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Factor Analysis of Seed Yield, Its Components and Oil Content of Corn Genotypes Affected Nitroxin Fertilizer

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ABSTRACT

Fertilizer management is essential for achieving sustainable agriculture and protecting the environment. To evaluate the effect of Nitroxin bio-fertilizer application on quantitative and qualitative traits of corn hybrids a farm research was arranged via split plot experiment based on the randomized complete block design with four replications in 2013. Main plots were Included: use of the chemical and biological fertilizers in four levels (F_1: 100% urea + 0% Nitroxin; F_2:75% urea + 100% Nitroxin; F_3:50% urea + 100% Nitroxin; F_4: 25% urea + 100% Nitroxin) and the sub plots consisted three maize hybrids (H_1: Single Cross 704, H_2: Mobin, H_3: Karoun). According result of analysis of variance effect of fertilizer treatments on seed yield, 100 seed weight, number of seed per unit area and oil yield was significant at 1% probability level, but effect of hybrid on all measured traits (instead oil percentage and oil yield) was significant. Also interaction effect of treatments on all measured traits (instead number of rows per ear) was significant. The mean comparison results indicated that the highest seed yield and 100 seed weight was belonged to 50% urea with 100% Nitroxin application treatment, also between different hybrids the highest seed yield and 100 seed weight belonged to Karoun. Interaction effect of treatments revealed the treatments of chemical fertilizer (50%) +biological fertilizer (100%) + single cross 701 (Karoun) had highest seed yield and can be advised to farmers. According to result of factor analysis five independent factors justify 98.5% of the data changes and the number of seed per row and number of seed per area was positively correlated with seed yield and the difference in yield among the studied populations was mainly due to the diversity of number of seed per area.

Key words: *Biofertilizer, Hybrid, Maize, Nitrogen.*

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INTRODUCTION

Every part of the maize plant has economic value which the seed, leaves, stalk, tassel and cob can all be used to produce a large variety of food and non-food production. Corn is a very versatile seed that benefits mankind in many ways (Audrac Erickson, 2006). Nutrient management is one of the most important factors that affect the growth and yield of maize (Verma, 2011). Overuse of different chemical fertilizers is one of the causes for the degradation of environment and soil. Bio fertilizers are the newest and most technically advanced way of supplying mineral nutrients to crops. Compared to chemical fertilizers, their supply nutrient for plant needs, minimizes leaching, and therefore improves fertilizer use efficiency (Subbarao *et al.,* 2013). Fertilizer management is one of the most important factors in successful cultivation of crops affecting yield quality and quantity (Tahmasbi *et al.,* 2011). Organic farming has emerged as an important priority area globally in view of the growing demand for safe and healthy food and long term sustainability and concerns on environmental pollution associated with indiscriminate use of agrochemicals. Though the use of chemical inputs in agriculture is inevitable to meet the growing demand for food in world, there are opportunities in selected crops and niche areas where organic production can be encouraged to tape the domestic export market (Venkatash-Warlu, 2008). Bio-fertilizers are more environmental friendly and in many cases, they have given the same or even better crop yields compared to mineral fertilizers (Saghir Khan *et al.,* 2007). So far considerable number of bacterial species, mostly associated with the plant rhizosphere, were tested and found to be beneficial for plant growth, yield and crop quality. They have been called 'plant growth promoting rhizobacteria (PGPR)' including the strains in the genera Azospirillium, Azotobacter, (Sudhakar *et al.,* 2000). PGPR participates in many key ecosystem processes, such as those involved in the biological control of plant pathogens, N fixation, solubilisation of nutrients and phytohormone synthesis (Vessey, 2003). Biological fertilizers release active precursors like gibberellin, auxin, cytokinine, vitamins, amino acids, polypeptides, anti-bacteria and anti-fungi especially exo polysaccharides to have a positive effect on yield of crops. Applied microorganisms as biological fertilizers have effects on growth of the plant to provide food elements by colonization in rhizosphere environment or in cooperation with symbiotic (Elanwar, 2010). On the other hand, these bacteria can produce fungi complexes that they can be used against plant diseases and improvement of germination and at last growth of the plant. These bacteria can reinforce performance of the plant by fixation of nitrogen and producing of materials causing growth stimulation, root growth and as a result water absorbent, reforming acidity of the soil and absorbing of food elements (Manfouz and Sharaf-Eldin, 2007). Ahmad *et al.* (2010) showed that higher yield under the effects of biologic fertilizers might be because of the increase in metabolic activities of biologic fertilizers and production of growth stimulating hormones by bacteria. Also Bahamin *et al*. (2014) showed that when seeds were in inculcation by Nitroxin biologic fertilizer seed yield reached 3840 kg per hectare, showing 28% increase compared to non-inculcation treatment. Seed yield of cereals is determined by two main components, seed number per unit area and mean seed weight. Seed yield is usually strongly associated with the number of

seeds per unit area (Azimi *et al.,* 2013). While this association has been extensively reported for a relatively wide range of environments. The final seed number per unit area is set immediately after anthesis, while seed filling occurs during the remaining post anthesis period (Ugarte *et al.,* 2007). Sharifi and Hagh Nia (2007) stated Nitroxin fertilizer had a significant effect on all the measured traits except 1000-seed weight. Nitrogen is important for plant growth, however plants have a limited ability to extract it from the environment, and thus need microbes involved in "nutrient recycling," to help a plant uptake and absorb these nutrients at optimal concentration, while plants donate waste byproducts to microbes for food. With this symbiotic relationship, plants develop stronger and bigger root systems. The larger the plants' roots, the more living space and food there is for the microbes to use. In a way, microorganisms serve as bio-fertilizers (Elkholy, 2005). This study was conducted to evaluate the effect of Nitroxin biological fertilizers on seed yield, its components and qualitative traits of maize Hybrid to identify suitable biological fertilizers in sustainable agriculture.

MATERIALS AND METHODS

Field and Treatment Information

To evaluate the effect of Nitroxin bio-fertilizer application on quantitative and qualitative traits of corn hybrids a farm research was arranged via split plot experiment based on the randomized complete block design with four replications in 2013. Place of research was located in Shoushtar region at southwestern of Iran (latitude: 32 30' N, longitude: 48 20' E and 18 meters above sea level) with moderate winters and hot summers. Main plots were Included: use of the chemical and biological fertilizers in four levels (F_1: 100% urea + 0% Nitroxin; F_2:75% urea + 100% Nitroxin; F_3:50% urea + 100% Nitroxin; F_4: 25% urea + 100% Nitroxin) and the sub plots consisted three maize hybrids (H_1: Single Cross 704, H_2: Mobin, H_3: Karoun).

Farm Management

Phosphorus and potassium fertilizers were used at rate of 150 kg.ha^{-1} triple super phosphate and 150 kg.ha^{-1} potassium sulfate. Biological fertilizer of Nitroxin was used as much as 2 liters per hectare as combined with seeds. Nitrogen chemical fertilizer was provided from the urea source, 50% during planting and 50% during 8-leaf stage. To determine some physical and chemical properties of the soil in the region two samples were taken from the depths of 0-30 and 30-60 cm (Table 1). Each sub plot included the 6 planting lines with a length of 5 m. The distance between row and seed on the row were 75 and 18 cm respectively. Irrigation was done every 3 or 4 days and after the plant establishment it was done every 7 to 10 days if necessary. The weeds were controlled via Cruise herbicide by 2 L.ha^{-1} at 4-to-5-leaf stage and Krakrown pesticide by 1 L.ha^{-1}.

Table 1. Physical and chemical properties of the experiment field

Soil depth (cm)	0-30	30-60
Acidity (pH)	8.44	8.51
Electrical conductivity (ds.m^{-1})	4.07	2.69
Organic carbon (%)	0.51	0.36
Absorbable Phosphorus (ppm)	8	7
Absorbable potassium (ppm)	181	171
Clay (%)	26	24
Silt (%)	41	40
Sand (%)	33	32
Soil texture	Loam	Loam

Measured Traits

The final harvest area of each plot was 1.5 m^2. Seed yield, its components and qualitative traits were estimated after the physiological maturity. After separating seed from selected plants and weighing them, seed yield was calculated based on 14% moisture. In order to estimate 100 seed weigh, 10 samples of seed containing 10 seed were separated and the means was calculated. The number of seed per unit area was obtained from number of plants per unit area (m^2) and number of seed per ear. To calculate the number of rows per ear, from each plot, ten rows were randomly selected and its number was counted and the mean was considered as this attribute. To measure the protein percentage, Kjeldahl method was used (Bremner and Breitenbeck, 1983). Also to measure the oil percentage, Soxhlet method was used and oil yield obtained from multiplying seed yield by oil percentage (Cox and Cherney, 2005). Inoculation percentage was obtained from the following equation (Farokhi and Eradatmand asli, 2008):

Equ. 1. Inoculation percentage = 100-Percent of ear without seed

In order to determine height of plants ten plants were selected randomly from each plot and average of 10 plants was recorded in cm.

Statistical Analysis

The analysis of variance was done by SAS (Ver 9.1) and Minitab software (Ver.16). The means were compared with using Duncan's multi range test (DMRT) at 5% probability level.

RESULTS AND DISCUSSION

Seed yield

The seed yield is a complex feature whose emergence depends on the function of the reactions of many physiological combinatorial processes, in particular the limiting components that change with the varieties. According to results 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 seed yield was significant at 5% probability level (Table 2). The mean comparison showed that mixing 50% urea with 100% Nitroxin fertilizer than the other treatments were significantly different and had the highest seed yield. 100% chemical fertilizer treatment, 75% urea + 100% Nitroxin fertilizer and 25% urea + 100% Nitroxin fertilizer were not significantly different (Table 3). Application of inorganic fertilizers along with bio-fertilizer significantly increased maize yield (Abou El-Magd *et al.,* 2006). Manure application has also been reported to increase the N and exchangeable cation levels in the soil (Boateng *et al*., 2006). Between different hybrids, the maximum (13.66 $t.ha^{-1}$) and minimum (12.37 $t.ha^{-1}$) amount of seed yield belonged to karoun and mobin, respectively (Table 4). Interaction effect between treatments showed that the highest seed yield were for 50% urea + 100% Nitroxin fertilizer and Karoun hybrid and 50% urea by 100% Nitroxin fertilizer and SC. 704 and the lowest belonged to the 100% chemical fertilizer and Mobin hybrid. In all three hybrids reducing nitrogen consumption by 50% and using of bio-fertilizer increased seed yield (Table 5). Azospirillum by the biological nitrogen fixation and development the roots, helped to optimize absorption of water, nutrients, hormones, certain vitamins production and boost plant growth quantitative and qualitative (Ram-Rao *et al*, 2007). Nitroxin biological fertilizer contains the most effective nitrogen fixation bacteria of Azotobacter and

Azospirillium, which stabilizes the nitrogen, balance absorption of micro nutrient and macronutrient rate needed by plant, as it causes growth and development of root and shoots of plant by synthesis and excretion of stimulants of plant growth such as types of regulating hormones such as Oxine, and also production of different amino acids and types of antibiotics, Cyanide hydrogen, Siderophore, and causes increase of quality and quantity of product by protecting root such as the terrestrial pathogenic agents (Cardoso and Kuyper, 2006).

Table 2. Analysis of variance of the effect of different level of fertilizers and hybrids on measured traits

S.O.V	df	Seed yield	100 seed weight	Number of seed per unit area	Number of rows per ear	Inoculation percentage	Oil percentage	Oil yield
Replication	3	0.25^{ns}	4.13^{ns}	17033.11^{ns}	0.61^{ns}	2.57^{ns}	1.17^{ns}	0.02^{ns}
Fertilizer (F)	3	11.48^{**}	31.36^{**}	711080.89^{**}	0.23^{ns}	4.46^{ns}	1.08^{ns}	0.12^{**}
Error a	9	1.31	4.87	292237.77	1.02	5.95	1.01	0.04
Hybrid (H)	2	6.77^{*}	54.42^{**}	399315.16^{**}	13.82^{**}	93.96^{**}	0.19^{ns}	0.02^{ns}
F × H	6	4.99^{*}	34.30^{**}	613867.67^{**}	0.31^{ns}	4.15^{*}	1.90^{**}	0.04^{*}
Error b	24	2.17	6.70	165023.94	0.55	5.12	0.31	0.01
CV (%)	----	11.29	7.89	9.78	5.1	2.42	6.90	12.62

$^{ns, *\text{ and }**}$: no significant, significant at 5% and 1% of probability level, respectively.

100 seed weight

The seed weight is a component of seed yield, which plays an important role in expressing the potential and production potential and is influenced by genetic and environmental factors. Effects of the combining fertilizer treatment and hybrids and the interaction between treatments on 100 seed weight were significant at the 1% probability level (Table 2). The mean comparison results of mixing fertilizer showed that the highest 100 seed weight belonged to 50% chemical fertilizer by 100% Nitroxin bio-fertilizer and there was not significant difference between 100% chemical fertilizer and the 75% chemical fertilizer treatments (Table 3). The highest 100 seed weight belonged to Karoun hybrid (Table 4). Interaction of treatments showed highest 100 seed weight in SC.704 hybrid and Karoun hybrid belonged to 25% chemical fertilizer with 100% Nitroxin bio-fertilizer and 50% chemical fertilizer by 100% Nitroxin bio-fertilizer treatments and the lowest one were in 25% chemical fertilizer by 100% Nitroxin bio fertilizer treatments in Mobin hybrid (Table 5). Research has also reported an increase in the seed weight of corn from an application of biological fertilizer (Mohammed *et al.,* 2001). The increase amount of nutrients available by use chemical and bio fertilizers has largely lead to increase seed weight (Hassan pour *et al*., 2011). Due to produce plant hormones, bio fertilizer, through stimulating cell division, increase reservoir capacity in plant and develop the root and provide conditions for improve nutrients uptake and lead to increase of photosynthesis, when plant approaches to maturity stage, it transfers assimilates into reproductive seeds (Jorfi, 2014).

Number of seed per unit area

According to results of analysis of variance, combining Nitroxin fertilizer with nitrogen fertilizer and also the interaction effect of treatments on seed number per unit area at the level of 1%

probability was significant, but the difference between hybrids did not make a significant difference (Table 2). The treatment of 50% of fertilizer with 100% bio-fertilizer had a significant difference with other treatments and had the highest number of seed per unit area. The reason of increasing the number of seed in this treatment was the increasing the number of seed per ear, which was affected by the increasing in the number of seeds in row and number of rows per ear in this treatment and 75% of fertilizer with 100% bio-fertilizer had the lowest number of seed per unit area (Table 3). Among hybrids, there was no significant difference in terms of number of seeds per unit area, however, hybrid SC704 had more seeds per unit area, but this increasing was also due to a slight increase in the number of seeds per ear in this hybrid (Table 4).

Table 3. Mean comparison of the effect of different level of biological and chemical fertilizer on measured traits

Treatments	Seed yield ($t.ha^{-1}$)	100 seed weight (g)	Number of seed per unit area	Number of rows per ear	Inoculation percentage (%)	Oil percentage (%)	Oil yield ($t.ha^{-1}$)
100% chemical fertilizer (F_1)	12.74^{*b}	31.16^{b}	4222.3^{a}	14.45^{a}	93.96^{a}	8.005^{a}	1.01^{bc}
75% chemical fertilizer + bio-fertilizer (F_2)	12.81^{b}	31.99^{b}	4120.3^{ab}	14.48^{a}	92.48^{a}	8.51^{a}	1.09^{ab}
50% chemical fertilizer + bio-fertilizer (F_3)	14.46^{a}	34.90^{a}	4421.0^{a}	14.71^{a}	93.34^{a}	8.20^{a}	1.18^{a}
25% chemical fertilizer + bio-fertilizer (F_4)	13.74^{b}	33.13^{ab}	3836.6^{b}	14.70^{a}	93.10^{a}	7.80^{a}	0.95^{c}

*In each column, means followed by similar letters do not have significant difference via Duncan test at 5% probability level.

Interaction of treatments showed that the highest number of seeds per unit area belonged to SC704 and 100% fertilizer application, and the Karoun hybrid had a minimum seed number per unit area in the application of 25% fertilizer with 100% bio fertilizer (Table 5). Osborne *et al*. (2002) reported positive effects of nitrogen fertilizer on increasing the number of seeds in different maize hybrids. Nasser *et al.* (2009) reported that application of nitrogen fertilizer significantly increases the number of seeds per ear. By increasing the number of seeds per unit area, seed yield can be expected to increase significantly. Also by increase the number of seeds per ear and the number of seeds per row, the number of seeds per unit area increased but with increasing the weight of 100 seeds due to the reduction in the number of seeds and the division of produced dry matter among a smaller number of seeds that increased the weight of the seeds and the number of seeds per unit area decreases.

Number of rows per ear

According to ANOVA results the combination of biological and chemical fertilizers treatment on the number of row per ear was not significant, but difference between the hybrids was significant at 1% probability level (Table 2). Results of mean comparison showed that there was no significant difference between incorporation of fertilizer treatments (Table 3). The most number

of row per ear belonged to the Mobin hybrid and the lowest one belonged to Karoun hybrid (Table 4). 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 is necessary. 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 by 100% bio-fertilizer had the minimum number seed rows per ear than the other treatments (Table 5). The result was similar to the results of Eydi Zadeh *et al.* (2012). It seems that the higher amount 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 effect of increasing the number of rows per ear with inoculation Azotobacter and Azospirillum.

Table 4. Mean comparison of the effect of different hybrids on measured traits

Treatments	Seed yield ($t.ha^{-1}$)	100 seed weight (g)	Number of seed per unit area	Number of rows per ear	Inoculation percentage (%)	Oil percentage (%)	Oil yield ($t.ha^{-1}$)
SC704 (H_1)	13.14^{*ab}	32.28^{b}	4331^{a}	14.42^{b}	95.25^{a}	8.03^{a}	1.05^{a}
Mobin (H_2)	12.37^{b}	31.26^{b}	4076.7^{a}	15.58^{a}	90.54^{b}	8.25^{a}	1.02^{a}
Karoun (H_3)	13.66^{a}	34.84^{a}	4042.1^{a}	13.75^{c}	93.87^{a}	7.10^{a}	1.10^{a}

*In each column, means followed by similar letters do not have significant difference via Duncan test at 5% probability level.

Inoculation percentage

Effect of fertilizer combination on inoculation percentage was not significant, but different between hybrids at 1% probability level and interaction effect of treatments was significant at 5% probability level (Table 2). Results of means comparison showed that despite the absence of significant differences, but maximum inoculation percentage was in 100% chemical fertilizer (Table 3). Among the hybrids, Mobin hybrid had a maximum inoculation percentage and SC.704 with Karoun hybrid showed no significant difference in terms of this trait (Table 4). Results of interaction treatments showed that the maximum inoculation percentage belonged to 100% urea fertilizer and single cross 704 and the lowest of this trait was in 75% urea fertilizer by 100% bio-fertilizer and Mobin hybrids (Table 5). Results showed that by increasing the number of rows per ear, inoculation rate of flowers decreased. Moreover, the inoculation rate of flowers increased, this is despite fact that by increasing inoculation percentage, the row number is also significantly increased. Also, by increasing length of ear, inoculation rate of flowers was increased.

Oil percentage

Result of ANOVA showed effect of different level of fertilizer and hybrids on seed oil percentage was not significant but interaction effect of treatments was significant at 5% probability level (Table 2). Mean comparison result revealed that there was no difference between different level of fertilizer and among different hybrids (Table 3, 4). The results of interaction of treatments showed that the highest percentage of seed oil was applied to 75% chemical fertilizer with 100% bio fertilizer and Karoun hybrid and the least of them belonged to Mobin hybrid and 25% chemical fertilizer with the 100% bio-

fertilizer (Table 5). Studies shown that by increase nitrogen consumption, formation of the nitrogenous protein foregoing increases and protein formation in photosynthetic material is increased, resulting in a decrease in amount of material needed for conversion to oil (Taher khani and Golchin, 2006).

Table 5. Interaction effects of biological and chemical fertilizer and hybrid on measured traits

Treatments		Seed yield ($t.ha^{-1}$)	100 seed weight (g)	Number of Seed per unit area	Number of rows per ear	Inoculation percentage (%)	Oil content (%)	Oil yield ($t.ha^{-1}$)
100% chemical fertilizer	SC704	13.45^{*abc}	28.40^{d}	4788.2^{a}	14.40^{bc}	96.71a	7.51^{bcd}	1.006^{abc}
	Mobin	11.00^{d}	29.97^{bcd}	3705.5^{cd}	15.45^{ab}	90.41cd	8.86^{a}	0.97^{bc}
	Karoun	13.77^{ab}	35.12^{ab}	4171.2^{abc}	13.50^{c}	94.75ab	7.64^{bcd}	1.05^{abc}
75% chemical fertilizer + bio-fertilizer	SC704	11.28^{cd}	29.47^{cd}	4018.2^{bcd}	14.05^{c}	94.94ab	8.20^{abcd}	0.93^{bc}
	Mobin	13.34^{abc}	33.62^{abc}	4032.3^{bcd}	15.40^{ab}	88.89d	8.19^{abcd}	1.09^{abc}
	Karoun	13.81^{ab}	32.87^{abcd}	4310.4^{abc}	14.00^{c}	93.61abc	9.13^{a}	1.26^{a}
50% chemical fertilizer + bio-fertilizer	SC704	14.84^{a}	35.62^{a}	4639.8^{ab}	14.45^{bc}	94.24ab	8.48^{abc}	1.25^{a}
	Mobin	13.41^{abc}	33.57^{abc}	4302.6^{abc}	15.70^{ab}	91.52bcd	8.67^{ab}	1.16^{ab}
	Karoun	15.14^{a}	35.50^{a}	4320.8^{abc}	14.00^{c}	94.25ab	7.46^{cd}	1.13^{ab}
25% chemical fertilizer + bio-fertilizer	SC704	12.98^{abcd}	35.65^{a}	3879.4^{cd}	14.80^{abc}	95.11ab	7.96^{abcd}	1.03^{abc}
	Mobin	11.72^{bcd}	27.87^{d}	4264.5^{abc}	15.80^{a}	91.33bcd	7.28^{d}	0.85^{c}
	Karoun	11.91^{bcd}	35.87^{a}	3366.0^{d}	13.50^{c}	92.86bc	8.17^{abcd}	0.97^{bc}

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

Sajadi Nik *et al.* (2011) stated nitrogen fertilizer does not have much effect on the percentage of seed oil, but if nitrogen is consumed at its highest level, treatments such as inoculation with nitrogen stabilizing bacteria (due to excessive nitrogen uptake.

Oil yield

According result of analysis of variance the effect of different level of fertilizer on oil yield was significant at 5% probability level but effect of hybrids and interaction effect of treatments was not significant (Table 2). Mean comparison result of mixed fertilizer treatments indicated that the maximum and the minimum oil yield belonged to 50% chemical fertilizer with 100% bio-fertilizer (1.18 $t.ha^{-1}$) and 25% chemical fertilizer by 100% bio fertilizer (0.95 $t.ha^{-1}$) (Table 3). That there was no difference between among different hybrids (Table 4). Some researchers such as Mobasser and Moradgholi (2012) reported same result. As the increasing seed weight, the oil yield increases due to the increased volume of reservoirs and more oil storage. Also, due to increased seed yield, two aspects of oil yield increase. Roshdi *et al.* (2008) stated inoculation of seed with Nitroxin plus 50% of urea required most positive effect in increasing seed and oil yield and use of biological fertilizers can improve traits of the oil seed be useful.

Factor Analysis of Traits

The most effective correction method for the more function is to recognize the morphological and physiological causes of the difference in yield and to find their genetic control. According to the results of Table 6, five independent factors justify 98.5% of the data changes. The first factor justifies 29.02% of the total data variance. In this factor, the highest positive factor

coefficients belonged to the number of seed per unit area and oil yield, respectively. Oil percentage was negative coefficient. The third factor justifies 19.6% of variation and the most factors belong to the 100 seed weight. This trait, with traits such as inoculation percentage, oil percentage and oil yield, had negative factor coefficients. The fourth factor justifies 14.7% of the total variation in data, the highest positive factor belonged to the number of rows in ear and 100 seed weight, inoculation percentage and oil yield had a negative factor coefficients. The fifth factor, with justification of 14.4% of the data, was attributable to the inoculation percentage and number of rows per ear and the oil percentage in this factor had negative coefficients. Ramezani *et al.* (2008) were able to introduce suitable cultivars for different purposes of maize by using functional plots derived from yield components and phonological characteristics for Hamedan region. By using factor analysis, they used 704 cultivars as superior cultivars for seed yield. Gardner *et al*. (1990) attributed the superiority of the yield of new maize hybrids to the increase in leaf area, number and seed weight, seed rate and seed filling period and growth rate. In the study of Corke and Kannenberg (1989) the number of seed per plant was positively correlated with seed yield and the difference in yield among the studied populations was mainly due to the diversity of number of seed per plant. They also stated that reformers would be better off choosing for the number of seed per plant instead of direct selection for seed yield.

Table 6. Factor Analysis of seed yield, yield components and oil content of corn hybrids affected nitroxin fertilizer

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Communality
Seed yield	0.842	0.067	-0.495	-0.063	0.097	0.971
100 seed weight	0.110	0.098	-0.974	-0.101	0.016	0.981
Number of Seed per unit area	0.933	0.004	0.109	0.214	0.166	0.956
Number of rows per ear	0.125	0.069	0.104	0.954	-0.237	0.997
Inoculation percentage	0.178	-0.054	-0.026	-0.235	0.953	0.999
Oil percentage	-0.012	0.993	-0.031	0.072	-0.065	0.996
Oil yield	0.635	0.657	-0.393	-0.008	0.033	0.990
Variance	2.0415	1.4391	1.3728	1.0304	1.0071	6.8909
% Var.	0.292	0.206	0.196	0.147	0.144	0.985

CONCLUSION

This study shows that application of Nitroxin bio-fertilizers compared to non-application of N bio-fertilizers had a better effect on seed yield and oil content that was observed in inoculation of seed by Nitroxin. In addition, our results indicated that the combination of integrated fertilizers, using N fertilizer, improved the growth and quality of corn plants, with a reduction of the chemical fertilizer consumption to help preserve the environment.

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