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FIBRE AND ENERGY FRACTIONS OF THE FODDER UNDER DIFFERENT YEAR ROUND FODDER CROPPING SYSTEMS

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SUMMARY

The experiment was conducted during *kharif*, *rabi* and summer seasons of 2018-19 and 2019-20 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya, Karnataka to study the fodder production potential and quality of different fodder cropping systems. The experiment was laid out in a randomized complete block design with fifteen different fodder cropping systems comprising both annual and perennial fodder crops and replicated thrice. The data revealed that, perennial B×N hybrid + Lucerne cropping system at 2:8 row proportion recorded significantly higher green fodder yield (1636 q/ha/year) and dry matter yield (321 q/ha/year) which was closely followed by B×N hybrid + Cowpea and B×N hybrid + Sesbania perennial systems at 2:8 row proportion. Withrespect to fibre fractions, significantly lower content of crude fibre (27.02 %), acid detergent fibre (31.22 %) and neutral detergent fibre (43.47 %) was noticed with B×N hybrid + Sesbania (2:8), sole oats and sole lucerne cropping systems but they found on par with other cropping systems involving legume crops. Sole cropping system of oats recorded significantly higher net energy of lactation (1.48 Mcal/kg DM) and metabolizable energy (14.32 MJ/kg DM). Thus perennial cereal-legume fodder cropping systems were identified as best systems for quality green fodder production.

Key words : Cropping systems, green fodder yield, quality, fibre fractions, energy

Biomass production from the forage crops forms a major source of feed for livestock in the country. At present, majority of farmers are cultivating the fodder crops on marginal lands with monocropping as a predominant practice. However, cereal fodder is considered as a major source of energy while legume fodder as a source of protein for livestock. On the other hand, the availability of green fodder is 734.2 million tonnes in the country as against the requirement of 827.19 million tonnes with a net deficit of 11.24 per cent (Roy *et al.,* 2019). At present only 8.4 m ha cultivated area is devoted to fodder production in the country. Thus a wide gap exists between the supply and demand of green fodder with increasing livestock population in the country. In this context, there is a need to increase the productivity of fodder within the available land. On the other side, the availability of qualitative fodder is considered as the prime limiting factor for decline in the potential of dairy sector (Prajapati *et al.,* 2018). Thus in addition to increasing the yield there is also a prerequisite of quality green fodder production interms of higher protein content, lower fibre fractions and higher energy from the fodder with increased palatability and digestibility. Thus adoption of perennial cereal-legume fodder cropping systems with improved varieties will provide an opportunity to bridge the gap between supply and demand of green fodder by increasing the productivity per unit area and time along with superior quality fodder. In this background current study was undertaken with an aim to improve the yield and quality of fodder around the year.

MATERIALS AND METHODS

To identify the qualitative fodder production potential of different fodder cropping systems, the current experiment was conducted at Zonal Agricultural Research Station, Vishweshwaraiah Canal Farm, Mandya, Karnataka during *kharif, rabi* and *summer* seasons of 2018-19 and 2019-20 using randomized complete block design. The experiment consisted of 15 treatments which comprised different fodder cropping systems *viz.,* T_1: Fodder Maize + Cowpea (3:1) - Fodder Oat + Cowpea (3:1) - Pearlmillet + Cowpea (3:1); T_2: Fodder Sorghum + Cowpea (3:1) - Fodder Maize + Cowpea (3:1) - Pearlmillet + Cowpea (3:1); T_3: B×N hybrid + Cowpea (2:8) perennial system; T_4: B×N hybrid + Lucerne (2:8) perennial system; T_5: B×N hybrid + Desmanthus (2:8) perennial system; T_6: B×N hybrid + Sesbania (2:8) perennial system and from T_7 to T_{15} sole cropping of maize, sorghum, cowpea, desmanthus, sesbania, B×N hybrid, lucerne, oats and pearlmillet, respectively in all the seasons. The soil of experimental site was sandy loam in texture with neutral in reaction (7.45 pH). The nutritional status of soil was medium in organic carbon (0.55 %), low in available nitrogen (265.40 kg/ha), medium in available phosphorous (21.51 kg/ha) and available potassium (162.35 kg/ha). The crops were established as per the recommended package of practices and uniformity was maintained during both the years of study with respect to establishment and management. The annual crops like maize and sorghum were harvested at milking and full flowering stage, respectively while pearlmillet, oats and cowpea were harvested at 50 per cent flowering. In case of perennial crops like B×N hybrid, lucerne, desmanthus and sesbania first harvest was taken at 70, 60, 90 and 180 days after sowing by leaving stubbles of suitable height with subsequent harvests at 35-45, 25-30, 45-50 and 45-50 days interval, respectively based on crop growth. Immediately after harvest of the crop green fodder yield was recorded and a known quantity of sample was taken and oven-dried for the estimation of quality parameters. The fibre fractions were estimated according to standard procedure recommended by AOAC (1965). Net energy of lactation (NEL) was estimated according to the equation adopted from Horrocks and Vallentine (1999): $NEL = [1.044 - (0.0119 \times \% ADF)] \times 2.205$. The metabolizable energy (ME) was calculated from the equation of Menke and Steingass (1988): $ME = 14.78 - 0.0147 ADF \%$. The data of two years were statistically analyzed and interpreted on pooled basis.

RESULTS AND DISCUSSION

Biomass yield

The biomass yield was varied significantly among the different fodder cropping systems (Fig. 1). The perennial B×N hybrid + Lucerne cropping system at 2:8 row proportion resulted in significantly higher green fodder yield (1636 q/ha/year) and dry matter yield (321 q/ha/year) which was closely followed by B×N hybrid + Cowpea (1552 and 308 q/ha/year, respectively) and B×N hybrid + Sesbania perennial systems (1440 and 313 q/ha/year, respectively) at 2:8 row proportion. However, sole cropping of cowpea, desmanthus, oats and pearlmillet throughout the year resulted in significantly lower green fodder yield (778, 796, 827 and 854 q/ha/year, respectively) and dry matter yield (155, 157, 167 and 178 q/ha/year, respectively). The efficient utilization of available nutrients, water and solar energy under perennial cropping systems in addition to atmospheric nitrogen fixation by the component legume fodder crops, multicut nature and quick regeneration capacity of crops might be the reason for higher green biomass yield. Subsequently higher green fodder yield resulted in higher dry matter yield. Similar kind of higher biomass yield under cereal-legume cropping systems was also reported by Shekara *et al.* (2015), Patil *et al.* (2018) and Hindoriya *et al.* (2019).

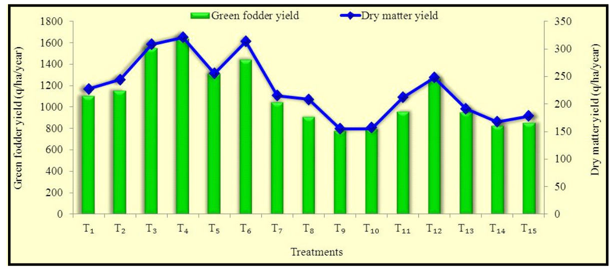

Fig. 1. Green fodder yield and dry matter yield of different year round fodder cropping systems (Pooled data of two years).

Fibre fractions

Generally the forage with less fiber fractions is considered to be of superior quality fodder as lower the fiber contents higher will be the digestibility of fodder by the livestock. In the present study the fibre fractions were significantly influenced by different fodder cropping systems (Fig. 2). Among different cropping systems, the lower crude fibre content was noticed with cropping systems involving legume crops (27.02 - 28.70 %) and sole oats (27.62 %) grown in all the three seasons. However, sole fodder sorghum system throughout the year recorded significantly higher crude fibre content (34.48 %). The lower crude fibre content with sole legume fodder crops and B×N hybrid grown along with higher proportion of legume

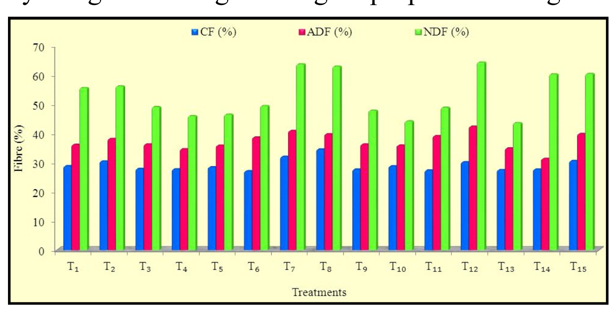

Fig. 2. Fibre fractions of fodder under different year round fodder cropping systems (Pooled data of two years)

Note: CF - Crude fibre; ADF - Acid detergent fibre; NDF - Neutral detergent fibre.

crops might be due to better nitrogen nutrition, which leads to higher nitrogen availability under grass-legume mixture and sole cropping of legumes that lead to more succulent and leafiness of fodder. However, higher crude fibre content with sole fodder cereal crops and that of intercropping systems involving higher proportion of cereal crops might be attributed to higher dry matter content and higher storage of photosynthates as cell wall contents during their partitioning. These results are in conformity with the findings of Prasanthi (2012), Rasool *et al.* (2017) and Islam *et al.* (2018).

On the other hand, significantly lower acid detergent fibre content was noticed with sole fodder oats (31.22 %) grown in all three seasons but it was found on par with B×N hybrid + Lucerne (2:8), sole lucerne, B×N hybrid + Desmanthus (2:8) and sole desmanthus cropping systems (34.53, 34.82, 35.78 and 35.80 %, respectively). Similarly, significantly lower neutral detergent fibre content (43.47 %) was noticed with sole lucerne but which was found on par with sole desmanthus, B×N hybrid + Lucerne (2:8), B×N hybrid + Desmanthus (2:8), sole fodder cowpea, sole sesbania, B×N hybrid + Cowpea (2:8) and B×N hybrid + Sesbania (2:8) cropping systems (44.06, 45.85, 46.35, 47.72, 48.74, 48.96 and 49.29 %, respectively). However, sole B×N hybrid system resulted in higher acid and neutral detergent fibre (42.26 and 64.19 %, respectively). The lower acid and neutral detergent fibre content might be due to lower hemicellulose and higher cell contents. These results are in agreement with the findings of Das *et al.* (2015), Baghdadi *et al.* (2016) and Jagadeesh *et al.* (2017).

Energy fractions

The fodder cropping systems significantly influenced the net energy for lactation and metabolizable energy from different fodder crops (Table 1). Among different cropping systems, sole cropping system of oats recorded significantly higher net energy of lactation (1.48 Mcal/kg DM) and metabolizable energy (14.32 MJ/kg DM) but found on par with perennial B×N hybrid + Lucerne system at 2:8 row proportion (1.40 Mcal/kg DM and 14.27 MJ/kg DM, respectively) and sole lucerne cropping system (1.39 Mcal/kg DM and 14.27 MJ/kg DM, respectively). However, the lower net energy of lactation and metabolizable energy was recorded in sole B×N hybrid cropping system (1.19 Mcal/kg DM and 14.16 MJ/kg DM, respectively). The higher net energy of lactation and metabolizable energy in the present study was

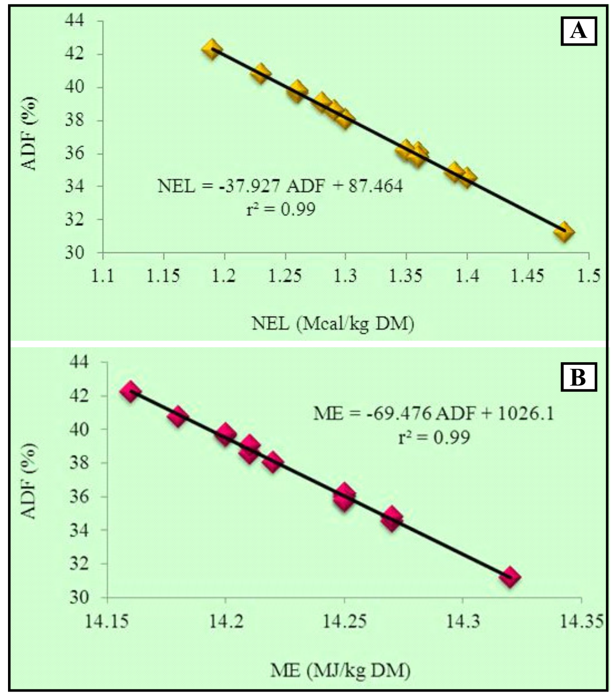

Fig. 3. Relationship of net energy of lactation (NEL) and metabolizable energy (ME) with ADF content of fodder under different year round fodder cropping systems.

mainly attributed to lower acid detergent fibre content of the cropping systems as they are negatively related with one another (r^2 = -0.99 and r^2 = -0.99, respectively) (Fig. 3). The inclusion of legumes with cereal fodder crops in cropping systems can enhances energy value of fodder mixture (Vasilakoglou and Dhiam, 2008). The cereal-legume intercropping systems might have enhanced the methionine and threonine amino acids in fodder mixture, which may lead to easy metabolization and release of energy. These results are in line with the findings reported by Pozdisek *et al.* (2011) and Prajapati *et al.* (2018).

The perennial cereal-legume fodder cropping systems of B×N hybrid + Lucerne, B×N hybrid + Cowpea and B×N hybrid + Sesbania at 2:8 row proportion were outperformed with higher green and dry biomass yield. Also the perennial systems resulted in superior quality fodder with lower fibre fractions and higher energy from the fodder. Thus perennial cereal-legume cropping systems will provide a way for quality green fodder production around the year.

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TABLE 1

Net energy of lactation and metabolizable energy of different year round fodder cropping systems (Pooled data of two years)

Treatments	Net energy of lactation (Mcal/kg DM)	Metabolizable energy (MJ/kg DM)
T_1 : Fodder Maize + Cowpea (3:1) - Fodder Oat + Cowpea (3:1) - Pearlmillet + Cowpea (3:1)	1.36	14.25
T_2 : Fodder Sorghum + Cowpea (3:1) - Fodder Maize + Cowpea (3:1) - Pearlmillet + Cowpea (3:1)	1.30	14.22
T_3 : B×N hybrid + Cowpea (2:8) perennial system	1.35	14.25
T_4 : B×N hybrid + Lucerne (2:8) perennial system	1.40	14.27
T_5 : B×N hybrid + Desmanthus (2:8) perennial system	1.36	14.25
T_6 : B×N hybrid + Sesbania (2:8) perennial system	1.29	14.21
T_7 : Fodder Maize - Fodder Maize - Fodder Maize	1.23	14.18
T_8 : Fodder Sorghum - Fodder Sorghum - Fodder Sorghum	1.26	14.20
T_9 : Fodder Cowpea - Fodder Cowpea - Fodder Cowpea	1.35	14.25
T_{10} : Desmanthus perennial system	1.36	14.25
T_{11} : Sesbania perennial system	1.28	14.21
T_{12} : B×N hybrid perennial system	1.19	14.16
T_{13} : Lucerne perennial system	1.39	14.27
T_{14} : Fodder Oats - Fodder Oats - Fodder Oats	1.48	14.32
T_{15} : Fodder Pearlmillet - Fodder Pearlmillet - Fodder Pearlmillet	1.26	14.20
S. Em±	0.04	0.03
C. D. (P=0.05)	0.12	0.06

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