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Proximate Composition and Fibre Fraction of Pearl Millet Fodder as Influenced by Different Nutrient Management Practices

Rakesh Kumar[1], Hardev Ram[1], Rakesh Kumar[1], R.K. Meena[1], B.L. Meena[2], Manisha[2], Deepak Kumar[1]

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ABSTRACT

Background: Quality traits of forage crops are largely influenced by various agronomic management practices at field conditions in different climatic strata. Judicious use of organic and inorganic sources of nutrients may sustain soil health, fodder productivity and quality. Keeping above facts in view an experiment was conducted for evaluation of nutrient management practices to increase fodder quality of pearl millet.

Methods: The experiment was carried out during *kharif* season (2019-20) at Agronomy Research Farm, ICAR-NDRI, Karnal and laid out in randomized block design with eight treatments, *viz*., T_1: Absolute control; T_2: 100% RDF; T_3: 100% RDF + Cow urine foliar spray; T_4: 100% RDF + PGPR; T_5: 100% RDF + PGPR + Cow urine foliar spray; T_6: 75% RDF + Cow urine foliar spray; T_7: 75% RDF + PGPR and T_8: 75% RDF + PGPR + Cow urine foliar spray. Each treatment had three replications.

Result: The results showed that the fodder proximate principles *viz*., dry matter, crude protein, ether extract and total ash content increase by 27.04, 21.33, 24.06 and 31.17% respectively, with T_5 treatment than absolute control. The cell wall constituents such as neutral detergent fibre (63.99%), acid detergent fibre (39.50%) and acid detergent lignin (5.60%) were also lower in T_5 treatment over the other treatments. It can be concluded that the fodder quality of pearl millet significantly better with application of T_5 treatment, that was found statistically at par with T_4 treatment. Which, will further strengthen and sustain the performance of livestock in terms of health and milk production.

Key words: Cow urine, Fodder, Milk, Pearl millet, Quality.

INTRODUCTION

India has highest number of livestock (536.76 million) in the world and according to 20th livestock census 2019, the population of major livestock *viz*., buffalo, cattle, sheep and goat in India is 109.85, 193.46, 74.26 and 148.88 million, respectively (Anonymous, 2020). Fodder is an essential component for livestock production, its demand increases with increasing population of livestock. Good quality fodder can curtail the cost of livestock feeding because feeding contributes about 65 to 70% of total cost of livestock farming. Currently, India is facing a net deficit of green fodder by 35.6%, dry fodder (straw) by 10.95% and concentrates by 44% (Kushwaha *et al*., 2018). Deficiency of quality fodder and feed for livestock leads to decrease their production level and has impact on their health, which ultimately influences return from livestock sector (Surve *et al.,* 2011). Among the different fodder crops pearl millet (*Pennisetum glaucum*) is a gifted crop of the tropical and sub-tropical regions that provide food, fodder and stover (dry straw) to millions of families of poor farmer and their livestock. Nutrient management is an important aspect to achieve sustainable crop production. Scenario from green revolution era, shows productivity of cereals increased largely with the use of high yielding variety, intensive agronomic practices and indiscriminate use of chemical fertilizers at higher rate with little or no use of organic source of nutrients to plant, that creates adverse effects on soil *viz.,* inadequacy in one or more nutrients and deterioration of soil fertility, which, leads to stagnating or even declining of crop productivity and quality (Shormy *et al*., 2013). Deficiency of nutrients in soils leads to the production of mineral deficient foods and fodder. However, animal and humans depending on such fodder and foods have also shown symptoms of nutrients deficiency (Shukla *et al*., 2015). Judicious use of inorganic and organic sources of nutrients may sustain and enhance the crop productivity and quality.

Among different organic source of nutrients for plant, cow urine and PGPR are excellent and important for agriculture uses. Cow urine contains; nitrogen, phosphorus, potassium, sulphur, sodium, manganese, iron, carbolic acid, silicon, chlorine, enzymes, and hormones (Saunders, 1982). PGPR, is a consortium of microorganisms that actively colonize around plant roots and enhances plant growth and

[1]ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India.
[2]Division of Soil and Crop Improvement, ICAR-Central Soil Salinity Research Institute, Karnal-132 001, Haryana, India.

Corresponding Author: Rakesh Kumar, ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India.
Email: rlohra13@gmail.com

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yield (Wu *et al.*, 2005). PGPR strains belongs to a wide range of genera *viz.*, *Pseudomonas, Azospirillum, Bacillus, Serratia* and *Azotobacter* (Bashan *et al.*, 2004). The beneficial effects of PGPR are due to their ability to produce various organic compounds *viz.*, auxins, gibberellins, cytokinin, ethylene, organic acids, siderophores, nitrogen fixation, solubilization of insoluble inorganic soil phosphate to available form, sulphur oxidation, extra cellular production of antibiotics, increase in root permeability and enhancement of essential plant nutrients uptake (Enebak and Carey, 2000 and Pal *et al.*, 1999). Considering the above facts, the present study was executed to find out a suitable combination of nutrient source to enhance the fodder quality of pearl millet.

MATERIALS AND METHODS

This study was conducted during *kharif* season, in the year 2019-20 at Agronomy Research Farm, ICAR-NDRI, Karnal, Haryana, India, located at 29°45′ North latitude and 76°58′ East longitude and at an altitude of 245 m above mean sea level. The area has a semi-arid climate, with a mean annual rainfall of 707 mm, 70-80% of the rainfall is received during the months of July-September and rest during winter and spring seasons. The mean minimum, maximum temperature during study period was 20.49°C and 34.54°C, respectively. The soil of experimental site was clay loam in texture (Piper, 1942) with pH of 7.35, Electrical conductivity of 0.37 dS/m (Jackson, 1967), organic carbon of 0.49% (Walkley and Black's, 1934), available nitrogen of 215 kg/ha (Subbiah and Asija, 1956), available phosphorus of 24.70 kg/ha (Olsen *et al.,* 1954) and available potassium of 285 kg/ha (Jackson, 1967).

The experiment was laid out in randomized block design with eight treatments *viz.*, T_1: Absolute control; T_2: 100% RDF; T_3: 100% RDF + Cow urine foliar spray; T_4: 100% RDF + PGPR; T_5: 100% RDF + PGPR + Cow urine foliar spray; T_6: 75% RDF + Cow urine foliar spray; T_7: 75% RDF + PGPR; T_8: 75% RDF + PGPR + Cow urine foliar spray. Each treatment had three replications. The land preparation involved one deep ploughing each with disc plough, disc harrow and thereafter planking. As per treatments, recommended dose of fertilizers (80:30:30 kg/ha, N: P_2O_5: K_2O, respectively) were applied. The half of N and full doses of P_2O_5 and K_2O were applied at the time of sowing. The remaining half of the nitrogen was top-dressed as two doses 1st at 25 days after sowing (DAS) and 2nd at 40 DAS as per the treatment. Other package of practices was followed as per standard procedure for fodder pearl millet cultivation.

The PGPR (100 ml/ha seeds) liquid culture was diluted in water and applied on seeds. Thereafter, inoculated seeds were dried in shade for 60-90 minutes, after drying seeds were manually sown. Nutrifeed variety of fodder pearl millet (*Pennisetum glaucum*) was sown using 10 kg seed per hectare with maintaining row to row spacing of 30 cm and plant to plant spacing of 10 cm. As per treatments, cow urine (10%) foliar spray was applied at 30 and 45 DAS. The crop was harvested manually at 50% flowering stage. Net plot area was harvested separately from each plot. Fresh chopped plant samples were collected and subjected to analysis of different quality parameters.

The oven-dried fodder samples were ground to pass through 40 mesh sieves using a Macro-Wiley Mill, stored in air tight containers and were used for chemical analysis. The proximate analysis was done as per AOAC (2005), crude protein (CP) in samples were determined by multiplying the N % by 6.25 factor. Fibre fractions were determined as per Van Soest *et al.* (1991). All data recorded were analysed with the help of analysis of variance (Gomez and Gomez, 1984) at 5% level of significance ($P<0.05$).

RESULTS AND DISCUSSION

Effect of nutrient management on green and dry fodder yield

The study indicated (Fig 1) that green and dry fodder yield of pearl millet were significantly influenced by different nutrient management practices. Significantly higher green fodder (548.33 q/ha) and dry fodder yield (113.35 q/ha) at harvest recorded with T_5 treatment (100% RDF+PGPR+ Cow urine foliar spray), which, was found statistically at par with T_4 treatment (100% RDF+PGPR) and both were significantly higher than the other treatments. Balanced and regular supply of essential plant nutrients increases plant physiological processes mainly photosynthetic process which produce organic compounds that are translocated and assimilated in different parts of plant and this produces higher number of basal nodes leading to increase tillers per plant; increase in length, diameter and number of internodes; leaf length and width; more number of internodes leads to increase number of leaves/plants, all these growth parameters contribute to the final green fodder yield. Dry fodder yield increases due to higher accumulation of photosynthates in plant that contribute to increase dry matter content. Similar result also was reported by Chattha *et al.* (2017).

Effect of nutrient management on proximate principles

Quality parameters of fodder pearl millet was significantly influenced by different nutrient management practices. Results presented in Table 1 indicates that significantly higher dry matter (20.67%), total ash (12.83%), crude protein (9.78%), ether extract (2.44%), hemicellulose (24.49%) and cell soluble (36.01%) on dry matter basis were observed with the application of 100% RDF+PGPR+CU. However, it remained at par with 100% RDF+PGPR and both these treatments were found significantly higher over rest of the treatments. The treatment of 100% RDF+PGPR+CU improved CP content by 3.27, 6.65, 8.78 and 21.33%; ether extract by 0.826, 6.70, 8.12 and 24.06%; total ash content by 1.63, 8.74, 9.84 and 31.17% over 100% RDF+PGPR, 100% RDF+CU, 100% RDF and absolute control, respectively.

PGPR produce phytohormones (Enebak and Carey, 2000), cow urine supply enzyme and hormones (Saunders, 1982) that attributed to stimulate plant growth. Optimum

supply of nutrients as well as production of growth promoting components attributed to increase leaf area index per unit area that is responsible for higher interception of solar radiation and produce more photosynthates and nutrients acquired, resulted in to increase dry matter content. Similar results also have been reported by Chattha *et al.* (2017). Further, nitrogen accumulation in plant increase carbohydrates metabolism and subsequently, increase total ash content and decrease organic matter and total carbohydrates content in plant (Iqbal *et al.*, 2017). The highest CP content with 100% RDF+PGPR+CU, might be due to ideal availability, uptake and utilization of nitrogen. Nitrogen is integral part of amino acid that contributes in amino acid synthesis and amino acids are building block of protein. The protein content increase with increase nitrogen levels has been reported by Kushwaha *et al.* (2018). The higher availability of nitrogen with application of recommended dose of nitrogen; PGPR additionally supplement atmospheric nitrogen through biological nitrogen fixation and cow urine foliar spray supplied nitrogen to plant foliage for quick recovery of nitrogen deficiency (Sadhukhan *et al.*, 2018). The ether extract contains dissolved fats, oils, fat-soluble substance and pigments that was recorded highest with 100% RDF+PGPR+CU, due to optimum availability of nitrogen and phosphorus (Kushwaha *et al.*, 2018) through recommended dose of fertilizer application along with PGPR inoculation and cow urine foliar spray. Cow urine contains hormones and enzymes (Kishore *et al.*, 2015), PGPR produce Phyto-hormones IAA (Kumar *et al.*, 2014) that increase physiological process of plant that could have resulted in increase of ether extract.

Effect of nutrient management on yield of proximate principles

The analysis of experimental data (Fig 2) shows that likewise, quality parameters the yields of these parameters significantly influenced by nutrient management practices. The fodder pearl millet received 100% RDF+PGPR+CU attributed maximum yields of CP (11.09 q/ha), EE (2.77 q/ha) and total ash (14.55 q/ha). However, remained at par with the treatment that received 100% RDF+PGPR and both were found significantly higher over rest of the treatments. Better quality and yields of quality parameters in fodder pearl millet was also reported by Chattha *et al.* (2017) and Yolcu *et al.* (2011).

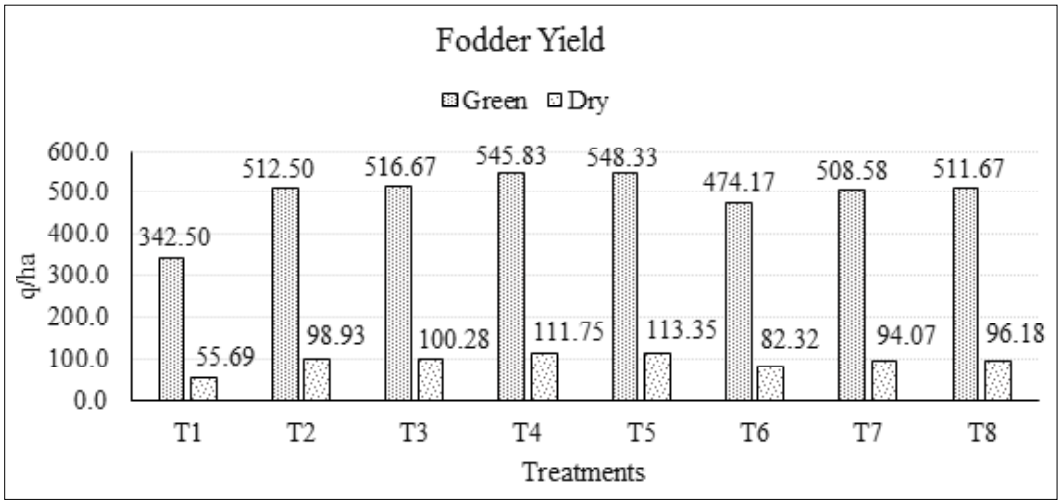

Fig 1: Effect of nutrient management practices on mean* green and dry fodder yield of pearl millet.
Note: *Mean of three replications.

Table 1: Effect of nutrient management practices on mean* proximate principles of pearl millet fodder.

Treatments	DM (%)	CP (%)	EE (%)	TA (%)	Cell soluble (%)	Hemi-cellulose (%)
T_1: Absolute control	16.27	8.06	1.97	9.78	30.61	21.24
T_2: 100% RDF	19.30	8.99	2.26	11.68	34.27	23.45
T_3: 100% RDF+CU	19.40	9.17	2.29	11.80	34.40	23.50
T_4: 100% RDF+PGPR	20.48	9.47	2.42	12.63	35.87	24.43
T_5: 100% RDF+PGPR+CU	20.67	9.78	2.44	12.83	36.01	24.49
T_6: 75% RDF+CU	17.37	8.47	2.13	10.57	32.00	22.45
T_7: 75% RDF+PGPR	18.50	8.72	2.19	11.30	33.39	23.36
T_8: 75% RDF+PGPR+CU	18.80	8.86	2.23	11.41	33.68	23.41
SEm (±)	0.31	0.12	0.04	0.21	0.42	0.30
CD (P=0.05)	0.95	0.35	0.12	0.63	1.26	0.90

Note: *Mean of three replications, DM: Dry matter, CP: Crude protein, EE: Ether extract, TA: Total ash, PGPR: Plant growth promoting rhizobacteria, CU: Cow urine, RDF: Recommended dose of fertiliser, SEm: Standard error of mean and CD: Critical difference.

Effect of nutrient management on fibre fraction

The chemical analysis of fodder pearl millet showed that fibre fractions was significantly influenced with different nutrient management practices (Table 2) and found decreasing trend of these parameters with increased fertility levels. Significantly lowest organic matter (87.17%), neutral detergent fibre (63.99%), acid detergent fibre (39.50%), acid detergent lignin (5.60%), organic matter (87.17%), cellulose (33.39%) and total carbohydrate contents (74.94%) was observed with the application of 100% RDF+PGPR+CU. However, it remained at par with the treatment that received 100% RDF+PGPR and both were found significantly lower over rest of the treatments. Fibre fraction *viz.*, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid

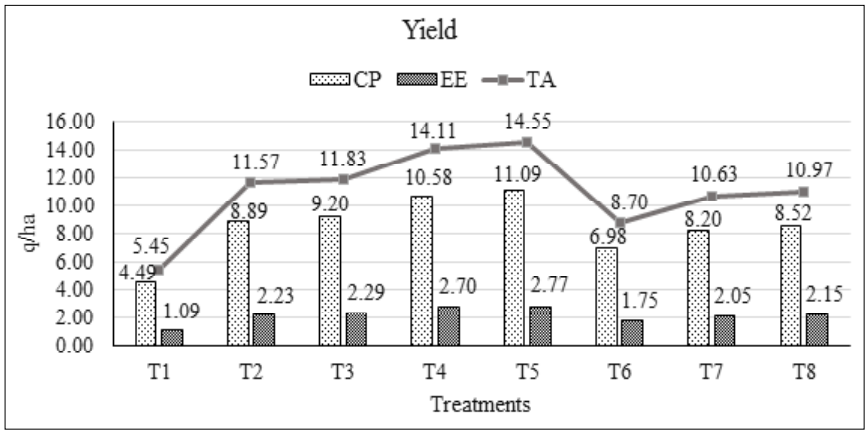

Fig 2: Effect of nutrient management practices on mean* yield of proximate principles.
Note: *Mean of three replications.

Table 2: Effect of nutrient management practices on mean* fibre fractions, organic matter and total carbohydrate of pearl millet fodder.

Treatments	NDF (%)	ADF (%)	ADL (%)	Cellulose (%)	OM (%)	T-CHO (%)
T_1: Absolute control	69.39	48.14	6.78	41.36	90.22	80.19
T_2: 100% RDF	65.73	42.28	6.06	36.22	88.32	77.07
T_3: 100% RDF+CU	65.60	42.10	5.92	36.18	88.20	76.74
T_4: 100% RDF+PGPR	64.13	39.70	5.61	34.10	87.37	75.48
T_5: 100% RDF+PGPR+CU	63.99	39.50	5.60	33.91	87.17	74.94
T_6: 75% RDF+CU	68.00	45.55	6.48	39.07	89.43	78.83
T_7: 75% RDF+PGPR	66.61	43.24	6.15	37.10	88.70	77.79
T_8: 75% RDF+PGPR+CU	66.32	42.90	6.12	36.78	88.59	77.50
SEm (±)	0.42	0.41	0.09	0.43	0.21	0.23
CD (P=0.05)	1.26	1.23	0.26	1.31	0.63	0.71

Note: *Mean of three replications, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADLL: Acid detergent lignin, OM: Organic matter and T-CHO: Total carbohydrates.

Table 3: Correlation coefficient (r) between yield and different fodder quality parameters of pearl millet.

Pearson	Correlations								
	GFY	DFY	CP	EE	TA	CS	NDF	ADF	ADL
GFY	1								
DFY	.978**	1							
CP	.861**	.944**	1						
EE	.908**	.972**	.988**	1					
TA	.898**	.970**	.989**	.994**	1				
CS	.904**	.973**	.982**	.991**	.998**	1			
NDF	-.904**	-.973**	-.982**	-.991**	-.998**	-1.000**	1		
ADF	-.926**	-.984**	-.976**	-.991**	-.996**	-.998**	.998**	1	
ADL	-.898**	-.969**	-.982**	-.990**	-.997**	-.996**	.996**	.995**	1

Note: GFY: Green fodder yield, DMY: Dry fodder yield, CP: Crude protein, EE: Ether extract, TA: Total ash, CS: Cell soluble, NDF: Neutral detergent fibre, ADF: Acid detergent fibre, ADL: Acid detergent lignin and ** - Correlation significant at 1% level.

detergent lignin (ADL) content recorded lowest with 100% RDF+PGPR+CU followed by 100% RDF+PGPR treatments, due to higher nitrogen level in plant tissue that increase metabolism of carbohydrates leads to decrease cell wall constituents/carbohydrates (Iqbal *et al.*, 2017). Less fibre fraction attributed to increase cell soluble contents in plant. These results are in line reported by Kushwaha *et al.* (2018).

Correlation studies

The results showed on correction (Table 3) indicates that the DFY (r=0.978), DM (r=0.903), CP (r=0.861), EE (r=0.908), TA (r=0.898) and CS (r=0.904) content were highly positively correlated with the yield of green fodder. Green fodder yield was highly negatively correlated with the contents of NDF (r=-0.904), ADF (r=-0.926) and ADL (r=-0.898). Quality parameter like DM, CP, EE, TA, CS increase with increase in green fodder yield. However, fibre fractions like NDF, ADF and ADL are inversely correlated with green fodder yield. Correlation matrix also indicates that DM, CP, EE, TA and CS were inversely correlated with fibre fractions. Similar results also reported by Bhakar *et al.* (2020).

CONCLUSION

Study concludes that conjoint application of inorganic fertiliser and organic sources of plant nutrients shows positive effect on quality and fibre fraction value of pearl millet fodder. In summary 100% RDF+PGPR+CU remained productive as well as profitable in term of quality and nutritional value. For future line of work, as like pearl millet, different cereal fodder crops can be explored location wise along with proper dose and sources (inorganic and organic) of nutrients for better productivity and quality.

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Conflict of interest: None.

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