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Study the effect of biological and chemical fertilizers on *Artemisia annua L.* root characteristics

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Abstract

To consider the effect of biological and chemical fertilizers on *Artemisia annua L.* root characteristics (root height, dry and wet weight of root and water amount of root after flowering stage) an experiment was carried out in factorial design in completely randomized design with 4 replications in a educational green house in Tehran in 2010. Treatments included chemical fertilizers (Nitrogen (N), Phosphorus (P)) in 4 levels (N0P0, N40P40, N80P40, N80P80) and biological fertilizers in 4 levels (control, Nitroxin [include bacteria which stimulus growth (Azotobacter and Azospirillum)], Bio-phosphorus [(include bacteria which stimulus growth (Bacillus and Pseudomonas)] and Vemricompost fertilizer. Results showed that using biological fertilizer, and increasing different levels of chemical fertilizers (N, P) had significant effect on under consideration characteristics. Means comparison showed that biological fertilizers application leads to significant increase in all under consideration features. Among biological fertilizer, Vemricompost treatments are the most effective. Means comparison of applying different levels of chemical fertilizers indicated that N80P80 had the most increase in features. Interaction effect had different effects on those feature.

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Introduction

Artemisia annua (Asteraceae) is native to China, where it is known as qinghao (green herb) and has been used for over 2,000 years to treat symptoms associated with fever and malaria. It is known in the United States as sweet Annie, annual or sweet wormwood (Ferreira *et al.* 1997).

Malaria is a major health problem in many developing countries, mostly in Africa and Southeast Asia (Snow *et al.* 2005). According to WHO report on malaria (2007), 40% world's population is living with risk of malaria, over 1.5 million death occur per year and the cost of malaria treatment is $1800 million US dollar. The first effective ant malarial drug was quinine, which was isolated from the bark of cinchona. Since then malaria has been treated with quinoline based drugs. However, Plasmodium falciparum developed resistant globally against two of the most common ant malarial drugs: chloroquine and the combination sulphadoxine/pyrimethamine (Ridely, 2002).

Nitrogen (N) is an important element for growth of *Artemesia*. It needs N in large content which is a basic material for protein and nucleic acid. Phosphorus (P) interferes with cells structure and most of vital activities such as storage and transfer chemical energy as well. Need for P in favor growth from 0.3 to 0.5% of dry weight is within growth and development stages (Ebrahim zadeh, 1994). Because N and P has been produced and used in chemical fertilizer form, its supply through using large content of chemical fertilizers in one of the water pollution in nature cycle and its production is expensive also, alternating this with organic fertilizers plays an important role (Chandrasekar *et al.* 2005). So that, avoid of negative pressure to environment, it is needed to improve developmental programs which supply plant fertilizers requirements'.

Improving soil quality could assess according to quality and quantity index of biological society. As a result, using biological fertilizers is one of the effective managerial methods to keep soil quality in favorable level (Kokalis *et al.* 2006).

Using useful micro organism in agriculture had been begun since 60 years ago. Increasing this useful population can increase plant resistant against different environmental stresses such as lack of water, nutrition and heavy material toxicity (Wu *et al.* 2005).

Biological fertilizers are materials which include different micro creatures which have the ability to convert main nutrition elements from unavailable form to available form during biological processes (Rajendran and Devaraj, 2004) lead to develop better seeds' germination and root system (Bi *et al.* 2003). In last decade biological fertilizers is applying as economically compatible compactly which lead reduction in using chemical fertilizers, improving soil fertility status to enhance plant production which is along with its biological activity in rhizosphere. A group of bacteria which can be along with plant belong to Azospirillum, Azotobacter, Pseudomonas, Bacillus species (Selosse *et al.* 2004).

Bacteria which work as solver of phosphate include a group of micro creatures most important species among this family is Pseudomonas and Bacillus (Tilak *et al.* 2005). Different species of Pseudomonas may cause to stimulate plant growth via different mechanisms such as antibiotics synthesis, plant hormone production, increasing P absorbance by plant, N stabling (Abdul-Jaleel *et al.* 2007).

Vermicompost is an organic biological fertilizer and consists of biological mixture of very active bacteria, enzymes, plant rests, animal fertilizer and soil worm capsule which cause continuation of soil organic material analysis and development of microbial activity in plant cultivation bed (Bashan and Holguin, 1997). The aim of this experiment was considering effect of biological and chemical fertilizers on *Artemisia annua L.* root characteristics.

Materials and methods

In order to consider biological fertilizers (Nitroxin,

Bio-phosphorus and Vermicompost) and chemical fertilizers (N, P) on features of the *Artemisia annua L.*, we had done an experiment in Tehran green house in 2011. The plan of this experiment was factorial design in completely randomized design with 4 replications.

Experimented factors

A. Biological fertilizers in 4 levels: A_1: controls (without using fertilizer), A_2: Nitroxin (include *Azotobacter* and *Azospirillum*), A_3: Biophosphorus (include *Bacillus* and *Pseudomonas*) and A_4: Vermicompost (10 t/ha).

There existed 10^8 live cell in each gr of Nitroxin liquid and 10^7 cells in each gr of Bio-phosphorus liquid.

To mix and Insemination the seeds, firstly we extend clean plastic under seeds and then sprayed the liquid fertilizers on them. Then we put Inoculated seeds in shadow for 1 hour, after drying they are ready for cultivation, 10 tons Vermicompost also had been used.

B. Chemical fertilizer of N and P in 4 levels: B_1: Control (without fertilizer), B_2: N40+P40, B_3: N80+P40 and B_4: N80+P80 ($Kg*ha^{-1}$).

Before cultivation, all the P fertilizers and N fertilizers in 3 parts added to pots according to soil test.

Statistical analysis

Statistical plan considered as factorial in completely accidental plot with 4 repetitions. Data analysis did by MSTAT-C and SAS software and graphs drew by excel software. In addition means compared in Duncan test and 1% probable level.

Results and discussion

Root length changes

Considering variance analysis about effects of chemical and biological fertilizers on root length changes (Table 1) indicated that this characteristic is significant 5% of probable level. About application of bio-fertilizers, means comparison (Table 2) shows that using bio-fertilizers leads to increase root length which among those treatments application of Vermicompost (10 ton) leads to highest root length (42.16 cm) and this increase was 60.91% more than control.

Table 1. Result of variance analysis of root characteristics in *Artemisia annua L.*

		Mean Square			
S.O.V	df	*Root length (Cm)*	*Root fresh weight (mg)*	*Root dry weight (mg)*	*Root water amount (ml)*
Bio-fertilizers (A)	3	807.16^{**}	126835.23^{**}	7956.9^{**}	0.0715^{**}
Chemical Fertilizers (B)	3	1212.33^{**}	412839.73^{**}	16845.8^{**}	0.0263^{**}
Bio-fertilizers × Chemical Fertilizers (A×B)	9	57.28^{*}	8192.06^{*}	603.21^{*}	0.0047^{ns}
Error	48	44.68	4278.521	337.85	0.003
C.V (%)		14.83	14.75	16.55	15.92

About effect of chemical fertilizers on after flowering root length, means comparison table (Table 2) shows that by increasing N, P amount, root length will increase. Regarding these results the highest root's length is related to [N (80 $kg*ha^{-1}$) + P (80 $kg*ha^{-1}$)] who was 43.35 cm and was 80.39% more than control.

Results of variance analysis table indicated that interaction effects of biological and chemical fertilizers on plant's root length in after flowering stage were significant in 1% of brobable level (Table 1).

Chandrasekar *et al* (2005) reported that inoculation of Azespirilum and Azetobacter along application of N

leads to root length increase. Tilak and Sink (1988) suggested that *Azospirilum barasilens* increased *Pennisetum glaucum* root length.

Samiran *et al*, (2010) studied *Phaseolus vulgaris L.* and reported that root length of *Phaseolus vulgaris L.* and Abelmoschus esculents increased by Vermicompost application.

Root fresh and dry weight

Effect of bio-fertilizers (Vermicompost, Nitroxin and Bio-phosphorus) on root fresh and dry weight was significant in 5% of probable level (Table 1). Means comparison of treatments (Table 2) indicated that all treatments which included bio-fertilizers application had superior impact than control.

Among them the weightiest root fresh weight single plant was related to Vermicompost (10 ton) (507.5 mg). About root dry weight, the weightiest root was 113.68 mg and refers to this treatment. The lightest root fresh and dry weights were 306 mg and 6.62 mg respectively and refer to control. Variance analysis results indicated that root fresh and dry weights were significant in 5% of probable level under effects of different levels of chemical fertilizers (Table 1).

Table 2. Comparison of experimental treatments' simple effects means on measured characteristics (root characteristics).

Mean Treatments				
Bio-Fertilizers	*Root length (Cm)*	*Root fresh weight (mg)*	*Root dry weight (mg)*	*Root water amount (ml)*
Control	26.2c	306d	64.62d	0.241d
Nitroxin	38.98a	456.25b	100.56b	0.355b
Bio-phosphorus	32.38b	373.63c	76.56c	0.297c
Vermicompost	42.16aa	517.5d	113.68a	0.393a
Chemical Fertilizers (Kg ha^{-1})				
N (0) + P (0)	24.03c	205.38d	46.7d	0.158d
N (40) + P (40)	32.01b	369.5c	82.25c	0.287c
N (80) + P (40)	40.33a	495.38b	104.68b	0.39b
N (80) + P (80)	43.35aa	573.13a	131.81a	0.451a

Note: Similar letters in each column hadn't any significant statistical difference.

The weightiest root fresh and dry weights were related to [N (80 kg*ha^{-1}) + P (80 kg*ha^{-1})] with (573.13 mg for root fresh weight) and (121.81 mg for root dry weight) and the highest weights were related to control (205.38 mg for fresh weight) and (46.7 mg for dry weight).

Interaction effects of chemical and biological fertilizers on root fresh and dry weights were significant 1% of probable level (Table 1).

Means comparison of interaction effects showed that the weightiest root fresh and dry weight were related to Vermicompost (10 ton) + [N (80 kg*ha^{-1} + P (80 kg*ha^{-1})] that were 695.25 mg and 156.25 mg and the lightest were refers to control that were 167.25 mg and 38 mg.

Changes in root water amount

Variance analysis about effect of biological and chemical fertilizers on changes of root water amount (Table 1) indicated that this feature was significant in 5% of probable level.

Means comparison on effect of bio-fertilizers on root water amount (Table 2) indicated that using biological fertilizers leads to enhance root water amount. Among them Vermicompost (10 ton) with 0.393 ml had the highest water amount and it was 63.07% more than control.

Means comparison on chemical fertilizers on root water amount (Table 2) indicated that by increasing N, P amount, root water amount will increase. Regarding to these results the most water amount was related to [N (80 kg*ha^{-1}) + P (80 kg*ha^{-1})] with 0.451 mg and the least water amount was related to control (0.158 ml).

Results of variance analysis table (Table 1) showed that interaction effects of biological and chemical fertilizers on root water amount weren't significant in all levels.

Conclusion

Effect of bio-fertilizer was positive on under consideration features. Impact of bio-fertilizers on root length, root fresh and dry weight and root water amount were significant. All treatments effect which included bio-fertilizers were superior than control; among them Vermicompost had the most positive impact.

N and P fertilizers had significant impact on these features which increasing N and P till 80 kg ha^{-1} leads to increase these features. Interaction effects of biological and chemical fertilizers were different on under consideration characteristics.

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