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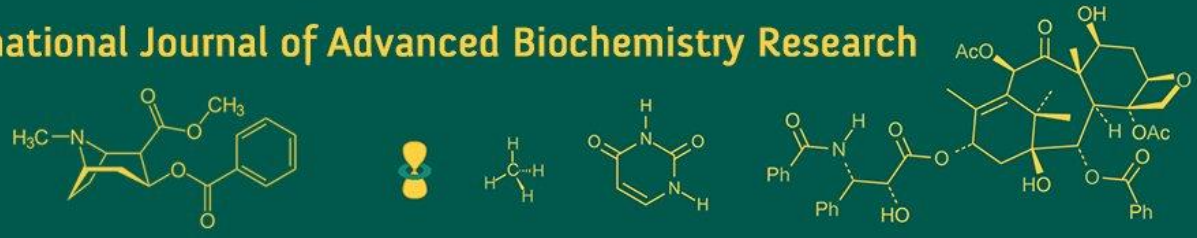

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Quality parameters and nutrient ratios of summer forage pearlmillet (*Pennisetum glaucum*) as influenced by of nitrogen, iron and zinc

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Abstract
A field experiment was conducted at Agronomy Instructional Farm, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during summer season of 2016 to, "different nutrient levels of nitrogen, iron and zinc on growth and yield of summer forage pearlmillet (*Pennisetum glaucum*)" There were Four levels of N viz., 80(N_1), 100(N_2), 120(N_3) and 140(N_4) kg ha^{-1}, two levels of Fe viz., (Fe_1) 2 and 9 (Fe_2) 4 kg ha^{-1} and two levels of Zn viz., 1.5(Zn_1) and 3(Zn_2) kg ha^{-1} were tried in factorial randomised block design with three replications. With uniform rates of phosphorus at 60 kg/ha, respectively. Application of 140 kg N/ha, 4 kg Fe/ha and 3 kg Zn/ha recorded Significantly the highest values of crude protein content and crude protein yield, nitrogen content and its uptake, zinc content and its uptake, iron content and its uptake and available nitrogen, iron, zinc But in case of crude fibre content highest value was observed by 80 kg N/ha, 2 kg Fe/ha, 1.5 kg Zn/ha in first, second and third cuts.

Keywords: Quality parameter, nitrogen, iron, zinc nutrient contain its uptaks

Introduction
Forage pearlmillet (*Pennisetum glaucum*) is known as "Rajka Bajri" and widely grown as multi-cut system in Gujarat. Forage pearlmillet having high percentage of crude protein (8 to 10%) and absence of HCN as in jowar so, it can be cut even before flowering. Due to its fast ratooning capacity, prolific yield potential, good number of cutting and high nutritive value. Nitrogen is an important constituent of protein and chlorophyll. It imparts dark green colour to plant, promote vegetative growth and rapid early growth. It improves the quality by increasing the protein content of fodder and governs to considerable degree the utilisation of potassium, phosphorus and other elements. The role of zinc and iron in crop nutrition is well recognised as it is used for bio-synthesis of plant auxins, nitrogen metabolism, oxidation-reduction reaction, chlorophyll formation, photosynthesis, important enzyme system and respiration in plants.

Materials and Methods
A field experiment was conducted during the summer season of the years 2016 Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, District : Banaskantha (Gujarat). The plots were fertilized with four levels of nitrogen, two levels of iron and two levels of zinc tried in Randomized Block Design (factorial) with three replication. Common application of phosphorus was given @ 60 kg P_2O_5/ha as a basal dose for all treatments. Forage pearlmillet, variety; Gujarat Fodder Bajra-1 (GFB 1) was sown in the experiment. The entire quantity of phosphorus was applied through single super phosphate as a common dose to all the plots at the time of sowing. The First dose of nitrogen was applied as a basal and remaining two doses of nitrogen were applied after the harvesting of first and second cut, respectively. The iron and zinc were applied at the time of sowing. The seeds of forage pearlmillet seed rate of 12 kg/ha. The first cut was taken at 50 days and second and third cut were taken at 40 days interval. The soil and plant samples were analyzed adopting standard procedure.

Results and Discussion

Quality parameters

Effect of nitrogen levels

The data presented in Table 1. Showed that the effect of different nitrogen levels on crude protein content and crude protein yield during all three cuts was found significant. The level N_4 (140 kg N/ha) registered significantly the highest crude protein content and crude protein yield in all three cuts. This increase in crude protein content and crude protein yield of forage pearl millet could be attributed to increase in nitrogen content in plant along with increase in nitrogen rate which might have helped in synthesis of more protein as nitrogen being a constituent of various metabolites including protein and amino acids. Increase in crude protein content and crude protein yield with increase in level of nitrogen in forage oat has been reported by Chaurasia *et al*. (2006[b]) [3] and Singh *et al*. (2014) [13].

The data presented in Table 1. Showed that the crude fibre content in three cuts was decreased with each successive increase in levels of nitrogen from 80 to 140 kg N/ha. Significantly the highest fibre content (29.9, 28.7 and 26.2%) was recorded by the application of 80 kg N/ha (N_1) during all three cuts. Higher nitrogen application in reduced rate of lignifications there by maintaining the fodder quality. Nitrogen application decreased the pectin, cellulose and hemicellulose contents, which are major constituents of crude fibre Kalra and Sharma (2015) [5].

Effect of iron levels

The results presented in Table 1. revealed that The application of 4 kg Fe/ha recorded significantly higher crude protein content and crude protein yield as compared to 2 kg Fe/ha during all three cuts, respectively. This might be due to application of iron is increase absorption of nitrogen, consequently in higher protein concentration in crop. These findings corroborate with reports of Singh and Yadav (1980) [21].

The results presented in Table 1. revealed that crude fibre content significantly differed owing to different levels of iron. Application of 2 kg Fe/ha recorded higher crude fibre content during all cuts. This might be due to the iron play important role in metabolism of carbohydrates, proteins and lipids. These results confirmed with the finding Amanullah *et al*. (2007) [1].

Effect of zinc levels

A Perusal of data presented in Table 1. revealed that crude protein content and crude protein yield significantly differed owing to different levels of zinc. Application of 3 kg Zn/ha produced significantly higher crude protein content and crude protein yield as compared to 1.5 kg Zn/ha during all three cuts. This might be due to zinc responsible for activation of number of enzymes associated with protein synthesis as well as with RNA synthesis which direct concern with protein synthesis. The above findings are in complete agreement with earlier work of Bhoya *et al*. (2013) [2] and Moinuddin (2010) [6].

The results outlined in Table 1. revealed that crude fibre content significantly differed owing to different levels of zinc. The application of 1.5 kg Zn/ha recorded highest crude fibre content as compared to The results outlined in Table 4.14 revealed that crude fibre content significantly differed owing to different levels of zinc. The application of 1.5 kg Zn/ha recorded highest crude fibre content as compared to 3 kg Zn/ha during first, second and third cut, respectively. This might be due to the zinc responsible for activation of number of enzymes associated with RNA synthesis which direct concern with protein synthesis. Similar results were also observed by Verma *et al*. (2005) [17] and Priyanka *et al*. (2009) [9].

Chemical Studies

Nutrients content and its uptake

Effect of nitrogen levels

The data presented in Table 2 showed that the effect of different nitrogen levels on nitrogen content and its uptake was Significantly higher nitrogen content and its uptake was recorded by the application of 140 kg N/ha (N_4) but, it was at par with the application of 120 kg N/ha (N_2) at first cut to third cut, respectively. Similar increase in nitrogen content and its uptake by summer forage pearlmillet due to nitrogen levels was observed by Reager *et al*. (2014) [11] and Singh *et al*. (2014) [13].

Examination of data revealed that different nitrogen levels recorded Significantly the higher iron content and its uptake was recorded under the level N_4 (140 kg N/ha) Application of higher level of nitrogen tended to increase the iron content and its uptake by summer forage pearlmillet. The nitrogen have a created favourable soil environment to enhance microbial activity and thereby improvement in iron availability. Similar finding have been reported by Singh *et al*. (2014) [13].

The different nitrogen levels showed Significantly the higher zinc content and its uptake was recorded under the level N_4 (140 kg N/ha) which was being at par with N_3 (120 kg N/ha). Significantly the lowest zinc content and its uptake was noted under level N_1 (80 kg N/ha) during all three cuts.application of higher level of nitrogen significantly increases the zinc content and its uptake by summer forage pearlmillet. This might be due to the nitrogen have a created favourable soil environment to enhance microbial activity and thereby improvement in Zn availability. Similar finding have been reported by Singh *et al*. (2014) [13]. The data pertaining the Table 3. showed that the effect of different nitrogen levels on available phosphorus, available potash, available iron and available zinc of the soil after harvesting of the crop was found non-significant.

Effect of iron levels

The results presented in Table 2 revealed that the different iron levels gave significant variation in respect to nitrogen content and its uptake. Application of 4 kg Fe/ha being recorded significantly higher nitrogen content and its uptake

The data revealed that iron content and its uptake was Significantly the maximum noticed with Fe_2 (4 kg Fe/ha) as compared was noticed with Fe_2 (2 kg Fe/ha) during all three cuts. similar increase in iron content and its uptake by summer forage pearlmillet due to iron levels was observed by Sarangi *et al*. (2006) [18]

An appraisal of data presented in Table 2 indicated that Significantly the maximum zinc contant and its uptake was noticed with Fe_2 (4 kg Fe/ha) This might be due to the iron is a component of many enzymes associated with energy transfer, nitrogen reduction and fixation. These results confirmed with the finding of Singh *et al*. (1995) [19].

Effect of zinc level

The data presented in Table 2 revealed that the different zinc levels gave significant variation in respect to nitrogen content and its uptake. Under the level Zn_2 (3 kg Zn/ha) recorded significantly higher nitrogen content and its uptake compared to Zn_1 (1.5 kg Zn/ha) during all three cuts.

An appraisal of data presented in Table 2 indicated that Significantly higher iron content and its uptake was noticed with Zn_2 (3 kg Zn/ha) The higher dose of zinc gave a significantly increase in iron content and iron uptake this might be due to, The zinc is increasing cation exchange capacity of roots helped in increasing absorption of nutrient from the soil Similar increase in iron content and its uptake by summer forage pearlmillet due to iron levels was observed by Abbas *et al*. (2009) [20].

The data revealed in Table 3 that the Significantly higher zinc content and its uptake was recorded under the 3 kg Zn/ha during all three cuts.It was due to increase in concentration of zinc in soil solution with the application of zinc resulting higher zinc content in plant tissues and dry-matter yield, to be a increase in zinc uptake in forage pearlmillet These results confirmed with the finding of (Verma *et al*., 2005) [17].

Table 1: Quality parameters of summer forage pearlmillet as influenced by nitrogen, iron and zinc levels

Treatments		Crude protein content (%)			Crude protein yield (kg/ha)			Crude fibre content (%)		
		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
[A]	**Nitrogen levels :**									
	N_1 : 80 kg/ha	5.11	5.08	4.92	398.0	355.8	317.5	29.9	28.7	26.2
	N_2 : 100 kg/ha	5.32	5.19	5.01	424.3	368.6	335.8	29.3	28.6	24.9
	N_3 : 120 kg/ha	5.47	5.34	5.16	466.8	391.6	359.0	27.5	26.0	23.5
	N_4 : 140 kg/ha	5.63	5.50	5.31	512.6	459.0	410.3	27.3	24.5	22.0
S.Em.±		0.10	0.10	0.09	22.3	11.7	16.2	0.7	0.7	0.7
C.D. at 5%		0.29	0.28	0.28	64.5	33.8	46.9	2.1	2.1	2.1
[B]	**Iron levels :**									
	Fe_1 : 2 kg/ha	5.15	5.04	4.86	411.2	365.0	323.4	29.4	25.0	24.9
	Fe_2 : 4 kg/ha	5.64	5.51	5.32	489.6	422.5	388.0	27.5	23.5	23.6
S.Em.±		0.07	0.07	0.06	15.8	8.3	11.5	0.5	0.6	0.5
C.D. at 5%		0.20	0.20	0.19	45.6	23.9	33.1	1.5	27.7	1.5
[C]	**Zinc levels :**									
	Zn_1 : 1.5 kg/ha	5.21	5.09	4.92	411.3	365.6	324.5	29.2	26.7	25.0
	Zn_2 : 3 kg/ha	5.58	5.46	5.27	489.5	421.9	386.8	27.7	25.2	23.3
S.Em.±		0.07	0.07	0.06	15.8	8.3	11.5	0.5	0.5	0.5
C.D. at 5%		0.20	0.20	0.19	45.6	23.9	33.1	1.5	1.5	1.5
C.V.%		6.59	6.58	6.61	17.2	10.3	15.8	8.9	9.9	10.6
Interaction :										
N x Fe		NS	NS	NS	NS	NS	NS	NS	NS	NS
N x Zn		NS	NS	NS	NS	NS	NS	NS	NS	NS
Fe x Zn		NS	NS	NS	NS	NS	NS	NS	NS	NS
N x Fe x Zn		NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Nitrogen and iron content and uptake of summer forage pearlmillet as influenced by nitrogen, iron and zinc levels

Treatments		Nitrogen content (%)			Nitrogen uptake (kg/ha)			Iron content (ppm)			Iron uptake (g/ha)		
		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
[A]	**Nitrogen levels :**												
	N_1 : 80 kg/ha	0.83	0.81	0.79	63.7	56.9	50.8	346.5	343.5	341.5	2647.3	2574.5	2204.1
	N_2 : 100 kg/ha	0.85	0.83	0.80	67.9	59.0	53.7	352.5	349.5	347.5	2810.7	2662.5	2324.2
	N_3 : 120 kg/ha	0.88	0.86	0.83	74.7	62.7	57.4	364.3	361.3	359.3	3099.5	2830.5	2482.0
	N_4 : 140 kg/ha	0.90	0.88	0.85	82.0	73.4	65.7	368.5	365.5	363.5	3350.5	3226.2	2803.8
S.Em.±		0.01	0.01	0.01	3.6	1.9	2.6	0.09	0.06	0.09	140.6	90.8	104.7
C.D. at 5%		0.04	0.04	0.04	10.3	5.4	7.5	NS	NS	NS	406.0	262.2	302.3
[B]	**Iron levels :**												
	Fe_1 : 2 kg/ha	0.82	0.80	0.77	65.8	58.4	51.7	352.1	349.1	347.1	2800.8	2704.3	2299.0
	Fe_2 : 4 kg/ha	0.90	0.88	0.85	78.3	67.6	62.1	363.8	360.8	358.8	3153.3	2942.6	2608.1
S.Em.±		0.01	0.01	0.01	2.5	1.3	1.8	3.8	3.8	3.8	99.4	64.2	74.0
C.D. at 5%		0.03	0.03	0.03	7.3	3.8	5.3	11.2	11.2	11.2	287.1	185.4	213.7
[C]	**Zinc levels :**												
	Zn_1 : 1.5 kg/ha	0.83	0.81	0.78	65.8	58.5	51.9	351.5	348.5	346.5	2770.9	2673.2	2278.4
	Zn_2 : 3 kg/ha	0.89	0.87	0.84	78.3	67.5	61.9	364.4	361.4	359.4	3183.1	2973.7	2628.7
S.Em.±		0.01	0.01	0.01	2.5	1.3	1.8	3.8	3.8	3.8	99.4	64.2	74.0
C.D. at 5%		0.03	0.03	0.03	7.3	3.8	5.3	11.2	11.2	11.2	287.1	185.4	213.7
C.V.%		6.59	6.58	6.61	17.2	10.3	15.8	5.3	5.3	5.4	16.4	11.1	14.8
Interaction :													
N x Fe		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
N x Zn		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Fe x Zn		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
N x Fe x Zn		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Zink content, uptake of summer forage pearlmillet as influenced by nitrogen, iron and zinc levels

Treatments		Zinc content (ppm)			Zinc uptake (g/ha)		
		1st cut	2nd cut	3rd cut	1st cut	2nd cut	3rd cut
[A]	**Nitrogen levels:**						
	N_1 : 80 kg/ha	32.0	30.2	28.1	246.4	210.3	182.0
	N_2 : 100 kg/ha	33.0	31.2	29.1	261.5	220.6	194.2
	N_3 : 120 kg/ha	34.9	33.1	31.0	300.6	240.2	214.8
	N_4 : 140 kg/ha	35.1	33.3	31.2	316.3	276.4	241.1
S.Em.±		0.3	0.3	0.3	6.0	6.2	9.0
C.D. at 5%		0.9	0.9	0.9	17.3	17.8	26.0
[B]	**Iron levels:**						
	Fe_1 : 2 kg/ha	33.3	31.5	29.4	270.4	227.1	195.1
	Fe_2 : 4 kg/ha	34.2	32.4	30.3	291.9	246.6	220.8
S.Em.±		0.2	0.2	0.2	4.2	4.4	6.3
C.D. at 5%		0.6	0.6	0.6	12.2	12.6	18.4
[C]	**Zinc levels:**						
	Zn_1 : 1.5 kg/ha	33.4	31.6	29.5	271.3	225.4	193.9
	Zn_2 : 3 kg/ha	34.1	32.3	30.2	291.1	248.3	222.0
S.Em.±		0.2	0.2	0.2	4.2	4.4	6.3
C.D. at 5%		0.6	0.6	0.6	12.2	12.6	18.4
C.V.%		3.4	3.6	3.9	7.4	9.0	15.0
Interaction :							
N x Fe		NS	NS	NS	NS	NS	NS
N x Zn		NS	NS	NS	NS	NS	NS
Fe x Zn		NS	NS	NS	NS	NS	NS
N x Fe x Zn		NS	NS	NS	NS	NS	NS

Conclusion

The overall results indicated that application of higher rate of N,Fe and Zn application increased CP and CPY but decreased CF contents in forage pearlmillet the nutrient of forage pearmillet were in the acceptable range and either favorably N,Fe and Zn application thues quality of forage pearl millet was improved through N,Fe and zn application

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