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Effect of co-inoculation with rhizobia and mycorrhiza on root parameters of lucerne (*Medicago sativa* L.) under dry organic farming conditions

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ABSTRACT

Knowledge of root traits associated with tolerance to water deficit condition is important for further understanding drought tolerance mechanisms of whole plant. This experiment was designed to investigate effect of dual inoculation of rhizobium and mycorrhiza on some important root characters under water deficit condition. The trial was located on the organically managed fields of the University of Natural Resources and Applied Life Sciences, Vienna(Raasdorf) in April 2007. Three factors included Rhizobium inoculation; Mycorrhiza inoculation and Irrigation, each one at two levels (with and without application) have been studied in a factorial experiment in the form of complete randomized block design. Results showed that increasing water deficit affected root dry weigh, specific root mass and root length significantly at 1% level and but co-inoculation of rhizobium and mycorrhiza with irrigation could increase root parameters .Regarding to the data's of root dry weight, there were not any significant differences between treatments for main effect of rizobium,double interaction of rhizobium x mycorrhiza, rhizobium x irrigation ,mycorrhiza x irrigation and triple interaction of rhizobium x mycorrhiza x irrigation but there were significant differences for main effect of mycorrhiza and main effect of Irrigation at 5% and 1% probability level ,respectively in both harvests .Our study demonstrated that responses of root parameters to dry condition varied with symbiont microbial activity in the soil and root characteristics associated with drought resistance in lucerne included enhanced root growth, water uptake and the maintenance of root activity.

Key Words: mycorrhiza, rhizobia, lucerne, roots parameters.

Introduction:

Symbiosis between plants and mycorrhizal fungi support plants with mineral nutrients and other services and the fungi,in turn,receive photosynthates from the autotrophic plants. Mycorrhizal associations are common in almost al ecosystems and 80% of all land plants associate with these mutualistic soil fungi. There is awareness among biologists, ecologists and mycologists that mycorrhizal associations need to be considered in order to understand ecology and evolution of plants, plant communities and ecosystems and also it has very suitable synergistic effects with most of soil microorganisms especially with rhizobia bacteria. Study of roots is also necessary to observe how root growth and other root properties are affected directly by formation of mycorrhiza and indirectly by other treatments.

Materials and Methods:

This experiment has been done to investigate effect of dual inoculation of rhizoba and mycorrhiza on Root Dry Weight (RDW), Mycorrhizal Colonization (MC), Specific Root Mass (SRM), Dry Weight of Mycorrhizal Root (DWMR), Root Length (RL) and Specific Root Length (SRL)

changes in lucerne under water deficit condition. Three factors included Rhizobium inoculation*;* Mycorrhiza inoculation and Irrigation, each one at two levels (with and without application) have been studied in a factorial experiment in the form of complete randomized block design. The trial was located on the organically managed fields of the University of Natural Resources and Applied Life Sciences, Vienna (Rassdorf) in April 2007. The crops were harvested two times during the experiment (H1: 09.07.2007 and H2: 20.09.2007), according to the development stages of the lucerne at beginning of flowering. Soil samples to investigate root parameters were taken by using a root auger (10 cm diameter, 30 cm deep with 2 replicates per plot-one in row and one between rows).The roots subsequently separated from soil by a hydro pneumatic elutriation system (Gillison´s Variety Fabrication Inc., USA) through a sieve with a mesh of 760 μm. For evaluation root length, WinRHIZO instrument has been used(Arsenault et al., 1995). Specific root mass is calculated as weight of root per unit volume of soil (g/cm^3). Dry weight of mycorrhizal roots, calculated by multiplying the estimated percentage of root colonization by the dry weight of roots (g/m2). specific root length is preferred over specific root mass ,because the formation of mycorrhiza is not directly related to weight of roots. In order to estimating the total root length we have used grind intercepts methods and using Tenant’s formula(Tennant 1975): $R = \pi NA/ 2H$

Root length (R) was measured by counting the number of intercepts (N) of roots in a regular area (A) with randomly located and oriented lines of total length (H).length rather than weight data were made feasible as indices of the functional size of root system. After calculation of total root length, we measured it into the soil volume of each sample (cm/cm3).

Results:

Results showed that increasing water deficit affected root dry weigh, specific root mass and root length significantly at 1% level and co-inoculation of rhizobium and mycorrhiza with irrigation could increase all root parameters. Data’s of variance analysis for mycorrhizal colonization showed that main effect of using mycorrhiza had significant effects on root parameters at 5% and 1% probability level in first and second harvest, respectively. Results of mean comparisons by Duncan’s multiple range test showed that mycorrhizal colonization was higher in R1, M1 and I1 treatments than R0, M1 and I1 treatments in both harvests.Double interaction of M1I1 was at the highest group in both harvests (37.05% and 65.73%, respectively). Water uptake depends on root size (length or mass), activity and spatial distribution. Therefore, extensive deep rooting often has been emphasized in relation to drought resistance (Taylor 1983; Marcum et al., 1995; Asseng et al., 1997).

References:

-Arsenault,J.,Pouleur,S.,Messier,C. and Guay,R.1995.WinRHIZO,a root measuring system with a unique overlap correction method.HortScience.30:906(Abstract).

-Asseng ,S.,Richter,C. and Wessolek,G.1997.Modeling root growth of wheat as the linkage between crop and soil. Plant Soil.190:267-277.

-Marcum, K.B., Engelke, M.C., Morton, S.J. and White, R.H.1995. Rooting characteristics and associated drought resistance of zoysiagrass. Agron. J. 87:534-538.

-Taylor, H.M.1983. A program to increase plant available water through rooting modification.p.463-472.In W. Bohm et al.(Ed.) Root ecology and its practical application : Verlag Gumpenstein,Irdning, Austria.

-Tennant, D.1975. A test of a modified line intersect method for estimating root length.J.Ecol.63:995-1001.