

## Evaluation Effect of Livestock Manure and Urea Fertilizer on Quantitative and Qualitative Characteristics of Corn and Correlation Between Traits (S.C 704)

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### RESEARCH ARTICLE

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#### ARTICLE INFO.

*Received Date:* 17 Mar. 2019

*Received in revised form:* 22 Apr. 2019

*Accepted Date:* 23 May. 2019

*Available online:* 30 Jun. 2019

#### To Cite This Article:

Mohammad Momeni and Ali Gholami. Evaluation Effect of Livestock Manure and Urea Fertilizer on Quantitative and Qualitative Characteristics of Corn and Correlation Between Traits (S.C 704). *J. Crop. Nutr. Sci.*, 5(2): 1-11, 2019.

### ABSTRACT

**BACKGROUND:** Overuse of fertilizers can lead to groundwater contamination, depletion of soil microorganisms and beneficial insects, increased crop susceptibility to diseases, acidification or alkalization of soil, damage to soil structure, reduced organic matter and soil fertility. Therefore, for achieve sustainable agricultural, it is necessary to reduce the consumption of conventional fertilizers.

**OBJECTIVES:** Current study was conducted to assess effect of different level of nitrogen fertilizer and livestock manure on crop production and protein percentage of maize.

**METHODS:** This research was arranged via factorial experiment based on randomized complete blocks design with three replications. The treatments included nitrogen fertilizer ( $F_1$ = none use of fertilizer or control,  $F_2$ = 50% less than soil test or 90 kg.ha<sup>-1</sup>,  $F_3$ =equal soil test or 180 kg.ha<sup>-1</sup>,  $F_4$ =50% more than soil test or 270 kg.ha<sup>-1</sup>) and livestock manure ( $M_1$ =none use of manure or control,  $M_2$ = 20 t.ha<sup>-1</sup>).

**RESULT:** According result of analysis of variance interaction effect of treatments on all measured traits was significant. Assessment interaction effect of treatments indicated maximum number of seed per row (42), number of row per ear (16), 1000-seed weight (280 gr), seed yield (9900 kg.ha<sup>-1</sup>) and protein concentration (10.5%) was noted for 180 kg.ha<sup>-1</sup> nitrogen (equal soil test) with 20 t.ha<sup>-1</sup> livestock manure and minimum of those belonged to control treatment. Comparison of different levels of nitrogen treatments showed that application of fertilizer equal soil test (180 kg.ha<sup>-1</sup>) caused 22.5% increase in number of seed per ear, 13.69% number of row per ear, 25% 1000 seed weight, 20.2% seed yield and 20.29% protein percentage were compared to control.

**CONCLUSION:** Finally based on result of this research use 180 kg.ha<sup>-1</sup> nitrogen fertilizer (equal soil test) and 20 t.ha<sup>-1</sup> livestock manure improve quantitative and qualitative traits of corn and can be advised to farmers.

**KEYWORDS:** *Maize, Nutrition, Organic matter, Protein, Yield.*

## 1. BACKGROUND

Currently, 65 to 70 percent of the country's poultry diet is made of corn, which has made corn a strategic commodity in our poultry industry. Also unfortunately currently, about 70 percent of the country's corn is needed from abroad. So according the growing population, the food security and importance of achieving self-sufficiency in agricultural production, especially in the production of maize, is one of the government's goals in the agricultural sector (Pouryousef Miandoab and Shahravan, 2014). Emmaline and Quirine (2016) reported by improve fertilizer management, potential of crop production increases and led to moderate effects of drought stress on the plant growth. 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). Among the macro nutrients essential for crop growth, nitrogen (N) is a very mobile element in the soil, due to

its susceptibility to the leaching, denitrification, and volatilization losses. Excessive use of nitrogen fertilizer can lead to pollution of water bodies and may lead to soil acidification. Balanced and efficient use of applied nitrogen is of paramount importance in the overall nutrient management system than any other plant nutrient in order to reduce its negative impact on the environment. Besides, even under the best management practices, 30%-50% of the applied nitrogen is lost through different routes and hence more fertilizer needs to be applied than actually needed by the crop to compensate for the loss. The transitory loss of N not only causes loss to the farmer but also causes irreversible damage to the environment. High rates of chemical fertilizer cause environmental pollution (Shamme *et al.*, 2016). 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). Organic manures including sheep manure, cattle manure and hen manure may be used for crop production as substitute of chemical fertilizers because the importance of organic manures cannot be overlooked (Abbas *et al.*, 2012). Ma-

nure plays an important role in improving physical, chemical and biological properties of the soil. Manures contain a low concentration of plant nutrients and they have a slow acting nature, organic manure alone may fail to tend the high nutritional requirements of crops (Hosian *et al.*, 2002). Continuous addition of manures to the soil increase its organic matter content year after year, improving physical and chemical soil properties (Bohme and Bohme, 2006). Alizadeh Dehkordi (2010) reported combination cow manure and urea fertilizer, even under drought stress, produce higher yield than to use urea fertilizer alone. Ghanbari *et al.* (2013) reported use 50% of manure + 50% of fertilizer treatment had the greatest effect on increasing forage yield, seed yield and barley yield components. Also that treatment had the highest accumulation of macro and micro elements in the seed. In other words, the integrated fertilizer and chemical fertilizer system as an effective solution to improve soil fertility and increase nutrient uptake has greatly improved the quality and quantity of barley.

## 2. OBJECTIVES

Current study was conducted to assess the effect of different level of nitrogen fertilizer and livestock manure

on the crop production and protein percentage of maize.

## 3. MATERIALS AND METHODS

### 3.1. Field and Treatments Information

This research was conducted in Shavor region of Khuzestan province at south west of Iran (32°11'N and 48°14'E), with annual rainfall (mean of 250 mm), 112 m above the sea level, with arid and warm climate and silty clay soil texture during 2015 growing seasons. Current research was arranged according factorial experiment based on the randomized complete blocks design with three replications. The treatments included four level of nitrogen fertilizer ( $F_1$ = none use of fertilizer or control,  $F_2$ = 50% less than soil test or 90 kg.ha<sup>-1</sup>,  $F_3$ =equal soil test or 180 kg.ha<sup>-1</sup>,  $F_4$ =50% more than soil test or 270 kg.ha<sup>-1</sup>) from urea source and livestock manure ( $M_1$ =none use of manure or control,  $M_2$ = 20 t.ha<sup>-1</sup>). This experiment had 36 plots. The length of each plot was 6 m and its width 3 m, each plot consisted of 4 lines and 60 cm wide lines. For measure the chemical and physical properties of soil, two composite samples were taken from 0 to 30 and 30 to 60 cm depth. Physical and chemical properties of the soil are mentioned in table 1.

**Table 1.** Physical and chemical properties of studied field

Soil depth (cm)	Soil texture	EC (ds.m <sup>-1</sup> )	pH	N (%)	P (ppm)	K (ppm)	O.C (%)	TNV (%)
0-30	Silty clay loam	6.2	7.6	0.06	8.4	149	0.7	38
30-60	Silty Clay	5.9	7.7	0.05	8.1	137	0.5	36

### 3.2. Farm Management

Single cross 704 was used in amount of 15 kg.ha<sup>-1</sup> and the distance between plants after thinning was 20 cm. Plots were plowed and disked after winter wheat harvest in June. Nitrogen was applied according treatments from urea source in two step, half with planting and the remaining half at the 8-leaf stage. Also 150 kg.ha<sup>-1</sup> phosphorus (from triple super phosphate source) and 150 kg.ha<sup>-1</sup> potassium (sulphate potassium source) was used before planting. For control weeds by herbicide, before planting field was sprayed by Atrazine (1 kg.ha<sup>-1</sup>) and Laso (4 L.ha<sup>-1</sup>) mix and after then the farm was discarded with tractor. Also during the growth period, all plots were weeded manually. No serious incidence of insect or disease was observed, so no pesticide or fungicide was applied.

### 3.3. Measured Traits

In the laboratory, physical properties of soil texture were determined by hydrometric method (Page, 1992a). The soil reaction (potential of hydrogen) was measured using with pH meter (Model Horiba F11) by a glass electrode in saturated mud prepared from soil sample (NSSC, 1996). The electrical conductivity of the soil sample was measured with using EC meter (Model HORIBA DS 14) by using platinum electrode in saturated soil extract (USDA, 1996). Total Neutralize Value was measured by reverse titration method and the amount of available potassium in soil samples was determined by Flame photometer (Page, 1992b). The amount of available phosphorus in

soil samples was measured by Olsen method with using Spectrophotometer (Olsen and Summers, 1982). Soil organic carbon was measured with Walkley-Black method (Nelson and Summers, 1982). Total nitrogen of soil was measured with the Kjeldahl method (Benton Jones and Case, 1990). So, to calculate the protein percentage the following formula was used (Bremner *et al.*, 1983): **Equ. 1.** Protein percentage= Nitrogen percentage\* 5.8.

To sampling the plant, the first half meter from every plot was removed as margins. Samples were randomly taken from the two rows of 0.25 square meter in the middle of each plot and transferred to the laboratory. In the laboratory, the bushes crop were separated into its components (stem, leaf, ear and flower crown) and dried at the 70°C until reaching the constant weight. Then the weight of plant organs was measured with the digital weighing scale of 0.01 gr.

### 3.4. Statistical Analysis

Analysis of variance and mean comparisons were done via SPSS (Ver.15) software and Duncan multiple range test at 5% probability level. All figures drawn by Excel Software (Ver. 2010).

## 4. RESULT AND DISCUSSION

### 4.1. Soil test results

The results of the measurement of some of the physical and chemical properties of the soil sample at the site of the study can be seen in table 1. The depth of sampling is from 0 to 30 and 30 to 60 cm layers of soil and the soil has medium to heavy texture and cal-

careous type. Soil phosphorus and potassium levels were moderately downward and the amount of soil organic carbon and nitrogen in both layers was lower than optimum level. Soil is classified in saline soils. Reaction or acidity of the soil due to calcareous soil is beyond the neutral range, which limits the absorption of nutrients by the plant.

#### 4.2. Descriptive statistics

Result of descriptive statistics showed the mean of number of seed per

row, number of row per ear, seed weight, seed yield and protein concentration was 30.2, 13.29, 7428 gr, 7384 kg.ha<sup>-1</sup>, 8.7%, respectively (Table 2).

#### 4.3. Number of seed per row

According result of analysis of variance effect of nitrogen fertilizer, livestock manure and interaction effect of treatments on number of seed per row was significant at 1% probability level (Table 3).

**Table 2.** Descriptive statistics of measured traits

Variable	Number of seed per row	Number of row per ear	1000-seed weight (gr)	Seed yield (kg.ha <sup>-1</sup> )	Protein concentration (%)
Mean	30.2	13.29	236	7384.12	8.7
Standard deviation	8.11	1.51	38.03	2789.29	1.48
Variance	65.82	2.3	59	490	2.20
Sample	24	24	24	24	24

Assessment interaction effect of treatments indicated maximum number of seed per row (42) was noted for 180 kg.ha<sup>-1</sup> nitrogen (equal soil test) with 20 t.ha<sup>-1</sup> livestock manure and minimum of that (19) belonged to control treatment (Fig.1). Increasing the amount of nitrogen led to increase the number of seed per row and showed a significant difference between treatments. Caliskan *et al.* (2008) reported a significant increase in

number of seed per row with increasing nitrogen application. Hanway (1979) believes the number of seed per row is the main components of seed yield and the positive effect of increasing nitrogen on seed yield affected improvement by increasing number of seed per row. Lak *et al.* (2008) reported that higher nitrogen intake increased leaf area index and leaf area duration led to increased the number of seeds per row.

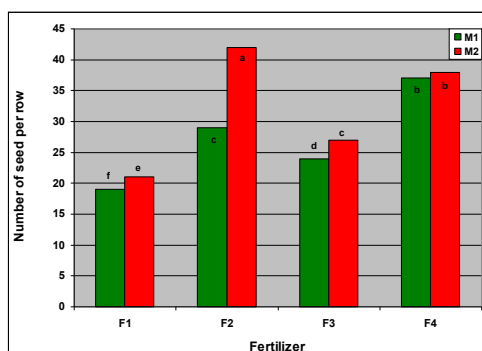
**Table 3.** ANOVA result of measured traits

S.O.V	df	Number of seed per row	Number of row per ear	1000-seed weight	Seed yield	Protein concentration
Replication	2	101.25 <sup>ns</sup>	19.42 <sup>ns</sup>	6425.78 <sup>ns</sup>	1100567.25 <sup>ns</sup>	7.81 <sup>ns</sup>
Fertilizer (F)	3	610.111 <sup>**</sup>	23.11 <sup>*</sup>	10333.11 <sup>**</sup>	1000640.88 <sup>ns</sup>	10.905 <sup>**</sup>
Manure (M)	1	68.056 <sup>**</sup>	3.55 <sup>ns</sup>	4640.05 <sup>**</sup>	8120269.77 <sup>ns</sup>	0.103 <sup>ns</sup>
F×M	3	122.111 <sup>**</sup>	24.77 <sup>*</sup>	2538.77 <sup>*</sup>	68522011.11 <sup>*</sup>	12.693 <sup>**</sup>
Error	14	67.33	21.33	5148.66	62878712	8.511

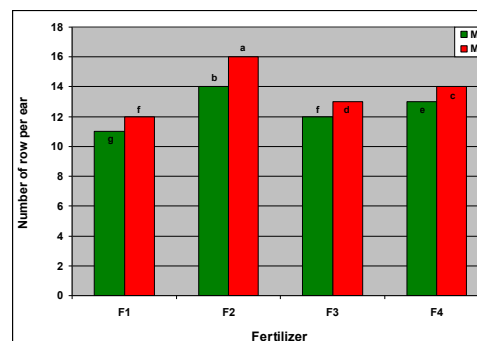
<sup>ns</sup>, <sup>\*</sup> and <sup>\*\*</sup> are non-significant and significant at 5 and 1% probability levels, respectively.

#### 4.4. Number of row per ear

Result of analysis of variance revealed effect of different level of nitrogen fertilizer and interaction effect of treatments on number of row per ear was significant at 5% probability level, but effect of different level of livestock manure was not significant (Table 3). Evaluation mean comparison result of interaction effect of treatments showed maximum number of row per ear (16) belonged to use 180 kg.ha<sup>-1</sup> nitrogen (equal soil test) with 20 t.ha<sup>-1</sup> livestock manure and lowest one (11) was for control treatment (Fig.2). 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. Modhej *et al* (2008) reported that, increasing nitrogen availability increase grain yield due to increase in number of grain per ear and grain weight.



**Fig.1.** Mean comparison interaction effect of treatment on number of seed per row via Duncan test at 5% probability level. F<sub>1</sub>= none use of fertilizer or control, F<sub>2</sub>= 50% less than soil test or 90 kg.ha<sup>-1</sup>, F<sub>3</sub>=equal soil test or 180 kg.ha<sup>-1</sup>, F<sub>4</sub>=50% more than soil test or 270 kg.ha<sup>-1</sup>, M<sub>1</sub>= control or none use of livestock manure, M<sub>2</sub>= 20 t.ha<sup>-1</sup> livestock manure.



**Fig.2.** Mean comparison interaction effect of treatment on number of row per ear via Duncan test at 5% probability level. F<sub>1</sub>= control, F<sub>2</sub>= 50% less than soil test or 90 kg.ha<sup>-1</sup>, F<sub>3</sub>=equal soil test or 180 kg.ha<sup>-1</sup>, F<sub>4</sub>=50% more than soil test or 270 kg.ha<sup>-1</sup>, M<sub>1</sub>= control, M<sub>2</sub>= 20 t.ha<sup>-1</sup> livestock manure.

#### 4.5. 1000-seed weight

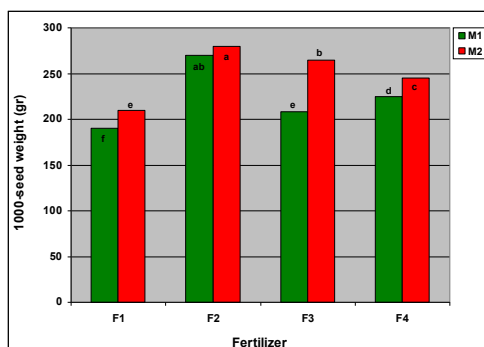
According ANOVA effect of nitrogen fertilizer, livestock manure and interaction effect of treatments on 1000-seed weight was significant at 1% and 5% probability level, respectively (Table 3). Assessment mean comparison result of interaction effect of treatments showed maximum 1000-seed weight (280 gr) was for use 180 kg.ha<sup>-1</sup> nitrogen with 20 t.ha<sup>-1</sup> livestock manure and lowest one (190 gr) belonged to control treatment (Fig.3). Increase nutrients by use of chemical fertilizers and bio-fertilizers has largely lead to increase seed weight (Hassanpour *et al.*, 2011).

#### 4.6. Seed yield

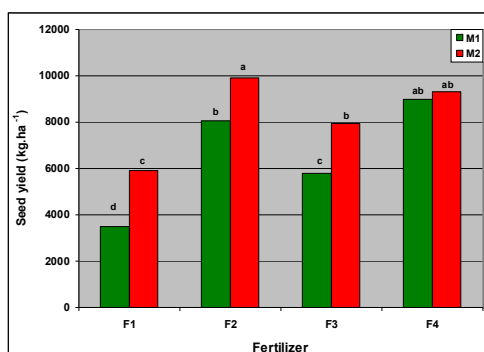
Result of ANOVA showed effect of nitrogen fertilizer and manure on seed yield was not significant but interaction effect of treatments was significant at 5% probability level (Table 3). Evaluation mean comparison result of interaction effect of treatments showed maxi-



imum seed yield ( $9900 \text{ kg}\cdot\text{ha}^{-1}$ ) was for  $180 \text{ kg}\cdot\text{ha}^{-1}$  nitrogen (equal soil test) with  $20 \text{ t}\cdot\text{ha}^{-1}$  livestock manure and minimum of that ( $3500 \text{ kg}\cdot\text{ha}^{-1}$ ) was for control treatment (Fig.4).



**Fig.3.** Mean comparison interaction effect of treatment on 1000-seed weight via Duncan test at 5% probability level. F<sub>1</sub>= control, F<sub>2</sub>= 50% less than soil test or  $90 \text{ kg}\cdot\text{ha}^{-1}$ , F<sub>3</sub>=equal soil test or  $180 \text{ kg}\cdot\text{ha}^{-1}$ , F<sub>4</sub>=50% more than soil test or  $270 \text{ kg}\cdot\text{ha}^{-1}$ , M<sub>1</sub>= control, M<sub>2</sub>=  $20 \text{ t}\cdot\text{ha}^{-1}$  livestock manure.



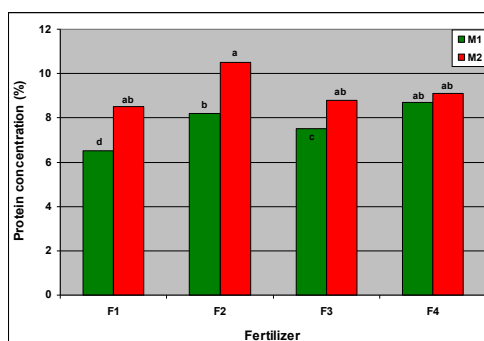
**Fig.4.** Mean comparison interaction effect of treatment on seed yield via Duncan test at 5% probability level. F<sub>1</sub>= non use of nitrogen control, F<sub>2</sub>= 50% less than soil test or  $90 \text{ kg}\cdot\text{ha}^{-1}$ , F<sub>3</sub>=equal soil test or  $180 \text{ kg}\cdot\text{ha}^{-1}$ , F<sub>4</sub>=50% more than soil test or  $270 \text{ kg}\cdot\text{ha}^{-1}$ , M<sub>1</sub>= non use of livestock manure or control, M<sub>2</sub>=  $20 \text{ t}\cdot\text{ha}^{-1}$  livestock manure.

Fallah *et al.* (2007) reported that a combination of manure and inorganic fertilizers increased maize yield than to use of mineral fertilizer alone. The reason for this is the role of livestock manure in improving soil structure and providing some of the low-consumption elements as well as essential elements of the plant by mineral fertilizers. Cheraghi *et al.* (2016) studied the effect of organic manure and phosphorus fertilizer on yield and yield components of bread wheat and reported that the combined application of organic manure or vermicompost with chemical fertilizer has a better effect on yield and yield components of common wheat rather than single application. On the other hand combined application of organic and chemical fertilizers had more efficiency due to some positive interaction between their micro organisms in the soil that led to a synergistic effect and therefore lead to an increase in seed yield.

#### 4.7. Protein concentration

According the result of analysis of variance effect of different level of nitrogen fertilizer and interaction effect of treatments on protein concentration was significant at 1% probability level, but effect of different level of livestock manure was not significant (Table 3). Assessment the mean comparison result of interaction effect of treatments showed the maximum protein concentration (10.5%) was for use  $180 \text{ kg}\cdot\text{ha}^{-1}$  nitrogen (equal soil test) with  $20 \text{ t}\cdot\text{ha}^{-1}$  livestock manure and the lowest one (6.5%) belonged to the control treatment (Fig.5).

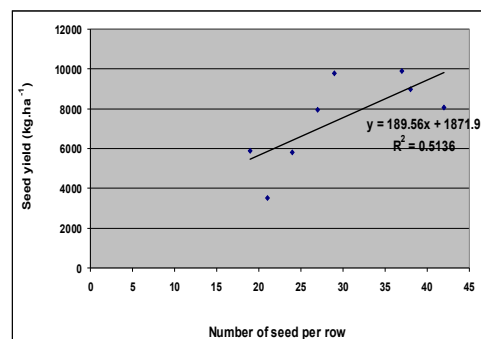
Some researcher such as Abakemal *et al.* (2016) and Birendra *et al.* (2016) reported same result. The combined use of chemical fertilizers and Nitroxin, by preventing loss due to use bio-fertilizer nitrogen, the more nitrogen, the amount of protein in the treatments increased (Yousef poor and Yadvy, 2014).



**Fig.5.** Mean comparison interaction effect of treatment on protein concentration via Duncan test at 5% probability level. F<sub>1</sub>= control, F<sub>2</sub>= 50% less than soil test or 90 kg.ha<sup>-1</sup>, F<sub>3</sub>=equal soil test or 180 kg.ha<sup>-1</sup>, F<sub>4</sub>=50% more than soil test or 270 kg.ha<sup>-1</sup>, M<sub>1</sub>= control, M<sub>2</sub>= 20 t.ha<sup>-1</sup> livestock manure.

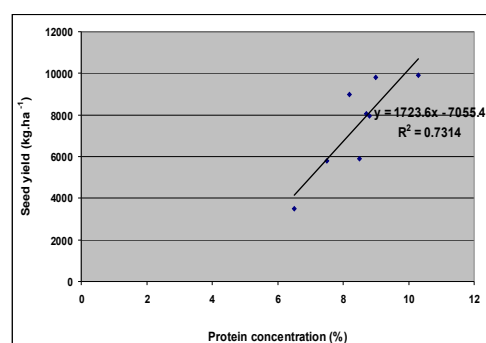
#### 4.8. Correlation between traits

Evaluation the correlation between studied characteristics revealed relation of seed yield and number of seed per row and protein percentage was significant and positive (Fig. 6, 7). Jorfi *et al.* (2015) reported that seed yield had a significant positive correlation with the number of seeds per ear, number of seeds per row, seed weight, and ear length. With the increase ear length due to the reduction percent of ear without seed and its direct impact on seed yield and its components, increased.



**Fig.6.** Correlation between seed yield and number of seed per row.

By other traits such as plant height, ear diameter and inoculation percentage had positive correlation and between number of seed row per ear, length of ear without seed and percent of ear without seed was negatively correlated, also, this correlation was not significant.



**Fig.7.** Correlation between seed yield and protein concentration.

## 5. CONCLUSION

According result of this research use 180 kg.ha<sup>-1</sup> nitrogen fertilizer (equal soil test) and 20 t.ha<sup>-1</sup> livestock manure improve quantitative and qualitative traits of corn and can be advised to farmers. The integrated application of fertilizers and manure led to reduce use of chemical fertilizers, save energy, decrease environmental pollution and im-



prove the soil physical conditions. Generally advised to combine manure and conventional fertilizer for several years to provide the conditions needed for sustainable agriculture.

#### ACKNOWLEDGMENT

The authors thank all colleagues and participants, who took part in the study.

#### FOOTNOTES

**AUTHORS' CONTRIBUTION:** All authors are equally involved.

**CONFLICT OF INTEREST:** Authors declared no conflict of interest.

**FUNDING/SUPPORT:** This study was done by scientific support of Department of Soil Science, Islamic Azad University, Ahvaz Branch.

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