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Research Article

Influence of Humic Acid and Mycorrhiza on Some Characteristics of Roselle

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ABSTRACT

Inoculation of plant roots with arbuscular mycorrhizal (AM) fungi may be effective in improving crop production under drought conditions. Colonization of roots by AM fungi has been shown to improve productivity of numerous crop plants in soils under drought stress. The effects of humic substances have been directly correlated with enhanced uptake of macronutrients, such as N, P and S, and micronutrients like Fe, Zn, Cu and Mn. The field experiment was laid out factorial with randomized complete block design with three replications. Treatments included mycorrhiza in three levels (M1: Control, M2: *Glumusmossea* and M3: *Glumusetanicatum*) and humic acid (S1: Once a week, S2: once every two weeks, S3: Once every three weeks and S4: once every four weeks).Analysis of variance showed that the effect of humic acid on all characteristics was significant. The maximum of biological yield, plant dry weight, Number of sub branch and Plant height of treatments S2was obtained. Analysis of variance showed that the effect of mycorrhiza on all characteristics was significant. The maximum of biological yield, plant dry weight, Number of sub branch and Plant height of treatments *G. mossea* was obtained. Inoculation of plant roots with arbuscular mycorrhizal (AM) fungi may be effective in improving crop production. Colonization of roots by AM fungi has been shown to improve productivity of numerous crop plants.

Key words: Mycorrhiza, Humic acid, Roselle

INTRODUCTION

Integrated nutrient management strategies involving chemical fertilizers and bio-fertilizers have been suggested to enhance the sustainability of crop production (Manske*et al*., 1998). The bio inoculants help the expansion of root systems and better seed germination and plant growth (Manske *et al*., 1995). In African soils, legume as a pre-crop also affects the biological properties: legume pre-crops result in earlier colonisation of cereal roots by AM fungi (Bagayoko *et al*., 2000). Inoculation of plant roots with arbuscular mycorrhizal (AM) fungi may be effective in improving crop production under drought conditions. Colonization of roots by AM fungi has been shown to improve productivity of numerous crop plants in soils under drought stress (Al- Karaki and Al-Raddad 1997; Al-Karaki and Clark 1998; Faber *et al*., 1990; Sylvia *et al*., 1993). Improved productivity of AM plants was attributed to enhanced uptake of immobile nutrients such as phosphorus, zinc and copper. In addition, other factors associated with AM fungal colonization may influence plant resistance to drought. These include changes in leaf elasticity (Auge *et al*., 1987a), improved leaf water and turgor potentials, maintenance of stomatal opening and transpiration, increased root length and depth, and development of external hyphae (Ellis *et al*., 1985). The organic manures are numerous, they prepared initially from either animal or plant residues. All organic manures improve the behaviors of several elements in soils through that active group (filvic and humic acids) which have the ability to retain the elements in complex and chelate form. These materials release the elements over a period of time and are broken down slowly by soil microorganisms. The extent of availability of such nutrients depends on the type of organic materials and microorganisms. Humic acid improves the physical, chemical and biological properties of the soil and influences plant growth. Humic substances are recognised as a key component of soil fertility properties, since they control chemical and biological properties of the rhizosphere (Rengrudkij and Partida, 2003, Nardi *et al*., 2005, Trevisan *et al*., 2009). The effects of humic substances have been directly correlated with enhanced uptake of macronutrients, such as N, P and S, and micronutrients like Fe, Zn, Cu and Mn (Chen *et al.*, 2001). The mechanism of humic acid activity in promoting plant

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growth is not completely known, but several explanations have been proposed by some researchers such as increasing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake, and root cell elongation (Turkmen *et al*., 2004). Roselle (*Hibiscus sabdarjffa* L.) belongs to the malvaceae family, and is an annual or biennial plant cultivated for its stem, fiber, edible calyces, leaves and seeds (Rao, 1996). The crop is used in a variety of ways for home consumption, medicinal and industrial uses. The crop is however most suited for tropical climate with high humidity and temperature of about 25°C to 35°C (Hikosaka, 2004). The plant requires an optimum PH of 6-7 and rainfall of about 450-500mm which should be well distributed over 90-120 days during the growing season. It can tolerate relatively high temperature throughout the growing and fruiting periods. The plant requires an optimum rainfall of approximately 45-50 cm distributed over a 90 - 120 day growing period (Rao, 1996).

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the zabol which is situated between 30° 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 mycorrhiza in three levels (M1: Control, M2: *Glumusmossea* and M3: *Glumusetanicatum*) and humic acid (S1: Once a week, S2: once every two weeks, S3: Once every three weeks and S4: once every four weeks).

Data collect

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

RESULTS AND DISCUSSION

Biological yield

Analysis of variance showed that the effect of Mycorrhiza on biological yield was significant (Table 1). The maximum of biological yield of treatments *G. mossea* was obtained (Table 2). The minimum of biological yield of treatments *G. etanicatum* was obtained (Table 2). Analysis of variance showed that the effect of humic acid on biological yield was significant was significant (Table 1). The maximum of biological yield of treatments S2 was obtained (Table 2). The minimum of biological yield of treatments S4 was obtained (Table 2).Inoculation of plant roots with arbuscular mycorrhizal (AM) fungi may be effective in improving crop production under drought conditions. Colonization of roots by AM fungi has been shown to improve productivity of numerous crop plants in soils under drought stress (Al- Karaki and Al-Raddad 1997; Al-Karaki and Clark 1998; Faber *et al*., 1990; Sylvia *et al*., 1993).The effects of humic substances have been directly correlated with enhanced uptake of macronutrients, such as N, P and S, and micronutrients like Fe, Zn, Cu and Mn (Chen *et al.*, 2001). The mechanism of humic acid activity in promoting plant growth is not completely known, but several explanations have been proposed by some researchers such as increasing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake, and root cell elongation (Turkmen *etal*., 2004).

Plant dry weight

Analysis of variance showed that the effect of Mycorrhiza on plant dry weight was significant (Table 1). The maximum of plant dry weight of treatments G. mossea was obtained (Table 2). The minimum of plant dry weight of treatments G. etanicatum was obtained (Table 2). Analysis of variance showed that the effect of humic acid on plant dry weight was significant was significant (Table 1). The maximum of plant dry weight of treatments S2 was obtained (Table 2). The minimum of plant dry weight of treatments S4 was obtained (Table 2). Improved productivity of AM plants was attributed to enhanced uptake of immobile nutrients such as phosphorus, zinc and copper. In addition, other factors associated with AM fungal colonization may influence plant resistance to drought. These include changes in leaf elasticity (Auge *et al*., 1987a), improved leaf water and turgor potentials, maintenance of stomatal opening and transpiration, increased root length and depth, and development of external hyphae (Ellis *et al*., 1985).

Number of sub branch

Analysis of variance showed that the effect of Mycorrhiza on number of sub branch was not significant (Table 1). The maximum of number of sub branch of treatments G. mossea was obtained (Table 2). The minimum of number of sub branch of treatments G. etanicatum was obtained (Table 2). Analysis of variance showed that the effect of humic acid on number of sub branch was significant was significant (Table 1). The maximum of number of sub branch of treatments S2 was obtained (Table 2). The minimum of number of sub branch of treatments S4 was obtained (Table 2). Theorganic manures are numerous, they prepared initially from either animal or plant residues. All organic manures improve the behaviors of several elements in soils through that active group (filvic and humic acids) which have the ability to retain the elements in complex and chelate form. These materials release the elements over a period of time and are broken down slowly by soil microorganisms. The extent of availability of such nutrients depends on the type of organic materials and microorganisms. Humic acid improves the physical, chemical and biological properties of the soil and influences plant growth. Humic substances are recognised as a key component of soil fertility properties, since they control chemical and biological properties of the rhizosphere (Rengrudkij and Partida, 2003, Nardi *et al*., 2005, Trevisan *et al*., 2009).

Table 1: Anova analysis of the Roselle affected by mycorrhiza and humic acid

Sov	df	Biological yield	Plant dry weight	Number of sub branch	Plant height
R	2	11266921.6^{ns}	562.78^{ns}	0.250^{ns}	23.52^{ns}
Mycorrhiza (A)	2	68730999.1**	20832.60**	0.583^{ns}	37.52^{ns}
humic acid (B)	3	35757006.5*	22959.46**	3.11**	105.36*
A*B	6	14306953.8^{ns}	11442.94**	9.25**	242.97**
Error	22	11958815.7	2134.20	0.613	24.92
CV	-	17.44	9.01	11.19	4.51

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

Table 2: Comparison of different traits roselle affected by mycorrhiza and humic acid

Treatment	Biological yield	Plant dry weight	Number of sub branch	Plant height
mycorrhiza	17375b	483.63b	6.83a	109.41a
G. mossea	22158a	560.45a	7.25a	112.66a
G. etanicatum	19930ab	494.08b	6.91a	109.83a
humic acid				
S1	19637ab	512.95a	6.67b	109.33b
S2	21938a	549.36a	7.77a	115.66a
S3	20518ab	547.35a	7.11ab	109.55b
S4	17191b	441.22b	6.44b	108b

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

Plant height

Analysis of variance showed that the effect of Mycorrhiza on plant height was not significant (Table 1). The maximum of plant height of treatments G. mossea was obtained (Table 2). The minimum of plant height of treatments G. etanicatum was obtained (Table 2). Analysis of variance showed that the effect of humic acid on plant height was significant (Table 1). The maximum of plant height of treatments S2 was obtained (Table 2). The minimum of plant height of treatments S4 was obtained (Table 2). The effects of humic substances have been directly correlated with enhanced uptake of macronutrients, such as N, P and S, and micronutrients like Fe, Zn, Cu and Mn (Chen *et al.*, 2001). The mechanism of humic acid activity in promoting plant growth is not completely known, but several explanations have been proposed by some researchers such as increasing cell membrane permeability, oxygen uptake, respiration and photosynthesis, phosphate uptake, and root cell elongation (Turkmen *et al*., 2004).

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