Methods:** Experiment was laid out in a split plot-factorial using randomized complete block design with three replications. Drought stress treatment stand in main plots in three levels consist of no drought stress (complete irrigation), moderate drought stress (irrigation at planting and early flowering) and severe drought stress (no irrigation). 2 Zn levels (using hand sprayer 1 L and control) and four chickpea cultivars Azad, Bivanij, Hashem and ILC482 stand in sub plots. **Results:** Result showed that the effect of drought stress was significant on al parameters. Effect of Zn fertilizer was significant only on Number of nodule and primary root length, but not significant on other parameters. Effect of cultivar treatments was significant only on Number of nodule and primary root length, but not significant on other parameters. Maximum number of nodule and root length was obtained in non stress condition and in Bivanij cultivar. With increase in drought stress number of nodules in plants and root length were decreased.

INTRODUCTION

Drought stress causes deceleration of cell enlargement and thus reduces stem length by inhibiting inter nodal elongation and also checks the tillering capacity of plants (Ashraf and O'Leary, 1996). Drought several studies have also shown that optimum yield can be obtained with irrigation at branching, flowering and pod formation stages (Prihar and Sandhu, 1968). Chickpea yield is depending of nutrient elements. Zinc is one of these important elements; in addition it has high pH that affects the absorption ability of phosphorus as macro-element. Zinc plays an important role as a metal component of enzymes (alcohol dehydrogenase, superoxide dismutase, carbonic anhydrate and RNA polymerase) or as a functional, structural, or regulator cofactor of a large number of enzymes (Marschner, 1986). Mahady (1990) found that foliar application of Zn SO for faba bean plants increased number of pods/plant and seed yield/fed. Highest seed yield obtain in normal condition of fertiling and environmental conditions (Shaban, 2013 a, b; Beyranvand et al. 2013; Kiani et al.

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2013). Soleimani (2006) reported marked increase in number of grains spike-1 of wheat for foliar application of boron and zinc, respectively. Soleimani (2006) reported increase in biological yield for foliar application of zinc. Grewal et al. (1997) reported increased wheat production with application of zinc and boron over control. Grain protein content and baking quality highly depend on genetic background and environmental factors, especially influence of drought and heat stress, during the grain filling period. Storage protein is a method to investigate genetic variation and to classify plant varieties (Isemura et al. 2001). During the growing season may have their roots in the upper soil profile where the density is greater than a dry face, but the plant is able to continue its vital work. So in this case the lower part of the soil, root density at low but adequate moisture, they are responsible to provide water for the plants (Li, et al. 2006). In other words, when faced with stress the ability of plant roots to absorb the increase in dry matter allocated to the root system will (Mohamadi et al. 2004; Michele et al. 2009). As a result of changes in morphological parameters, such as root elongation occurs (Aerts et al. 1999). Many plants by increasing the proportion of assimilates allocated to root growth and thus increasing the ratio of root to shoot and enjoying more water available to the lack of moisture will respond (Michele et al. 2009; Kaffi et al. 2000). Therefore this study was planned to examine effect of drought stress and Zinc fertilizer on some root traits of chickpea cultivars.

2. MATERIALS AND METHODS

A field experiment was conducted in order to study on effect of drought stress and Zinc fertilizer on some root traits of four chickpea cultivars. Soil of the experiment was clay with pH 7.4, organic matter content 1.63, total P 0.15% and 0.9 mg/kg of zinc. The experiment was laid out in a split-factorial design with drought stress in main plots and cultivar with Zinc microelement in subplots with three replications. The experimental treatments consisted of three levels of drought stress [severe drought stress (S2), moderate drought stress (S1) and no drought stress (S0)] in the main plots and four cultivars of chickpea, Azad, Bivanij, Hashem and ILC482 and 2 Zinc levels in the sub plots [Zn0 (application of Zinc fertilizer) and Zn1 (non application of Zinc fertilizer)].

Root parameters were calculated as follows:

Main root length: root length was measured using an accurate meter.

The total length of roots: measurement of the total length of the roots of the equation was proposed by Alizadeh (2006).

The number of root nodules: the maximum number of nodes in the early flowering plants Fabas·h families are formed, this time selecting five plants from each plot and the Bill of appropriate diameter and depth of sampling was conducted after washing the roots and nodules were counted. Root dry weight of root samples that were used for measuring of other characters were used for this attribute. Samples in oven for 48 h at 80 ° C were maintained and after drying, the samples used.

2.1. Statistical analysis

Data analysis software EXCELL, SAS and Spss conducted comparing means using LSD test at 5% probability level was used.

3. RESULTS AND DISCUSSION

The total length of roots: effects of water stress, cultivar and interaction between cultivar × fertilizer, and stress × cultivar × fertilizer on the total length of roots were significant (Table 1). The difference between stress and non-stress levels in different varieties of root length was significant, indicating that with increasing of drought stress, the attribute declined (Table 2). In non tress condition cultivars were highest number and in severe drought stress were lowest of it. With increasing drought and salinity reduced leaf photosynthesis and sugar requirements for osmo regulation cells increases resulting in decreased availability of assimilates and root growth inevitably stops, so when the drought on the plant is governed Terms of root growth and reduced water availability (Michele et al. 2009). The results of work (Khazaei and Kafi, 2003) were consistent. In this study mmaximum total root length was obtained in non stress condition and in Bivanij cultivar (Table 2). With increase in drought stress total root length in chickpea cultivars were decreased.

Table 1:

Summary of analysis of variance for root characteristics in chickpea cultivars as affected by drought stress and Zn fertilizer levels

S.O.V	df	Number of nodule	Primary root length	total root length
R	2	2.1	0.21	0.33
Drought stress (S)	2	9125**	39.1**	51**
Error a	4	0.9	0.12	0.33
Zn fertilizer (ZN)	1	185*	0.99*	0.99
Cultivar ©	3	92	2.65*	3.56*
S*Zn	2	58	2.3*	1.1
C*Zn	3	121*	1.98*	2.13*
S*C	6	88	0.94	0.86
S*Zn*C	6	456*	0.99*	3.21**
Error b	42	11.2	0.11	0.42
CV%		14.5	7.6	16.3

* and **: Significant at the 5% and 1% probability levels, respectively

Primary Root length: effects of water stress, cultivar, Zn fertilizers, fertilizers × stress, cultivar × fertilizer, and stress × cultivar × fertilizer on root length was significant (Table 1). The severity of drought stress on root length and maximum rate of stress-lowering effect was achieved. Zn Fertilizer increased root length (Table 2). The result (Tupitsyn et al. 1968) also confirm this is**.** Interaction between stress and genotype showed the highest root length in terms of average stress in the figure severe stress condition Bivanij and the lowest number obtained ILC482. Maximum primary root length was obtained in non stress condition and in Bivanij cultivar (Table 2). With increase in drought stress primary root length in chickpea cultivars were decreased. In one study it was found that increasing severity of drought stress on wheat genotypes increased the root: shoot ratio (Maadelat, 1981). With fertilizer significantly increased the root: shoot ratio. Because nitrogen-fixing nodules on the plant and this has caused more than enough nitrogen available for plant growth and shoot growth has been more limited and root: shoot ratio increased.

The number of nodules on the roots: Analysis of variance showed that the effect of drought stress and fertilizer, cultivar × fertilizer interaction, and strain × cultivar × cultivar × fertilizer were significant on the number of nodules on the roots (Table 1). Maximum number of nodule was obtained in non stress condition and in Bivanij cultivar (Table 2). With increase in drought stress number of nodules in plants were decreased. Reduction or absence of nodules in plants under water stress due to decreased survival of Rhizobium in soil (Mckee, 1960). Drought has reduced the number of nodules on bean plants (Saito et al. 1984). Bring (Asseng et al. 2000; Ceotto et al. 1995) the maximum number of nodes and the number of non-stress conditions Bivanij respectively, while the lowest rates were found in terms of stress-free number so that the number of nodules in these circumstances Bivanij figure double the figure was released.

Table 2:

Mean of root characteristics in chickpea cultivars as affected by drought stress and Zn fertilizer

	Number of nodule	Primary root length (cm)	total root length (cm)
stress			
No stress	19a	9.2a	8.3a
Moderate stress	9b	3.2b	6.2b
Severe stress	2c	2.1c	2.1c
Zn fertilizer			
No fertilizer	11	5.2b	5.5
Use of fertilizer	13	6.3a	6.8
Cultivars			
Azad	5c	6.3b	8.2b
Bivanij	16.2a	7.9a	9.3a
Hashem	9.3b	8.2a	8.1ab
ILC482	8.1c	6.2b	7.1c

Means, in each column and for each factor, followed by at least one letter in common are not significantly different at the 5% probability Level-using least significant Difference Test.

Conclusion

The root system is suitable for areas that face water restrictions could help Peas in maintaining stability. In present study in final with increasing intensity of water stress, root traits except root: shoot ratio decreased root: shoot ratio increased, which is likely to reduce the growth of shoots relative to roots is a. Because of as with enhanced drought reduced growth of shoots and underground, but underground organ growth slower than growth shoots are reduced and this feature makes the plant can dry conditions in the water required for other parts of their supply. In conclusion in this study we revealed that mmaximum number of nodules, primary and root length was obtained in non stress condition and in Bivanij cultivar. With increase in drought stress number of nodules, primary and root length in chickpea cultivars were decreased.

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