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# Investigation of different soil fertilizing systems on forage yield and quality of Sorghum (*Sorghum bicolor* (L.) *moench*)

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**Key words:** Sorghum (*Sorghum bicolor (L.) moench*), forage yield, soil fertilization system, integrated system, quality of forage.

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**Abstract**

In order to study the effect of soil fertilization systems on yield and quality of sorghum (*Sorghum bicolor (L) Moench*) an experiment was conducted using a randomized completed block design (RCBD) with three replications in 2008 at the college of Aboureihan research farm of University of Tehran. The treatments were various levels of chemical fertilizers (N.P.K), different level of animal manure, mixture of different ratios of fertilizer and manure as integrated systems and a control without fertilizer and manure. Fertilizations treatments significantly affected forage yield and quality of sorghum. For chemical fertilizers, total DM yield was increased to 7.61 and 7.39 t $ha^{-1}$ by the treatments (kg $ha^{-1}$) $N_{120}/P_{96}/K_{120}$ and $N_{40}/P_{32}/K_{40}$, respectively. For organic systems, the highest yields of 10.1 and 9.23 t $ha^{-1}$ were obtain by treatments of 20 and 10 tones of manure/ha respectively. In the integrated system, the highest DM values of 11.5 and 10.1 t $ha^{-1}$ were obtained in treatments $N_{120}/P_{96}/K_{120}/$ $manure_{10000}$ and $N_{140}/P_{112}/K_{140}/$ $manure_{5000}$, respectively. Chemical and integrated systems increased crude protein (CP) in sorghum. For dry matter digestibility (DMD) there were no significant difference among fertilizing systems, although all of them produced higher DMD compared to control. For water soluble carbohydrate (WSC) the positive effect of organic fertilizer was higher than in the other two systems. According to the results soil fertilizing systems had significant effect on forage yield and quality and among different soil fertilizing systems, integrated system was the most appropriate but further studies would be needed.

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**Introduction**

Today, The problem of population growth and tendency to more consumption of foodstuffs especially livestock products and animal proteins, has turned to a challenging issue. Considering the high population growth rate, especially in developing countries (which perhaps about 50% of their population suffering from starvation) the problem of food preparation is propounded more seriously. According to the population of livestock animal in our country, which is more than 90 million, and with attention to the area of pastures, obtained forage and incidence of successive droughts which affected the pastures, the extent of pastures are decreasing. These sources can provide only %25 of nutritious needs of animals (Noor-Mohammadi *et al.*, 2001). So the pastures not only cannot afford the nutritious need of animals but also at current conditions manifold imposition of animals to pastures, disordered, irregular and inopportune grazing are the main cause of pasture destruction and soil erosion (Vandermeer, 1989). Because of the lack of meaty products in Iran, annually exorbitant charges are paid to import required products from other countries. But try to provide nutritious source for livestock within country is the most important step to overcome this problem. Development of animal husbandry and depended alimentary industries is possible when necessary food and confident nutritive sources are available. So behind modification and extension of natural pastures, production of forage plants is also one of the important initial steps. According to fact that Iran is located in the waist of dry and semidry areas and also population growth which leads to increase food necessities specially proteins, the importance of plants with high adaptability to this climate and high capacity to protein storage as forages has attracted a great deal of interests. Although cultivation of forage plants such as sorghum with low need to water is a solution to increase livestock products. So development of species with remarkable characteristics such as less water consumption and more production of dry matter or in other words with higher water use efficiency (WUE), has a great importance. Also the amount of nitrogen fertilizer has a great role in obtaining maximum yield of forage and its nutritive value promotion (Yousefzadeh *et al.*, 2009) Determination of optimized level of nitrogen is very important to achieve reach-protein forage with no nitrate toxicity.

Soil fertility may be defined as the capacity to supply plant nutrients in adequate amount and in suitable proportion. The fertility develops by application of organic animal manure and mineral fertilizers. Moreover, the nutritional requirement of plants could not be fully met by the use of organic animal manure only. Hence, application of mineral nutrient becomes essential to satisfy nutrient uptake. It is universally accepted that the use of mineral fertilizers is an integral part of practices for increasing the agricultural production (Poudel *et al.*, 2001). The effect of different soil fertilizing systems has been studied on several plants such as globe artichoke (*Cynara scolymus* L.) (fateh, *et al.*, 2009), common vetch (*Vicia sativa* L.) (Gul *et al.* (2009), Pea (*Pisum sativum* L.) (Khanday *et al,* 2012) and Rice (*Orysa sativa* L.) (Amiri Larijani and Hoseini, 2012). Fateh *et al*, (2009) reported that Chemical and integrated systems increased crude protein (CP), K and P contents in globe artichoke. Field experiment on Rice (*Orysa sativa* L.) showed combined use of organic and chemical fertilizer - compared with chemical fertilizer alone - resulted in more tiller number (28%), more chlorophyll content at panicle initiation stage (28%) and flowering time (13.5%), more panicle/m2 (60%), number of filled grains/m2 (20.6%), spikelet per panicle (19.6%) and more grain yield (30.6%) (Amiri Larijani and Hoseini, 2012). Rahman *et al.* (1998) found that the vegetative growth and yield of berry was the highest with the combined application of manures and fertilizers. The aim of this study was to evaluate the effects of soil fertilizing systems on forage yield and its quality of Sorghum (*Sorghum bicolor (L.) moench*) for livestock feeding.

**Materials and methods**

*Experimental site and soil characteristics*

The experiment was conducted in 2008 at Aboureihan research farm of University of Tehran

(35°26́ N, 71° 28́ E, 1321 m above sea level) in 2008 growing season.

This location characterized by arid condition of mild winter and dry hot summer. Mean annual rainfall in 2008 were 271 mm. The experiment site was clay loam with pH of 7.4, organic matter (6.1 g $kg^{-1}$), total nitrogen (0.08%), P2O5 (22.8 mg $kg^{-1}$) and K2O (140 mg $kg^{-1}$). We used a randomized complete block experimental design with three replications.

*Treatment details and fertilizer application*

The treatments were arranged as five levels of chemical fertilizer including N, P and K (Chemical fertilizing system), four levels of animal manure (Organic fertilizing system), seven levels of integrated use of animal manure and chemical fertilizers (Integrated fertilizing system) (Table1). We used a randomized complete block experimental design with three replications.

The sources of N, P, K and animal manure were Urea, Super phosphate, potassium sulfate and dairy cow animal manure respectively. The first half of the nitrogen fertilizer and total of phosphor and potassium fertilizers were applied before sowing and the rest at 9-10 leaf stages. A randomized completed block design (RCBD) with three replications in this study.

*Planting / sowing and harvesting*

Three seeds were sown per hill and thinning was done as to be one plant per hill after full establishment. Planting date and sowing depth (3-5 cm) were as recommended by agricultural specialist for similar farming conditions. Irrigation was performed about weekly. Plants were in Areas of 5m² hand-harvested from each plot.

*Plant sampling and chemical analysis*

Data were recorded at 14-15 leaf, vegetarian rosette stage for aboveground biomass (kg $ha^{-1}$) and to determine dry matter yield a sample for each plots was weighted, dried at 70°C for 24 h, and reweighed. This sample subsequently was ground with a Retsch Impeller-type mill (1mm screen) for measurement of quality traits. Quality traits crude protein (CP %), acid detergent fiber (ADF), water-soluble carbohydrate (WSC), ash and dry matter digestibility (DMD) were estimate using near infrared spectroscopy (NIR).

*Statistical Analysis*

Data analysis were performed using SAS (statistical analysis system ver 9.1) and comparisons were made using Duncan's multiple range test at $P<0.05$.

**Results and discussion**

*Forage dry matter*

One of the main quantitative in forage crop yield is forage dry matter production. Statistical analysis of data indicates that soil fertilizing systems had significant ($p<0.01$) effect on sorghum dry matter production (Table 2). Similarly, Lanyasunya *et al.* (2007); Efthimiadou *et al.* (2009), Gul *et al.* (2009), Naveen *et al.* (2009), Fateh *et al.* (2009), Urkurkar *et al.* (2010) and Yolcu, (2011) reported significant differences in yield with the application of different fertilizer system. The results of mean comparison (Table3) showed that the highest DM yield was determined by application of integrated treatment 11 (N = 40, P = 32, K = 40 kg ha + OM = 30 t ha) by 10161 kg dry matter production per ha. Treatment 2 (N = 40, P = 32, K = 40 kg ha) had the highest values of 7392 kg ha among chemical treatments. For organic fertilization system, treatments 15 (OM = 15 t ha) and 16 (OM = 10 t ha) had the highest values. Application of all kind of fertilizers significantly increased biomass of sorghum compared to control. The rates of increasing were 39, 111 and 86% for chemical fertilizer, integrated system and organic systems, respectively. The results were in agreement with the literature (Eghbal, *et al.,* 2001; Adediran *et al.*, 2004; Ullah, *et al.*, 2008; fateh, *et al.*, 2009). It seems that, organic fertilizing systems had less effect on biomass compared to the other fertilizing systems. This could be attributed to the slow releasing from manures in the first year of application (transient period) or negative effect of high level of manure on plant-Rhizobium ssp relation (Tan and Serin, 1995; Acikgoz, 2001). The same results may be expected in some of integrated fertilizing systems when integrated fertilizing systems received higher value of manures than others. Nevertheless, Acharya, (1998) suggested in some of integrated fertilizing systems, biomass increase because they had no transient period. It seems that manure fertilizing or other organic fertilizing had increasing DM yield at the second or third years of application. Ghosh *et al.* (2004) reported the highest values of DM yield at integrated fertilizing systems compared to organic and chemical fertilizing systems in sorghum (*sorghum bicolor*) and soybean (*Glycin max*). Gerbil and power, (1999) & Adediran *et al.* (2004) reported that application of manure fertilizer on absorbable nitrogen had the same yield as chemical systems. However, Loecke *et al.* (2004) reported that, just well-decayed manure fertilizing had the same yield with the chemical systems. Vanload *et al.* (2001) suggested that application of organic fertilizers could not provide the nitrogen need of plants. Kramer *et al.* (2002) reported that, although total absorbing nitrogen by plants in the organic system is less than the chemical system but continuous releasing of nitrogen from organic matter lead to nitrogen absorbing had a continuous and sustaining compared to chemical systems. Our results provide the better synchronizing between rate of absorbing and available nitrogen value that it caused to increase in yields.

**Table 1.** Used dosage of the soil fertilization treatments and fertilizer types.

| Soil fertilizing systems | Treatment number | Chemical fertilizer(Kg/ha) | | | Manure fertilizer (Tone/ha) |
|---|---|---|---|---|---|
| | | K2O | P2O5 | N | |
| Control | 1 | - | - | - | - |
| Chemical | 2 | 40 | 32 | 40 | - |
| | 3 | 80 | 64 | 80 | - |
| | 4 | 120 | 96 | 120 | - |
| | 5 | 160 | 128 | 160 | - |
| Integrated( Chemical + Organic) | 6 | 20 | 16 | 20 | 35 |
| | 7 | 40 | 32 | 40 | 30 |
| | 8 | 60 | 48 | 60 | 25 |
| | 9 | 80 | 64 | 80 | 20 |
| | 10 | 100 | 80 | 100 | 15 |
| | 11 | 120 | 96 | 120 | 10 |
| | 12 | 140 | 112 | 140 | 5 |
| Organic | 13 | - | - | - | 40 |
| | 14 | - | - | - | 30 |
| | 15 | - | - | - | 20 |
| | 16 | - | - | - | 10 |

*Quality traits*

Forage quality was shown close linkage with fiber content, which is needed in coarse form to maximize rumen function. The lignified part of fiber is indigestible yet it is a requirement because undignified material will not elicit adequate rumination (Van Sorest, 1994).

*Crude protein (CP)*

Soil fertilization treatments significantly ($p<0.05$) affected CP % (Table 2). CP varied from 22.16 % at treatment 15(OM = 20 t/ ha$^{-1}$) to 26.54% in treatment 10 (K = 100, P = 80, P = 100 kg ha$^{-1}$ + OM = 15 t ha$^{-1}$). In chemical treatments, all Treats were at the same statistical groups by 24.61, 25.03 26.24 and 26.22 CP%. For integrated system, the highest CP% values were obtained at treatment 10 (26.54%) and 6 (25.60%). Based on these results it can conclude that treatment 10 provided the best mixture of chemical and manure fertilizer in comparison with other treatments because plant absorbed the most nitrogen. For organic system, treatments 14 and 16 with values 24.34 and 23.80% had the highest CP%, respectively (Table3). Crude protein percent increased for chemical, integrated and organic systems 11, 8 and 1% compared to control treatment. The lower CP% for organic treatments compare with chemical and integrated systems was probably due to lower nitrogen content and also slow release of nitrogen in these fertilizers (Brussaard and Ferrera-Cerrato, 1997). It seems that higher levels of nitrogen in the soil lead to higher CP value. These results reported by other research.

*Dry Matter Digestibility (DMD)*

Soil fertilizing systems significantly affected DMD (p<0.01) (Table 2). DMD values were varied from 51.06% in control to 58.93% in treatment 6 (K = 20, P = 16, N = 20 kg ha$^{-1}$ + OM = 35 t ha$^{-1}$) (Table 3). It seems that increasing in DMD in chemical system than other systems is related to effect of nitrogen (there is a positive significant relation between nitrogen amounts and DMD) (table 4). According to the study also with increase in chemical fertilizers from treatment 2 (k=40 ‹P=32 ‹N=40 k ha$^{-1}$) to treatment 5 ( K = 160, P = 128, N = 160 kg ha$^{-1}$), DMD values increased significantly. It is likely due to the positive impact of chemical fertilizers specially nitrogen fertilizer on characteristics of forage and vegetative growth. For integrated fertilizing systems, the highest DMD were related to treatments 6 (58.93%) and 8 (57.85%). Treatments 7 and 9 had highest values at organic system with 57.71% and 54.66% respectively. Three soil fertilizing systems (chemical, integrated and organic) were increased DMD values compared to control treatment. The mean values were 41, 89.8 and 64% respectively. It seems that the increase in DMD value with higher chemical fertilizer were due to rapid release of nitrogen from inorganic fertilizers.

**Table 2.** Mean squares of soil fertilizing system on forage yield and quality traits of sorghum (*Sorghum bicolor (L.) moench*).

| SOV | Df | DM (t/ha$^{-1}$) | CP (%) | Ash (%) | ADF (%) | DMD (%) | WSC (%) |
|---|---|---|---|---|---|---|---|
| | | Mean squares | | | | | |
| Replication | 2 | 9.6 $^{**}$ | 46.7 $^{*}$ | 0/09635$^{ns}$ | 5/86$^{ns}$ | 12/38$^{*}$ | 5/1259$^{*}$ |
| Soil fertilizing systems | 15 | 13.61$^{**}$ | 6/99* | 0/2047$^{ns}$ | 22/04$^{**}$ | 22/2957$^{**}$ | 11/1988$^{**}$ |
| Error | 30 | 4.85 | 6/41 | 0/2255 | 4/77 | 4/9736 | 1/068 |
| CV | - | 2/88 | 8.12 | 6.75 | 8.49 | 3.5 | 8.55 |

Ns: means no significant at level (p≤0.05), *means significant at level (p≤0.05) and **means significant at level (p≤0.01).

*Water Soluble Carbohydrates (WSC)*

Carbohydrates are the most abundant compounds in plants and about 50-80% of dry biomass of forage species are allotted to them. The water soluble carbohydrate in forage represents the more rapidly digestible part of the non structural or storage carbohydrate of the plant. Water-soluble carbohydrates are important for microbial degradation activities. If WSC be increased before ensilaging, the silage pH will increase and silage quality decreased (Ward, J. D., D. D. Red earn 2001). Soil fertilizing systems had significant effect on WSC% (p<0.01). The WSC values were varied from 2.35% at treatment 1 to 8.62% at treatment 11. In the chemical system, treatment 4 had the highest between them. For chemical fertilizing systems, the highest WSC were obtained at treatments 4 (7.04%) and 2 (6.45%). For integrated system, treatment 11 and 12 with 8.62 and 6.94% had the highest WSC% respectively. For organic system, treatment 13 and 15 with 2.98 and 2.89 had the highest WSC value respectively.

*Acid detergent fiber (ADF)*

Another important factor that affects energy or total digestible nutritious material of forage is Acid detergent fiber (ADF). Typically at the maturing step, ADF increases so the amount of energy which is taken by livestock decreases (buxton *et al.*, 1999). ADF was significantly affected by soil fertilizing systems (p<0.01) (table 2) and has a reverse relation with chemical fertilizer increasing (table 4). Ramroudi reported that higher level of nitrogen in fertilizer leads to reduction in ADF value in sorghum (Ramroudi *et al.*, 20011).The lowest and highest ADF values was obtained by treatment 1 (control) with value 32.07 % and treatment 5 (K=160 ،P=128 ، N=160 kg per ha) with value of 39.71 respectively. Correlation coefficient table showed that there was a negative significant relation between ADF, percent of digestibility of dry matter and crude protein.

*Ash*

Ash percent represents mineral nutrients values that with increasing of ash percent in plants, the nutritive value of the forage crops increased. Soil fertilizing systems had no significant effect on ash percentage (table 2). Ash varied from7.06% (treatment 12) to 8.77 (treatment 9). For this trait, organic and integrated system had higher values than organic systems. The ash content in plants in organic and integrated systems was higher than in chemical fertilization. Perhaps it is due to chemical fertilizers level of washing and nitrogen fixation were high at first year and animal manure provided small amount of nutritive material for plant. Ash percent had positive significant relations with crude protein.

**Table 3.** Mean comparison of forage traits as affected by soil fertilization.

| fertilization treatments | Treat. No. | DMY (t/h$^{-1}$) | | CP (%) | | WSC (%) | | DMD (%) | | ADF (%) | | Ash (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control | 1 | 5.46 | h | 22.96 | ab | 2.35 | Abc | 51.06 | de | 32.07 | d | 7.22 | ab |
| Chemical | 2 | 7.39 | fg | 24.61 | ab | 6.45 | Bc | 57.13 | ab | 33.18 | d | 7.08 | ab |
| | 3 | 5.56 | h | 25.03 | ab | 5.64 | Bcd | 57.10 | ab | 33.33 | cd | 7.43 | ab |
| | 4 | 7.61 | f | 26.24 | ab | 7.04 | Ab | 58.77 | A | 39.51 | a | 7.58 | ab |
| | 5 | 7.14 | g | 26.22 | ab | 3.97 | Dfe | 55.44 | abc | 39.71 | a | 7.35 | ab |
| Integrated | 6 | 4.06 | j | 25.60 | ab | 3.26 | Fe | 58.93 | A | 33.30 | cd | 7.32 | ab |
| (Chemical + | 7 | 5.22 | h | 24.55 | ab | 3.64 | Fe | 55.08 | abcd | 35.65 | abcd | 7.25 | ab |
| Organic) | 8 | 8.12 | e | 23.06 | ab | 3.58 | Fe | 57.85 | ab | 35.45 | bcd | 7.58 | ab |
| | 9 | 7.18 | g | 25.60 | ab | 4.84 | Cde | 54.68 | abcde | 35.31 | bcd | 7.88 | a |
| | 10 | 9.69 | c | 26.54 | a | 3.58 | Fe | 57.33 | ab | 33.58 | cd | 7.43 | Ab |
| | 11 | 11.5 | a | 23.47 | ab | 8.62 | A | 51.86 | bcd | 38.48 | ab | 7.49 | ab |
| | 12 | 10.1 | b | 24.94 | ab | 6.94 | Ab | 54.15 | bcde | 37.43 | abc | 7.06 | ab |
| Organic | 13 | 8.08 | e | 22.85 | ab | 2.89 | Fe | 52.21 | cde | 35.31 | bcd | 7.41 | ab |
| | 14 | 5.48 | h | 24.34 | ab | 2.45 | F | 52.43 | cde | 38.20 | ab | 7.30 | ab |
| | 15 | 10.1 | b | 22.16 | b | 2.98 | Fe | 57.71 | ab | 32.06 | d | 7.56 | ab |
| | 16 | 9.23 | d | 23.80 | ab | 2.68 | Fs | 54.66 | abcde | 35.64 | abcd | 7.43 | ab |

* Means in the same column followed by different letter(s) are significantly using Duncan test (p≤0.05).

*Statistical correlation among traits*

Correlation between DM and fresh weight yield was found strongly positive (5.61**). The correlation between DM and fresh weight yield vs. quality traits were not consistent, suggesting that quality traits are largely independent of DM yield; hence, it should be possible to improve both yield and forage quality. DMD had negative correlation with ADF and positive one with CP (table 4). Because ADF is completely indigestible fiber, a negative correlation CP is expected and is in agreement with other work (jafari and naseri, 2007; fateh *et al.*, 2009).

**Table 4**.Correlation coefficients between forage yield, quality traits of sorghum (*Sorghum bicolor (L) Moench*) as affected by soil fertilization.

| Traits | ASH (%) | CP (%) | ADF (%) | DMD (%) | WSC (%) | FW (t ha$^{-1}$) | DM yield (t ha$^{-1}$) |
|---|---|---|---|---|---|---|---|
| Ash (%) | | | | | | | |
| CP (%) | 0.46** | | | | | | |
| ADF (%) | 0.08 | -0.19 * | | | | | |
| DMD (%) | -0.10 | 0. 47** | -0.92** | | | | |
| WSC (%) | 0.21 | -0.54** | 0.54** | 0.64** | | | |
| FW (t ha$^{-1}$) | 0.14 | -0.47* | -0.60** | -0.66** | 0.88** | | |
| DM yield (t ha$^{-1}$) | 0.11 | -0.04 | -0.17 | 0. 12 | 0.15 | 5.61** | |

Ns: means no significant at level (p≤0.01), *means significant at level (p≤0.05) **means significant at level (p≤0.01).

Total ash content was positive and statistically significant with CP. This result is expected since total ash is produced from minerals. WSC was positive correlated with both total ash content. For WSC vs. CP, correlations were negative and significant. In perennial ryegrasses, as growth increases with rapid uptake of nitrogen fertilizer, a decrease in WSC and an increase in CP content are environmentally induced effects (Humphreys, 1989). There was positive correlation between fresh weight and dry weight but there was no significant correlation between forage yield and quality traits, (r = 5.61**) (table 4).

## Discussion

The results of this research have shown the high potential of the sorghum to produce biomass for animal feeding with good chemical – nutritive characteristics (quality). This potential has even greater interest considering that the cultivation, with the exception of the first year, was carried out in low input management. It was possible to obtain more than 5 t $ha^{-1}$ dry biomass and up to 30 t $ha^{-1}$ fresh weight per year.

The results of this experiment showed that soil fertilizing systems had significant effect on forage yield and quality of sorghum. Crude protein percent increased for chemical, integrated and organic systems 11, 8 and 1% compared to control treatment and nitrogen had most important role between other nutrients on crude protein percent. This assumes that high solubility of nitrogen at chemical and integrated system caused significant increase in it. Low efficiency for organic system may be for slow releasing of nutrients of the manure. The effects of soil fertilization treatments on dry matter digestibility were similar for all treatments (except treatment 4 and 6). That indicated among three soil-fertilizing systems no differences were obtained. In this report, all treatments had significantly increased forage quality parameter compared control. In this study, statistically insignificant responses were obtained for effects of soil fertilization on fiber (ADF) values. These results showed that soil fertilizing system had no effects on lignifications of the sorghum.

In order to achieve a sustainable soil fertilizing system some important characters should be investigated .According to our study in the case of sorghum some of this characters are as bellow; in chemical nutrient system high level while utilization of pure chemical fertilizer, not only had no significant effect on quantitative efficiency but also reduced the quality of forage, application of integrated nutrient systems increased both nitrogen efficiency and forage quality. For systems based on usage of chemical fertilizers, a remarkable decrease in nitrogen storage was detected while application of animal manure in integrated and organic nutrient systems improved soil fertility and chemical situation. Based on the efficiency of integrated nutrient method, it was found that chemical and organic fertilizers are complementary. In conditions which addition of chemical fertilizer is not possible, application of animal manure can improve the physical and chemical soil conditions to achieve a higher efficiency. Of course application of chemical and organic fertilizers in proper ratios is as the case may be. According to the result of this study it was found that at first hand, high level application of pure chemical fertilizers in an agro ecosystem isn't a suitable way and at second hand while application of animal manure has many benefits but qualitative and quantitative efficiency of products aren't acceptable so organic nutrient system by itself is not suitable to achieve stable agricultural goals too and it is essential to use an intermediate template which is called integrated system.

## Conclusion

The results of this research showed the potential of the sorghum to produce biomass for animal feeding with good chemical–nutritive characteristics (quality). Also it was found that soil fertilizing systems had significant effect on forage yield and quality and among different soil fertilizing systems (organic, chemical and integrated) integrated system was the most appropriate.

**References**

**Acharya CL, Bishoni SK, Yadavanshi HS.** 1998. Effect of long term application of fertilizers and organic manures and inorganic amendments under continuous cropping on soil physical and chemical properties in an Alison. Indian Journal of Agriculture Science **58,** 509-516.

**Acikgoz E.** 2001. Forage Crops (in Turkish), University of Uludag, Publication No: 182, Bursa, Turkey.

**Adediran JA, Taiwo LB, Akande MO, Sábulo RA, Iowa OJ.** 2004. Application of organic and inorganic fertilizer for fertilizer for sustainable maize and cowpea yields in Nigeria. Journal of plant nutrition **27,** 1163-1181. http://dx.doi.org/10.1081/PLN-120038542

**Amiri Larijani, B, Hoseini SJ.** 2012. Comparison of integrated chemical and organic fertilizer management on rice growth and yield under system of rice intensification (SRI). International Journal of Agronomy and Plant Production **3,** 726-731.

**Brussaard L, Ferrera-Cerrato R.** 1997. Soil ecology in sustainable agricultural systems. New York: Lewis Publjshers U.S.A., 168 P.

**Buxton DR, Anderson IC, Hallam A.** 1999. Performance of sweet and forage sorghum grown continuously double cropped with winter rye, or in rotation with soybean and maize. Agronomy journal **91,** 93-101.

**Efthimiadou A, Bilalis D, Karkanis A, Froud-Williams B, Eleftherochorinos I.** 2009. Effects of Cultural System (Organic and Conventional) on Growth, Photosynthesis and Yield Components of Sweet Corn (Zea mays L,) under Semi-Arid Environment. Not Bot Hort Agrobot Cluj **37,** 104-111.

**Eghbal B, Winhold B, Gilley J.** 2001. Intensive manure management for improved nutrient utilization and environment quality. Soil and Water Conservation Research **1,** 128-135.

**Fateh E, Chaichi MR, Sharifi Ashorabadi E, Mazaheri D, Jafari AA, Rengel Z.** 2009. Effects of organic and chemical fertilizers on forage yield and quality of globe artichoke (Cynara scolymus L.). Asian Journal of Crop Science, **1,** 40-48.

**Gerbil B, Power JF.** 1999. Composted and non-composted manure application to conventional and no-tillage system: corn yield and nitrogen uptake. Agronomy journal **91,** 819-825.

**Ghosh PK, Ramesh P, Bandyopadhyay KK, Hati KM, Misra AK.** 2004. Comparative effectiveness of cattle manure, poultry manure, phosphocompost and fertilizer-NPK on three cropping systems in verticals of semi-arid tropics. Crop yield and system performance. Bio resource Technology **95,** 77-83.

**Gul I, Tan M, Dumlu Gul Z.** 2009. The effects of chemical fertilizer, farmyard manure and some soil amendments on seed yield of common vetch. I. GAP Organic Agriculture Congress, 17-20 November 2009 Sanlıurfa, Turkey.

**Humphreys MO.** 1989. Assessment of perennial rygrass (*Lolium perenne* L.) for breeding. II. Component of winter hardiness. Euphytica, **41,** 99-106. http://dx.doi.org/10.1007/BF00022418

**Kramer AW, Timothy AD, Horwath WR, Kassel CV.** 2002. Combining fertilizer and organic input to synchronize N supply in alternative cropping systems in California. Agriculture Ecosystem & Environment **91,** 233-243. http://dx.doi.org/10.1016/S0167-8809(01)00226-2

**Jafari A, Nasser H.** 2007. Genetic variation and correlation among yield and quality traits in cocksfoot (Dactylis glomerata L.). Journal of the Agriculture Science Cambridge **6,** 599-610.

http://dx.doi.org/10.1017/S0021859607007332

**Lanyasunya TP, Wang H, Mukisira EA, Lukibisi FB, Kuria DM, Kibitok NK.** 2007. Effect of manure and fertilizer application on yield of sorghum almum harvested at different maturity stages. J Anim Vet Adv. **6,** 879-882.

**Loecke TD, Liebman M, Cambardella CA, Richard TL.** 2004. Corn response to composting and time of application of solid swine manure. Agronomy Journal **96,** 241-223. http://dx.doi.org/10.2134/agronj2004.2140

**Naveen NE, Panneerselvam SR, Anand SR, Sathymorthi K, Meena S.** 2009. Effect of organic manures on the yield and quality of green chillies (Capsicum annuum L.). Research on Crops. **10,** 621-625.

**Noor Mohammadi Gh, Siadat A, Kashani A.** 2001. Cereal Agronomy Volume 1. Published by Shahid Chamran University-Ahwaz, 446 P.

**Poudel DD, Horwath JP, Mitchell T, Temple S.** 2001. Impact of cropping systems on soil nitrogen storage and loss. Agricultural systems. **68,** 253-268. http://dx.doi.org/10.1016/S0308-521X(01)00011-7

**Rahman MM, Sarker MAM, Hasina A, Kashem MA.** 1998. Role of some indigenous substances as organic fertilizers on the growth and yield of brinjal plants. Bangladesh J. Sci. Indus. Res. **33,** 275-281.

**Ramroudi M, Majnoun Hosseini N, Hosseinzadeh H, Mazaheri D, Hosseini MB.** 2011. Evaluating the effects cover crops, tillage systems and nitrogen rates on soil properties and sorghum forage yields. Agronomy Journal **24,** 18-23.

**Shakoor Khanday AB, Sharma U, Dubey PK, Bhardawaj SB.** 2012. Effect of different fertilizer and irrigation management systems on soil physic-chemical properties and pod yield of garden pea (*Pisum sativum* L.). International Journal of Food, Agriculture and Veterinary Sciences **2,** 155-160.

**Tan M, Serin Y.** 1995. The effects of rhizobium inoculation and various nitrogen fertilization doses on hay, seed, straw and crude protein yields, percentage of crude protein and nodule number in common vetch (Vicia sativa L.) under irrigated conditions in Erzurum. Türk Tar. ve Orm. Derg **19,** 137-144.

**Ullah MS, Islam MS, Islam MA, Haque T.** 2008. Effects of organic manures and chemical fertilizers on the yield of brinjal and soil properties. J. Bangladesh Agril. Univ **6,** 271–276. http://dx.doi.org/10.3329/jbau.v6i2.4821

**Urkurkar JS, Tiwari A, Chitale S, Bajpai RK.** 2010. Influence of long- term use of inorganic and organic manures on soil fertility and sustainable productivity of rice (Oryza sativa) and wheat (Triticum aestivum) in inceptisols. Indian J Agr Sci., **80,** 208-212.

**Vandermeer JH.** 1989. The ecology of intercropping. Cambridge Univ, Press New York.

**Vanload B, Aihou K, Aman S, Olwuafor EN, Tossah BK, dials S, Singing N, Lease O, Mark R, Deckers J.** 2001. Maize yield as affected by organic inputs and urea in the West African moist savanna. Agronomy Journal. **93,** 1191-1199. http://dx.doi.org/10.2134/agronj2001.1191

**Van Sorest PJ.** 1994. Nutritional ecology of the ruminant. Comstock publishing associates a division of Cornell University Press. Ithaca, New York, USA.

**Ward JD, Redfearn DD, Mccormick ME, Cuomo GJ.** 2001. Chemical composition, ensiling characteristics, and apparent digestibility of summer annual forages in a subtropical double-cropping system with annual ryegrass. Dairy Science Journal **84,** 177-182.

**Yolcu H, Seker H, Gullap MK, Lithourgidis A, Gunes A.** 2011. Application of cattle manure, zeolite and leonardite improves hay yield and quality of annual ryegrass (Lolium multiflorum Lam.) under semiarid conditions. Aus J Crop Sci.

**Yousefzadeh S, AghaAlikhani M, Mokhtassi-Bidgoli A.** 2009. Effect of total amount of nitrogen and its application methods on yield and quality in twice harvesting of forage sorghum. Proceedings of the 16th Nitrogen Workshop Connecting different scales of Nitrogen use in Agriculture. June, 28th-July, 1st 2009.