



## EFFECT OF BIOLOGICAL FERTILIZER AND MINERAL FERTILIZER ON YIELD AND YIELD COMPONENTS OF CORN (*Zea mays*) CV. S.C. 504

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### ABSTRACT

To evaluate the effect of Biosuper biofertilizer and mineral fertilizer on yield and yield components of corn separately and collectively, a research was conducted in Tabriz Islamic Azad university research field in 2010 based on factorial experiment in completely randomized block design in three replications. Biosuper biofertilizer was considered as factor B and mineral fertilizer was considered as factor A and collective application was considered as AB. The results showed that using Biosuper biofertilizer had positive effect on 100 Kernel weight, Ear weight and Grain yield. Also, using mineral fertilizer (once Application treatment) led to increase 100 Kernel weight, Ear Weight and Grain yield. Application of fertilizers was effective on the traits and collective application of mineral fertilizer with Biosuper biofertilizer (once application of mineral fertilizer treatment with Biosuper) increased yield components, as this enhancement led to increase yield by 30.69% related to when the biofertilizer not applied.

**Keywords:** corn, biosuper, biofertilizer, mineral fertilizer.

### INTRODUCTION

Population and economic growth rate resulted in broad demand for food at last two decades. To meet this demand might be difficult, because current fields are not accountable and yield loss clearly appears. Under these conditions, agriculture could not supply growing global requirement to food. Corn is one of the high yielding cereals that ranked as third cereal crop after wheat and rice to supply global population consumption (Biari *et al.*, 2008). Today, micronutrients use to achieve maximum production per unit area. This fertilizer should be able to increase crop production and quality, enhance fertilizer efficiency and provide human and animal health (Goldbach *et al.*, 1998). Biological fertilizers have special significance in increasing crop production and reserve soil sustainable fertility (Sharma, 2003). The term of biological fertilizer is not particularly for organic matters from manure, crop residue, green manure, etc., but also includes bacterial and fungus micro organisms, specially PGPRs and compounds from their activity (Manaffee and Kloepper, 1994). These types of bacteria, in addition to increasing mineral elements of soil through biological N fixation, phosphate and potassium solubilizing and inhibition of pathogens, also by growth regulator hormones produce affect crop yield (Sturz and Chrisite, 2003). Overall, biological fertilizers term refers to fertile materials that involve one or more beneficial soil organism within a suitable preservative. In fact, this fertilizers include different types of micro organisms (Chen, 2006; Vessey, 2003), that could converse nutrients from unavailable form to available form during a biological process (Rajendran and Devaraj, 2004), and resulted in develop root system and increase seed germination rate (Chen, 2006).

### MATERIALS AND METHODS

Biosuper biofertilizer and mineral fertilizer on early corn (maize) yield and yield components separately

and collectively, a research was carried out at Research Field of Islamic Azad University, Tabriz Branch 15 kilometers east of Tabriz, Iran, during growing season of 2010 summary, which based on Domarton's classification is representative of semiarid cold climate with warm summers and cold winters. Annual temperature average is about 10°C, maximum temperature average is about 16 °C, minimum is 2.2°C in last 10 years, and annual rainfall average is about 271.3 mm in this area. Analysis of soil indicated that pH is about weak alkaline (About 7.67).

This study was performed in a factorial experiment with three replications, arranged in a completely randomized block design with using single cross 504 of corn.

Biosuper biofertilizer was considered as factor B and mineral fertilizer was considered as factor A and collective application was considered as AB. This experiment constituted from 18 plots in three replications, each plot's length was 3.5 m and 2.4 m width with five planting row and 60 cm distance between rows. Seeds were planted with 20 cm distance between each other. Distance between main plots was 200 cm and distance between sub plots was 120 cm and also distance between experimental repetitions was 150 cm. In this experiment Biosuper fertilizer applied that is a biological fertilizer containing Azotobacter, Azospirillum, Tillobasillus, and Pseudomonas and Mineral fertilizer containing appropriate amount of Ammonium Nitrate Nitrogen (NH<sub>4</sub>, NO<sub>3</sub>), Phosphorus (P<sub>2</sub>O<sub>5</sub>), Potassium (K<sub>2</sub>O) and also containing appropriate amount of microelements including Iron (Fe), Zinc (Zn), Manganese (Mn), copper (Cu) and boron (B). In the Biosuper applied treatments, first at planting time seed mixed with this fertilizer (as manufacturers recommended rate) and then, when the plant had 6-8 leaves, this fertilizer used through mixing with irrigated water. Mineral fertilizer applied fortnight up to end of growth stage. Irrigation was performed once a week.

After emergence and establishment of plants in 10-15 cm height stage, thinning was done to maintain a

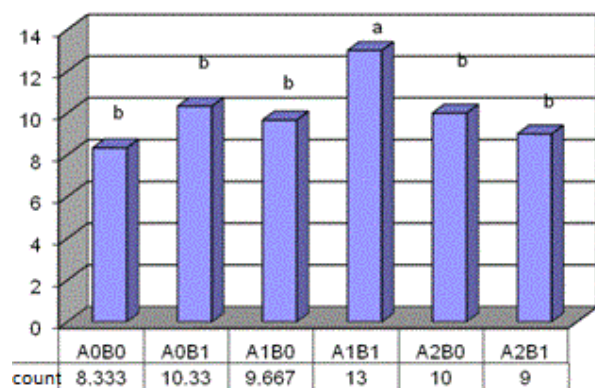


stronger plant and desirable density. After harvesting, on five randomized selected plants assessed traits include Number of Leaves, Row in Ear, Ear Weight, 100 Kernel Weight, Seed Weight per Plant, Grain Yield was calculated by all of plants in 1.5 m<sup>2</sup>. Analysis, include analysis of variance and mean square was performed through MSTAT-C and SPSS software and Danken's multiple range test at 5% level of probability, and charts was performed by Excel software.

## RESULTS AND DISCUSSIONS

### Number of leaves

Biofertilizer/ mineral fertilizer mean square results (Figure-1) indicated that highest Number of Leaves was in the once application of mineral fertilizer with biosuper use (A<sub>1</sub>B<sub>1</sub>) with 13.00 that is significantly different with other treatments. Lowest Number of Leaves observed in control plot (A<sub>0</sub>B<sub>0</sub>) with 8.33. once application of mineral fertilizer with Biosuper use led to an increase in Number of Leaves by 35.9%. With respect to these results we can suggest that increasing in Number of Leaves enhance photosynthesis rate and this enhancement lead to increasing yield. There was no correlation between Number of Leaves and other traits. Dordas and Sioulas (2009) suggested that Nitrogen affects accumulation of dry matter in different parts of plants. Differences in dry matter accumulation in response to Nitrogen is arises from difference in active solar radiation intake by plant canopy and plant performance in use of solar radiation.



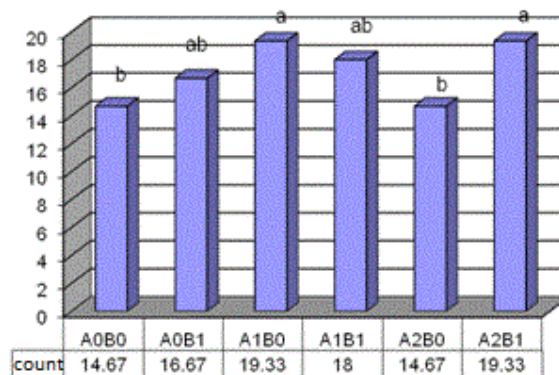
**Figure-1.** Effect of biosuper biofertilizer and mineral fertilizer on number of leaves.

A<sub>0</sub>: no mineral fertilizer application, B<sub>0</sub>: without Biosuper  
A<sub>1</sub>: once application of mineral fertilizer, B<sub>1</sub>: with Biosuper, A<sub>2</sub>: complete use of mineral fertilizer

### Row in ear

With respect to Figure-2 and biofertilizer/mineral fertilizer results, once application of mineral fertilizer with no biofertilizer application (A<sub>1</sub>B<sub>0</sub>) and complete application of mineral fertilizer with biofertilizer use (A<sub>2</sub>B<sub>1</sub>) resulted in a significant increase in Row in Ear.

The highest treatments showed 24.1% increase in Row in Ear related to control plot. Row in Ear affected from genetic factors, but, nevertheless Biosuper biofertilizer and mineral fertilizer application could help to increase this trait. Row in Ear had no correlation with other traits. Kader (2002) indicated that bacteria that live in Rhizosphere enhance root growth by nominating biological materials such as auxin and gibberellins and cause an increase in nutrient uptake from soil that this influence plant vegetative and reproductive growth.

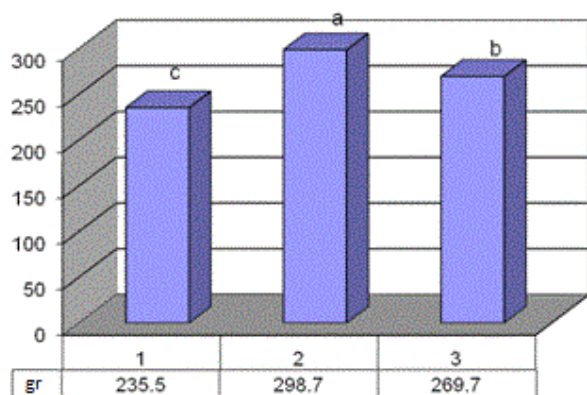


**Figure-2.** Effect of biosuper biofertilizer and mineral fertilizer on row in ear.

A<sub>0</sub>: no mineral fertilizer application, B<sub>0</sub>: without Biosuper  
A<sub>1</sub>: once application of mineral fertilizer, B<sub>1</sub>: with Biosuper, A<sub>2</sub>: complete use of mineral fertilizer

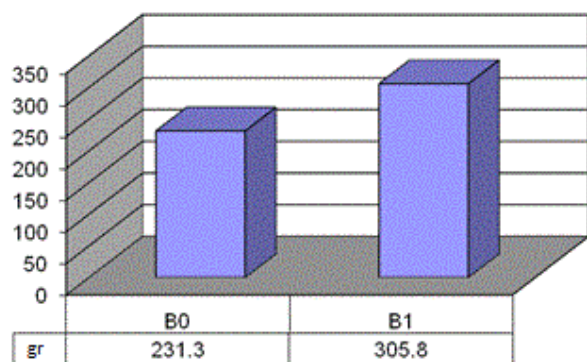
### Ear weight

Mineral fertilizer use mean square results (Figure-3), showed that, once application of mineral fertilizer treatment cause a significant increase in Ear weight from 235.5 g to 298.7 g. Thus, once application of mineral fertilizer treatment related to control plot, enhanced this trait by 21.14%. Biosuper biofertilizer application related to no biofertilizer application resulted in a significant increase in Ear weight by 24.19% (Figure-4). Hence, we can suggest that, with Biosuper biofertilizer application we can increase this trait and consequently increase the Grain Yield. Ear Weight had highest correlation with Seed Weight per Plant (933\*\*), Grain Yield (990\*\*), and 100 Kernel Weight (957\*\*) (Table-2). With respect to these results we can suggest that Seed weight per Plant cause an increase in ear weight and in general, elevated the Grain Yield. Zahir *et al.* (1998) reported an increase by 18% in ear weight when seed was inoculated by Azotobacter and P. florescence. In the research by Biari *et al.* (2008) was found that growth stimulator bacteria such as Azospirillum and Azotobacter have positive effects on corn yield when grown at field conditions.



**Figure-3.** Effect of mineral fertilizer on ear weight.

- 1: no mineral fertilizer application  
 2: once application of mineral fertilizer  
 3: complete use of mineral fertilizer

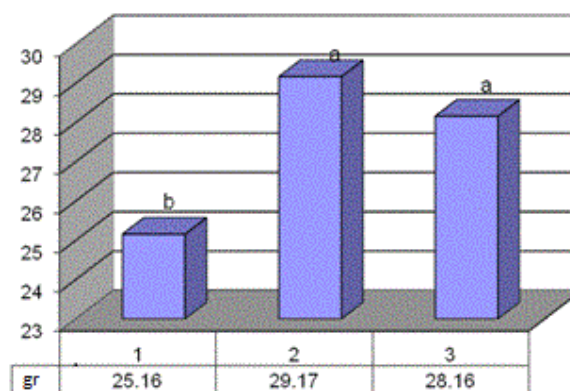


**Figure-4.** Effect of biosuper biofertilizer on ear weight.

B<sub>0</sub>: without Biosuper  
 B<sub>1</sub>: with Biosuper

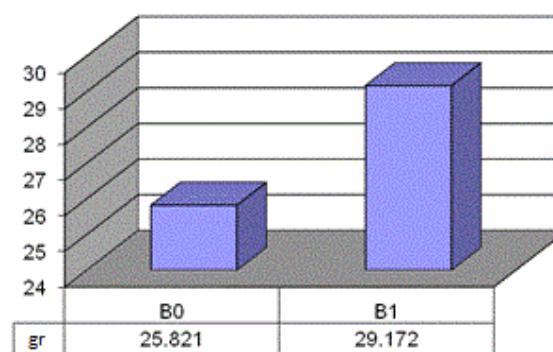
#### 100 Kernel weight

With respect to Figure-5 and mineral fertilizer mean square results, once application of mineral fertilizer resulted in increase in 100 Kernel Weight from 25.16 g (control plot) and 28.16 g (complete application of mineral fertilizer) to 29.17 g. So we can suggest that once application of mineral fertilizer had highest positive effect on 100 Kernel Weight related to other treatments. Biosuper biofertilizer application related to no biofertilizer application cause an increase in 100 Kernel Weight by 11.4% (Figure-6). 100 Kernel Weight had highest correlation with Ear Weight (957\*\*), Seed Weight per Plant (971\*\*) and Grain Yield (969\*\*) (Table-2). So, changes in related traits with grain such as 100 Kernel Weight could alter this plant's biomass. Gholami *et al.* (2009) indicated that Azospirillum and Pseudomonas cause an increase in 100 Kernel Weight. Researchers found that use of zinc increase bean 100 Kernel Weight (Thalooth *et al.*, 2006).



**Figure-5.** Effect of mineral fertilizer on 100 kernel weight.

- 1: no mineral fertilizer application  
 2: once application of mineral fertilizer  
 3: complete use of mineral fertilizer



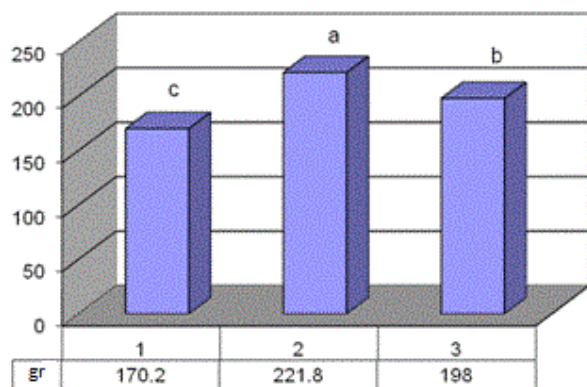
**Figure-6.** Effect of Biosuper biofertilizer on 100 kernel weight.

B<sub>0</sub>: without Biosuper  
 B<sub>1</sub>: with Biosuper

#### Seed weight per plant

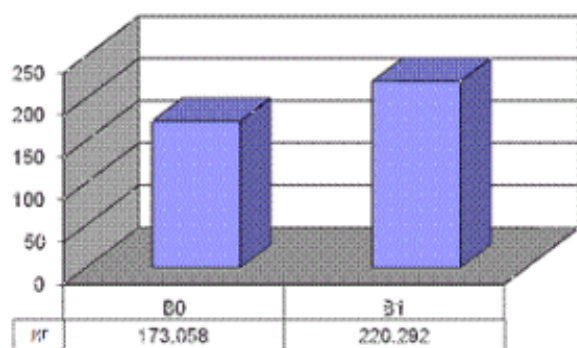
Mineral fertilizer mean square results (Figure-7) indicated that once application of mineral fertilizer increased Seed Weight per Plant by 23.2% related to the control plot. In comparison of Biosuper biofertilizer effect on this trait, Biosuper applied plot showed a significant increase from 220.292 g to 173.058 g. Therefore, Biosuper application enhanced Seed Weight per plant by 21.4% related to the control plot (Figure-8). With respect to Table-2 Seed Weight per Plant had had highest correlation with Seed Yield (999\*\*), 100 Kernel Weight (971\*\*) and Ear Weight (991\*\*). Seed Weight per Plant have direct relation with Seed Yield, that's it with increasing Seed Weight per Plant, also yield components and Eventually Seed Yield will increase.





**Figure-7.** Effect of mineral fertilizer on seed weight per plant.

- 1: no mineral fertilizer application  
 2: once application of mineral fertilizer  
 3: complete use of mineral fertilizer



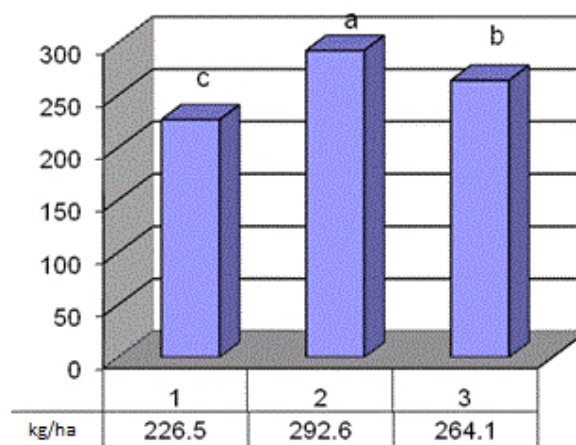
**Figure-8.** Effect of biosuper biofertilizer on seed weight per plant.

- B<sub>0</sub>: without Biosuper  
 B<sub>1</sub>: with Biosuper

### Grain yield

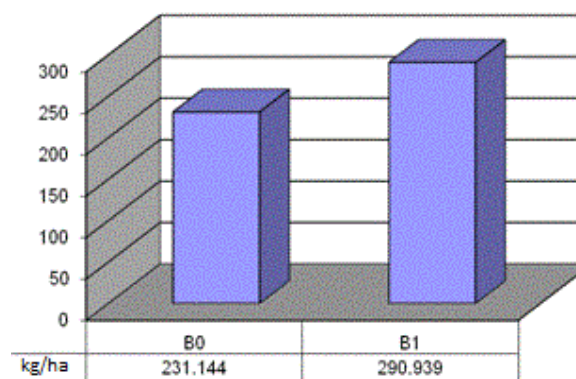
Highest Grain Yield obtained from once application of mineral fertilizer treatment, with a significant difference by 292.6 kg/ha (Figure-9). Biosuper biofertilizer application mean square (Figure-10) showed that, biofertilizer use can increase Grain Yield by 20.5 related to no biofertilizer use. Hence, we can suggest that, Biosuper biofertilizer application may affect the yield components and consequently Grain Yield of maize. Grain Yield had highest correlation with 100 Kernel Weight (969\*\*), Ear Weight (990\*\*) and Seed Weight per Plant

(999\*\*) (Table-2). Yadav *et al.* (2011) reported that biological fertilizers, especially when combined with mineral fertilizers have many effects on crop yield and productivity. Also they suggest that corn seed inoculation with Azospirillum, cause an increase in Grain Yield related to the control plot.



**Figure-9.** Effect of mineral fertilizer on grain yield.

- 1: no mineral fertilizer application  
 2: once application of mineral fertilizer  
 3: complete use of mineral fertilizer



**Figure-10.** Effect of Biosuper biofertilizer on grain yield.

- B<sub>0</sub>: without Biosuper  
 B<sub>1</sub>: with Biosuper

**Table-1.** Analysis of variance for evaluated traits.

Source of variation	df	Sum of square					
		Number of leaves	Row in ear	Ear weight	100 kernel weight	Seed weight per plant	Grain yield
Repetition	2	0.222	6.222	0.002	11.444	1016.968	2468.056*
Factor A (mineral fertilizer)	2	7.389*	13.556*	0.006**	26.12*	4001.763**	6592.464**
Factor B (biofertilizer)	1	9.389*	14.222	0.025**	50.53**	10039.915**	16089.186**
Interaction between two factor	2	7.389*	13.556*	0.001	0.316	424.893	904.185
Error	10	1.356	3.289	0.000	3.897	258.705	428.113
Coefficient of variation(%)	---	6.65	10.60	8.28	7.18	8.18	7.93

\* and \*\* Significant difference in 5% and 1%, respectively

**Table-2.** Simple correlation between evaluated traits.

	100 kernel weight	Ear weight	Row in ear	Seed weight per plant	Number of leaves	Grain yield
100 kernel weight	1.000					
Ear weight	.957**	1.000				
Row in ear	.724	.803	1.000			
Seed weight per plant	.971**	.991**	.799	1.000		
Number of leaves	.698	.640	.211	.687	1.000	
Grain yield	.969**	.990**	.810	.999**	.664	1.000

## CONCLUSIONS

Results of this study indicated that once application of mineral fertilizer increased 100 Kernel Weight, Ear Weight, Row in Ear, Seed Weight per Plant, Number of Leaves and Grain Yield. Also use of Biosuper biofertilizer had positive effects on all traits. Biosuper biofertilizer use resulted in increasing 100 Kernel Weight, Ear Weight, Seed Weight per Plant, Number of leaves and Grain yield. Most of the traits affected from mineral fertilizer and biofertilizer and most effect on traits were observed in once application mineral fertilizer + Biosuper biofertilizer use treatment. Interaction between mineral fertilizer and Biosuper biofertilizer on Row in Ear and Number of Leaves indicated that, once application of mineral fertilizer with Biosuper biofertilizer use in all traits (except for Row in Ear), had highest positive effect than other treatments and in the case of Row in Ear highest positive effect was in once application of mineral fertilizer treatment without Biosuper biofertilizer. Azospirillum, in addition to N fixation ability, improve root growth by produce growth stimulants and subsequent increase in water and nutrient uptake rate, that raising yield (Tilk *et al.*, 2005).

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