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Qualitative forage production potential of different cereal and legume fodder crops under southern dry zone of Karnataka

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Abstract
A field experiment was conducted to identify the fodder crops having higher potential for quality green fodder production during *kharif*, *rabi* and *summer* seasons of 2018-19. The treatments consist of nine different fodder crops which were laid out in randomized complete block design with three replications. The results revealed that, significantly higher green fodder and dry matter yields were noticed with bajra Napier hybrid (1246.8 and 244.4 q/ha) followed by maize (1030 and 211 q/ha) compared to other crops. But, sesbania and lucerne fodder recorded significantly higher crude protein (22.2 and 20.53%), ash (11.12 and 10.57%) and ether extractable fat (3.75 and 3.14%) content while dry matter and crude fibre content was observed in sorghum fodder (23.01 and 34.49%). However, significantly higher non-fibre carbohydrate content was noticed in fodder oats (37.19%). Withrespect to quality yield, sesbania recorded higher crude protein, total digestible crude protein and fat yields (45.6, 42.2 and 7.7 q/ha, respectively) while higher ash, crude fibre and non-fibre carbohydrate yields were noticed in bajra Napier hybrid crop (25.4, 74.2 and 83.6 q/ha, respectively). Among different crops, bajra Napier hybrid and sesbania performed well in terms of quantitative as well as qualitative fodder.

Keywords: fodder yield, protein, ash, fat, crude fibre, carbohydrates

Introduction

Traditionally, green fodder is the natural feedstuff for livestock population since ancient times. Green fodder is highly nutritious and palatable in nature with rich in minerals and vitamins and also considered as a cheap source of quality fodder in the country. At present our country faces a net deficit of 36 per cent green fodder, 11 per cent of dry crop residues and 44 per cent of concentrate feeds as the availability of concentrates and crop residues depend directly on the agricultural crop production (Anon., 2016) [1]. Due to adoption of improved genotypes, extensive use of mechanical harvesters in cereal crops causing field wastage of crop residues and burning of straw are resulted in further decline in the availability of crop residues for livestock. On the other hand in India only 8.4 m ha of the cultivated land area is devoted to forage crops at present and further there is no scope to increase the area under fodder crops due to pressure of increasing population on available cultivable land for food production (Hindoriya *et al.* 2019) [5]. However, considerably less area and lower green fodder yield of cultivated fodder and pastures are the main reasons for green fodder deficit in the country. Because of deficit green fodder, dramatic increase in the cost of available feed and crop residues have observed and that leads to dairy farming as challenging enterprise for landless small and marginal farmers of the country. Hence to meet the fodder and nutrient requirement of the increasing livestock population there is a need to focus on quality green fodder production as it is cheap source compared to concentrate feeds (Kumar *et al.* 2017) [9]. In this context we have studied the potentiality of different cereal and legume fodder crops for their yield and quality and discussed in the present paper.

Materials and Methods

A field experiment was conducted during *kharif*, *rabi* and *summer* seasons of 2018-19 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya, Karnataka which is situated between 12º 45’ and 13º 57’ North latitude and 76º 45’ and 78º 24’ East longitude at an altitude of 695 m above mean sea level. It comes under Southern Dry Zone (ACZ-VI) of Karnataka and receives mean annual rainfall of 735.9 mm with maximum contribution from south west monsoon (42.59%). The soil of experimental field was red sandy loam with neutral in reaction (7.13), low in available nitrogen (265.4 kg/ha) and medium in available phosphorus (49.25 kg/ha) and potassium (162.35 kg/ha). The experiment was laid out in randomized complete block design with nine different cereal and legume fodder crops and replicated thrice. The details of the crops adopted, their varieties and time of harvesting was given the Table 1.

The crops were raised as per the recommended agronomic package of practices. At the time of harvest, immediately green fodder yield was recorded and a known quantity of sample was taken and then shade dried first followed by oven-dry at a temperature of 60 ^{0}C till constant weight attained for the estimation of dry matter as well as quality parameters. Quality parameters like crude protein (CP), crude fibre, ash and ether extractable fat percentage were determined by using standard procedure as recommended by AOAC (1984)[2] and their respective yields were calculated by multiplying with dry matter yield of the crops.

Total digestible crude protein yield (TDCPY) and non-fibre carbohydrate (CHO) percentage was calculated by using following formulae. The recorded data statistically analyzed for interpretation of results.

TDCPY = (0.97 × crude protein yield) - 0.67 (Iqbal *et al.*, 2013) [6].

Carbohydrates (%) = 100 – (crude protein + fat + crude fibre + ash + moisture)

Table 1: Treatment details of the experiment

Crop	Variety	Stage of Harvest/ First Harvest (Days)	Subsequent Harvest (Days)
Fodder maize	African Tall	Milky stage	-
Fodder sorghum	CO (FS) 29	Full flowering	-
Fodder oats	OS-6	50% flowering	-
Fodder Pearlmillet	BAIF bajra-1	50% flowering	-
Bajra Napier hybrid	BNH-10	70	35-45
Sesbania	Local	180	45-50
Lucerne	RL-88	60	25-30
Hedge lucerne	Co-1	90	45-50
Fodder Cowpea	MFC-09-1	50% flowering	-

Results and Discussion

Green Fodder and Dry Matter Yield

The recorded data showed significant differences with respect to green fodder and dry matter yield of different crops (Table 2). Bajra Napier hybrid recorded significantly higher green fodder yield (1246.8 q/ha) and the magnitude of increase was 21, 39, 55, 51, 34, 33, 62 and 63 per cent over maize, sorghum, oats, pearlmillet, sesbania, lucerne, hedge lucerne and cowpea, respectively. This was mainly attributed to higher growth parameters like plant height, number of tillers, very long and broad semi-drooping leaves and also may be due to quick regenerating and high yield potential nature of the bajra Napier hybrid crop. Similarly, significantly higher dry matter yield (244.4 q/ha) was recorded in bajra Napier hybrid followed by maize (q/ha), sorghum (205.9 q/ha) and sesbania (205.5 q/ha). The higher dry matter yield in bajra Napier hybrid crop was mainly because of higher green fodder yield compared to other crops. Similar kind of higher green fodder and dry matter yields were also reported by the Singh *et al.* (2018) [12]. However, significantly lower green fodder (771.7 and 764.7 q/ha) and dry matter yield (151.8 and 152.2 q/ha) were recorded in hedge lucerne and cowpea respectively. The lower yields in hedge lucerne and cowpea might be due to higher moisture content and lower fibre content in these fodders.

These results are in conformity with the findings of Hindoriya *et al*. (2019) [5].

Among different crops, significantly higher dry matter content was noticed in sorghum (23.01%) followed by sesbania (22.10%) compared to other crops while significantly lower was observed in bajra Napier hybrid (19.60%), hedge lucerne (19.66%) and cowpea (19.90%) (Table 2). The higher dry matter content might be due to higher fibre content of sorghum while lower content in bajra Napier hybrid, hedge lucerne and cowpea was mainly attributed to more succulent nature of these shoots. These results are in accordance with the findings of Hindoriya *et al*. (2019) [5]. and Iyanar *et al*. (2015) [7].

Table 2: Green fodder and dry matter yield of different cereal and legume fodder crops (Total of 3 seasons)

Crops	GFY (q/ha)	DM (%)	DMY (q/ha)
Fodder Maize	1030.0 b	20.58 c	211.0 b
Fodder Sorghum	894.7 c	23.01 a	205.9 b
Fodder Oats	802.3 d	20.24 d	162.4 de
Fodder Pearlmillet	825.0 d	20.80 c	171.8 d
Bajra Napier hybrid	1246.8 a	19.60 e	244.4 a
Sesbania	930.0 c	22.10 b	205.5 b
Lucerne	936.3 c	19.98 de	187.2 c
Hedge lucerne	771.7 d	19.66 e	151.8 e
Fodder Cowpea	764.7 d	19.90 e	152.2 e
S.Em.±	21.28	0.11	4.45
C.D. @ 5%	63.8	0.33	13.3

Note: Values with different alphabets in a column differ significantly ($P<0.05$)

Quality parameters

Quality content was differed significantly with the fodder crops. Among different crops, sesbania recorded significantly higher crude protein (22.2%), ash (11.12%) and fat content (3.75%) followed by the lucerne (20.53, 10.57 and 3.14%, respectively). However, lower crude protein (8.43 and 8.09%) and ash content (8.13 and 8.27%) was noticed in pearlmillet and sorghum respectively while lower fat content (2.59, 2.60 and 2.65%, respectively) was observed in maize, pearlmillet and cowpea (Table 3). Generally legume fodders have twice the protein content of cereal fodder crops. Similarly in the present study legume fodders have recorded higher crude protein content possibly due to specific symbiosis with *rhizobia* present in the soil that allows the plants to fix atmospheric nitrogen and diverts to the effective protein biosynthesis as nitrogen is a major constitute of amino acid compared to cereal fodders. Similar kind of results was also reported by the Singh and Garg (2015) [11]. Uday Kumar *et al.* (2017) [13]. and Mallikarjun *et al.* (2018) [10]. On the other hand, significantly higher crude fibre content was recorded in sorghum (34.49%) followed by maize (32.09%) while sesbania (27.37%), lucerne (27.53%), oats (27.72%) and cowpea (27.73%) recorded lower values. Generally fibre content has indirect relation with fodder quality as higher fibre content decreases the digestibility of fodder. The higher fibre content was mainly owing to lower leaf to stem ratio in sorghum and maize compared to other crops as plant's stem is richest source of fibre and is relatively higher in total plant at the time of crop harvest. Similar kind of higher fibre content in sorghum and maize was also reported by Yadav *et al.* (2019) [15]. Bharti *et al.* (2019) [4]. respectively. Withrespect to non-fibre carbohydrates content, cereal fodders recorded higher content compared to legume fodders, in particular oats (37.19%) recorded significantly higher content while significantly lower content was observed in sesbania crop (23.06%). It might be attributed to lower crude protein content and higher amount of non-fibre carbohydrate constituents like starch, simple sugars and soluble fibre in the cereal fodders. This was further strongly evident by the negative relationship of non-fibre carbohydrates content with crude protein and ash content of fodder (r^2= -0.88 and r^2= -0.55, respectively). Similar kind of higher carbohydrate content in oats was also reported by Verma *et al.* (2016) [14].

Table 3: Quality parameters of different cereal and legume fodder crops (Average of 3 seasons)

Crops	CP (%)	Ash (%)	Fat (%)	Crude Fibre (%)	CHO (%)
Fodder Maize	9.90 ^{d}	10.28 ^{c}	2.59 ^{d}	32.09 ^{b}	32.67 ^{c}
Fodder Sorghum	8.09 ^{e}	8.27 ^{ef}	3.03 ^{bc}	34.49 ^{a}	34.24 ^{b}
Fodder Oats	10.43 ^{d}	8.41 ^{e}	3.03 ^{bc}	27.72 ^{e}	37.19 ^{a}
Fodder Pearlmillet	8.43 ^{e}	8.13 ^{f}	2.6 ^{d}	30.60 ^{c}	35.12 ^{b}
Bajra Napier hybrid	9.92 ^{d}	10.4 ^{bc}	2.82 ^{cd}	30.35 ^{c}	34.20 ^{b}
Sesbania	22.2 ^{a}	11.12 ^{a}	3.75 ^{a}	27.37 ^{e}	23.06 ^{f}
Lucerne	20.53 ^{b}	10.57 ^{b}	3.14 ^{b}	27.53 ^{e}	25.74 ^{e}
Hedge lucerne	18.41 ^{c}	8.84 ^{d}	2.76 ^{cd}	28.59 ^{d}	29.91 ^{d}
Fodder Cowpea	20.51 ^{b}	10.33 ^{c}	2.65 ^{d}	27.73 ^{e}	26.14 ^{e}
S.Em.±	0.21	0.08	0.09	0.24	0.31
C.D. @ 5%	0.63	0.23	0.27	0.71	0.94

Note: Values with different alphabets in a column differ significantly (P<0.05)

Quality yield

Quality yield of fodder was significantly differed by different cereal and legume fodders (Table 4). The significantly higher crude protein yield and TDCPY was recorded in sesbania (45.6 and 42.2 q/ha) followed by lucerne (38.5 and 35.3 q/ha) while lower yield was recorded in pearlmillet (14.5 and 12.0 q/ha). The higher crude protein yield and TDCPY in sesbania and lucerne was mainly attributed to considerably higher protein content compared to other crops. These findings are in line with those earlier reported by Singh and Garg (2015) [11]. and Babu *et al.* (2014) [3]. However, significantly higher ash, fibre and carbohydrate yield were recorded in bajra Napier hybrid (25.4, 74.2 and 83.6 q/ha, respectively) compared to other crops while lower fibre (42.2 q/ha) and carbohydrate yield (39.8 q/ha) was recorded in cowpea but lower ash yield was noticed in hedge lucerne (13.4 q/ha) and oats (13.7 q/ha). Because of higher dry matter yield along with considerably higher content of these parameters, bajra Napier hybrid recorded higher ash, fibre and carbohydrate yield. Similar kind of results was also reported by Kaur *et al.* (2017) [8]. But significantly higher fat yield was recorded in sesbania (7.7 q/ha) followed by bajra Napier hybrid (6.9 q/ha) which might be due to higher fat content while lower fat yield was noticed in hedge lucerne (4.2 q/ha) and cowpea (4.0 q/ha).

Table 4: Quality yield of different cereal and legume fodder crops (Total of 3 seasons)

Crops	CPY (q/ha)	TDCPY (q/ha)	Ash (q/ha)	Fat (q/ha)	Fibre (q/ha)	CHO (q/ha)
Fodder Maize	21.0 ^{f}	18.3 ^{f}	21.8 ^{b}	5.5 ^{de}	68.0 ^{b}	69.3 ^{b}
Fodder Sorghum	16.6 ^{gh}	14.1 ^{gh}	17.0 ^{d}	6.2 ^{c}	71.0 ^{ab}	70.5 ^{b}
Fodder Oats	17.0 ^{g}	14.4 ^{g}	13.7 ^{e}	4.9 ^{ef}	45.0 ^{e}	60.3 ^{c}
Fodder Pearlmillet	14.5 ^{h}	12.0 ^{h}	14.0 ^{e}	4.5 ^{fg}	52.6 ^{cd}	60.3 ^{c}
Bajra Napier hybrid	24.3 ^{e}	21.5 ^{e}	25.4 ^{a}	6.9 ^{b}	74.2 ^{a}	83.6 ^{a}
Sesbania	45.6 ^{a}	42.2 ^{a}	22.8 ^{b}	7.7 ^{a}	56.3 ^{c}	47.4 ^{d}
Lucerne	38.5 ^{b}	35.3 ^{b}	19.8 ^{c}	5.9 ^{cd}	51.6 ^{d}	48.1 ^{d}
Hedge lucerne	27.9 ^{d}	25.1 ^{d}	13.4 ^{e}	4.2 ^{g}	43.4 ^{e}	45.4 ^{d}
Fodder Cowpea	31.2 ^{c}	28.3 ^{c}	15.7 ^{d}	4.0 ^{g}	42.2 ^{e}	39.8 ^{e}
S.Em.±	0.77	0.76	0.48	0.23	1.27	1.6
C.D. @ 5%	2.3	2.23	1.43	0.61	3.8	4.8

Note: Values with different alphabets in a column differ significantly (P<0.05)

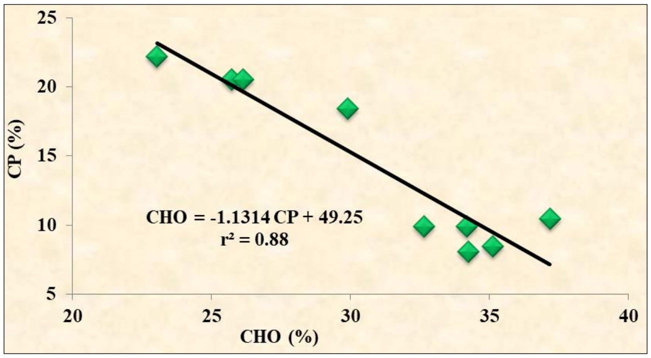

Fig 1: Relationship between crude protein and non-fibre carbohydrate content of different fodder crops

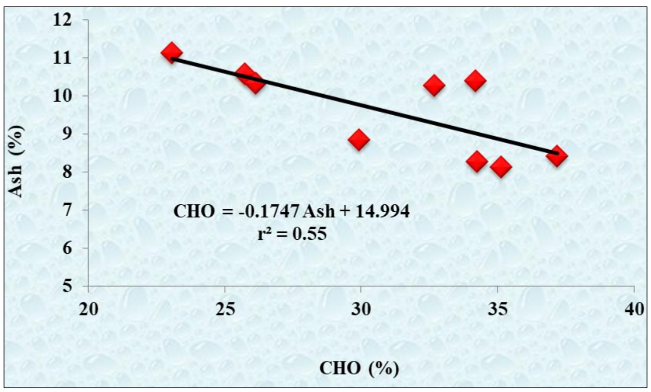

Fig 2: Relationship between ash content and non-fibre carbohydrates content of different fodder crops

Conclusion

Based on the results obtained it can be inferred that higher green fodder, dry fodder and carbohydrate yield were realized with cereal crops, particularly bajra Napier hybrid followed by maize performed well compared to legume fodders. While considerably higher quality content and its yield was observed in legume fodder crops like sesbania and lucerne. Thus with respect to biomass bajra Napier hybrid and fodder maize are best choice while regarding quality legume fodders are to be preferred.

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References

1. Anonymous. Annual Report, ICAR-Indian Grassland and Fodder Research Institute, Jhansi, India, 2016, 1-137.
2. AOAC. Official Methods of Analysis. 18th ed. Assoc. off. Anal. Chemi, Arlington, Virginia, USA, 2005.
3. Babu C, Iyanar K, Velayudham K, Kalamani A. A high yielding Lucerne variety CO-2. Electron. J. Plant Breeding. 2014; 5(3):345-349.
4. Bharti R, Gupta SK, Singh MK, Choudhury SR, Kohli A. Effect of plant population and varied nitrogen levels on quality and economics of fodder maize (*Zea mays* L.). Int. J. Chemic. Stud. 2019; SP6:325-328.
5. Hindoriya PS, Meena RK, Kumar R, Singh M, Ram H, Meena VK, *et al.* Productivity and profitability of cereal-legume forages vis-a-vis their effect on soil nutrient status in Indo-Gangetic Plains. Legume Res. 2019; 42(6):812-817.
6. Iqbal M, Iqbal Z, Farooq M, Ali L, Fiaz M. Impact of nitrogenous fertilizer on yield and quality of oat. Pak. J. Sci. 2013; 65(1):1-4.
7. Iyanar K, Babu C, Kumaravadivel N, Kalamani A, Velayudham K, Sathia Bama K, *et al.* A high yielding multicut fodder Sorghum CO-31. Electron. J. Plant Breeding. 2015; 6(1):54-57.
8. Kaur R, Goyal M, Tiwana US. Yield and quality attributes with seasonal variation in Napier Bajra hybrid (*Pennisetum purpureum* × *Pennisetum glaucum*) under different nitrogen environments. J. App. Natural Sci. 2017; 9(3):1350-1357.
9. Kumar R, Singh M, Meena BS, Ram H, Parihar CM, Kumar S, *et al.* Zinc management effects on quality and nutrient yield of fodder maize (*Zea mays*). Indian J. Agric. Sci. 2017; 87(8):29-33.
10. Mallikarjun, Hardev Ram, Rakesh Kumar, Meena RK, Ginwal D. Yield and chemical composition of cowpea (*Vigna unguiculata*) fodder as affected by tillage practices and nitrogen management. Indian J. Anim. Nutr. 2018; 35(3):333-338.
11. Singh D, Garg AK. Performance of public and private sector developed lucerne (*Medicago sativa* L.) varieties for forage yield and quality. Range Manag. Agroforestry. 2015; 36(2):225-228.
12. Singh D, Garg AK, Chauhan A. Fodder yield and quality assessment of different bajra napier hybrids in central Gujarat of India. Range Manag. Agroforestry. 2018; 39(2):269-273.
13. Uday Kumar, Narasimha Murthy HN, Chandrapal Singh K, Mahadevappa DG, Rajeshwari YB, Siddeshwara NC, *et al.* Biomass yield and chemical composition of Sesbania grandiflora and Moringa oleifera. Int. J. Sci. Environ. Technol. 2017; 6(6):3264-3269.
14. Verma D, Gontia AS, Jha A, Deshmukh A. Study of cutting management on proximate analysis in wheat, oat and barley crops. Int. J. Agric. Environ. Biotechnol. 2016; 9(4):593-597.
15. Yadav K, Verma A, Yadav MK, Choudhary M, Choudhary KM. Effect of fertilizer levels on fodder productivity and quality of multi-cut sorghum genotypes. Int. J. Bio-resource Stress Manag. 2019; 10(2):119-123.