Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.2557

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **5 (3):** 596-604 (2017)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Fodder Quality of Teosinte Fodder as Influenced by Nitrogen, Phosphorus and Zinc Application

Surendra Mohan[1], Eajaz Ahmad Dar[2*] and Magan Singh[3]

[1]M.Sc scholar, Forage Research and Management Centre

[2]Ph.D. Scholar, Department of Agronomy, Punjab Agricultural University, Ludhiana

[3]Senior Scientist and In-charge, Forage Research and Management Centre

National Dairy Research Institute-Karnal (Haryana)-132001

*Corresponding Author E-mail: darajaz9@gmail.com

Received: 6.02.2017 | Revised: 15.02.2017 | Accepted: 16.02.2017

ABSTRACT

A field experiment was conducted at National Dairy Research Institute, Karnal during rainy season of 2012 in randomized block design with 30 treatment combinations comprises five levels of nitrogen (0, 40, 80,120 and 160 kg N ha^{-1}), three levels of phosphorus (0, 20 and 40 kg P_2O_5 ha^{-1}) and two levels of zinc (0 and 30 kg $ZnSO_4$ ha^{-1}) with four replications. The present study concluded that application of 160:40:30 kg ha^{-1} of N: P: Zn resulted in highest percentage of dry matter, crude protein (CP), ether extracts (EE) and ash content in teosinte fodder. However, crude fibre (CF), nitrogen free extracts (NFE), organic matter, carbohydrates, neutral detergent fibre (NDF), acid detergent fibre (ADF) and hemicelluloses content were lowest for the same treatment combination (160:40:30 kg ha^{-1} N: P: Zn). Thus nutritive factors of fodder like CP and EE were enhanced, while as anti nutritive factors like CF, NDF and ADF were reduced with balanced nutrient application.

Keywords: *Teosinte, Nitrogen, Phosphorus, Zinc, Quality.*

INTRODUCTION

Teosinte (*Zea mexicana* L.) popularly known as 'Makchari' is considered as an ancestor of modern multiple rowed corn. It is a neglected fodder crop which has not received the attention it deserves and very little work has been done to explore its yield potentiality. It is an excellent multi-cut fodder which gives high yield of nutritious green lush fodder in 65-70 days, with less use of inputs as compared to maize. As a fodder crop, it can be cultivated in any intensive fodder production system on account of its versatile adaptability and biomass production ability. It can be fed safely to animals as green, dry or as conserved fodder in the form of silage or hay even before flowering.

The country inhabits 15% of world livestock population on 2% geographical area, which is an indicative of the extent of livestock pressure on our resource in comparison to other countries. The total area under cultivated fodder is only 8.4 m ha, which is not sufficient to meet the needs of the growing livestock population.

Cite this article: Mohan, S., Dar, E.A. and Singh, M., Fodder Quality of Teosinte Fodder as Influenced by Nitrogen, Phosphorus and Zinc Application, *Int. J. Pure App. Biosci.* **5(3):** 596-604 (2017). doi: http://dx.doi.org/10.18782/2320-7051.2557

The country faces a net deficit of 61.1% green fodder, which may further rise due to consistent growth of livestock population at the rate of 1.23% in the coming years. By the end of 12th plan, demand for milk is expected to increase to 141 m t. The objective of the increased milk production can be met only through ensuring availability of good quality fodder. This increase in demand of fodder cannot be met through horizontal expansion of fodder crops on arable lands, as we have the limited land resources and that too used for high income cereal and cash crops. The best option is to introduce the fodder crops that can be grown under adverse soil and climatic conditions with minimum cost and maximum income.

The teosinte is one of the ideal fodder crop for such conditions as it can be grown on the acidic and waterlogged soils profitably where the other fodder crops like maize and sorghum are not even able to sustain. But the main hurdle in the cultivation of teosinte is the lack of production technology. Very little work has been done in generating the crop production technology in India and abroad. The lack of the knowledge regarding the use of optimum dose of nutrients especially nitrogen, phosphorus and zinc is of serious concern

Among the different agronomic practices, nutrient management is one of the most important factors influencing the quality attributes of teosinte fodder production. In India about 62 % and 49 % soils are deficient in nitrogen and phosphorous respectively[10]. Almost 50% of the soils globally used for cereal production are Zn deficient (Gibson[9]). Little or no use of Zn fertilizers along with imbalanced fertilization has further aggravated Zn deficiency in soils resulting in lower Zn content in grain and fodder (Rashid and Ryan[15]). These nutrients are also essential for animals, so well-nourished crop will meet the demand of these nutrients. The antagonism between phosphorus and zinc is observed mainly when both nutrients are deficient especially zinc. Keeping in view all these factors, a study was conducted to evaluate the effect of different levels of nitrogen, phosphorus and zinc on fodder quality for better animal health

MATERIAL AND METHODS

A field experiment was conducted during *Kharif* season of 2012 at the research farm of Forage Research and Management Centre, NDRI, Karnal, Haryana. The field experiment comprising 30 treatment combinations was laid out in factorial randomized block design with five levels of nitrogen (0, 40, 80,120 and 160 kg N ha^{-1}), three levels of phosphorus (0, 20 and 40 kg P_2O_5 ha^{-1}) and two levels of zinc (0 and 30 kg Zn ha^{-1}) with four replications. The soil of the experimental field was clay loam in texture. The chemical analysis of top 15 cm soil showed a neutral pH (7.2), 0.5 % organic carbon, 190.5 kg/ha permanganate extractable nitrogen, 19.2 kg/ha Olsen's (0.5 M $NaHCO_3$ extractable) phosphorus and 270.8 kg/ha exchangeable potassium with 1.5 g/cm^3 bulk density. Total rainfall and evaporation received during the crop season was 397.7 mm and 303.4 mm respectively. Half dose of nitrogen, full dose of phosphorus and zinc was applied as a basal dose as per the treatments and remaining dose of nitrogen was applied equally in two split at 30 and 45 days after sowing (DAS). The samples of teosinte fodder were collected randomly from the experimental plots, chopped to 2-3 cm particle size and dried in hot air oven at 60 ºC till a constant weight was attained. The dried samples were ground through 1 mm sieve using electrically operated Willey Mill. Dry matter, crude protein, ether extract, and total ash content, organic matter, carbohydrates and Nitrogen free extract (NFE) were estimated as per the standard procedures of AOAC[3]. Cell wall constituents (NDF, ADF and hemicelluloses) were estimated as per Van Soest *et. al.*[21]. The methods for calculating these quality factors are briefly discussed as:

Dry matter content (DM %):

Ground samples of known quantity (about 5-10 g) was taken in pre-weighed moisture cups and kept overnight in a hot air oven at 100±5°C. Dried samples were weighed and DM was calculated as follows:

$$\text{DM}\ (\%) = \frac{\text{Weight of sample after drying}}{\text{Weight of sample before drying}} \text{X } 100$$

Total ash (TA %):

About 3 g of ground sample was taken in a pre-weighed silica crucible and charred over the heater to make it smoke free. The crucible along with the sample was ignited at 600^{o}C for 3 hrs in muffle furnace. The crucible with ash was taken out and kept in desiccators to cool down and weighed again till a constant weight was obtained. The difference between the weight of empty silica crucible and with ash was the amount of total ash. The per cent ash was calculated from the following formula.

$$\text{TA}\ (\%) = \frac{\text{Weight of ash}}{\text{Weight of sample on DM basis}} \text{X } 100$$

Organic matter (OM %):

Organic matter (OM) was determined by subtracting the total ash content from 100

Crude protein content (CP %):

Total nitrogen was measured by Kjeldahl method. A known quantity of sample (1 g) was weighed and quantitatively transferred into 500 ml Kjeldahl flask and 25 ml sulphuric acid (commercial grade) and 2-3 g of digestion mixture (potassium sulphate and copper sulphate in the ratio of 10: 1) was added to it. After complete digestion, the flask was allowed to cool and finally the volume of 100 ml was made from it. 10 ml aliquot was taken in micro Kjeldahl distillation assembly and 10-15 ml Sodium hydroxide (40%) was added in and the content was heated, the liberated ammonia was trapped in 2% boric acid solution containing Tashiro's indicator (Mixture of 0.1% Methyl red + 0.1% Bromocresol green) and titrated against standard 0.01N sulphuric acid solution. The CP content was determined by the formula-

$$\text{CP}\ (\%) = \frac{\text{Vol. of} \frac{\text{N}}{10} \text{H2SO4 (ml)X Vol. made (ml) X 0.0014 X 6.25 X 100}}{\text{Aliquot taken (ml)X Dry wt. of sample (g)}}$$

Ether extracts (EE):

A known quantity (3 g) of ground moisture free sample was taken in the thimble (Whatman) and extracted for 6-8 h with petroleum ether (B.P. 40-60ºC) in Soxhlet extraction apparatus. After the extraction, the thimble was taken out and the remaining petroleum ether was recovered. The oil flask with extracted material was dried at 100±5^{o}C in hot air oven to a constant weight. The ether extract was estimated as the difference in the weight of oil flask with ether extract and the empty flask.

$$\text{EE}\ (\%) = \frac{\text{Wt. of oil flask with ether extract (g)} - \text{Wt. of empty oil flask(g)}}{\text{Wt. of sample (g)}} \text{X100}$$

Crude fibre (CF):

Accurately 3 g of defatted sample was placed in a spoutless beaker and 200 ml boiling sulphuric acid solution (0.225 N) was added and boiled for 30 minutes. The acid solution was removed by transferring it in to sintered crucible through muslin cloth and washed untill it is acid free. The acid digested residue was then subjected to alkali digestion with NaOH (0.313 N) solution. After 30 minutes, the residue was removed in sintered crucible and kept in hot air oven at 105 ^{0}C for 24 hours. The crucible was placed in a muffle furnace for 3 hours weight of the ash was recorded.

$$\text{CF}\ (\%) = \frac{\text{Wt. of crucible with dry residue (g)} - \text{Wt. of crucible with ash(g)}}{\text{Wt. of sample (g)}} \text{X100}$$

Nitrogen Free Extract (NFE):

NFE were recorded by subtracting the crude protein, ether extract, crude fibre and ash content from 100.

$$\text{NFE (\%)} = 100 - (\text{CP} + \text{CF} + \text{EE} + \text{Total ash})$$

Total carbohydrate:

Total carbohydrate was recorded by subtracting the crude fibre, ether extract and total ash from 100.

$$\text{Total carbohydrate (\%)} = 100 - (\text{CF} + \text{EE} + \text{Total ash})$$

Estimation of cell wall constituents:

The fraction of cell wall constituents such as NDF, ADF, and hemicelluloses were estimated as per Van Soest *et. al*.[21].

Neutral detergent fibre (NDF):

One gram of ground sample was taken in spoutless beaker and to this 100 ml of neutral detergent solution was added. The contents were heated to boil and refluxed for 60 min. The contents were filtered through a pre-weighed Gooch crucible (G_1) under vacuum. The contents were given 3-4 washings with hot distilled water and a final washing of acetone. The crucibles were dried to a constant weight at 100 ºC and weighed. Cell wall contents or NDF was calculated as follows:

$$\text{NDF (\%)} = \frac{\text{Wt. of crucible with residue (g)} - \text{Wt. of crucible with residual ash(g)}}{\text{Wt. of sample (g)}} \times 100$$

Acid detergent fibre (ADF):

One gram of ground sample was taken in spout less beaker and to this 100 ml of acid detergent solution was added. The contents were heated to boil and refluxed for 60 min. The contents were filtered through a pre-weighed Gooch crucible (G1) under vacuum. The contents were given 3-4 washings with hot distilled water and a final washing of acetone. The crucibles were dried to a constant weight at 100 ºC in oven and weighed. Acid detergent fibre was calculated as follows:

$$\text{ADF (\%)} = \frac{\text{Wt. of crucible with residue (g)} - \text{Wt. of empty crucible(g)}}{\text{Wt. of sample (g)}} \times 100$$

Hemicelluloses:

Hemi cellulose was calculated as the difference between NDF and ADF.

$$\text{Hemicellulose (\%)} = \text{NDF (\%)} - \text{ADF(\%)}$$

Statistical analysis:

Statistical analysis of the recorded data for each character was done using the standard procedures of analysis of variance in factorial randomized block design at α=0.05 with the help of statistical software IRRISTAT.

RESULTS AND DISCUSSION

Dry matter (%):

The data presented in Table 1 revealed that dry matter content increased with increase in the levels of nitrogen, phosphorus and zinc. Application of 160 kg N ha^{-1} produced significantly higher dry matter content as compared to 40 kg N ha^{-1} and control. However it was at par with 120 and 80 kg N ha^{-1}. Maximum (24.76 %) and minimum (22.40 %) dry matter content was noticed from 160 kg N ha^{-1} and control respectively. The results were in conformity with Shehzad *et. al.*[19]. Application of 40 kg P_2O_5 ha^{-1} produced significantly higher dry matter content (24.31%) than control (22.87 %), however it was at par with 20 kg P_2O_5 ha^{-1}. Similarly, application of 30 kg Zn ha^{-1} produced significantly higher dry matter (24.47%) content than control (23.05 %).

Crude protein (%):

The data presented in Table 1 revealed that nitrogen, phosphorus and zinc had significant effect on crude protein content of teosinte fodder. Increase in the each successive levels of nitrogen from 0 to 160 kg N ha^{-1} significantly increased the crude protein content of teosinte fodder. Maximum (8.30 %) and minimum (6.09 %) crude protein content was recorded at 160 kg N ha^{-1} and control respectively. These results are in conformity with Singh *et. al.*[20]; Ayub *et. al*.[5]; Reddy and Bhanumurthy[17] and Afzal *et. al.*[1]. Increasing levels of phosphorus also increased the crude protein content significantly. Application of 40 kg P_2O_5 ha^{-1} produced significantly higher crude protein content as compared to 20 kg P_2O_5 ha^{-1} and control. Keshwa and Jat[12]; Polat *et. al*.[14] and Rashid and Iqbal[16] also reported similar result. Zinc application (30 kg Zn ha^{-1}) also significantly increased the crude protein content of teosinte fodder. Maximum (7.09 %) crude protein content was recorded with 30 kg Zn ha^{-1}. The results are in agreement with those of Jaliya *et. al*.[11].

Ether Extract (crude fat):

Data presented in Table 1 showed that nitrogen, phosphorus and zinc application had significant effect on crude fat content of teosinte fodder. An Increase in the levels of nitrogen from 0 to 120 kg N ha^{-1} resulted in a significant increase in the crude fat content. However, an increase in crude fat with 160 kg N ha^{-1} was not statistically significant over 120 kg N ha^{-1}. Maximum (2.12 %) and minimum (1.01 %) crude fat content was recorded with the application of 160 kg N ha^{-1} and control respectively. Ayub *et. al*.[5] and Shehzad *et. al.*[19] also reported that crude fat content was positively correlated with nitrogen. Increasing levels of phosphorus significantly increased the crude fat content. Similarly, application of 20 kg P_2O_5 ha^{-1} significantly increased the crude fat content as compare to control. However it was at par with 40 kg P_2O_5 ha^{-1}. Maximum (1.83 %) and minimum (1.40 %) crude fat content was recorded with 40 kg P_2O_5 ha^{-1} and control respectively. These result are in conformity of Roy and Khandaker[18] who reported that crude fat content improved with phosphorus application. Zinc application (30 kg Zn ha^{-1}) also significantly increased the crude fat content of teosinte fodder. Maximum (1.75 %) and minimum (1.56 %) crude fat content was recorded with 30 kg Zn ha^{-1} and control respectively.

Total ash (TA):

Data presented in Table 1 showed that with an increase in the level of nitrogen from 0 to 160 kg N ha^{-1}, the total ash content increased significantly. Maximum (5.10 %) and minimum (8.31 %) ash content was recorded with application of 160 kg N ha^{-1} and control respectively. These results are also supported by Shehzad *et al.*[19]. Application of 20 kg P_2O_5 ha^{-1} had non-significant effect on total ash content as compared to control. However, it was at par with 40 kg P_2O_5 ha^{-1}. Application of 40 kg P_2O_5 ha^{-1} produced maximum (6.62 %) ash content than control (6.94 %) and the difference was statistically significant. Roy and Khandaker[18] and Rashid and Iqbal[16] also reported that phosphorus application significantly improves the ash content. Zinc application also significantly increased the ash content of teosinte fodder. The maximum (6.50 %) and minimum (7.04 %) ash content was recorded with 30 kg Zn ha^{-1} and control respectively. The ash content was increased due to increase in mineral uptake.

Crude fibre (%):

The data presented in Table 2 indicated that increasing the dose of nitrogen decreased the crude fibre content of teosinte fodder. The control plot significantly produced maximum crude fibre (32.02 %) as compared to other levels, except with 40 kg N ha^{-1}. The ash content recorded with application of 40 kg N ha^{-1} was also statistically different from 120 kg N ha^{-1} and 160 kg N ha^{-1}. Minimum crude fibre was recorded in those plots which received highest levels of nitrogen (160 kg N ha^{-1}). These results are conformity with findings of several researchers like Almodares *et. al.*[2]; Nadeem *et. al.*[13] and Ayub *et. al*.[6]. Phosphorus application significantly decreased the crude fibre content from maximum value of 31.21 % to minimum value of 29.41 % at 40 kg P_2O_5 ha^{-1} and control respectively. Chand *et. al*.[7] and Rashid and Iqbal[16] also reported similar result that increase in crude fibre contents was due to more dry matter accumulation with P application. Application of 30 kg Zn ha^{-1} also decreased significantly the crude fibre content of teosinte fodder. Maximum (31.92 %) and minimum (29.26 %) crude fibre was found in plot treated with 0 and 30 kg Zn ha^{-1} respectively.

Nitrogen free extract (%):

The data presented in Table 2 indicated that nitrogen and zinc application significantly influenced the NFE content of teosinte fodder. However there was no significant effect of phosphorus application on NFE. The increasing dose of nitrogen decreased the NFE content of teosinte fodder. The highest NFE content was recorded in control plot (55.78 %) and minimum (51.73 %) with application of 160 kg N ha^{-1}. The percentage decrease in NFE content with increase in nitrogen dose from 0 160 kg N $ha^{-}1$ was 7.3 %. The NFE content decreased because of increase in other constituents like CP, EE and ash content with application of nitrogen. Nadeem *et. al.*[13] also reported decrease in NFE content with increase in dose of nitrogen. Oppositely, application of zinc significantly increased the NFE content of teosinte fodder. The highest (54.6 %) and lowest (52.9 %) NFE content was recorded with application of 30 and 0 kg Zn ha^{-1}. However phosphorus application didn't produce any significant change in NFE content of teosinte fodder.

Organic matter (%):

The data presented in Table 2 revealed that application of nitrogen, phosphorus and zinc significantly influenced the OM content of teosinte fodder. The OM content was highest (94.9 %) in control plot and lowest with application of 160 kg N ha^{-1} (91.7 %). The percentage decrease in OM content was 3.4 %. The OM content decreased because of consequent increase in mineral ash with application of nitrogen. Similarly, application of phosphorus and zinc significantly decreased the OM content of teosinte fodder. The highest (93.4 %) and lowest (93.1 %) OM content was recorded with application of 0 and 40 kg P ha^{-1}. The OM content was lower with application of 30 kg Zn ha^{-1} as compared to no application of Zn.

Total carbohydrates:

Total carbohydrates significantly decreased with each successive dose in the nitrogen, phosphorus and zinc. The highest carbohydrate percentage was recorded in the plot where no N, P and Zn were applied. Similar findings were also reported by Almodares *et. al.*[2] that soluble carbohydrate decreased with increase in N levels (Table 2).

Neutral Detergent Fibre (NDF):

The data presented in Table 3 showed that effect of different levels of nitrogen and zinc had significant effect on NDF content, however phosphorus application had non-significant effect. Increasing the levels of nitrogen up to 120 kg N ha^{-1} significantly decreased the NDF content over lower levels of nitrogen. However difference was not statistically significant for 160 kg N ha^{-1} which was at par with 120 kg N ha^{-1}. Cox *et. al*.[8] and Ayub *et. al*.[5] also reported that NDF content decreased with nitrogen application. Maximum (63.35 %) and minimum (60 %) NDF content was noticed in control and 160 kg N ha^{-1} plots respectively. Application of phosphorus levels had non-significant effect on NDF content. Similar findings were also reported by other researchers *viz.,* Chand *et. al*.[7] and Rashid and Iqbal[16]. Zinc application (30 kg ha^{-1}) significantly decreased the NDF content of teosinte fodder. Maximum (61.60 %) and minimum (61.14 %) NDF content was noticed in control and 30 kg Zn ha^{-1} plots respectively.

Acid Detergent Fibre (ADF):

The data regarding ADF content presented in Table 3 indicate that increasing the levels of nitrogen up to 120 kg N ha^{-1} significantly decreased the ADF content of teosinte fodder. Application of nitrogen 160 kg N ha^{-1} produced significantly lower ADF content (30.69 %) than other levels, however it was at par with 120 kg N ha^{-1}. Maximum ADF content (32.98 %) was noticed in those plots where no N was applied. Cox *et. al*.[8] and Ayub *et. al*.[5] also reported similar result. Phosphorus application had non-significant effect on ADF content. Zinc application @ 30 kg ha^{-1} significantly decreased the ADF content of teosinte fodder. Maximum (31.84 %) and minimum (31.30 %) ADF content was noticed at control and 30 kg Zn ha^{-1} respectively.

Hemicelluloses (%):

The data presented in Table 3 showed increasing the levels of nitrogen, decreased the hemicelluloses content of teosinte fodder. However phosphorus and zinc application had non-significant on hemicelluloses content. Application of 160 kg N ha^{-1} produced significantly lower hemicelluloses content than 0 and 40 kg N ha^{-1}. Maximum hemicelluloses content was noticed in that plot where no N was applied (control).

Table 1: Effect of nitrogen, phosphorus and zinc application on DM, CP, EE and total ash content (%) of teosinte fodder

Treatment (kg/ha)	DM (%)	CP (%)	EE (%)	Total ash (%)
Nitrogen levels				
N_0	22.40	6.09	1.01	5.10
N_{40}	23.15	6.69	1.42	6.06
N_{80}	23.76	7.19	1.72	6.75
N_{120}	24.74	7.84	2.00	7.63
N_{160}	24.76	8.30	2.12	8.31
SEm ±	0.41	0.14	0.08	0.15
CD (p= 0.05)	1.14	0.41	0.22	0.43
Phosphorus levels				
P_0	22.87	6.82	1.40	6.62
P_{20}	24.10	7.22	1.72	6.75
P_{40}	24.31	7.63	1.83	6.94
SEm ±	0.32	0.11	0.06	0.12
CD (p= 0.05)	0.89	0.31	0.17	0.33
Zinc levels				
Zn_0	23.05	7.09	1.56	6.50
Zn_{30}	24.47	7.36	1.75	7.04
SEm ±	0.26	0.09	0.05	0.10
CD (p= 0.05)	0.72	0.26	0.14	0.27

Table 2: Effect of nitrogen, phosphorus and zinc on CF, NFE, OM and total carbohydrate content (%) of teosinte fodder

Treatment (kg ha^{-1})	CF (%)	NFE (%)	OM (%)	Carbohydrate (%)
Nitrogen levels				
N_0	32.02	55.78	94.90	87.80
N_{40}	31.20	54.63	93.94	85.83
N_{80}	30.45	53.89	93.25	84.34
N_{120}	29.80	52.73	92.37	82.53
N_{160}	29.53	51.73	91.69	81.27
SEm ±	0.45	0.47	0.15	0.23
CD (p= 0.05)	1.26	1.33	0.43	0.64
Phosphorus levels				
P_0	31.23	53.92	93.38	85.16
P_{20}	31.16	53.15	93.25	84.31
P_{40}	29.41	54.19	93.06	83.60
SEm ±	0.35	0.37	0.12	0.18
CD (p= 0.05)	0.97	NS	0.33	0.50
Zinc levels				
Zn_0	31.94	52.91	93.50	84.85
Zn_{30}	29.26	54.60	92.96	83.86
SEm ±	0.28	0.30	0.10	0.14
CD (p= 0.05)	0.79	0.84	0.27	0.41

Table 3: Effect of nitrogen, phosphorus and zinc application on NDF, ADF and hemicelluloses content (%) of teosinte fodder

Treatment (kg/ha)	NDF (%)	ADF (%)	Hemicelluloses (%)
Nitrogen levels			
N_0	63.35	32.98	30.36
N_{40}	62.20	32.01	30.19
N_{80}	61.09	31.32	29.76
N_{120}	60.23	30.83	29.40
N_{160}	60.00	30.69	29.30
SEm ±	0.22	0.15	0.26
CD (p= 0.05)	0.62	0.43	0.72
Phosphorus levels			
P_0	61.52	31.60	29.92
P_{20}	61.11	31.41	29.70
P_{40}	61.47	31.68	29.79
SEm ±	0.17	0.11	0.20
CD (p= 0.05)	NS	NS	NS
Zinc levels			
Zn_0	61.60	31.84	29.76
Zn_{30}	61.14	31.30	29.85
SEm ±	0.14	0.10	0.16
CD (p= 0.05)	0.39	0.27	NS

CONCLUSION

The present study concluded that application of 160:40:30 kg ha^{-1} of N: P: Zn resulted in highest percentage of dry matter, crude protein (CP), ether extracts (EE) and ash content in teosinte fodder. However, crude fibre (CF), nitrogen free extracts (NFE), organic matter, carbohydrates, neutral detergent fibre (NDF), acid detergent fibre (ADF) and hemicelluloses content were lowest for the same treatment combination (160:40:30 kg ha^{-1} N: P: Zn). Thus nutritive factors of fodder like CP and EE were enhanced, while as anti nutritive factors like CP, NDF and ADF were reduced with balanced nutrient application.

REFERENCES

1. Afzal, M., Ahmad, A. and Ahmad A.U.M., Effect of nitrogen on growth and yield of sorghum forage (*Sorghum bicolour* L.) Moench cv.) under three cuttings system. *Cercetări Agronomice în Moldova*. **45:** 57-64 (2012).
2. Almodares, A., Jafarinia, M. and Hadi, M.R., The effects of nitrogen fertilizer on chemical compositions in corn and sweet sorghum. *American-Eurasian Journal of Agricultural & Environmental Sciences*. **6:** 441-446 (2009).
3. AOAC., Official Methods of Analysis, Eighteenth Revised. Association of Official Analytical Chemists, Arlington, Virginia, USA (2005).
4. Ayub, M., Nadeem, M.A., Sharar, M.S. and Mahmood, N., Response of maize (*Zea mays* L.) fodder to different levels of nitrogen and phosphorus. *Asian Journal of Plant Sciences*. **1:** 352-354 (2002).
5. Ayub, M., Nadeem, M.A., Tanveer, A. and Husnain, A., Effect of different levels of nitrogen and harvesting times on growth, yield and quality of sorghum fodder. *Asian Journal of Plant Sciences*. **4:** 304-307 (2002a).
6. Ayub, M., Tanveer, A., Ahmad, R. and Tariq, M., Fodder yield and quality of two maize (*Zea mays* L.) varieties at different nitrogen levels. *The Andhra Agricultural Journal*. **4:** 7-11 (2000).
7. Chand, K., Dixit, M.L. and Arora S.K., Yield and quality of forage sorghum as affected by phosphorus fertilization. *Journal of Indian Society of Soil Science*. **40:** 302-306. (1992).

8. Cox, W.J., Kalonge, S., Cherney, D.J.R. and Reid, W. S., Growth, yield and quality of forage maize under different nitrogen management practices. *Agronomy Journal* **85:** 341-347 (1993).
9. Gibson, R.S., Zinc: The missing link in combating micronutrient malnutrition in developing countries. In*: Proceedings of the Nutrition Society* **65:** 51–60 (2006).
10. ICAR, Handbook of Agriculture 6th Edition, Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi, India (2010).
11. Jaliya, M.M., Falaki, A.M., Mahmud, M. and Sani, Y.A., Effects of sowing date and NPK fertilizer rate on yield and yield components of quality protein maize (*Zea mays* L.). *ARPN Journal of Agricultural and Biological Science*. **3:** 22–29 (2008).
12. Keshwa, G.L. and Jat, P.C., Effect of phosphorus and zinc on quality and fodder production of summer pearl millet (*Pennisetum glaucum*). *Indian Journal of Agricultural Sciences*. **37:** 118-120 (1992).
13. Nadeem, M.A., Iqbal, Z., Ayub, M., Mubeen, K. and Ibrahim, M., Effect of nitrogen application on forage yield and quality of maize sown alone and in mixture with legumes. *Pakistan Journal of Life and Social Sciences*. **7:** 161-167 (2009).
14. Polat, T., Bukun, B. and Okant, M., Dose response effect of nitrogen and phosphorus on forage quality, yield and economic return of rangelands. *Pakistan Journal of Botany*. **39:** 807-816 (2007).
15. Rashid, A and Ryan, J., Micronutrients constraints to crop production in soils with Mediterranean-type characteristics*:* A review. *Journal of Plant Nutrition*. **27:** 959-975 (2004).
16. Rashid, M. and Iqbal, M., Effect of phosphorus fertilization on the yield and quality of maize (*Zea mays*) fodder on clay loam soil. *The Journal of Animal and Plant Sciences*. **22:** 199-203 (2012).
17. Reddy, D.M. and Bhanumurthy, V.B., Fodder, grain yield, nitrogen uptake and crude protein of forage maize as influenced by different nitrogen management practices. *International journal of Biodiversity Science and Management*. **1:** 69-71 (2010).
18. Roy, P.R.S. and Khandaker, Z.H., Effect of phosphorus fertilizer on yield and nutritional value of sorghum (*Sorghum bicolor*) fodder at three cuttings. *Bangladesh Journal of Animal Sciences*. **39:** 106 – 115 (2010).
19. Shehzad, M.A., Maqsood, M., Bhatti, M.A., Ahmad, W. and Shahid, M. R., Effects of nitrogen fertilization rate and harvest time on maize (*Zea mays* L.) fodder yield and its quality attributes. *Asian Journal of Pharmaceutical and Biological Research*. **2:** 19-26 (2012).
20. Singh, V., Sharma, S.P., Verma, S.S. and Joshi, Y. P., Effect of nitrogen fertilization and cutting management on the yield and quality of herbage of teosinte. (*Euchlaena mexicana* Schrad.). *Tropical Agriculture*. **65:** 194-196 (1988).
21. Van Soest, P.J., Robertson, J.B. and Lewis, B.A., Methods for dietary fibre, neutral detergent fibre, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science.* **74:** 3583-3597 (1991).