



Evaluation of Radiation Absorption and Use Efficiency in Row Intercropping of Wheat (*Triticum aestivum* L.) and Canola (*Brassica napus* L.)

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Abstract

In order to evaluate radiation absorption and use efficiency in row intercropping for wheat and canola, a field experiment was conducted based on a randomized block design with three replications at Agricultural Research Station of Ferdowsi University of Mashhad during two growing seasons of 2008-2009 and 2009-2010. Treatments included four combinations of row intercropping of wheat and canola (one row of wheat + one row of canola (1:1), two rows of wheat + two rows of canola (2:2), three rows of wheat + three rows of canola (3:3) and four rows of wheat + four rows of canola (4:4)) and their monoculture. Results indicated that the effect of row intercropping was significant on radiation use efficiency of wheat and canola. The highest radiation use efficiency based on biological yield of wheat and canola were observed in monoculture (with 1.6 and 1.04 g.MJ⁻¹) and three rows wheat+ three rows canola (with 1.4 and 0.57 g.MJ⁻¹), respectively. The maximum radiation use efficiency based on economical yield of wheat and canola were obtained in monoculture (with 0.52 and 0.3 g.MJ⁻¹) and three rows wheat+ three rows canola (0.49 and 0.23 g.MJ⁻¹), respectively. The range of land equivalent ratio for radiation absorption efficiency in different row intercroppings of wheat and canola was 1.31-1.61. In general, row intercropping of wheat with canola increased radiation use efficiency and combination of three rows of wheat + three rows of canola was the most promising one.

Keywords: Row intercropping, Radiation absorption, Radiation use efficiency, Land equivalent ratio

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Cardinal Temperatures for Germination of *Ziziphora clinopodioides*. Lam.

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Abstract

In order to study the cardinal temperatures of seed germination for *Ziziphora clinopodioides*. Lam., an experiment was conducted in Special Plants Research Laboratory, Faculty of Agriculture, Ferdowsi University of Mashhad in 2008. The experiment was a completely randomized design with 8 treatments and four replications. Treatments consisted of 8 constant temperatures (5, 10, 15, 20, 25, 30, 35 and 40 °C) with 50- 60 percent relative humidity and constant light radiation (12 h lightness / 12 h darkness) during germination for 21 days. Cardinal temperatures of seed germination for *Z. clinopodioides*. Lam. were calculated with three models (Intersected-lines Model (ISL), Five-Parameters Beta Model (FPB) and Quadratic Polynomial Model). Results showed that there was no dormancy of seeds of *Z. clinopodioides*. Lam. Effect of temperature on rate, percentage and average time of seed germination for *Z. clinopodioides*. Lam. was significant ($p \leq 0.01$). Maximum germination percentage and rate of germination at 20°C were 29.6 and 6.37 per day and minimum average time of seed germination was 0.006 per day. Maximum germination rate at 20°C was 0.4. According to three models cardinal temperatures including base temperature (T_b), optimum temperature (T_o) and ceiling temperature (T_c) for *Z. clinopodioides*. Lam. were varied between 5 - 5.8, 22 - 22.6 and 39.5 - 40.5 °C respectively and their differences was lower than 1 °C., among models.

Keywords: Germination, Base temperature, Optimum temperature, Ceiling temperature, *Ziziphora clinopodioides* Lam.

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Effect of Salinity on Leaf and Stem Cellulose, Hemicellulose and Lignin, and Stem Cell Walls Characteristics of *Kochia (Kochia scoparia)*

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Abstract

Forage production in biosaline agricultural is a practical approach to use saline water and soil resources. In this context, considering the quality of forage produced can be effective in increasing livestock production. To evaluate the effect of salinity on stem cell wall characteristics and chemical composition of leaf and stem in *Kochia (Kochia scoparia)* a field experiment was conducted on 2008. Three saline waters (5.2, 10.5 and 23.1 dS m⁻¹) and three *kochia* population (Birjand, Borujerd and Sabzevar) were allocated as main and sub plots, respectively in a split plot design based on RCBD with three replications. In this study traits include; stem cells wall thickness, percentage of stem cells in cross section, the percentage of cellulose, hemicellulose and lignin in leaf, stem and whole plant. The results showed that there were no significant different observed among all traits except percentage of stem lignin and total lignin. Thickness of stem cells was in 1.11 μm in epidermis, 1.12 μm in chlorenchyma, 0.92 μm in cortical chlorenchyma, 3.67 μm in vascular fibers, 2.82 μm in vascular cells and 1.02 in parenchyma, respectively. The proportion of parenchyma, xylem, Vascular fibers and other parts (epidermis, chlorenchyma and cortical chlorenchyma) in the stem cross-section area were; 55.56, 24.16, 2.73 and 17.51% respectively. Percentage of cellulose, hemicellulose and lignin in shoots of *Kochia* showed that stem contains more cellulose than the leaf, but leaves have more hemi cellulose than stem. Increasing salinity levels to 10.5 dS m⁻¹ reduced the percentage of lignin in stem (1.2), leaf (2.2) and whole plant (5.9). Correlation between the percentage of total lignin and thickness of epidermis and vascular fibers were positive significant, but correlated with the percentage of stem cellulose and hemicellulose in whole plant were negative significant. Despite of no significant effect of salinity at 10.5 dS m⁻¹ on stem cell walls thickness, reduced lignin under salinity stress can increase its forage quality.

Keywords: Salt stress, Cell wall, Forage quality

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The Effects of Winter Cover Crops and Plant Growth Promoting Rhizobacteria on some Soil Fertility Aspects and Crop Yield in an Organic Production System of *Ocimum basilicum* L.

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Abstract

Sustainable agriculture systems emphasized on the on-farm inputs likes use of biofertilizers, crop rotation and cover crops. This experiment was conducted in a split plots arrangement with two factors based on randomized complete block design with three replications during years 2009-2010, at Research Farm of Ferdowsi University of Mashhad. The main factor consisted of cultivation and no cultivation of cover crops in autumn. The sub factor was biofertilizer application with four levels, included 1-Nitroxin[®] (containing *Azotobacter* spp. and *Azospirillum* spp.), 2-Biophosphorous[®] (*Bacillus* sp. and *Pseudomonas* sp.), 3-Nitroxin[®] + Biophosphorous[®] and 4-Control. Results showed that most characteristics, e.g. seed yield and harvest index were increased with no cover crop cultivation. However in control treatment, the biological yield, seed yield and harvest index were more than biofertilizeres treatments, as Nitroxin[®] and Biophosphorous[®] ranked after the control. Amongst the biofertilizers, Biophosphorous[®] had the most positive effects. The maximum grain weight was obtained from Nitroxin[®]+ Biophosphorous[®] treatment. The interaction effects of biofertilizer and cover crops were significant among some characteristics. The results showed that the interaction between biofertilizers and no cover crop cultivation was significant, as use of the biofertilizers especially Nitroxin[®] and Biophosphorous[®] in no cover crop condition increased the amounts of biological yield and seed yield.

Keywords: Biological yield, Biophosphorous[®], Clover, Lathyrus, Nitroxin[®]

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Evaluation of Effect of Nitrogen Topdress Fertilizer Application by Using Chlorophyll Meter on Yield, Yield Components and Growth Indices of Potato

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Abstract

Nitrogen as a essential nutritious element in plant structure has a vital role and among the essential elements for potato (*Solanum tuberosum* L.) crop growth, nitrogen has the more important role in leaf area increment, shoots growth rate and tuber yield. Therefore, to determine the time and value of supplemental nitrogen fertilizer in different stages of potato crop growth, it is required to use a reliable method to assess the uptakable nitrogen of soil during growth season. So, in order to use chlorophyll meter to identify the required proper time of potato crop to nitrogen fertilizer and increment of nitrogen use efficiency, an experiment was conducted based on randomized complete blocks design with three replications in research field of Ferdowsi University Agricultural College. Nitrogen topdress fertilizer was applied in two levels of 100 and 150 kgN.ha⁻¹ and in two nitrogen indices of 90 and 95 percent. The results indicated that 95 percent nitrogen index versus 90 percent nitrogen index has a better efficiency in increment of potato crop yield. But in 95 percent index, nitrogen fertilizer levels of 100 and 150 kgN.ha⁻¹ did not showed significant difference in tuber yield. Nitrogen indices and nitrogen fertilizer levels did not have significant effect on number of main stems and number of tubers in plant. The percentage of medium and large tubers were increased when the nitrogen fertilizer was increased. Also increment of topdress fertilizer lead to increase dry plant weight, crop growth rate (CGR) and leaf area index (LAI) and decreased net assimilation rate (NAR) and not obvious change in relative growth rate (RGR). In generally it seems that application of nitrogen fertilizer by using chlorophyll meter, in addition to make desirable yield of tuber, leads to economy in nitrogen fertilizers.

Keywords: Nitrogen fertilizer, Yield and yield components of potato, Chlorophyll meter, Growth indices, Nitrogen index

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Discrimination of Species and Hybrid Detection in *Myriophyllum* Spp.: an Introduction to Biodiversity Conservation and Invasion Avoidance

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Abstract

Minimizing economical loss through introduction of invasive alien species (IAS) in local ecosystem is one of the most important issues in biosecurity. The hybridization potential between non-indigenous and native species has raised concerns due mainly to introgression, which can cause extirpation of native species through gene contamination. In the present study, 71 samples belonging to 12 species from *Myriophyllum* genus were assessed in Plant Breeding group of Wageningen University. Internal transcribed spacer (ITS) was used for identification of invasive species from related native and possible hybrid plants. The result showed that based on universal application, high sequence divergence and species discrimination, ITS is a powerful sequence for the identification of invasive species from related non-invasive foreign and native species. In contrast to morphological data, ITS grouped suspected hybrid plants in to *M. heterophyllum* and demonstrated that they have not resulted from hybridization. These observations suggest that multiple introduction and genetic recombination among different introduced genotypes or genetic pools could be reasons of non-flowering in suspected hybrid plants. Results showed that molecular markers enable to distinguish invasive plant species from their most closely related congeners. This could be helpful with enforcing a ban on important of such invasive which can help to plant ecosystem and biodiversity stability.

Keywords: Biosecurity, Ecosystem stability, Invasive species, Hybridization

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Study of Sesame (*Sesame indicum* L.) Cultivars based on Morphological Characteristics Under Water Deficit Stress Condition Using Factor Analysis

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Abstract

In order to evaluation sesame cultivars based on morphological characteristics under water deficit stress condition using factor analysis, an experiment was conducted as a split plot based on randomized complete block design with three replications during 2009 in Research Center of Agriculture and Natural Resources in Parsabad. In this experiment, irrigation as the main factor at three levels (50, 75 and 100 percent of crop water requirement) and ten sesame cultivars as the sub-factor were studied. The water requirement of sesame was calculated using CROPWAT software (Penman-Monteith method) according to FAO-56. Results showed significant differences between the cultivars and the irrigation levels for all studied traits. Interaction between cultivars and irrigation levels was significant for some of traits. Comparisons of means showed that in water deficit condition, yield and all of traits reduced. In all traits the greatest amounts observed in complete irrigation treatment. In 50 percent of water requirement treatment, amount of leaf chlorophyll, root length, root branches and root length/plant height ratio were greater than other treatments. The Karaj1, Ultan, Naze and IS cultivars were better than other cultivars in stress and non stress condition. In factor analysis 5 and 4 first factors in non stress and stress condition explained 91.36 and 89.52 percent of trait variance, respectively. Grouping of sesame cultivars based on first and second factors in non stress conditions showed that Karaj1, Ultan and Naze cultivars were better than other cultivars. Also, in stress conditions Karaj1 and Ultan cultivars grouped as water deficit stress and better cultivars.

Keywords: Factor analysis, Sesame, Water deficit stress, Water requirement

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The Study on the Effect of Different Levels of Vermicompost and Plant Density on Oil Content and Components of Evening Primrose (*Oenothera biennis* L.)

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Abstract

To investigate the effects of different levels of vermicompost and plant density on oil content of evening primrose and its components, an experiment was conducted as a factorial layout based on Randomised Complete Block Design with 12 treatments and 3 replications in experimental field of Faculty of Agriculture, Ferdowsi University of Mashhad during 2008-2009. The treatments were included 4 levels of vermicompost (0, 2, 3 and 5 kg.m⁻²) and 3 levels of plant density (9, 12 and 20 plant/m⁻²). Oil extraction was carried out by Soxhlet apparatus and its percentage was determined as weight. Analysis of fatty acids was done by Gas Chromatography device. Density and refractive index of the oil also was evaluated. According to the results, simple effect of vermicompost and plant density was significant only on oil percentage and its refractive index, while the interaction between them was significant on all of the traits. Fatty acids composition of oil in all treatment was the same. The major saturated fatty acid was palmitic acid and linoleic acid was the major unsaturated fatty acid. The amount of γ -linolenic acid was in optimum range (7-8 %). Overall, treatment of 2 kg.m⁻² vermicompost and plant density of 20 and 9 plant/m⁻² was determined as the best treatments by considering the improving of oil production, oil quality and ratio of unsaturated fatty acids to saturated fatty acids, respectively.

Keywords: Fatty acids, γ -linolenic acid, Density, Refractive index

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The Effects of Seed Inoculation with Rhizobium and Nitrogen Application on Yield and some Agronomic Characteristics of Soybean (*Glycine max* L.) under Ardabil Condition

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Abstract

In order to study the effects of seed inoculation with rhizobium and nitrogen application on yield and some agronomic characteristics of soybean (*Glycine max* L.), a split plot experiment based on randomized complete block design with three replications was conducted in 2011 at the research farm of the Islamic Azad University, Ardabil Branch. Factors were inorganic nitrogen fertilizer urea at four levels (0, 30, 60 and 90 kg urea/ha) in the main plot and two levels of inoculation with *Rhizobium japonicum* bacteria (with and without inoculation) assigned to the sub plots. Study the growth indices showed that the maximum total dry matter (435.4 gr/m²), crop growth rate (6.75 gr/m².day) and relative growth rate (0.1003 gr/gr.day) were obtained from compound of treatments high levels of urea application × inoculation with rhizobium while, the minimum values of these indices recorded in without nitrogen application × non inoculation with rhizobium. The highest plant height, number of pod per plant and grain yield were obtained from the highest level of nitrogen fertilizer (90 kg/ha urea) and seed inoculation with rhizobium. Number and dry weight of nodules per plant increased significantly with increasing nitrogen application till 60 kg/ha in seed inoculation with rhizobium. The lowest values of these traits recorded in non application of urea × non inoculation with rhizobium. Inoculation with rhizobium bacteria increased the number and dry weight of nodules per plant. Thus, it can be suggested that in order to increasing of grain yield, seed can be inoculated with rhizobium bacteria × application of 60 kg urea/ha in conditions of Ardabil region.

Keywords: Nitrogen, Soybean, Seed inoculation, Yield

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Comparison of Stability and Adaptability in New Cereal; Primary Tritipyrum, with Iranian Bread Wheat and Triticale Using Different Stability Parameters in Iran

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Abstract

In order to study the genotype-environment interaction for grain yield in eight primary and combined primary tritipyrum lines in comparison with four Iranian bread wheat varieties and five promising triticale lines, an experiment in randomized completely block design with three replication in three locations of Iran (Kerman, Sirjan, Neyriz) including 7 separate environment during 2001-2002, 2005-2006 and 2010-2011 were conducted. The results of combined analysis of variance for grain yield showed significant differences between environments and genotype \times environment interactions. The results of stability analysis for high yielding lines/cultivars indicated first, in Eberhart and Russell grouping method Based on slope of regression line, grain yield average and also deviation of regression line parameters, combined primary tritipyrum line (Ka/b)(Cr/b)-5 and triticale 4115, 4108 and M45 lines showed good compatibility in all environments. Second, the results of genotypes category in cluster analysis based on criteria ecovalance and stability variance was exactly the same. Third,, based on ecovalance, stability variance parameters and mean yield, the combined primary tritipyrum line (Ka/b)(Cr/b)-5 and promising triticales 4108 and M45 Lines indicated low genotype \times environment interaction and high growth performance in comparison with all varieties and lines. This tritipyrum line can be introduced as a potential pasture Line in arid and semi arid area of Iran particularly with brackish water and saline soils. The two triticale lines can be registered as high grain lines in poor lands of Iran for cereal production for the first time.

Keywords: Stability, Stability parameters, Primary tritipyrum, Combined primary tritipyrum, Triticale, Bread wheat

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Evaluate Effect of Water Stress and Different Amounts of Nitrogen Fertilizer on Seed Quality of Black Cumin (*Nigella Sativa* L.)

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Abstract

In order to study the effects of water stress and different levels of nitrogen fertilizer on grain yield and accumulation macronutrients included: nitrogen, phosphorus and potassium and micronutrient included: iron, zinc, manganese and copper, oil, protein and thymoquinone contents in seed of black cumin, a field experiment was conducted as split plot design with three replications at Agricultural Research Station, Zahak, Zabol during growing season of 2010-2011. Water stress treatments included: W_1 = control, W_2 = no irrigation at stem elongation stage to flowering, W_3 = irrigation at flowering stage until the beginning of grain filling and W_4 = no irrigation at flowering and grain filling as the main plots and four levels of nitrogen application fertilizer, including N_1 = control or without any fertilizer consumption, N_2 = 30 kg N/ha, N_3 = 60 kg N/ha and N_4 = 90 kg N/ha in sub plot. Results showed that water stress had significant effect on the grain yield and accumulation of macro and micronutrient in the seed of Black Cumin. Except for iron, the highest amounts of nitrogen, phosphorus, potassium, manganese, copper and zinc and the lowest amount of grain yield were obtained at W_4 treatment and manganese at W_3 treatment. In this experiment the interaction effect between stress and nitrogen fertilizer except grain yield and potassium had significant impact on others elements. The results indicated that water stress at flowering and grain filling (W_4) stages, the maximum amount of micro and macronutrients in seed was obtained at N_1 and N_2 nitrogen treatment. Also, water stress and nitrogen treatments increased the percentage of protein, oil and thymoquinone contents of seed, but during the onset of water stress and the use of nitrogen fertilizer, the highest percentage of protein in and thymoquinone were obtained in W_4N_4 .

Keywords: Grain yield, Nitrogen, Nutrient elements, *Nigella Sativa*, Essential oil, Water stress

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Effect of Duck Density on Some Morphological and Physiological Determinants of Paddy Yield in Three Rice (*Oryza sativa* L.) Cultivars in Organic Rice-Duck Farming

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Abstract

In order to evaluate the effects of duck density on some morphological and physiological determinants of paddy yield of three rice (*Oryza sativa* L.) cultivars in rice paddy fields, a field experiment was conducted in research field of Sari Agriculture Sciences and Natural Resources University in 2011. This experiment was arranged in split plot based on complete randomized block design with four replications. Number of duck (0, 400 and 800 piecesha⁻¹) and rice cultivars (Tarom, Shirodi and Ghaem) were considered as main and sub plots, respectively. The results of variance analysis showed significantly differences among studied cultivars in terms of tiller number, SPAD value, chlorophyll a and grain yield. Results indicated that the maximum amount of morphological parameter (tiller number, leaf number and root length), physiological traits (chlorophyll content and SPAD value and paddy yield) were belonged to 400 and 800 duck per hectare. The highest paddy yield was recorded in Shirodi (5.3 tonha⁻¹), Ghaem (4.3 ton ha⁻¹) and Tarom (3.6 ton ha⁻¹) under 800 duck per hectare. These amounts were 23, 7 and 20 percent higher than Shirodi (4.1 ton ha⁻¹), Ghaem (4 tonha⁻¹) and Tarom (2.4 ton ha⁻¹) in 400 duck per hectare, respectively. Regression analysis revealed that tiller number, root length, SPAD value and paddy yield differently related to duck number per hectare. Contrast cultivars differently respond to duck density in rice fields in which Tarom cultivar had the maximum equation slope. In conclusion, using Tarom as a traditional cultivar with higher competitive index was superior to dwarf and improved cultivars (Ghaem and Shirodi) especially at 800 duck per hectares in terms of higher economic yields for farmers.

Keywords: Rice, Duck density, Cultivar, Sustainably farming, Grain yield

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Evaluation the Possibility of Utilization of Biological Fertilizer Mycorrhiza in Phosphorus Supply in Chickpea Cultivation (*Cicer arietinum* L.)

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Abstract

In order to evaluating the possibility of utilization of biological fertilizer mycorrhiza instead of part of phosphorus fertilizer in cultivation chickpea an experiment was conducted in 2009-2010 in randomized complete block design with three replications at research farm faculty of agriculture of Shahrood University of Technology. Treatments included 1- B₁ (Control), 2- B₂ (biological fertilizer mycorrhiza), 3- B₃ (25 kg/ha phosphorus fertilizer), 4- B₄ (25 kg/ha phosphorus fertilizer + biological fertilizer mycorrhiza), 5- B₅ (50 kg/ha phosphorus fertilizer), 6- B₆ (50 kg/ha phosphorus fertilizer + biological fertilizer mycorrhiza). Results indicated that treatments increased grain yield, biological yield, stem and leaf dry weight, pod number per plant, seed number in pod and seed phosphorus compared with control, significantly. Effect of treatments were not significant on 100 seed weight and harvest index. According to results, application of biological fertilizer mycorrhiza increased traits biological yield, grain yield and number of pod in chickpea, this increment was in one significant level with 50 kg/ha phosphorus fertilizer. Application of phosphorus fertilizer decreased percentage of root colonization, significantly. Therefore, with attention to importance of reducing application of chemical fertilizers, using of mycorrhiza in cultivation of chickpea can be recommended.

Keywords: Arbuscular Mycorrhiza, Grain yield, Biological yield, Chickpea

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Effects of Mycorrhiza Symbiosis on Initial Establishment and Morphological Traits of Thyme (*Thymus vulgaris*) Under Natural Conditions

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Abstract

While producing medicinal plants is more economic in their natural habitat than in farms, their establishment problems and slow growth rate are the main constraints under the natural conditions. This study was conducted to investigate the possibility for seedling transplantation of thyme into the natural conditions, in order to investigate the effect of mycorrhiza inoculation on establishment of this species in *Bahar Kish rangeland, Quchan*. Seeds were planted in glasshouse in small trays for 45 days, after that, seedlings were inoculated with two mycorrhiza species, *Glomus mosseae* and *Glomus intraradices*. After one month growth, the inoculated seedlings were transplanted into the natural. A complete randomized Block design with 30 replication was used. The results showed that mycorrhiza colonization with *G. mosseae* was 92% and with *G. intraradices* was 68%. There was no significant effect of inoculation on seedling establishment at early season, but at the end of growth there was a negative effect by *G. intraradices* but a positive effect by *G. mosseae*. Symbiosis with *G. mosseae* increased dry matter of leaf, stem, total dry matter and height of the plants while with *G. intraradices* had reduced these traits or the effects were non-significant. In conclusion pot planting can be an efficient method for establishing *T. vulgaris* under natural habitats, *G. mosseae* can be a beneficial symbiont for establishment of *T. vulgaris* in *Baharkish* rangelands.

Keywords: Biofertilizer, Colonization, Seedling transplantation

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