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ORIGINAL ARTICLE

Evaluation of Mycorrhiza Biological Fertilizers on Some Macro Elements Absorbtion in Water Stress Condition in Sorghum

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ABSTRACT

In our time human need to agriculture as ever, but it has many more bad environmental effects. Nutrients are the materials of production in agriculture and remove of them is one of the chemical fertilizers more using inducement which provoke removing and it's a grate restriction for environment, but its partly avoidable by increasing the plants absorption. Plants, during the period of growth and development are exposed to environmental stresses. One of the most important stresses is water stress.Which can make problemes for plants Absorption and transmission of nutritions, but some kinds of useful terricolous fungies such as Mycorrhiza can naturaly effect on this process which is matched with environmental protection objectives.The experiment was carried out in pot to determine symbiotic effect of Mycorrhiza and also effect of this microorganism in water stress on absorption of elements in sorghum plant .This experiment was carried out in factorial by using a randomized complete block design in three replications in 2009 in Shiraz-Iran. The results showed that water stress can effect significantly on Nitrogen and Phosphorus and Potassium absorbtion. Also Mycorrhiza significantly increased the absorption of Nitrogen,Phosphorus and Potassium in water stress conditon. In similar water stress condition, mycorrhizae treatment showed, in comparison with non-mycorrhizae, an increase in relative absorption of nitrogen, phosphorus and potassium**.**

Key words: Mycorrhizae, water stress, sorghum, Nitrogen, Phosphorus, Potassium

Introduction

Biofertilizer has been identified as an alternative to chemical fertilizer to increase soil fertility and crop production in sustainable farming, which has several environmental protection effects.[28]

Using microorganisms, that play an important role in nutrients providing, is a way to reduce chemicals using. One of these microorganisms is mycorrhiza fungus which causes the superabundant symbiosis in the world,which is Mycorrhiza symbiosis.

Mycorrhizea,means fungous root, generaly call to symbiosis between fungous myceliums and plants root.[21] and Endo-Mycorrhizae is the most prevalent kind of it.In these species of Mycorrhizae, Fungus penetrates inside the plant roots and creates communication devices which are called Arbuscular. Visicular Arbuscular fungus are capable of existence with the most varieties of plants and herbs. It can reduce the absorption of heavy metals in soil, and also increase the plant resistance to root pathogeny, the development of phito-hormones, and the growth of radicle rootlets (hairy roots); Besides it intensificate the Nitrogen development ,which increase the photosynthesis that cause host plant to grow more. [27] thou these abilities depend on different factors. Some of them are the ability of

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external mycelium of VAM fungus in propagation through soil and seepage inside the roots, [17] environment causes including light intensity soil acidity.[13] and soil aerification. [21]. These kind of fungus are effective in attracting food elements like Phosphorus and Nitrogen and absorption of water in tension condition, and in producing botanic hormones and harmonizing the environmental stress effect, increasing the plant's resistance to botanic patogens. reducing root damage, increasing the stabilization of biologic Nitrogen and also improving the quality and quantity of crops[23].

One of the important reasons of supporting Mycorrhizae in dryness stress of host plant is increasig the absorbtion of food elements in soil and well feeding the plant. phosphore is just one of the important elements which active Mycorrhizae absorbs. research and sudies shows that the current speed and acceleration of Phosphor inside a Mycorrhizea infected plant, is 3 to 6 times more than a normal plant without Mycorrhizae.[9]

Except Phosphorus ,Nitrogen is an important element. Studies show that a Mycorrhizea hosted plant increases the absorption of nitrogen.[6]Mycorrhiza hyphas have the ability of absolv the soil's nitrogen and transfer it to plant's root.[5]

And for Potassium absorption of mycorrhizae some researchers say that it has no effect and some are saying its usefull.[8]

Surghom is one of the most producer plant in grain family . But one of the reasons of decreasing in production this plant in dry and semi dry areas like Fars state in Iran is water shortage stress. [10]

Water stress happens when the amount of receiving water is less than the wasted water due to soil and weather's dryness , high temperature and salty ground.but the bad effect to Surghom's growth during water shortage depends on time and the amount of the water shortage tension , the severity of tension and the germinating stage and plant's genotype.[14] In relation between water ,soil and plant ,the existance of symbiosis relation is severely important for plant's noutrishing. This experiment planed and performed to survey the effects of mycorrhizeal symbiosis on absorption of Nitrogen Phosphor and Potassium in water stress condition in sorghum plant.

Materials and Methods

This experiment was carried out in 2009 in pot condition in natural farm environment. The method of research was carried out based on factorial design by using a randomized complete block design in three replications. Treatments are Consisted of Water Stress in foure levels:I_1:Reirrigation when %75 of plant available water is remained.I_2: Reirrigation when %55 of plant available water is remained.I_3: Reirrigation when %35 of plant available water is remained.I_4: Reirrigation when %15 of plant available water is remained Influencing water stress treatment ; first, soil (pb) and (pwp) and (fc) was measured, then available water was determinded by difference (fc-pwp) and available water in (fc) condition was theorized 100 and other treatments was measured in relation to it. For determining soil moisture, sampling of sub pot each 2 days. Then , each sample was draied 24 hours in oven in 105 cantigrad degree..And mycorrhizae (M1)and nonmycorrhizae (M0)

The planting is forage sorghum vulgare variate atlas which is common in most of the regions in state of fars in iran. In each pott three seeds of Sorghum were planted. Each potts were consisted of 6.5kg streel soil with sandy- loom texture . this soil first became streel in autoclave with 121^{oc} heat and 15 psi presure for 2 hrs. This killed all the possible fungal or bacterial pollutions.Then streel the walls of the potts with alcohole ,then inside each pott were filled with mixture of agricultural soil and sand. And put the seeds ,which were germinate in germinator , in soil in the 3 to 5cm hole.Then put the soil that has the fungus of Mycorrhizae Visicular-Arbuscular, *Glumos intraradices*, in the bottom of the hole in away that the seeds root are in contact with it. In such pott the amount of N ,P and K were calculated by sampling from laef in silk growth leve Plant samples were sent to the laboratory immediatly. They were cleaned thoroughly after being washed with ordinary and distilled water in the laboratory. Then they were dried in oven for 72 hours and in 70 cantigrad degree and grinded afterwards. To measure nitrogen , 0.3 grams of the plant sample were digested using sulphuric acid , salcilic acid and distilled water and then , its amount was specified with kejeldal. To measure other elements , 1 gram of samples put in the electrical kiln in the temperature of 550 cantigrad degree for 5 hours to become ash , then , it was digested with chloridric acid 2 normal. The elements were measured as follows:potassium , using the film photometer machine (fater electric,model 405-made in iran) andphosphore , using the method of calorimetry with spectrophotometer machine , wavelength of 880(nm) (ERMA PHOTIC 100-made in japan)The results were analysed after classification using the SAS software.

Results and discussion

Water stress effects on N, P, K absorption:

The variance analysis (table 1) shows that the variant quantities of water are effective in N and P absorption in 99% and K absorption in 95%.

The Means compare of K also shows significant difference between treatments.I4 with 1.51% has the highest and I2 with 1.03% shows the lowest K absorb. Also we see this happens for P and N with more intensity that I1 with mean 0.12% is the highest and I4 with mean of 0.057% is the lowest P absorber. For N absorbing I1 with mean of1.69% has the most and I4 with 0.9% has the least percentage. Potassium absorbing is less impressible than Nitrogen and Phosphorus by drought stress treatment. [19]

Mycorrhiza effects on N, P, K absorption:

As shown in table 1, Mycorrhizae treatment has been Significantly effective on N, P and K acquisition. But the less effect on K is obvious in means compare and the comparison of the means express the obvious effect of mycorrhiza on Phosphorus and Nitrogen uptake.

The addition of soluble P as fertilizer increases the concentration of P initially in soil solution followed by a decrease. The process of removal of P from soil solution is generally termed phosphate 'fixation' or 'retention'.[7] But Its sensible that fungus myceliums increase the absorption of P and N with suitable expansion in soil. Considerable literature is also available on the use of phosphatic fertilizers by AM fungi, which suggests that mycorrhiza plants possess greater efficiency to take up P from the fertilizers.[6]

The extraradical hyphal component of AM infection constitutes an important means for phosphorus (P) transport through soil as these organs go beyond the P depletion zones around the roots and gain access to P which is otherwise translocated only by slow diffusion process .[11]

But the reasons are several. By some evidences, mycorrhiza plants myceliums discharge some substances which are effective for making P solvable in soil and then usable for plant. Prompting absorption of P and N is the other reason.

The increasing in absorption of N is sensible to be connect with P absorption increasing and inverse. There are plenty of reports confirming the utilization of inorganic N by extraradical hyphae of AM fungi . [17]

Johansen showed the stimulation of growth of extraradical hyphae of *Glomus intraradices* by the addition of NH_4^+ -N to the soil. Transport of NO_3^- by AM fungi has been observed by.[17] ^{15}N studies have shown however that soil N can be taken up by the extraradical hyphae as NH_4^+ -N [2] and NO_3^- -N . [18]

Mycorrhiza just has 5% effect on Potassium acquisition in this experiment which is parallel with other researches.

The reason why micorrhizae absorbs phosphore more guickly and violently is:

A) Because of external mycelia scatetring of micorrhiza fungi in soil that eventfully enhances absorption level,mycelia are able to absorb phosphore from inaccessible areas of the plant roots and transfer it to the plant roots,since,among all different ways of nutrients absorption,phosphore is absorbed through diffusion generally,but in the presence of micorrhizae fungi,mycelia fungi are able to absorb these elements actively and consequently,phosphore absorption rath eliminates.[3]
B) Synergistic impacts between external mycelia of micorrhizae fungi and phosphate solvent bacteras,which in this condition unavailable mineral phosphore transforms to available mineral phosphore transforms to available minral phosphore,can increase Usable phosphate for plant diffusion increase of H+ or hydoxidaz by hyphae.[20,16]
C) Increase of P absorption by micorrhizae plants hyphae may be because of increase of P absorbtion in the root length unit.this increased speed of absorption is 2 to 3 times more than non-micorrhizae plants.[25]
D) Micorrhizae fungi discharge enzymes and materials in soil cansing transformation of unavailable organic phosphore to available one.[26,22] but many studies demonstrated that Micorrhizae plants have higher phosphore absorption in the drought stress condition comparing to Non- Micorrhizae plants which has a harmony with this experiment results. [24,12,1] In addition to phosphore absorption the increase of Nitrogen absorption in the Micorrhizae plants has been frequently reported as well. [15,2]

Interaction of mycorrhizea and water stress on absorption:

Mycorrhizae and water stress interaction is 99% meaningful for phosphorus absorption but unmeaning for Nitrogen and Potassium absorbing (table 1).

Also comparing of means shows that mycorrhizae helps the plants in water stress or when the water was not enough. The root expantion by mycorrhizae is an evident and this help the plant to experience more of the soil and use some nutrients which was unusable before. The results have also demonstrated an increased potassium absorption in both Micorrhizae and Non- Micorrhizae plants as stress increased. Other researchers report the Micorrhizae impact on absorbing cations like " K, Mg, Ca " is contradictory; so that somewhere

Table 1: Mean squares for effect of water stress and mycorrizae on nutrients uptake.

SOV	df	N Absorption	P Absorption	K Absorption
Rep	2	0.149^{ns}	0.113^{ns}	0.004^{ns}
Water stress	3	0.69*	0.111**	0.24*
Mycorrhizae	1	4.36**	0.487**	0.051*
M*W	3	0.16^{ns}	0.142**	0.013^{ns}
Error	14	0.42	0.456	0.0043

n.s , * and ** : not signifiamt , significant at the 5 and 1% Levels of probability.respectively

Tables 2: Mean squares for the effect of water stress and Mycorrhizae treatments on persentage of nutrients absorbtion

Treatment	N Mean% dunkan	Treatment	P Mean % dunkan	Treatment	K Mean % dunkan
I1	1.69^{a}	I1	0.12^{a}	I1	1.2^{a}
I2	1.52^{b}	I2	0.10^{b}	I2	1.03^{b}
I3	1.46^{c}	I3	0.065^{c}	I3	1.32^{c}
I4	0.9^{d}	I4	0.057^{c}	I4	1.51^{d}
M1	0.97^{a}	M1	0.18^{a}	M1	1.31^{a}
M0	1.82^{b}	M0	0.088^{b}	M0	1.22^{b}

means followed by the similar letters are not significantly different(dunkan %5)

Tables 3: Mean squares for mycorrhizae and water stress interaction

Nitrogen		Phosphorus		Potassium	
Treatment	Mean% dunkan	Treatment	Mean% dunkan	Treatment	Mean % dunkan
I_1M_1	2.183^{a}	I_1M_1	0.113^{b}	I_1M_1	1.266^{b}
I_2M_1	2.026^{a}	I_2M_1	0.136^{b}	I_2M_1	1.013^{c}
I_3M_1	1.993^{b}	I_3M_1	0.670^{a}	I_3M_1	1.403^{a}
I_4M_1	1.086^{c}	I_4M_1	0.576^{a}	I_4M_1	1.576^{a}
I_1M_0	1.020^{d}	I_1M_0	0.113^{b}	I_1M_0	1.130^{c}
I_2M_0	1.026^{d}	I_2M_0	0.096^{c}	I_2M_0	1.060^{c}
I_3M_0	0.923^{e}	I_3M_0	0.073^{c}	I_3M_0	1.250^{b}
I_4M_0	0.726^{e}	I_4M_0	0.073^{c}	I_4M_0	1.450^{b}

Means followed by the similar letters are not significantly different(dunkan %5)

increase of absorption, sometime decrease and sometime without impact has been reported. [4]

It seems the reasons of difference in results of these elements would be the type of soil (acidic or alkaline), soil Ph, the type of plant, the type of Micorrhizae fungi, temperature, . . .

References

1. Alizadeh, O., 2010. Evaluation Effect of Water Stress and Nitrogen Rates on Amount of Absorbtion SomeMacro and Micro Elements in Corn Plant Mycorrhizae and non Mycorrhizae. Advances in Natural and Applied Sciences, 4(2): 153-158.
2. Alizadeh, O., A. Alizadeh, 2007. Effect of mycorrhiza in different soil moisture condition on absorption of nutrition elements in corn.journal of research in agricultureal science, 3(1): 101-109.
3. Al-karaki, G.N. and A. Al-Raddad, 1997. Effects of arbuscular mycorrhizal fungi and drough stress on growth and nutrient uptake of wheat genotypes differing in drought resistance. mycorrhiza, 7: 83-88.
4. Azcon, R. and J.M. Barea, 1992. Nodulation, N2 Fixation (N) and N Nntrition relationships in Mycorrhizal and phosphate – amended alfalfa plants.symbiosis, 12: 33-41.
5. Bago, B., H. Picke and C. Aguilar, 1996. Nitrate deplation and pH changes induced by the extraradical mycelium of the AM fungus Glomus intraradices grown in monoxenic culture, New Pkitol., 133: 273-280.
6. Bolan, N.S., 1991. A critical review on the role of Mycorrhiza fungi in the uptake of phosphorus by plants. Plant soil., 134: 187-207.
7. Bache, B.W., 1964. Aluminium and iron phosphate studies relating to soils. Journal of Soil Science, 15: 110-116.
8. Barea, J.M., 1992. VAM as modifier of soil fertility.Advances in Soil Sci., 15: 1-40.
9. Bolan, N.S, A.D. Robson and N.J. Barrow, 1987. Effects of phosphorus application and mycorrhiza inoculation on characteristic of shb clover and rye grass in relation to phosphorus uptake. Plant Soil,, 104: 294-298.
10. Brown, J.S., 1979. Water transport in plant: Mechanism of apparent changes in resistance during absorbtion plant phytologist, 117: 182-207.
11. Clarkson, D.T., 1985. Factors affecting mineral nutrient acquisition by plants. Annualreview of Plant Physiology.
12. Clark, R.B., S.K. Zeto and R.W. Zobel, 1999. Effectiveness of arbuscular Mycorrhizal fungal isolato on mineral acuistion of panicum virgratum grown in acidic soil. Mycorrhizal, 9: 167-176.

13. FItter, A.H. and J. Garbaye, 1994. Interaction between mycorrhiza fungi and other soil organism in management of mycorrhizas in agricuiture. Academic publisher.Klower, pp: 123-132.
14. Grant, R.F., B. Sjackson, J.R. Kiniry and G.F. Arkin, 1989. Water deficit timming effects on yield components in maize. Agron. J., 81: 61-65.
15. George, E., H. Marshner and I. Jakobsen, 1995. Role of arbuscular Mycorrhizal fungi in uptake of phosphorus and nitrogen from soil. critical Review of Biotechnol., 15: 257-270.
16. Isaac, S., 1992. Fungal-plant interactions. Chapman and Hall poblisher Jakobsen. I. 1995. Transport of phosphorus and carbon in VA Mycorrhizas in. Mycorrhizas, structre, function, Molecular Biology and Biotechnology. A VArman and B. Hock(eds). Springer-verlage. Berlin, pp: 297-324.
17. Johansen, A., I. Jakobsen and E.S. Jensen, 1993. external hyphae of AM fungi associatedwith Trifolium subterranecum L.3.Hyphal transport of ^{32}p and 15N. New Phytologist., 124: 61-68.
18. Johansen, A., I. Jakobsen and E.S. Jensen, 1992. Hypha transport of ^{15}N-labled Nitrogen by AM fungi and its effect on deleption of inorganic soil N. New Phytologist, 122: 281-288.
19. Logan, T., J. Goins and B. Jlindsay, 1997. Field assessment of trace element uptake by six vegetables from n-viro soil. Water environment research, 69: 28-33.
20. Marschner, H., 1991. Mechanisms of adaptation of plants to acid soils in:plant-soil interactions at low PH.R.J. wright, V.C. Baligar and R.P. murmanm (eds). Kluwer Academic publisher, Dordrecht. The Nether lands, pp: 683-702.
21. Nadian, H., S.E. Smith, A.M. Alston and R.S. Murray, 1996. Effects of soil compaction on plant growth ,phophorus uptake and morphological characteristics of vesicular-arbuscular mycorrhiza colonization of *Trifolium subterraneum*. New phytologist, 135: 303-311.
22. Nurlaeng, N., H. Marschner and E. George, 1996. Effects of Liminig and Mycorrhizal Golozination on soil phosphate deplation and phosphate uptake by maize and soybean. Grown in two tropical acid soil. plant soil, 181: 275-285.
23. Portas, C.A.M. and H.M. Taylor, 1975. Growth and surrival of youny plant roots in dry soil. Soil Sci., 121: 170-175.
24. Sieverding, E., 1983. Influence of soil water regimes on VA Mycorrhizal ∏. Effect of soil temperature and water regine on growth, nutrient uptake and water utilization of Eupatorium odoratum L. Journal of Agronomy and crop science, 152: 56-67.
25. Tinker, P.B., M.D. Johns and D.M. Durall, 1992. A functional comparison of ecto and endo-Mycorrhizas. CAB int wellingford UK, pp: 303-310.
26. Tarafdar, J.C. and H. Marshner, 1994. Effictiencey of VAM hyphae in utilization of organic phosphorus by wheat plants. soils sci and plant nutr., 40: 593-600.
27. Warcup. J.H., 1971. Specificity of mycorrhiza association in some Australian terresterial orchids, new phgtologist., 70-41-46.
28. Wu, S.C.Z.H., Z.G. Cao, K.C. Li and M.H. Cheunga, Wong, 2005. Effects of biofertilizer containing N-fixer, P and K solubilizers and AM fungi on maize growth Geoderma., 125: 155-166.