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## Assessment Maize Hybrids Response to Biological and Chemical Nitrogen Fertilizers

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### ABSTRACT

This research set out to evaluate the effect of combined biological and chemical nitrogen fertilizers on some corn hybrids. To this end an experiment was conducted as split plot on the basis of randomized complete block design with four replications. Main plots were included: use of chemical and biological fertilizers in four levels: 100% chemical fertilizer, 75% chemical fertilizer + 100% bio-fertilizer, 50% chemical fertilizer + 100% bio-fertilizer, 25% chemical fertilizer + 100% bio-fertilizer and sub plots included three corn hybrids: single cross 704 hybrid, Mobin hybrid and Karoun hybrid. Chemical fertilizers used included urea, triple super phosphate and potassium sulphate and Nitroxin for biological fertilizer. Results showed that Karoun hybrid in 50% Chemical fertilizer + 100% biological fertilizer treatment had the highest grain yield, and biological yield and protein percent and the lowest number of grain per row, grain yield, plant height and biological yield belonged to 100% chemical fertilizer and Mobin hybrid treatment. Highest 1000 grain weight belonged to Karoun hybrid and the lowest protein percent was in Mobin hybrid. Finally results revealed that single cross 704 and Karoun hybrids in number of grain per row and protein yield and Mobin hybrid and single cross 704 in 1000-grain weight were not significantly different. Single cross 704 hybrid only in protein percent was higher than other hybrids. Finally consumption of biological fertilizers with 50% organic fertilizer produced the highest grain yield.

**Keywords:** *Bio-fertilizer, Corn, Nitroxin, Yield.*

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### INTRODUCTION

Nitrogen element is one of the most consumed crop nutrients and so it is the most important factor limiting of plant production and nutrient element in the production of agricultural products in the global scope (Modhej *et al.*, 2008). By conventional chemical fertilizers,

about 40 to 50 percent of nitrogen is absorbed by plants and only a small part of it remains in the soil and residual the nitrogen fertilizers gradually will be lost (Sharma, 2003).

Considering to the environmental pollution caused by the indiscriminate use of nitrogen fertilizers, development of biological strategies for safe and cost-effective option for management of nitrogen in order to reduce the dangers of indiscriminate use of it, is one of the priority in the sustainable agriculture (Sahoo *et al.*, 2013). Application of bio-fertilizers, especially the plant growth promoting bacteria, is most important strategy for the integrated management of the plant nutrition in the sustainable agriculture system with sufficient input (Sharma, 2003). Bio-fertilizers are the solid material, semi-solid or the liquid containing in live micro organisms or biological products connection with the supply or provision of the biological nitrogen, phosphorus, sulfur and other nutrients, especially micro nutrients in the soil are active (Han *et al.*, 2006). Fertilizers are expressed as microbial inoculum capable of animating nutrient for crop from unavailable to available mode via biological processes and led to development the root system and better seed germination (Wu *et al.*, 2005). Biari *et al.* (2007) reported that inoculation with *Azotobacter* led grain weight per plant, total plant weight, grain yield and the nitrogen content of grain, compared with control. Hamidi *et al.* (2009) study the effect of increasing the growth of bacteria on maize hybrids and reported that use of the bacteria increases during pollination, tasseling, adaptation of flowering, grain filling and grain yield. It seems that increasing in grain yield with bio-fertilizers use is due to evolve long grain filling period and increase absorption of the nutrients from soil (Shehata and El-khawas, 2003). In addition, effect of the biological fertilizers on dry matter and photosynthesis is also reported (Geneva *et al.*, 2006). Since the nitrogen is one of the main structures of amino acids,

nitrogen consumption causing a high protein percentage (Asghari *et al.*, 2006). Stancheva and Dinew (2003) stated that inoculation of maize root system with *Azospirillum brasilense* bacteria increased total plant biomass and nitrogen. Also, Tohidi Moghadam *et al.* (2008) reported increasing the amount of the protein by chemical fertilizers with the *Azospirillum* and *Azotobacter*. This study aimed to determine the best amount of mixing of biological and the chemical nitrogen fertilizers, introduction the hybrids with higher yield potential and sustainable use of the biological and chemical fertilizers.

## MATERIALS AND METHODS

### *Field and Treatment Information*

This experiment was carried out in 2013 at the south west of Iran with latitude 32° 14' northern and longitude 48° 49' eastern and 110 meters above sea level. The experiment was arranged as split plot based on the randomized complete block design in four replications. Main-plots were Included: use of the chemical and biological fertilizers in four levels (100% chemical fertilizer; bio-fertilizer fertilizer + 75% chemical fertilizer; bio-fertilizer + 50% chemical fertilizer; bio-fertilizer + 25% chemical fertilizer) and the sub plots included three maize hybrids (Single Cross 704, Mobin and Karoun).

### *Crop Management*

To determine physical and chemical characters of the soil, samples were taken from the depths of 0-30 and 30-60 centimeters. Based on the soil physico-chemical test, the applied chemical fertilizers were contained 400, 150 and 150 kg ha<sup>-1</sup> nitrogen, phosphorous and potassium, respectively. The source of chemical fertilizers was urea, triple superphosphate and potassium sulfate.

Half of nitrogen fertilizer and the all phosphorous and potassium fertilizers were consumed before planting and the other half of nitrogen was used at the 6 to 8 leaf stage. The maize seeds were inoculated with Nitroxin bio-fertilizer in the rate of 1 liter per 30 kg seed. Adjust the plant density in 2-4 leaf stage plant thinning operation was performed.

#### *Traits measure*

Total dry matter, grain yield and the components were estimated after the physiological maturity. The samples were dried for 48 hours in the oven at 72-75 °C and dry weight was measured. To calculate the number of grain per row and number of row per ear, 10 ears was selected randomly and number of grain per row and number of row per ear were counted. To measure the grain protein percentage, Kjeldal method was used (Page *et al.*, 1982). Protein yield obtained from multiplying grain yield and protein percentage.

#### *Statistical analysis*

Analysis of variance for all traits was performed by SAS software (Ver. 9.1) and mean comparison was done by Duncan's multiple range test at 5% probability level.

## **RESULTS AND DISCUSSION**

### **Biological yield**

The effect of fertilizer treatments on biological yield was significant at 1% level, but differences between the hybrids and fertilizer× hybrids were not significant (Table 1). The highest biological yield (B.Y) was belonged to 50% chemical fertilizer and 100% bio-fertilizer and the lowest one belonged to the 100% chemical fertilizer treatment (Table 2). Although there was no significant difference between the hybrids in terms of biological yield, but highest biological yield was belonged to

the Karoun hybrid and the lowest to one Mobin hybrid (Table 3). The higher B.Y was found when the 50% chemical fertilizer and 100% bio-fertilizer was consumed in Karoun hybrid and the lowest B.Y when 100% chemical fertilizer was applied in Mobin hybrid (Table 4). Bio-fertilizers by increasing the efficiency and nitrogen uptake cause most of shoot growth and consequently increasing the biological yield.

### **Grain yield**

Analysis of variance showed that the combination of nitroxin bio-fertilizer and chemical fertilizer was significant at 1% probability level and the difference between hybrids and the interaction effect of treatments on grain yield was significant at 5% probability level (Table 1). The mean comparison showed that mixing 50% chemical fertilizer with the 100% biological fertilizer than the other treatments were significantly different and had highest grain yield. 100% chemical fertilizer treatment, 75% chemical fertilizer + 100% bio-fertilizer and 25% chemical fertilizer + 100% bio-fertilizer were not significantly different (Table 2). Between hybrids the highest grain yield belonged to Karoun hybrid and the lowest one was for Mobin hybrid (Table 3). Interaction effect between treatments showed that the highest grain yield were for 50% chemical fertilizer + 100% bio-fertilizer and Karoun hybrid and 50% chemical fertilizer with 100% bio-fertilizer and SC. 704 and the lowest one belonged to the 100% chemical fertilizer and Mobin hybrid. In all three hybrids reduce nitrogen consumption by 50% and combined use of bio-fertilizer increase grain yield (Table 4). Modhej *et al* (2014) reported that, increasing nitrogen availability increase grain yield due to increase in number of grain per ear and grain weight.

**Table 1.** Summary of Analysis of variance for grain yield, yield components and some qualitative and quantitative indicators maize hybrids.

| S.O.V          | df   | Biological Yield    | Grain yield         | Harvest index        | 1000 grain weight     | Number of rows per ear | Number of grains per row | Protein content    | Protein yield       | Plant Height         |
|----------------|------|---------------------|---------------------|----------------------|-----------------------|------------------------|--------------------------|--------------------|---------------------|----------------------|
| Replication    | 3    | 0.87 <sup>ns</sup>  | 0.25 <sup>ns</sup>  | 10.22 <sup>ns</sup>  | 413.96 <sup>ns</sup>  | 0.61 <sup>ns</sup>     | 5.96 <sup>ns</sup>       | 0.25 <sup>ns</sup> | 0.005 <sup>ns</sup> | 71.43 <sup>ns</sup>  |
| Fertilizer (F) | 3    | 41.63 <sup>**</sup> | 11.48 <sup>**</sup> | 164.17 <sup>**</sup> | 3136.90 <sup>**</sup> | 0.23 <sup>ns</sup>     | 67.92 <sup>**</sup>      | 1.99 <sup>**</sup> | 0.16 <sup>**</sup>  | 244.56 <sup>ns</sup> |
| Error a        | 9    | 8.37                | 1.31                | 54.57                | 487.81                | 1.02                   | 10.61                    | 0.37               | 0.02                | 120.02               |
| Hybrid (H)     | 2    | 15.71 <sup>ns</sup> | 6.77 <sup>*</sup>   | 3.65 <sup>ns</sup>   | 5442.77 <sup>**</sup> | 13.82 <sup>**</sup>    | 122.71 <sup>**</sup>     | 2.02 <sup>*</sup>  | 0.11 <sup>*</sup>   | 298.57 <sup>ns</sup> |
| F × H          | 6    | 10.84 <sup>ns</sup> | 4.99 <sup>*</sup>   | 25.70 <sup>ns</sup>  | 3430.15 <sup>**</sup> | 0.31 <sup>ns</sup>     | 42.98 <sup>**</sup>      | 3.77 <sup>**</sup> | 0.07 <sup>*</sup>   | 235.40 <sup>ns</sup> |
| Error b        | 24   | 7.46                | 2.17                | 33.77                | 670.47                | 0.55                   | 12.70                    | 0.48               | 0.02                | 158.08               |
| CV (%)         | ---- | 11.17               | 11.29               | 10.82                | 7.89                  | 5.1                    | 9.37                     | 8.7                | 15.26               | 7.34                 |

\*\* and \*: Significant at 1% and 5% probability level, respectively. ns: not significant.

**Table 2.** Mean comparison of the effect of different amounts of biological and chemical fertilizer on qualitative and quantitative indicators of maize hybrids.

| Fertilizer treatment                          | Biological yield (t.ha <sup>-1</sup> ) | Grain yield (t.ha <sup>-1</sup> ) | Harvest index (%)  | 1000 grain weight (g) | Number of rows per ear | Number of grains per row | Protein percentage (%) | Protein yield (t.ha <sup>-1</sup> ) | Plant height (cm)   |
|---|--|-----------------------------------|--------------------|-----------------------|------------------------|--------------------------|------------------------|-------------------------------------|---------------------|
| 100% chemical fertilizer (N1)                 | 22.43 <sup>c</sup>                     | 12.74 <sup>b</sup>                | 56.71 <sup>a</sup> | 311.67 <sup>b</sup>   | 14.45 <sup>a</sup>     | 39.18 <sup>a</sup>       | 8.15a                  | 1.03 <sup>bc</sup>                  | 167.75 <sup>a</sup> |
| 75% chemical fertilizer + bio-fertilizer (N2) | 23.43 <sup>bc</sup>                    | 12.81 <sup>b</sup>                | 54.69 <sup>a</sup> | 319.92 <sup>b</sup>   | 14.48 <sup>a</sup>     | 38.02 <sup>a</sup>       | 8.25a                  | 1.05 <sup>b</sup>                   | 170.76 <sup>a</sup> |
| 50% chemical fertilizer + bio-fertilizer (N3) | 26.49 <sup>a</sup>                     | 14.46 <sup>a</sup>                | 55.10 <sup>a</sup> | 349.00 <sup>a</sup>   | 14.71 <sup>a</sup>     | 40.19 <sup>a</sup>       | 8.26a                  | 1.19 <sup>a</sup>                   | 168.51 <sup>a</sup> |
| 25% chemical fertilizer + bio-fertilizer (N4) | 25.50 <sup>b</sup>                     | 13.74 <sup>b</sup>                | 48.31 <sup>b</sup> | 331.33 <sup>ab</sup>  | 14.70 <sup>a</sup>     | 34.71 <sup>b</sup>       | 7.41b                  | 0.91 <sup>c</sup>                   | 177.66 <sup>a</sup> |

In each column, means which have similar letters do not have significant difference based on Duncan's multiple-range test at 5% probability level.

**Table 3.** Mean comparison of the effect of quantitative and qualitative characteristics for maize hybrid.

| Maize hybrid          | Biological yield (t.ha <sup>-1</sup> ) | Grain yield (t.ha <sup>-1</sup> ) | Harvest index (%)  | 1000 grain weight (g) | Number of rows per ear | Number of grains per row | Protein percentage (%) | Protein yield (t.ha <sup>-1</sup> ) | Plant height (cm)   |
|-----------------------|--|-----------------------------------|--------------------|-----------------------|------------------------|--------------------------|------------------------|-------------------------------------|---------------------|
| Single Cross 704 (H1) | 24.79 <sup>a</sup>                     | 13.14 <sup>ab</sup>               | 53.76 <sup>a</sup> | 322.87 <sup>b</sup>   | 14.42 <sup>b</sup>     | 40.06 <sup>a</sup>       | 8.41 <sup>a</sup>      | 1.10 <sup>a</sup>                   | 175.6 <sup>a</sup>  |
| Mobin (H2)            | 23.35 <sup>a</sup>                     | 12.37 <sup>b</sup>                | 53.20 <sup>a</sup> | 312.62 <sup>b</sup>   | 15.58 <sup>a</sup>     | 34.87 <sup>b</sup>       | 7.71 <sup>b</sup>      | 0.95 <sup>b</sup>                   | 166.97 <sup>a</sup> |
| Karoun (H3)           | 25.25 <sup>a</sup>                     | 13.66 <sup>a</sup>                | 54.15 <sup>a</sup> | 348.43 <sup>a</sup>   | 13.75 <sup>c</sup>     | 39.15 <sup>a</sup>       | 7.94 <sup>ab</sup>     | 1.09 <sup>a</sup>                   | 170.93 <sup>a</sup> |

In each column, means which have similar letters do not have significant difference based on Duncan's multiple-range test at 5% probability level.

**Table 4.** Mean comparison of the interaction effects of biological and chemical fertilizer and hybrid on qualitative and quantitative indicators of maize hybrid.

| Fertilizer treatments                   | Hybrids | Biological yield (t.ha <sup>-1</sup> ) | Grain yield (t.ha <sup>-1</sup> ) | Harvest index (%)  | 1000 grain weight (g) | Number of rows per ear | Number of grains per row | Protein Percentage (%) | Protein yield (t.ha <sup>-1</sup> ) | Plant height (cm)   |
|---|---------|--|-----------------------------------|--------------------|-----------------------|------------------------|--------------------------|------------------------|-------------------------------------|---------------------|
| 100% chemical fertilizer                | Sc704   | 23.46 <sup>bcd</sup>                   | 13.45 <sup>abc</sup>              | 57.20 <sup>a</sup> | 284.00 <sup>d</sup>   | 14.40 <sup>bc</sup>    | 44.35 <sup>a</sup>       | 7.18 <sup>c</sup>      | 0.96 <sup>bc</sup>                  | 180.95 <sup>a</sup> |
|   | Mobin   | 19.85 <sup>d</sup>                     | 11.00 <sup>d</sup>                | 55.58 <sup>a</sup> | 299.75 <sup>bcd</sup> | 15.45 <sup>ab</sup>    | 32.05 <sup>e</sup>       | 9.06 <sup>a</sup>      | 0.99 <sup>bc</sup>                  | 156.20 <sup>a</sup> |
|   | Karoun  | 23.97 <sup>abcd</sup>                  | 13.77 <sup>ab</sup>               | 57.34 <sup>a</sup> | 351.25 <sup>a</sup>   | 13.50 <sup>c</sup>     | 41.15 <sup>abc</sup>     | 8.21 <sup>abc</sup>    | 1.13 <sup>abc</sup>                 | 166.10 <sup>a</sup> |
| 75% chemical fertilizer+ bio-fertilizer | Sc704   | 22.12 <sup>cd</sup>                    | 11.28 <sup>cd</sup>               | 51.16 <sup>a</sup> | 294.75 <sup>cd</sup>  | 14.05 <sup>c</sup>     | 37.97 <sup>bcd</sup>     | 8.59 <sup>c</sup>      | 0.97 <sup>bc</sup>                  | 175.53 <sup>a</sup> |
|   | Mobin   | 23.58 <sup>abcd</sup>                  | 13.34 <sup>abc</sup>              | 56.64 <sup>a</sup> | 336.25 <sup>ab</sup>  | 15.40 <sup>ab</sup>    | 35.05 <sup>de</sup>      | 7.89 <sup>bc</sup>     | 1.05 <sup>bc</sup>                  | 167.60 <sup>a</sup> |
|   | Karoun  | 24.59 <sup>abc</sup>                   | 13.81 <sup>ab</sup>               | 56.27 <sup>a</sup> | 328.75 <sup>abc</sup> | 14.00 <sup>c</sup>     | 41.05 <sup>abc</sup>     | 8.26 <sup>abc</sup>    | 1.14 <sup>ab</sup>                  | 169.15 <sup>a</sup> |
| 50% chemical fertilizer+bio-fertilizer  | Sc704   | 25.96 <sup>abc</sup>                   | 14.84 <sup>a</sup>                | 58.58 <sup>a</sup> | 356.25 <sup>a</sup>   | 14.45 <sup>bc</sup>    | 42.97 <sup>ab</sup>      | 9.02 <sup>a</sup>      | 1.33 <sup>a</sup>                   | 163.38 <sup>a</sup> |
|   | Mobin   | 25.37 <sup>abc</sup>                   | 13.41 <sup>abc</sup>              | 52.81 <sup>a</sup> | 335.75 <sup>ab</sup>  | 15.70 <sup>ab</sup>    | 36.45 <sup>cde</sup>     | 7.81 <sup>bc</sup>     | 1.04 <sup>bc</sup>                  | 165.60 <sup>a</sup> |
|   | Karoun  | 28.15 <sup>a</sup>                     | 15.14 <sup>a</sup>                | 53.90 <sup>a</sup> | 355.00 <sup>a</sup>   | 14.00 <sup>c</sup>     | 41.15 <sup>abc</sup>     | 7.96 <sup>abc</sup>    | 1.21 <sup>ab</sup>                  | 176.55 <sup>a</sup> |
| 25% chemical fertilizer+bio-fertilizer  | Sc704   | 27.60 <sup>ab</sup>                    | 12.98 <sup>abcd</sup>             | 48.10 <sup>a</sup> | 356.50 <sup>a</sup>   | 14.80 <sup>abc</sup>   | 34.95 <sup>de</sup>      | 8.84 <sup>ab</sup>     | 1.14 <sup>ab</sup>                  | 182.55 <sup>a</sup> |
|   | Mobin   | 24.61 <sup>abc</sup>                   | 11.72 <sup>bcd</sup>              | 47.76 <sup>a</sup> | 278.75 <sup>d</sup>   | 15.80 <sup>a</sup>     | 35.95 <sup>cde</sup>     | 6.09 <sup>d</sup>      | 0.72 <sup>d</sup>                   | 178.50 <sup>a</sup> |
|   | Karoun  | 24.29 <sup>abcd</sup>                  | 11.91 <sup>bcd</sup>              | 49.07 <sup>a</sup> | 358.75 <sup>a</sup>   | 13.50 <sup>c</sup>     | 33.25 <sup>de</sup>      | 7.31 <sup>c</sup>      | 0.87 <sup>cd</sup>                  | 171.95 <sup>a</sup> |

In each column, means which have similar letters do not have significant difference based on Duncan's multiple-range test at 5% probability level.

Azospirillum and Azotobacter by the biological nitrogen fixation and development the roots, help to optimize the absorption of water, nutrients, hormones, certain vitamins production and boost plant growth quantitative and qualitative (Ram Rao *et al*, 2007). Bashan *et al* (2004) showed that the use of bio-fertilizers with a 50 percent reduction in the recommended amounts of the chemical fertilizers increased the yield of millet and maize.

### Harvest index

Analysis of variance showed that effect of mixed fertilizer treatment was significant at 1% probability level, but the difference between hybrids and interaction between treatments were not significant (Table 1). Mean comparison showed that no significant differences among hybrids and fertilizer treatments in Harvest index (Table 2 and 3). The result was similar to the results of Ghasemi *et al* (2011).

### 1000 grain weight

Effect of the combining fertilizer treatment and hybrids and the interaction between treatments on 1000-grain weight was significant at the 1% probability level (Table 1). The mean comparison results of mixing fertilizer showed that the highest 1000-grain weight belonged to the 50% chemical fertilizer with 100% bio-fertilizer treatments and there was not significant difference between 100% chemical fertilizer and 75% chemical fertilizer (Table 2). The highest weight of 1000 grain belonged to karoun hybrid (Table 3). Interaction of treatments showed that the highest 1000 grain weight in SC704 hybrid and Karoun hybrid belonged to 25% chemical fertilizer with 100% bio-fertilizer and 50% chemical fertilizer by 100% bio-fertilizer treatments and the lowest one

were in 25% chemical fertilizer with 100% bio-fertilizer treatments and Mobin hybrid (Table 4). Increase the amount of nutrients available by the application of chemical fertilizers and bio-fertilizers has largely lead to increasing the 1000 grain weights (Hassanpour *et al.*, 2011).

### Number of row per ear

The combination of biological and chemical fertilizers treatment on the number of row per ear was not significant, but the difference between the hybrids was significant at 1% probability level (Table 1). The results of mean comparison showed that there was no significant difference between incorporation of the fertilizer treatments (Table 2). The most number of row per ear belonged to the Mobin hybrids and the lowest one belonged to Karoun hybrid (Table 3). Interaction between the treatments showed that the most number of row per ear belonged to the Mobin hybrid and 25% chemical fertilizer with the 100% bio-fertilizer application and Karoun hybrid at the level of 25% chemical fertilizer with 100% bio-fertilizer had the minimum number grain rows per ear than the other treatments (Table 4). The results was similar to the results of Eydi Zadeh *et al* (2012). It seems that the higher mount of nitrogen increased the photosynthesis, flowering period and the fertility of flowers and thereby increased the number of row per ear. Naserirad *et al* (2011), report the effect of increasing the number of rows per ear with inoculation the Azotobacter and *Azospirillum*. Yasseri *et al.* (2008) stated that the *Azotobacter* alone cannot make a significant difference in the number of row per ear and adding the inorganic nitrogen, phosphorus and potassium fertilizers is necessary.

### Number of grain per row

Effect of the mixing fertilizer and different between the hybrid and the interaction between treatments on number of grain per row was significant at the 1% probability level (Table 1). Results of mean comparison showed that although the maximum number of the grain per row was 50% chemical fertilizer with 100% bio-fertilizer treatments, but this difference with two treatments treated by 100% chemical fertilizers and 75% chemical fertilizer with 100% bio-fertilizer was not significant and 25% chemical fertilizer by 100% bio-fertilizer treatments (Table 2). Among hybrids, there was no significant difference between single cross 704 and Karoun hybrid. The Mobin hybrid in number of grain per row was less and significant with two other hybrid (Table 3). The results of interaction treatments showed that the maximum number of grains per row belonging to 100% chemical fertilizer and single cross 704 hybrid treatments and the lowest number of grains per row was in 100% the chemical fertilizer treatments and Mobin hybrid (Table 4). Increased levels of nitrogen leads to removing restrictions nitrogen for maize and increase photosynthetic efficiency and plant production and increase the number of grains per row (Naserirad *et al.*, 2011). Some researchers believe that hormonal effects induced by plant growth promoting bacteria, directly increases the number of grain per row. Alizadeh *et al.* (2008) expressed that increasing the number of grain per ear using Azospirillum associated with the consumption of chemical fertilizers was significantly.

### Grain protein content

Analysis of variance showed that the effect of fertilizer treatments interaction on the grain protein percentage was

significant at 1% probability level (Table 1). Mean comparison showed that there was no significant difference between the three fertilizer treatments were 100% chemical fertilizer and 100% bio-fertilizer, 75% chemical fertilizer and 100% bio-fertilizer and 50% chemical fertilizer by 100% bio-fertilizer them, But 25% chemical fertilizer with the 100% bio-fertilizer treatments was less effective than other treatments (Table 2). SC.704 hybrid had the highest protein percentage and Mobin hybrid has the lowest one (Table 3). The interaction effects showed that the most protein percentage belonged to 100% chemical fertilizer and Mobin hybrid and 50% chemical fertilizer by 100% bio-fertilizer and SC.704 hybrid treatments. In SC.704 hybrid reduce chemical fertilizer use increased protein percentage and in Mobin and Karoun hybrid has decreased (Table 4). The results were in similar with the finding of other researchers (Behdarvand, 2012, Tohidi Moghadam *et al.*, 2008). Increase protein percentage by the use of bio-fertilizers is due to the effect of bacterial inoculation that increased the effective regulation of the growth, physiological and metabolic activity of the plant (Ram Rao *et al.*, 2007). Tohidi Moghadam and *et al.* (2008), reported increasing the protein percentage with chemical fertilizer by Azospirillum and Azotobacter. Yasari *et al.* (2008) showed that application of Azotobacter was significantly affected mineral concentrations of nitrogen, phosphorus, potassium, calcium and the protein percentage in aboveground plant and dry matter yield and application of Azotobacter alone or in combination with Mycorrhiza with application of 150 kilogram nitrogen per hectare was recommended.

### Protein yield

The effect of fertilizer treatments on protein yield and the difference between different hybrids and the interaction between treatments was significant at 1% and 5% probability level, respectively (Table 1). The Mean comparison effects of mixed fertilizer treatments showed that most protein yield belonged to 50% chemical fertilizer with 100% bio-fertilizer and minimum protein yield belonged to 25% chemical fertilizer by 100% bio-fertilizer (Table 2). Among the hybrids, SC.704 and Karoun hybrids did not differ significantly protein yield, and protein yield of the Mobin hybrid was lower than the other hybrids (Table 3). The most protein yield was in 50% chemical fertilizer with 100% bio-fertilizer and SC.704 hybrid and the minimum protein yield was in 25% chemical fertilizer by 100% bio-fertilizer treatment and Mobin hybrid. In SC.704 and Karoun hybrid with 50 percent reduction in chemical fertilizer and application of the bio-fertilizer, increasing the yield protein was observed. In Mobin hybrid with 25% reduction in consumption of chemical fertilizer and using the bio-fertilizers maximum protein yield was obtained (Table 4). The result was similar to the results of Yousef poor and Yadvy (2014). The combined use of chemical fertilizers and Nitroxin, by preventing loss due to use bio-fertilizer nitrogen, the more nitrogen, the amount of protein in the treatments increased (Yousef poor and Yadvy, 2014).

### Plant height

The effect of fertilizer treatment and the hybrid and interaction between treatments was non-significant (Table 1). Results mean comparison the effects of mixing fertilizer treatment showed that there was no significant difference

between treatments (Table 2). Also in terms of Plant height was not significantly different between hybrids (Table 3). Interaction of the treatments showed that there was no significant difference between the treatments; the maximum plant height belonged to 25% chemical fertilizer with 100% bio-fertilizer treatments and hybrid SC.704, and the minimum plant height was of the 100% chemical fertilizer and the Mobin hybrid treatment (Table 4). An important reason that can increase the impact of bio-fertilizers for Plant height this is that use of fertilizers leading to increased internode length and it can stimulate the production of plant hormones produced by these fertilizers (Hassanpour, *et al.*, 2011).

### CONCLUSION

Consummation of the biological fertilizers with 50% organic fertilizer produced the highest grain yield. Higher grain yield in this treatment was due to higher grain number and grain weight. Also it can be stated that Nitroxin bio-fertilizer, by alone cannot provide all nutrients needed for maize plant but if combined with the chemical fertilizers improves nutrients use efficiency and increase the qualitative and quantitative yield of maize hybrids.

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