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EFFECT OF DIFFERENT AMOUNT OF MINERAL NITROGEN AND BIOLOGICAL FERTILIZER ON YIELD AND YIELD COMPONENTS OF CORN

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ABSTRACT

To evaluate the effects of different amount of mineral nitrogen and biosuper fertilizer on yield and yield components of corn, a research was conducted in Tabriz Islamic Azad University research field in 2011 based on factorial experiment in completely randomized block design in three replications. Mineral nitrogen fertilizer (N) levels (0, 60, 120, 180 and 240 kg/ha) and two levels of Biosuper fertilizer (B) application (control and biosuper) and collective application was considered as (NB). The results showed that using mineral nitrogen fertilizer had positive effect on 100 Kernel weight, Row in ear, Number of leaves, Ear weight, Leaf area index and Grain yield. Also, using Biosuper fertilizer (once application treatment) led to increase Grain yield. Most of the grain yield obtained from application of Biosuper fertilizer equal to 295.051gr/m^2 and application of 180 kg/ha of mineral nitrogen equal to 445.547 gr/m^2. Application of Biosuper fertilizer led to increase of Grain yield by 16% and application of Nitrogen fertilizer led to increase of Grain yield by 61% CV. 504 of corn.

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

INTRODUCTION

Population and economic increasing 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). Economical and environmental problems due to overuse of chemical fertilizers and intensification of agriculture, especially applying agricultural modern technologies such as chemical fertilizers and pesticides use has led to water pollution, increase diversity of diseases, loss genetic diversity and decrease soil quality (Namazari and Babaoghli, 2013). So 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). In sustainable agriculture system, biological fertilizers play an important role in crop production and increasing soil fertility conservation (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 solubulizing 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

To investigate the effects of different amount of mineral nitrogen and biosuper as biofertilizer on yield and yield components of corn, a research was carried out at Research Field of Islamic Azad University, Tabriz Branch 15 kilometers east of Tabriz, Iran, duringgrowing season of 2010 summary, which based on Domarton's classification is representative of semiarid coldclimate with warm summers and cold winters. Annualtemperature average is about 10^0C, maximum temperature average is about 16 ^{0}c, minimum is 2.2^0C 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 in completely randomized block design with using single cross 504 of corn. Treatments include five nitrogen fertilizer levels (0, 60, 120, 180 and 240 kg/ha) and two levels of biologic fertilizer application (control and biosuper). This experiment constituted from 30 plots in three repetitions, each plot's length was 4 m and 3 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 60 cm and also distance between experimental repetitions was 150 cm. In this

experiment biosuper fertilizer applied that is a biological fertilizer containing Azotobacter, Azosprillum, Tillobasillus, and Pseudomonas. 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. Irrigation was performed once a week and up to last stage of plant vegetative growth. In the nitrogen fertilizer applied treatment, first at planting time mineral nitrogen fertilizer quantities 0- 60- 120- 180 and 240 kg/ha at planting and the remaining half of the eight leaves stage this fertilizer used through mixing with irrigated water. 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, Leaf Area Index, Ear Weight, Plant Height, Seed Weight per Plant, Grain Yield was calculated by all of plants in 1.5 m^2. 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 nitrogen fertilizer mean square results (Figure-1) indicated that highest Number of Leaves was in the no biosuper application with 120 kg/ha mineral nitrogen fertilizer (N_2B_0) with 14.00 unit that is significantly different with other treatments except (N_1B_0). Lowest Number of Leaves observed in application of biosuper with 60 kg/ha mineral nitrogen fertilizer (N_1B_1) with 10.17 unit. no biosuper application with 120 kg/ha mineral nitrogen fertilizer use led to an increase in Number of Leaves by 32.07%. With respect to these results we can suggest that increasing in Number of Leaves enhance photosynthesis rate and this enhancement lead to increasing yield. With respect to Table-2 Number of Leaves had highest correlation with Plant Height (707*) and Leaf Area Index (718*) (Table-2). 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.

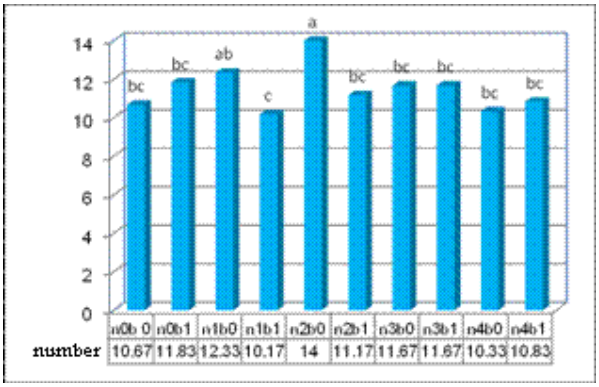

Figure-1. Effect of biosuper biofertilzer and mineral nitrogen fertilizer on number of leaves.

N_0: no mineral nitrogen fertilizer, N_1: 60 Kg/ha mineral nitrogen fertilizer, N_2: 120 Kg/ha mineral nitrogen fertilizer, N_3: 180 Kg/ha mineral nitrogen fertilizer, N_4: 240 Kg/ha mineral nitrogen fertilizer, B_0: without Biosuper, B_1: with Biosuper.

Leaf Area Index

Biofertilizer/mineral nitrogen fertilizer mean square results (Figure-2) indicated that highest Leaf Area Index was in the no biosuper application with 120 kg/ha mineral nitrogen fertilizer (N_2B_0) with 4.483 unit. Lowest Leaf area index observed in application of biosuper with 180 kg/ha mineral nitrogen fertilizer (N_3B_1) with 2.813 unit. no biosuper application with 120 kg/ha mineral nitrogen fertilizer use led to an increase in Leaf area index by 48.3% related to control plot. Leaf Area Index had highest correlation with Number of leaves (718*) (Table-2). Sepehri *et al*. (2003) indicated that one of the factors for the subsequent development of leaf and canopy development is amount of nitrogen that affect the size and each leaf lifetime and cause increased of leaf area index.

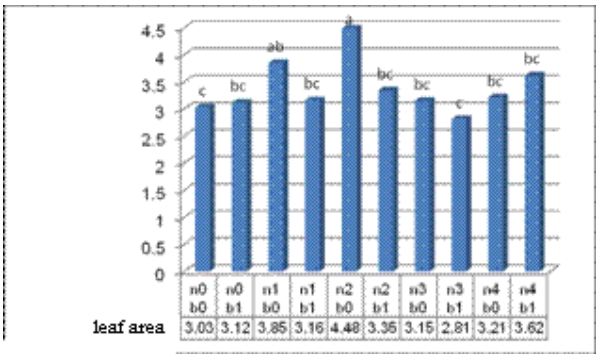

Figure-2. Effect of biosuper biofertilzer and mineral nitrogen fertilizer on leaf area index.

N_0: no mineral nitrogen fertilizer, N_1: 60 kg/ha mineral nitrogen fertilizer, N_2: 120 kg/ha mineral nitrogen fertilizer, N_3: 180 kg/ha mineral nitrogen fertilizer, N_4: 240 kg/ha mineral nitrogen fertilizer, B_0: without Biosuper, B_1: with Biosuper.

Ear Weight

Mineral nitrogen fertilizer levels mean square results (Figure-3), showed that, application of 60 kg/ha mineral nitrogen fertilizer treatment cause a significant increase in Ear Weight from 329.7 g to 359.5 g. Thus, application of 60 kg/ha mineral nitrogen fertilizer treatment related to control plot, enhanced this trait by 9.03%. Lowest ear weight observed in application of 120 Kg/ha mineral nitrogen fertilizer (N_2) with 323.5 g. Hence, we can suggest that, with 60 kg/ha mineral nitrogen fertilizer application we can increase this trait and consequently increase the Grain Yield. Ear Weight had highest correlation with Seed Weight per Plant (881**) (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. Malakuti and Nafisi. (1994) reported that if sufficient nitrogen is available to plants, corn will cause rapid growth and positive effects on protein products will be saved.

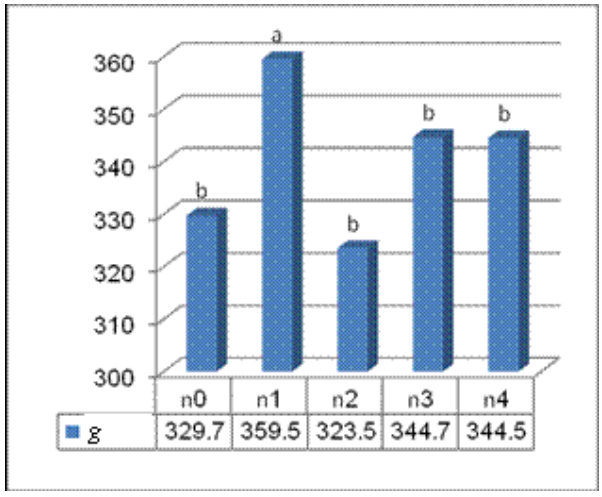

Figure-3. Effect of mineral nitrogen fertilizer on ear weight.

N_0: no mineral nitrogen fertilizer, N_1: 60 kg/ha mineral nitrogen fertilizer, N_2: 120 kg/ha mineral nitrogen fertilizer, N_3: 180 kg/ha mineral nitrogen fertilizer, N_4: 240 kg/ha mineral nitrogen fertilizer.

Seed Weight per Plant

Mineral nitrogen fertilizer levels mean square results (Figure-4), showed that, application of 240 kg/ha mineral nitrogen fertilizer increased Seed Weight per Plant by 30.5% related to the control plot. In comparison of Biosuper fertilizer effect on this trait, Biosuper applied plot showed a significant increase from 183.105 g to 290.387 g. Therefore, Biosuper application enhanced Seed Weight per plant by 58.5% related to the control plot (Figure-5). With respect to Table-2 Seed Weight per Plant had highest correlation with Seed Yield (695*), and Ear Weight (881**) (Table-2). 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. Namazari *et al*. (2012) indicated that application of mineral fertilizer and biofertilizer positive effect on seed weight per plant and biofertilizer application enhanced seed weight per plant by 27.2% related to the control plot.

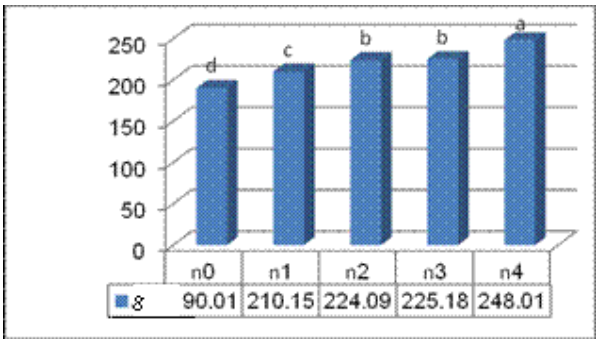

Figure-4. Effect of mineral nitrogen fertilizer on seed weight per plant.

N_0: no mineral nitrogen fertilizer, N_1: 60 kg/ha mineral nitrogen fertilizer, N_2: 120 kg/ha mineral nitrogen fertilizer, N_3: 180 kg/ha mineral nitrogen fertilizer, N_4: 240 kg/ha mineral nitrogen fertilizer.

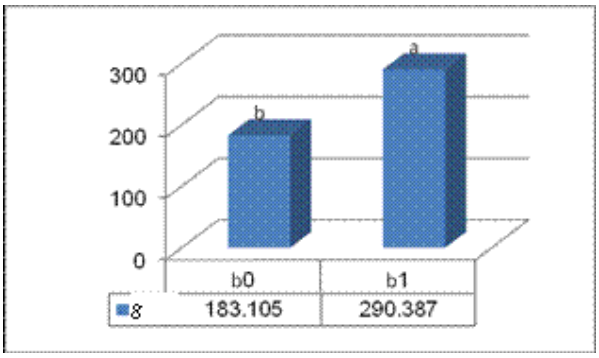

Figure-5. Effect of biosuper biofertilizer on seed weight per plant.

B_0: without Biosuper
B_1: with Biosuper

Plant Height

Plant height reflects the vegetative growth behavior of crop plant to applied inputs. data pertaining to Plant Height showed that highest Plant Height was in the application of 60, 120 and 240 kg/ha mineral nitrogen fertilizer treatment with 193, 194 and 196.3 cm that a significant increase related to the application of 180 kg/ha mineral nitrogen fertilizer and control plot treatment (Figure-6). In comparison of Biosuper fertilizer effect on this trait, no biofertilizer applied plot showed a significant increase by 193.47 cm (Figure-7). With respect to Table-2 Plant Height had highest correlation with Number of Leaves (707*) (Table-2). Plant Height have direct relation

with Number of Leaves, that's it with increasing Plant Height, Number of Leaves will increase. Positive effect of nitrogen fertilizer on plant height observed. Researchers have stated that seed inoculation with Azosprillum strain 21 and Azotobacter increased plant height related to no inoculation, Also positive effect of nitrogen fertilizer on plant height observed. Simultaneously use of bacteria causes root development and better uptake of water and nutrients and is effective on vegetative growth and plant height (Biari *et al*., 2008).

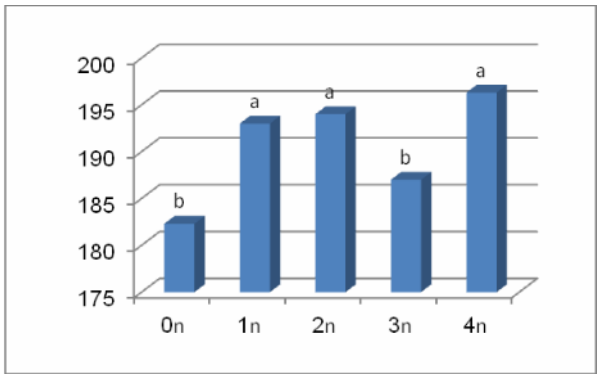

Figure-6. Effect of mineral nitrogen fertilizer on plant height.

N_0: no mineral nitrogen fertilizer, N_1: 60 kg/ha mineral nitrogen fertilizer, N_2: 120 kg/ha mineral nitrogen fertilizer, N_3: 180 kg/ha mineral nitrogen fertilizer, N_4: 240 kg/ha mineral nitrogen fertilizer.

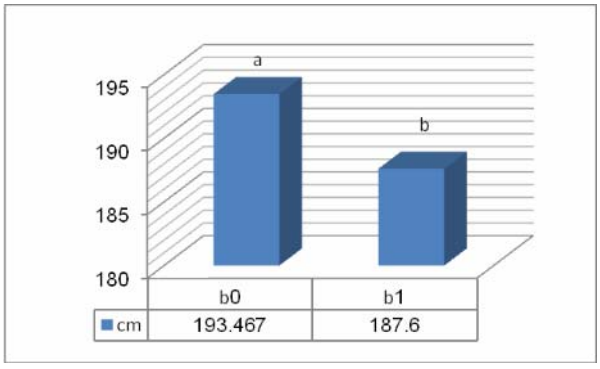

Figure-7. Effect of biosuper biofertilizer on plant height.

B_0: without Biosuper
B_1: with Biosuper

Grain Yield

The results obtained from the data collected showed that highest Grain Yield obtained from application of 180 kg /ha mineral nitrogen fertilizer treatment, with a significant difference by 290.547 g/m^2 (Figure-8).

Biosuper fertilizer application mean square (Figure-9) showed that, biofertilizer use can increase Grain Yield by 16.05% related to no biofertilizer use. Hence, we can suggest that, Biosuper fertilizer application and 180 kg/ha mineral nitrogen fertilizer treatment may affect the yield components and consequently Grain Yield of maize. Grain Yield had highest correlation with Seed Weight per Plant (695*) (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 Azosprillum, cause an increase in Grain Yield related to the control plot.

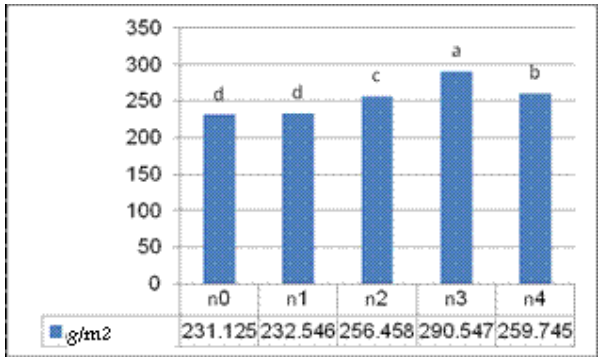

Figure-8. Effect of mineral nitrogen fertilizer on grain yield.

N_0: no mineral nitrogen fertilizer, N_1: 60 kg/ha mineral nitrogen fertilizer, N_2: 120 kg/ha mineral nitrogen fertilizer, N_3: 180 kg/ha mineral nitrogen fertilizer, N_4: 240 kg/ha mineral nitrogen fertilizer.

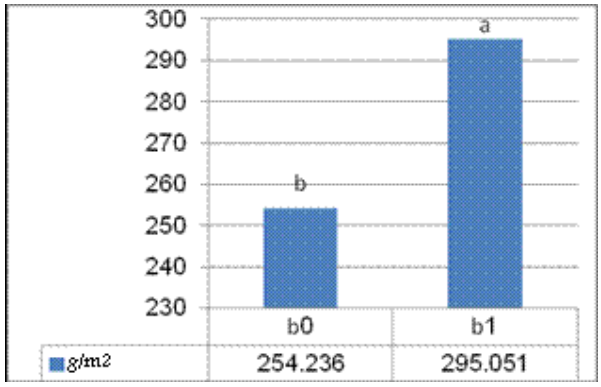

Figure-9. Effect of biosuper biofertilizer on grain yield.

B_0: without Biosuper
B_1: with Biosuper

Table-1. Analysis of variance for evaluated traits.

Source of variation	df	Sum of square					
		Number of leaves	Leaf Area index	Ear weight	Seed weight per plant	Plant height	Grain yield
Repetition	2	1.008	677723.68*	1416.13*	1020.539	14.443	2568.056
Factor A (biofertilizer)	1	3.333	663260.08	86.700	5240.980*	258.133**	7692.451**
Factor B (mineral N fertilizer)	4	4.575*	882449.78**	1200.95*	10390.453**	197.2**	17098.196**
Interaction between two factor	4	3.208*	555615.66*	521.117	588.880	40.467	940.035
Error	18	1.110	172074.38	382.652	330.266	23.989	922.762
Coefficient of variation (%)	---	9.19	12.28	5.75	7.88	6.57	8.76

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

Table-2. Simple correlation between evaluated traits.

	Number of leaves	Seed weight per plant	Plant height	Ear weight	Grain yield	LAI
Number of leaves	1.000					
Seed weight per plant	.957**	1.000				
Plant height	.707*	---	1.000			
Ear weight	---	.881**	---	1.000		
Grain yield	.155	.695*	---	.543	1.000	
LAI	.718*	.276	.458	.161	.511	1.000

CONCLUSIONS

Results of this study indicated that Bisuper biofertilizer use resulted increasing Seed weight per plant, amounted to 58% and Grain yield amounted to 16% related to when the biofertilizer not applied. Application 240 kg/ha of mineral nitrogen fertilizer had most effects on Plant height, Seed weight per plant. Also use 180 kg/ha of mineral nitrogen increased Grain yield. Most of the Grain yield obtained from application of Biosuper fertilizer Equal to 295.051 gr.m^2 and application of 180 kg/ha of mineral nitrogen equal to 445.547 g/m^2. Azosprillum, 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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