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Original article

Effect of *Trichoderma harzianum* on growth characteristics and absorption of some elements in basil under drought stress

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Extended abstract

Introduction

Today, in order to prevent the destruction of water, soil and environment resources, and at the same time to achieve the desired performance in agriculture, in the conditions of environmental tensions such as drought, the use of biofertilizers is a desirable solution. Drought is one of the most important non-living environmental stresses and a limiting factor in agricultural production, especially in arid and semi-arid regions around the world. Trichoderma isolates are stimulated by various mechanisms such as competition for food and the growing environment, stimulation of plant resistance mechanisms, stimulation of plant growth and development, change of environmental conditions, especially rhizosphere and increase the solubility of mineral elements to be absorbed by the plant. Experiments have shown that the use of Trichoderma Harzianum during the basil basil can increase the number of leaves, weight and dryness, nitrogen levels and plant phosphorus relative to the control (Tallapragada 2013). Due to the increasing reduction of water resources and the confrontation of plants with water stress and reduction of quality and quantity of agricultural products in this study, the effect of different concentrations of Trichoderma Harzianum on basil plant in drought stress on morphological, biochemical characteristics and adsorption of elements was investigated.

Materials and methods

An experiment was conducted in a completely randomized design with three replications in 2018 in the greenhouse. The treatments included 3 levels of drought stress (50, 75 and 100% field capacity) as the first factor and inoculation with Trichoderma fungus (concentration 108) and non-inoculation with Trichoderma fungus as the second factor. Sampling was performed 60 days after drought stress, coinciding with the development of flowering plants. Morphological traits including wet and dry weight of aerial limbs and roots were weighed. The length of the stem and root was measured by a ruler and the leaf surface by a device measuring the surface of the leaf gauge. The total amount of nitrogen was measured by the kjeldahl method device, the amount of phosphorus was measured using a colorimeter by a spectrophotometer, and the amount of potassium was measured by a film photometer. Data analysis was performed using minitab 18 statistical software and comparison of means based on Bonferroni test at 5% probability level ($p < 0.05$). The charts were also drawn using EXCEL software.

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Results and discussion

The results showed that the use of Trichoderma harzianum in different levels of drought stress had a significant effect on growth traits and adsorption of elements in basil. The highest fresh and dry weights of shoot and root organs, relative leaf water content and leaf area were observed in the treatment of 100% irrigation capacity along with the use of Trichoderma fungus with a concentration of 108 spore. Also, the highest adsorption of phosphorus, potassium and nitrogen was observed in the treatment of irrigation level of 100% field capacity with the use of Trichoderma fungus with a concentration of 108.

Conclusion

The use of Trichoderma harzianum in stressful conditions in basil has improved the growth properties and increased the absorption of phosphorus, potassium and nitrogen in the plant. In general, in this study, the highest increase in the observed trait was observed in the treatment of irrigation level of 100% field capacity with the use of Trichoderma fungus with a concentration of 108.

Keywords: Leaf area, Potassium, Phosphorus, Nitrogen, *Ocimum sativum*

Table 1. Physical and chemical properties of soil

Texture	Sand	Silt	Clay	pH	EC	N	P	K	Organic matter
	----------%----------				ds/m	%	----------mg/kg----------		%
Clay Loam	43	29	28	7.1	1.18	0.11	13.3	301	1.3

Table 2. Analysis of variance of growth characteristics and elements in basil under treatment of irrigation levels and application of Trichoderma fungus

S.O.V	df	Wet weight of the aerial parts	Dry weight of the aerial parts	Wet root weight	Dry root weight	Stem length
Irrigation levels (I)	2	489.90^{**}	5.13^{**}	3.97^{**}	1.27^{**}	327.25^{**}
Trichoderma fungus (T)	1	73.36^{**}	2.44^{**}	0.98^{*}	0.18^{**}	10.18^{**}
I * T	2	5.10^{**}	0.15^{*}	0.55^{*}	0.07^{*}	1.38^{ns}
Error	12	0.489	0.0295	0.1394	0.0190	1.201
CV%		*14.41*	*11.66*	*10.74*	*14.11*	*12.44*

Table 2. Continued

S.O.V	df	Root length	Leaf area	potassium	Phosphorus	Nitrogen
Irrigation levels (I)	2	57.71^{**}	606.29^{**}	0.22^{**}	0.0109^{**}	0.357^{**}
Trichoderma fungus(T)	1	1.86^{*}	114.10^{**}	0.011^{**}	0.001250^{**}	0.005^{ns}
I * T	2	0.93^{ns}	9.74^{*}	0.0014^{*}	0.000350^{*}	0.00005^{ns}
Error	12	0.3189	2.018	.000206	0.00005	0.0015
CV%		*7.9*	*13.17*	*9.2*	*8.84*	*9.7*

* And **، significant difference at the probability level of 5 and 1%, ns = no significant

Table 3. Effect of irrigation levels and application of Trichoderma on growth characteristics and absorption of nutrients in basil under different levels of irrigation

Trichoderma fungus	Irrigation levels	Wet weight of the aerial parts	Dry weight of the aerial parts	Wet root weight
		----------g per plant----------		
Do not use Trichoderma fungus	50	16.16^{e}	3.146^{e}	3.276^{c}
	75	27.87^{c}	4.413^{cd}	3.926^{bc}
	100	34.69^{b}	5.026^{b}	5.143^{a}
Trichoderma fungus	50	21.71^{d}	4.096^{d}	3.98^{bc}
	75	29.86^{c}	4.786^{bc}	4.85^{ab}
	100	39.27^{a}	5.916^{a}	5.36567^{a}

Table 3. Continued

Trichoderma fungus	Irrigation levels	Dry root weight	Leaf area	Potassium	Phosphorus
		g per plant	cm^2	------mg / g dry weight-----	
Do not use Trichoderma fungus	50	1.033^{c}	5.148^{e}	0.0157^{e}	0.0028^{e}
	75	1.293^{bc}	8.145^{cd}	0.0174^{d}	0.0031^{d}
	100	2.063^{a}	10.755^{b}	0.0194^{b}	0.0035^{b}
Trichoderma fungus	50	1.36^{bc}	6.911^{d}	0.0159^{e}	0.0028^{e}
	75	1.63^{b}	8.861^{c}	0.0181^{c}	0.0032^{c}
	100	2.126^{a}	11.828^{a}	0.0199^{a}	0.0038^{a}

In each column, averages with similar letters at the statistical probability level of 5 and 1% did not differ significantly from the LSD test

Table 4. Comparison of the average simple effects of different irrigation levels on basil

Treatment		Stem length	Root length	Nitrogen
		----------cm----------		mg / g dry weight
Irrigation levels	50	21.471^{c}	30.8667^{c}	0.01196^{c}
	75	27.178^{b}	32.2667^{b}	0.0134^{b}
	100	36.123^{a}	36.8^{a}	0.01673^{a}

In each column, averages with similar letters at the statistical probability level of 5 and 1% did not differ significantly from the LSD test.

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Table 5. Comparison of the mean simple effects of Trichoderma on basil under different levels of irrigation

Treatment		Stem length	Root length
		---------- cm ----------	
Trichoderma fungus levels	No use *Trichoderma* fungus	27.5056^{b}	32.9889^{b}
	Trichoderma fungus	29.01^{a}	33.6333^{a}

In each column, averages with similar letters at the statistical probability level of 5 and 1% did not differ significantly from the LSD test