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Investigation of different methods of biological Ema (effective microorganism active) use on quality and quantity production and water use efficiency in two cultivars of corn

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ABSTRACT
A field experiment was conducted at Firozabad region of Iran to study the effect of Effective Microorganisms Activate (EMa), EMa levels on growth, yield, Yield Components and Water Usage Efficiency of two Maize cultivars (Ns640 and Back cross 666). The experiment consisted of 10 treatments which were the combinations between two factors: two cultivars and five EMa levels.Ns640 cultivar significantly exceeded Back cross 666 in more growth characters, yield and its components. The result indicates that EMa increases growth and grain yield and water usage efficiency of Maize.

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Introduction

Maize is an important cereal crop that provides staple food to large number of human population in the world. It is a tropical plant but at present its cultivation in subtropical and temperate regions is also done intensively on world wide bases It can successfully be cultivated twice in a year. In developing countries maize is a major source of income to many farmers (Tagne et al., 2008).

In environments with low nutrient concentrations or the new reclaimed lands, plants are stressed directly by the lack of adequate nutrients (Eman et al., 2007). Farming practices, which involve heavy application of chemical fertilizers, may cause depletion of certain nutrients in soil and certain others would generally accumulate in excess resulting in nutrient imbalance, which affects soil productivity. Among available means to achieve sustainability in agricultural production.Organic manure and bio-fertilizer play an important and key role because they possesses many desirable soil properties and exerts beneficial effect on soil physical, chemical and biological characteristics (Son et al., 2004). Organic materials are used for increasing crop production but pure organic farming can never meet the increasing demand for nutrient supply, as sufficient quantities of organic materials are not available.

Application of bio-fertilizers are frequently recommended firstly for improving biological, physical and chemical properties of soil and secondary to get high and clean agricultural yield products free from undesirable high doses of heavy metals and other pollutants.(Kramany et al., 2007) Another way of supplying nutrients to soil is through biological inoculums. But it also needs large amounts of organic matter and alone can not favour the plant nutrient supply to soil eco-system (Hussain *et al*., 1999). So, one of the alternative of nutrient supply is the integration of Effective Microorganisms (EM) inoculums and organic/inorganic materials. It is suggested that Effective Microorganisms Activate (EMa) increases the numbers of beneficial microorganisms in soil. Thus maintaining the natural ecosystem of the cultivated land and diminishing the risk of environmental pollution with improved crop productivity and quality(Higa, 1991).

Microorganisms enhance the efficacy of organic farming systems (Dobreiner, 1994, Parr et al, 1994) due to their role in decomposition of manures, symbiotic and fermentative processes. The use of EM in crop production is either by direct application to the soil, to organic matter spread on the soil surface or to the plant. However, it can be used in composing organic matter at a different location and this material applied to the soil prior to planting (APNAN, 1995). In this investigation a field experiment was carried out to determine the effect of EMa on water use efficiency, growth, yield, yield components and to identify the best method of EMa appliance on maize.

Material and methods

The experiment was conducted in Research field of Firozabad, Iran. The height of the experimental site from the sea level was 1600 m, The soil was silty clay loam with a pH of 8.2, The soil chemical properties before the start of the experiment are presented in (Table 1). The experiment was laid out in A factorial experiment in randomized complete block design (RCBD) with three replicates and a plot size of 6 m x 5 m was used. All the agronomic operations except those under study were kept normal and uniform for all the treatments.

The treatments were as follows:

- T_1: EMa applied on to leaves pre flowering stage at a dilution Rate of 1:10 (300 l per ha) three times.
- T_2: EMa applied onto leaves pre flowering stage at a dilution of 2:10 (300 l per ha) three times.
- T_3: EMa applied onto stubble pre furrowing at a dilution of 1:7 (400 l per h)
- T_4: EMa applied as fertigation at dilution of 1:3 (200 l per h)
- T_5: Control, without EMa application

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Two Maize cultivars (Ns640(V1) and Back Cross 666(V2)) were compared at 5 treatments for their Growth, Yield and Yield Components and Water Use Efficiency.

Data on various growth and yield components were collected using standard procedures and analyzed statistically by using Fisher's analysis of variance technique (Steel & Torrie, 1984). Duncan test at 0.05 probability was employed to compare the means.

Result and Discussion

The results of comparison of the means of effects of threatments different crop traits are presented in Table 2.

The results of the experiments indicated that there were significant effect of EMa on growth and development of maize when compared to control.

Any two means not sharing a letter in common differ from each other significantly at 5% level of probability.(Duncan test)

Plant height is important parameter of yield in maize as usually taller plant bears more cobs and give more yield. Comparison of various treatment means indicated that plant height increased significantly compared to control (Table 2), Maximum plant height of 2.5 m was recorded in T1 and T2 for both cultivars.

The maximum biological yield of 23490 kg ha-1 was obtained in V1T1 treatment (EMa applied onto leaves preflowering at a dilution of 1:10 (300 l per h) which was not significantly different from the V1T2 treatment (Table 2). The obtained results conclude that the application of EMa can considerably increase biological yield. Salehrastin reported the considerable increase in maize, soybean and wheat yield as a result of the use of bacterial fertilizer.

Maximum number of grains per cob 833 was obtained in V1T2. wich did not differ significantly from either V1T1 or V2T1, which produced 781.7and 790 grains per cob, respectively. The lowest number of grains per cob (516) was produced in the control. It is evident from the data presented in Table 2 that maximum 1000-grain weight of 213 g was obtained in treatment V1T1 where EMa was applied onto leaves. Non significant difference was found between treatments V1T2 and V2T2 but they were significantly different from that of T1, T3, T4 and Control in both varieties. The lowest weight per 1000-grains of 108.7 g was recorded in V2T5 treatment. Grain yield was maximum when crop was treated with T1 and T2 respectively in both varieties. It was followed by T4.

Grain yield recorded in V2T5 treatment was the lowest (4.63 t ha-1) of all other treatments. Yamada and Xu (2000), affirmed higher crop maze productivity due to the use of EM. Application of EMa onto leaves at a dilution of 1:10 (300 l per h) increased yields of maize to a greater extent than when Ema was applied onto stubble pre furrowing at a dilution of 1:7 (400 l per h), with irrigation at dilution of 1:3 (200 l per h) and Control.

The results of the Duncan test in the 5 percent level revealed that between different cultivars of corn, no meaningful difference concerning water usage efficiency exists and they fall into the same group. In general, water usage efficiency in Ns640 (V1) was better than 666 (V2) and the water usage efficiency difference was 5 percent. In fact, water usage efficiency in Ns640 was 55 percent, while it equaled 50 percent in 666. The highest water usage efficiency between different treatments belonged to the two spraying treatments with concentrations of 100 in 1000 and 200 in 1000. No meaningful statistical difference was observed between the two and they both fell in the same group. The lowest efficiency in water usage belonged to the treatment of spraying on straw. There existed no meaningful difference between the treatment of spraying on straw and the control treatment and they both fell into the same group.

In general Effective Microorganisms Active seem to have direct impact on growth and yield of Maize but doesn't show a meaningful statistic effect in increasing water usage efficiency. Previous studies have demonstrated a consistent positive response with the use of effective microorganisms in crop production and indicate the potential of this technology to reduce fertilizer use and increase the yield and quality of crops (Higa, 1991).

The results show that application EMa for Maize can improve their growth and yields. To prevent the environmental pollution from extensive application of fertilizers, the effective microorganisms could be recommended to farmers to insure the public health and a sustainable agriculture. The data collected proves that the use of EMa can lead to higher Maize yield.

Table 1: Soil chemical properties of experimental area

Sample depth	pH	EC(ms)	N(%)	OC(%)	K(ppm)	P(ppm)	Mn(ppm)	Cu (pp m)	Zn (ppm)	Fe (ppm)
0-30	8.2	0.48	0.06	0.63	362	8.3	14	1.94	0.8	1.92

Table 2. Growth and yield parameters of maize as affected by various treatments

Treatments		Plant height (m)	Biological Yield (kg/h)	No. of grains cob^{-1}	1000-grain weight (g)	Water efficiency	Grain yield (t ha^{-1})
	T_1	2.5a	23490a	781.7abc	213.3a	72.69a	10.81a
	T_2	2.5a	22460a	833a	158.7b	76.67a	10.55a
V_1	T_3	1.95a-d	1220a	718.7c	118d	39.25b	5.408f
	T_4	2.2a	16440cd	626d	118.3d	47.76b	6.911d
	T_5(control)	1.53cd	15290d	581d-e	115d-e	40.94b	5.952e
	T_1	2.1abc	20090b	790ab	181.3b	66.62a	8.233b
	T_2	2.2d	17280c	724bc	155c	65.02a	7.634c
V_2	T_3	1.7bcd	10710e	613.3d	113.3de	37.29b	4.650g
	T_4	2.4a	15500d	576.7d-e	150c	48.83b	6.192e
	T_5(control)	1.46d	11010e	516e	108.7e	36.91b	4.630g

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