P-ISSN: 2305-6622; E-ISSN: 2306-3599

International Journal of Agriculture and Biosciences

www.ijagbio.com; editor@ijagbio.com

Research Article

Influence of Micorrhiza and Variety on Some Characteristics of Sunflower

Homa Nourzayi[1], Hamid Reza Mobasser[1*] and Mehdi Dahmardeh[2]

[1]Department of Agronomy, Islamic Azad University, Zahedan Branch, Zahedan, Iran
[2]Department of Agriculture, Agriculture Faculty, University of Zabol, IR, Iran
***Corresponding author:** hamidrezamobasser@gmail.com

Article History: Received: October 18, 2015 Revised: December 20, 2015 Accepted: January 25, 2016

ABSTRACT

Sunflower is the world's fourth largest oil-seed crop. Sunflower, a member of compositae family is the most important edible oilseed crop in the world. The mycorrhizal symbiosis provides the plant with an increased ability for nutrient capture and cycling in soils with low nutrient availability. Many plants are capable of forming association with AM fungi to help boost native soil nutrients. The experiment was conducted at the zabol which is situated between 41° North latitude and 61° East longitude. The field experiment was laid out factorial with randomized complete block design with three replications. Treatments included two factors: sunflower variety esfahan (v1), ghasem (V2) and inoculation with mycorrhyza in eight levels included control (M1), inoculation with *glumus mossea* (M2), inoculation with *glumus etanicatum* (M3), inoculation with G.HOI (M4), inoculation with M3+ M2 (M5), inoculation with M4+ M3 ‘ (M6) , inoculation with M4+ M2 (M7), , inoculation with M4 +M3+M2 (M8). Analysis of variance showed that the effect of variety on all characteristics was significant except head diameter. Analysis of variance showed that the effect of micorrhyza on all characteristics was significant except head weight.

Key words: Head weight, Grain yield, Plant height, Head diameter

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one of the most important oil crops in the world, because it offers advantages in crop rotation systems, such as high adoption capability, suitability to mechanization and low labor needs. Sunflower is the world's fourth largest oil-seed crop (FAO, 2000). Sunflower, a member of compositae family is the most important edible oilseed crop in the world (Weiss, 2000). Which is mainly grown in Rabi season as a rain fed crop mostly by marginal farmers. Sunflower seed has high concentration of linolic acid, a poly unsaturated fatty acid is essential for human beings and cannot be synthesized by animal body (Seiler, 2007). Sunflower is categorized as a low to medium drought sensitive crop (Stone *et al*., 1996; Tolga and Lokman, 2003; Turhan and Baser, 2004). Sunflower is one of the most important oil crops and due to its high content of unsaturated fatty acids and a lack of cholesterol, the oil benefits from a desirable quality (Razi, H. and M.T. Asad, 1998). D'Andria *et al*. (1995) reported that the ability of sunflower to extract water from deeper soil layers "when water stress during the early vegetative phase causes stimulation of deeper root system" and a tolerance of short periods of water deficit, are useful traits of sunflower for producing acceptable yields in dry land farming. On the other hand, some evidences have indicated that stress during vegetative phase, flowering or seed filling period causes considerable decrease in yield and oil content of sunflower (Razi, H. and M.T. Asad, 1998). The mycorrhizal symbiosis provides the plant with an increased ability for nutrient capture and cycling in soils with low nutrient availability (Barea *et al*., 2011). The rhizosphere, representing the thin layer of soil surrounding plant root zone and soil occupied by the roots, supports large and metabolically active groups of microorganisms such as bacteria, fungi, actinomycetes and mycorrhizae (Balagurunathan *et al*., 2012). These microorganisms deliver positive impact on growth and yield of crop plants through several mechanisms such as 1) N2 fixation, 2) induction of IAA, 3) mineralization of phosphates, 4) secreting antimicrobial substances. Micorrhiza is symbiotic association between the soil fungi and roots of higher plants (Smith *et al*., 2010). These fungi enhance the plant growth through making availability of mineral nutrients such as P, Zn and Cu (Phiri *et al*., 2003). Vazquez-Hernandez *et al*. (2011) cited that inoculation of papaya (*Carica papaya* L.) plants with

Cite This Article as: Nourzayi H, HR Mobasser and M Dahmardeh, 2016. Influence of micorrhiza and variety on some characteristics of sunflower. Inter J Agri Biosci, 5(1): 19-23. www.ijagbio.com

mycorrhizal fungi increased the number of fruits and yield in these plants. Use of agrochemicals such as synthetic fertilisers and pesticides has resulted into soil and water pollution, and loss of biodiversity. In the humid tropics of Africa, where agrochemicals, especially fertilisers are often wrongly used, arbuscular mycorrhizae (AM), found in natural ecosystem, including agricultural areas do improve soil fertility (Daft and Nicolson, 1969). Many plants are capable of forming association with AM fungi to help boost native soil nutrients (Burke *et al*., 2000). These fungi are well known to improve plant growth on poor soils. Arbuscular mycorrhizae have also been observed to play a vital role in metal tolerance (Del Val *et al*., 1999) and accumulation (Zhu *et al*., 2001; Jamal *et al*., 2002). External mycelium of AM fungi provides a wider exploration zone (Khan *et al*., 2000; Malcova *et al*., 2003), thus providing access to greater volume of heavy metals present in the rhizosphere. These symbiotic fungi increase nutrient and water uptake, alleviate cultural and environmental stresses, and enhance disease resistance and plant health (Bethlenfalvay and Linderman 1992, Davies *et al*. 1992, 1993, 1996, Filion *et al*. 1999, Pfleger and Linderman 1994). Mycorrhiza affect nutrients which have a very low mobility in the soil and which are present in the soil solution in very low concentrations (Marschner and Dell 1994). Mycorrhiza enhance the uptake of Cu (Gildon and Tinker 1983), Zn (Davies 1987), Ni (Killham and Firestone 1983), Cd (Guo *et al*. 1996, Joner and Leyval 1997), Pb (Díaz *et al*. 1996), and other metals (Galli *et al*. 1994). An important arbuscular mycorrhiza genus is Glomus, which colonize a variety of host species (Marschner 1995), including sunflower (Chandrashekara *et al*. 1995). The rhizosphere, representing the thin layer of soil surrounding plant root zone and soil occupied by the roots, supports large and metabolically active groups of microorganisms such as bacteria, fungi, actinomycetes and mycorrhizae (Balagurunathan *et al*., 2012). These microorganisms deliver positive impact on growth and yield of crop plants through several mechanisms such as 1) N2 fixation, 2) induction of IAA, 3) mineralization of phosphates, 4) secreting antimicrobial substances. Micorrhiza is symbiotic association between the soil fungi and roots of higher plants (Smith *et al*., 2010). These fungi enhance the plant growth through making availability of mineral nutrients such as P, Zn and Cu (Phiri *et al*., 2003). Colonization of AM fungi in cortical tissues of sunflower increased growth parameters of sunflower (Jalaluddin & Hamid, 2011). It has been recently reported that AMF play a vital role in protecting plant from soil borne pathogen and root-knot causing nematode (Jalaluddin *et al*., 2008). Hence an attempt was made to reveal the effect AM fungi on the agronomical characteristics of sunflower which is more economic and ecofriendly.

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the zabol which is situated between 41° North latitude and 61° East longitude.

Composite soil sampling

Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

Field experiment

The field experiment was laid out factorial with randomized complete block design with three replications.

Treatments

Treatments included two factors: sunflower variety esfahan (v1), ghasem (V2) and inoculation with micorrhiza in eight levels included control (M1), inoculation with *glumus mossea* (M2), inoculation with *glumus etanicatum* (M3), inoculation with G.HOI (M4), inoculation with M3+ M2 (M5), inoculation with M4+ M3 ، (M6) , inoculation with M4+ M2 (M7), , inoculation with M4 +M3+M2 (M8).

Data collect

Data collected were subjected to statistical analysis by using a computer program SAS. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

RESULTS AND DISCUSSION

Grain yield

Analysis of variance showed that the effect of variety on grain yield was significant (Table 1). The maximum of grain yield of treatments ghasem was obtained (table 2). The minimum of grain yield of treatments esfahan was obtained (table 2).

Analysis of variance showed that the effect of micorrhiza on grain yield was significant (Table 1). The maximum of grain yield of treatments M2+M3+M4was obtained (fig 1). The minimum of grain yield of treatments control (M1) was obtained (fig 1).

1000 grain weight

Analysis of variance showed that the effect of variety on 1000 grain weight was significant (Table 1). The maximum of 1000 grain weight of treatments esfahan was obtained (Table 2). The minimum of 1000 grain weight of treatments ghasem was obtained (Table 2). Analysis of variance showed that the effect of micorrhiza on 1000 grain weight was significant (Table 1). The maximum of 1000 grain weight of treatments M2+M3+M4was obtained (fig 2). The minimum of grain yield of treatments control (M1) was obtained (fig 2).

The number of seeds per head

Analysis of variance showed that the effect of variety on the number of seeds per head was significant (Table 1). The maximum of the number of seeds per head of treatments esfahan was obtained (Table 2). The minimum of the number of seeds per head of treatments ghasem was obtained (Table 2). Analysis of variance showed that the effect of micorrhiza on the number of seeds per head was significant (Table 1). The maximum of the number of seeds per head of treatments M2+M3+M4was obtained (fig 3). The minimum of the number of seeds per head of treatments control (M1) was obtained (fig 3).

Table 1: Anova analysis of the Sunflower affected by variety and micorrhiza

S.O.V	df	Grain yield	1000 Grain weight	The number of seeds per head	Head weight (gr)	Head diameter	Plant height
R	2	1742.12^{ns}	41.94**	1511.36 ^{ns}	107.64 ^{ns}	4.47*	67.32^{ns}
Variety (V)	1	12545093.4**	194.28**	154207.0**	815.01*	2.85 ^{ns}	34076.2**
Micorrhiza (M)	7	436046.8**	25.73**	61835.4**	1.24 ^{ns}	68.04**	1057.7**
V*M	7	87000.9**	2.55^{ns}	1270.4^{ns}	0.14 ^{ns}	12.70**	89.04 ^{ns}
Error	30	17551.9	7.04	983.2	115.40	3.07	178.39
CV (%)	-	5.22	9.17	6.71	4.32	11.54	10.54

*, **, ns: significant at p<0.05 and p<0.01 and non-significant, respectively.

Table 2: Comparison of different traits affected by variety and micorrhiza

Treatment	Grain yield	1000 Grain weight	The number of seeds per head	Head weight	Head diameter	Plant height
Variety						
Ghasem	3046.51a	26.91b	409.9b	252.24a	14.94 a	153.07a
Esfahan	2024.05b	30.94a	523.2a	244.00b	15.43a	99.78b
Micorrhiza						
Control (M1)	2247.05e	26.03c	340.8g	247.12a	11.28e	104.13d
Glumus mossea (M2)	2391.6de	28.18 bc	426.3e	248.04a	14.40cd	123.97bc
Glumus etanicatum (M3)	2347.7de	27.83 bc	385.3f	248.31a	12.57de	120.84c
G.HOI (M4)	2312.7e	27.63 bc	379.2f	248.05a	12.19e	118.66cd
M2 + M3	2829.8b	30.28ab	563.1b	248.26a	18.19b	140.28ab
M3 + M4	2504.8cd	29.09bc	476.6d	248.32a	15.11c	126.61bc
M2+ M4	2642.9c	29.42bc	530.1c	248.16a	16.52bc	129.56bc
M2+M3+M4	3005.4a	32.94a	630.9a	248.71a	21.26a	147.35a

Any two means not sharing a common letter differ significantly from each other at 5% probability

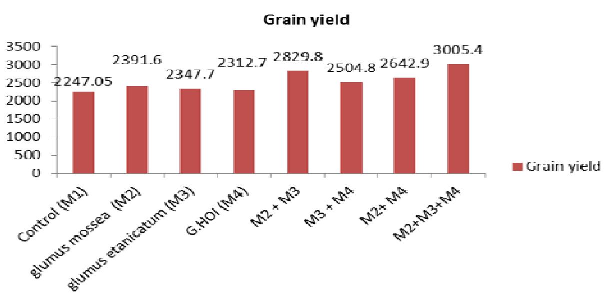

Fig. 1: Effect of micorrhiza on grain yield

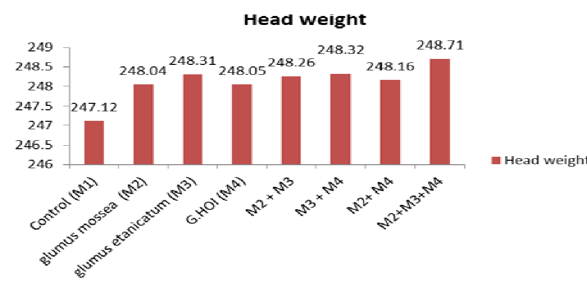

Fig. 4: Effect of micorrhiza on head weight

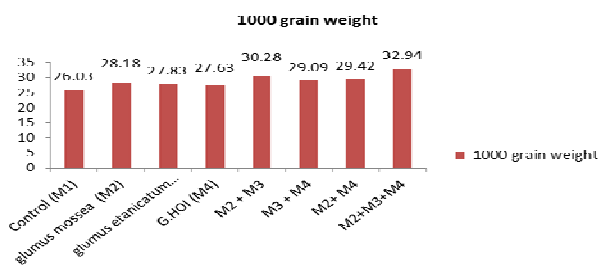

Fig. 2: Effect of micorrhiza on 1000 grain weight

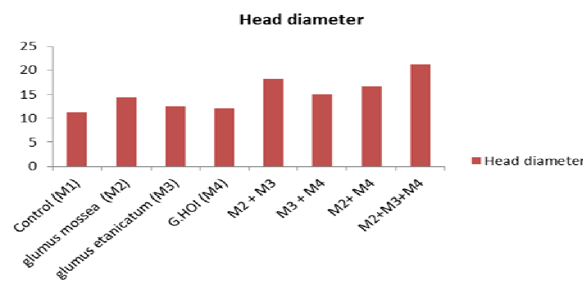

Fig. 5: Effect of micorrhiza on head weight

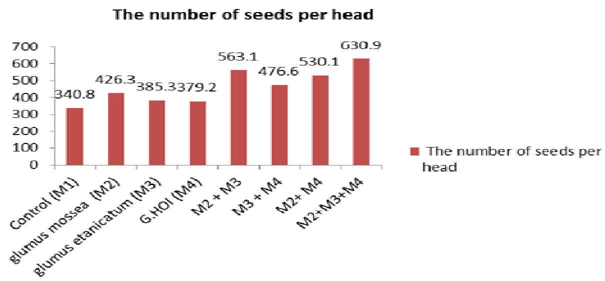

Fig. 3: Effect of micorrhiza on the number of seeds per head

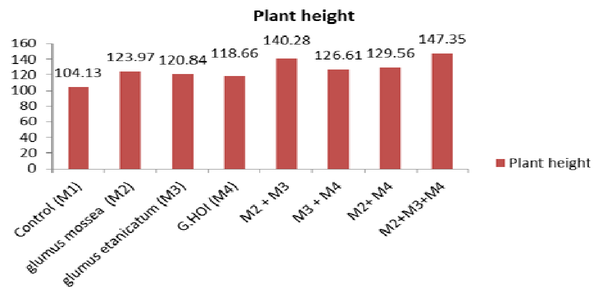

Fig. 6: Effect of micorrhiza on plant height

Head weight

Analysis of variance showed that the effect of variety on head weight was not significant (Table 1). The maximum of head weight of treatments esfahan was obtained (Table 2). The minimum of head weight of treatments ghasem was obtained (Table 2). Analysis of variance showed that the effect of micorrhiza on head weight was significant (Table 1). The maximum of head weight of treatments M3 + M4 was obtained (fig 4). The minimum of head weight of treatments control (M1) was obtained (fig 4).

Head diameter

Analysis of variance showed that the effect of variety on head diameter was significant (Table 1). The maximum of head diameter of treatments ghasem was obtained (Table 2). The minimum of head diameter of treatments esfahan was obtained (Table 2). Analysis of variance showed that the effect of micorrhiza on head diameter was not significant (Table 1). The maximum of head diameter of treatments M2+M3+M4was obtained (fig 5). The minimum of head diameter of treatments control (M1) was obtained (fig 5).

Plant height

Analysis of variance showed that the effect of variety on Plant height was significant (Table 1). The maximum of Plant height of treatments ghasem was obtained (Table 2). The minimum of Plant height of treatments esfahan was obtained (Table 2). Analysis of variance showed that the effect of micorrhiza on Plant height was not significant (Table 1). The maximum of Plant height of treatments M2+M3+M4was obtained (fig 6). The minimum of Plant height of treatments control (M1) was obtained (fig 6).

Conclusion

The mycorrhizal symbiosis provides the plant with an increased ability for nutrient capture and cycling in soils with low nutrient availability. The rhizosphere, representing the thin layer of soil surrounding plant root zone and soil occupied by the roots, supports large and metabolically active groups of microorganisms such as bacteria, fungi, actinomycetes and mycorrhizae. According to the observed results influence of micorrhiza and variety on sunflower have desirable effects on, grain yield, 1000 Grain weight, number of seeds per head, head height, head diameter and Plant height. Therefor it seems that besides improving yield, micorrhiza and variety can improve sunflower yield.

REFERENCES

Balagurunathan R, J Shanthi, V Santhi and S Ramya, 2012. Effect of Azotobacter SPP and Phosphobacter SPP. Bioinoculants on the growth of Sunflower (*H. annuus*. L). World Journal of Agricultural Science. 8: 218-222.

Barea JM, J Palenzuela, P Cornejo, I Sanchez-Castro, C Navarro-Fernandez, A Lopez-Garcia, B Estrada, R Azcon, N Ferrol, C Azcon-Aguilar, 2011. Ecological and functional roles of mycorrhizas in semi-arid ecosystems of Southeast Spain. J Arid Environ, 75: 1292-1301.

Bethlenfalvay GJ and RG Linderman (eds), 1992. Mycorrhizae in sustainable agriculture. Amer Soc Agron Publication #54. Amer Soc Agron Madison, Wisconsin.

Burke SC, JS Anglwe and RL Chaney, 2000. Arbuscular mycorrhizae effects on heavy metal uptake by corn. Int. J Phytoremediation 2: 23-29.

Chandrashekara CP, VC Patil and MN Screenivasa, 1995. VA-mycorrhiza mediated P effect on growth and yield of sunflower (*Helianthus annuus* L.) at different P levels. Plant Soil, 176: 325-328.

D'Andria R, FQ Chiaranda, V Magliulo and M Mori, 1995. Yield and soil water uptake of sunflower sown in spring and summer. Agron J, 87: 1122-1128.

Daft MJ and TH Nicolson, 1969. Effect of Endogone mycorrhiza on plant growth. II. Influence of soluble phosphate on endophyte and host in maize. New Phytol, 68: 945-952.

Daniels BA and HD Skipper, 1982. Methods for recovery and quantitative estimation of propagules from soil. In: Schenck, N.C. (Ed.), Methods and principles of mycorrhizal research. The American Phytopathological Society, St. Paul, Minnesota, USA, pp: 29-35.

Davies FT Jr, 1987. Mycorrhizal fungi, fertility and media effects on growth and nutrition of Rosa multiflora. Plant Soil, 104: 31-35.

Davies FT Jr, JR Potter and RG Linderman, 1992. Mycorrhiza and repeated drought exposure affect drought resistance and extraradical hyphae development of pepper plants independent of plant size and nutrient content. J Plant Physiol, 139: 289-294.

Del Val C, JM Barea, C Azcon-Aguilar, 1999. Assessing the tolerance of heavy metals of arbuscular mycorrhizal fungi isolated from sewage-sludge contaminated soils. Appl Soil Ecol, 11: 261-269.

FAO (2000). http//www.fao.org.

Filion M, M St-Arnaud and JA Fortin, 1999. Direct interaction between the arbuscular mycorrhizal fungus Glomus intraradices and different rhizosphere microorganisms. New Phytol, 141: 525-533.

Gildon A and P Tinker, 1983. Interactions of vesicular-arbuscular mycorrhizal infection and heavy metals in plants. II. The effect of infection on uptake of copper. New Phytol, 95: 263-268.

Guo Y, E George and H Marschner, 1996. Contribution of an arbuscular mycorrhizal fungus to the uptake of cadium and nickel in bean and maize plants. Plant Soil, 184: 195-205.

Jalaluddin M, 2005. Effect of inoculation with VAM fungi and Bradyrhizobium on growth and yield of soybean in Sindh. Pak J Bot, 37: 169-173.

Jamal A, N Ayub, M Usman and AG Khan, 2002. Arbuscular mycorrhizal fungi enhance zinc and nickel uptake from contaminated soil by soya bean and lentil. Inter J Phytoremediation 4: 205-221.

Khan AG, C Knek and TM Chaudhry, 2000. Role of plants, mycorrhizae and phytochelation in heavy metal contaminated land remedian. Chemosphere 41: 197-207.

Killham K and MK Firestone, 1983. Vesicular-arbuscular mycorrhizal mediation of grass response to acidic and heavy metal depositions. Plant Soil, 72: 39-48.

Malcova R, M Vosatka and M Gryndler, 2003. Effects of inoculation with Glomus intraradices on lead uptake by Zea mays L. and Agrostis capillaries L. Appl Soil Ecol, 23: 55-67.

Marschner H, 1995. Mineral Nutrition in Higher Plants. 2nd ed, Academic Press, New York.

Pfleger FL and RG Linderman (eds), 1994. Mycorrhizae and plant health. Amer Phytophath Soc Press. St. Paul, Minn.

Phiri S, IM Rao, E Barrios and BR Singh, 2003. Plant growth, Mycorrhizal association, nutrient uptake and Phosphorus dynamics in a volcanic ash soil in colombia as affected by the establishment of Tithonia diverssifolia. J Sust Agric, 21: 41-49.

Razi H and MT Asad, 1998. Evaluation of variation of agronomic traits and water stress tolerant in sunflower conditions. Agric Nat Res Sci, 2: 31-43.

Seiler GJ, 2007. Wild annual Helianthus anomalus and H. deserticola for improving oil content and quality in sunflower. Industrial Crops and Products, 25: 95-100.

Smith ES, E Facelli, S Pope and FA Smith, 2010. Plant performance in stressful environments: Interpreting new and established knowledge of the roles of arbuscular mycorrhizas. Plant Soil, 326: 3-20.

Stone LR, AJ Schlegel, RE Gwin and AH Khan, 1996. Response of corn, grain sorghum and sunflower to irrigation to the High Plains of Kansas. Agric. Water Manage, 30: 251-259.

Tolga E and D Lokman, 2003. Yield response of sunflower to water stress under Tekirdag conditions. Helia. 26: 149-158.

Turhan H and I Baser, 2004. In vitro and In vivo water stress in sunflower (Helianthus annuus L.). Helia 27: 227-236.

Vazquez-Hernandez MV, L Arevalo-Galarza, D Jaen-Contreras, JL Escamilla-Garcia, A Mora-Aguilera, E Hernandez-Castro, J Cibrian-Tovar and D Teliz-Ortiz, 2011. Effect ofGlomusmosseae and Entrophosporacolombiana on plant growth, production, and fruit quality of 'Maradol' papaya (Carica papaya L.). ScientiaHorticulturae, 128: 255-260.