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Production Potential and Forage Quality of Cereal-Legume Intercropping Systems in Cauvery Command Area of Karnataka

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A B S T R A C T

A field experiment was conducted during *kharif* season of 2018 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya to study the productivity and quality of different cereal-legume intercropping systems. The treatments consist of three intercropping systems *viz.*, maize + cowpea (3:1), sorghum + cowpea (3:1) and bajra Napier hybrid + cowpea (2:8) and four sole crops like maize, sorghum, bajra Napier hybrid and cowpea. Among different treatments, higher green fodder yield (552.17 q/ha), dry fodder yield (110.37 q/ha), crude fodder yield (19.59 q/ha), total digestible crude fodder yield (18.33 q/ha), ash yield (12.73 q/ha), fat yield (3.33 q/ha), fibre yield (30.78 q/ha) and carbohydrate yield (29.46 q/ha) were noticed in bajra Napier hybrid + cowpea system. The higher content of crude protein was observed in sole cowpea (20.5 %) while higher dry matter (22.97 %), fibre (34.17 %) and carbohydrate (34.43 %) content were observed in sole sorghum compared to other treatments. Bajra Napier hybrid + cowpea performed well both quality and quantity wise and can be a best system.

Introduction

Livestock production is the keystone of Indian agriculture and plays an important role in providing employment especially in rural areas. Fodders as a group of crops generally that differ from normal food and commercial crops as they are primarily grown for the fresh vegetative biomass. The fodder supply situation in India is extremely precarious and the gap is very wide. India has 15 % of world cattle population and there is tremendous pressure of livestock on available feed and fodder, as land available for fodder production has been decreasing. Presently, it is estimated that only 4.4 % of the total

cropped area is devoted to fodder production. Feed and fodder cost constitute about 60-70 % of cost of milk production, thus cultivated fodder has an important role in meeting requisite of various nutrients and roughage in our country to produce milk and is most economical as compared to concentrates.

In India, there is no practice of fodder production in rural areas and generally animals consume naturally grown grasses and shrubs which are of low quality in terms of protein and available energy, they are thus heavily dependent on seasonal variations and this results in fluctuation in fodder supply affecting supply of milk round the year. Cereal fodder crops such as maize, sorghum, pearl millet, oat, barley, rye grass and bajra Napier hybrid give higher fodder yield but are deficient in protein content while fodder legumes such as ricebean, phillipesara, soybean, cowpea, cluster bean *etc.*, are rich sources of protein but their fodder yield is lower than cereal fodder (Iqbal *et al.,* 2015).

The chronic shortage of feed and fodder resources during the last few decades indicate that most of the livestock were underfed. Thus, legume-cereal composition is considered as a management strategy to produce both high quality and quantity forage. Legumes, which are good source of protein, that can be intercropped with cereals to compensate their protein shortage (Eskandari, 2012). Non-legumes intercropped with legumes significantly increased the total mixed green forage yield and crude protein content of mixed forage (Iqbal *et al.,* 2006). Thus efforts need to be made to intensify fodder productivity and production per unit area and time with good quality. Hence, the experiment was conducted to find out suitable cereal legume intercropping system for availability of good quality fodder with maximum yield.

Materials and Methods

The experiment was conducted during *kharif* season of 2018 at Zonal Agricultural Research Station, Vishweswaraiah Canal Farm, Mandya 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 and comes under Southern Dry Zone (ACZ-VI) of Karnataka with mean annual rainfall of 735.9 mm with maximum contribution from south west monsoon (42.59%). The soil of the experimental site was red sandy loam in texture having low in available nitrogen (265.4 kg/ha), medium in available phosphorus (49.25 kg/ha) and potassium (162.35 kg/ha) with neutral in reaction. The experiment was laid out in randomized completely block design (RCBD) replicated three times with four sole crops *viz.*, maize (African tall), sorghum (CO-FS 29), cowpea (MFC-09-1), bajra Napier hybrid (BNH-10) and three intercropping systems like maize + cowpea (3:1), sorghum + cowpea (3:1) and BNH + cowpea (2:8). The crops were raised as per the package of practices. Maize, sorghum and cowpea were harvested at 75, 70 and 50 days after planting while bajra Napier hybrid was harvested at 70 days after planting with subsequent harvest at 35 days interval. Immediately after harvest of the crops green fodder yield was recorded and known quantity of sample was taken and oven-dried for the estimation of dry matter as well as quality parameters. Quality parameters like crude protein (CP), crude fibre, ash and ether extractable fat percent age were determined by using standard procedure as recommended by AOAC (1984) 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 formula.

TDCPY = (0.97 × crude protein yield) - 0.67
Carbohydrates (%) = 100 – (crude protein + fat + fibre + ash + moisture)

Statistical analysis

The data recorded for each parameter were subjected to statistical analysis adopting Fisher's method of analyses of variance as outlined by Gomez and Gomez (1984). The level of significance used in the F test was given at 5 per cent. Wherever the F test was significant, critical difference (CD) values are given in the table at 5 per cent level of significance.

Results and Discussion

Green fodder yield and dry fodder yield

Among different forage crops, significantly higher green and dry fodder yields were recorded in the BNH intercropped with cowpea (552.17 and 110.37 q/ha, respectively) followed by maize intercropped with cowpea (445.43 and 91.41 q/ha, respectively) but the later treatment was found statistically at far with sole BNH (435.7 and 86.78 q/ha, respectively) when compared to other treatments (Table 1). Higher yields of the intercropping systems indicate the advantage of intercropping with cowpea over the sole crops. This higher green and dry fodder yields might be because intercropped cowpea have provided nitrogen through nitrogen fixation to the main crops which may have enhanced the production potential of the crops by promoting the growth parameters and fast accumulation of photosynthates in the sink. However significantly lower green and dry fodder yields were observed with sole fodder cowpea (252.33 and 49.96 q/ha, respectively) might be due to lower fibre content and higher moisture content. Hindoriya *et al.,* (2019) also found similar kind of higher yields with Napier bajra hybrid intercropped with cowpea. The results of the present study are in conformity with findings of Anita *et al.,* (2015) and Aulakh *et al.,* (2012).

Quality parameters

The higher dry matter (DM) content was observed with sole sorghum (22.97 %) followed by sorghum intercropped with cowpea (22.27 %) which was statistically at for with each other (Table 1). This higher DM content was due to the presence of higher fibre content in the sorghum when compared to other crops. Similar kind of higher DM content (23.6 %) was also recorded by Iyanar *et al.,* (2015). While, lower DM content was found with cowpea (19.81 %) and BNH (19.95 %) may be due to more succulent shoots of these crops led to reduction in the DM content of crops.

The crude protein content was highest in sole fodder cowpea (20.5 %) followed by BNH intercropped with cowpea (17.75 %), maize intercropped with cowpea (12.03 %), sorghum intercropped with cowpea (11.07 %) while the lowest was recorded in sole sorghum (8.23 %). However BNH intercropped with cowpea recorded higher CPY (19.59 q/ha) and TDCPY (18.33 q/ha) followed by maize intercropped with cowpea (10.99 and 9.99 q/ha, respectively) and sole fodder cowpea (10.24 and 9.26 q/ha, respectively) while lower yields were recorded with sole sorghum (5.54 and 4.7 q/ha, respectively) (Figure 1). This lower yields might be due to lower CP content while higher yields with intercropping systems was attributed to higher dry matter yields. Similar kind of lower yields in sorghum was also reported by Kushwaha *et al.,* (2018). Asangla and Gohain (2016) also opinioned that a considerable proportion of nitrogen was available to non-legume crops in the mixtures compared to pure stands and more crude

protein content was because of more uptake of nitrogen which is a important constituent of protein, amino acids and amides.

The higher total ash content and total ash yield was recorded in BNH intercropped with cowpea (11.53 % and 12.73 q/ha, respectively) followed by maize intercropped with cowpea (10.68 % and 9.76 q/ha, respectively) compared to other treatments. However, the lower ash content was observed in sole sorghum (8.21 %) and sorghum intercropped with cowpea (10.68 %) this might be attributed to the higher DM content of sorghum compared to other fodder crops while lower ash yield was noticed in cowpea (5.15 q/ha) that was mainly due to lower drymatter yield of crop (Table 2 and Figure 2). The ether extractable fat content was highest in sorghum intercropped with cowpea (3.27 %) followed by BNH intercropped with cowpea (3.02 %) but the later one was found on far with sole sorghum (2.98 %) while lower value was recorded with sole maize (2.48 %). The higher values were attributed to higher nitrogen uptake as it is positively correlated with ether extractable fat. However, the higher ether extractable fat yield was recorded in BNH intercropped with cowpea (3.33 q/ha) followed by maize intercropped with cowpea (2.77 q/ha). Similar kind of higher ether extractable fat yield in Napier bajra hybrid intercropped with cowpea was also reported by Hindoriya *et al.,* (2019).

Among the different treatments, higher crude fibre content was recorded in sole sorghum (34.17 %) followed by sorghum intercropped with cowpea (32.05 %) and maize (31.9 %) while lower values were recorded with sole cowpea (27.83 %) and BNH intercropped with cowpea (27.88 %) (Table 2). This lower fibre content might be attributed to succulent nature of these crops led to reduction in the fibre content of crops. Similar kind of highest amount of crude fibre content in pure stand of forage sorghum (41.22 %) was also reported by Reza *et al.,* (2012).

Table.1 Green fodder yield (GFY), dry matter yield (DMY) and drymatter percentage

Treatments	GFY (q/ha)	DM (%)	DMY (q/ha)
Sole Maize	343.5 d	20.82 b	71.54 d
Sole Sorghum	292.5 e	22.97 a	67.23 d
Sole Cowpea	252.33 f	19.81 b	49.96 e
Sole BNH	435.17 b	19.95 b	86.78 bc
Maize + cowpea (3:1)	445.43 b	20.54 b	91.41 b
Sorghum + cowpea (3:1)	380.67 c	22.27 a	84.72 c
BNH + cowpea (2:8)	552.17 a	19.99 b	110.37 a
LSD (P=0.05)	31.48	1.01	6.31
SEm±	10.21	0.33	2.05

Note: Values with different alphabets are significantly differ with each other and values with same alphabets are non significant

Table.2 Quality parameters of fodder as influenced by cereal-legume intercropping systems

Treatments	Ash (%)	Fat (%)	Fibre (%)	CHO (%)
Maize	10.22 b	2.48 c	31.9 b	32.72 ab
Sorghum	8.21 d	2.98 b	34.17 a	34.43 a
Cowpea	10.30 b	2.65 c	27.83 d	25.93 c
BNH	10.3 b	2.98 b	30.15 c	34.43 a
Maize + cowpea (3:1)	10.68 b	2.65 c	30.17 c	32.15 b
Sorghum + cowpea (3:1)	8.92 c	3.27 a	32.05 b	32.35 b
BNH + cowpea (2:8)	11.53 a	3.02 ab	27.88 d	26.70 c
LSD (P=0.05)	0.56	0.28	1.29	1.83
SEm±	0.18	0.09	0.42	0.59

Note: Values with different alphabets are significantly differ with each other and values with same alphabets are non significant

Fig.1 Crude protein content, Crude protein yield and TDCPY of fodder as influenced by cereal-legume intercropping systems

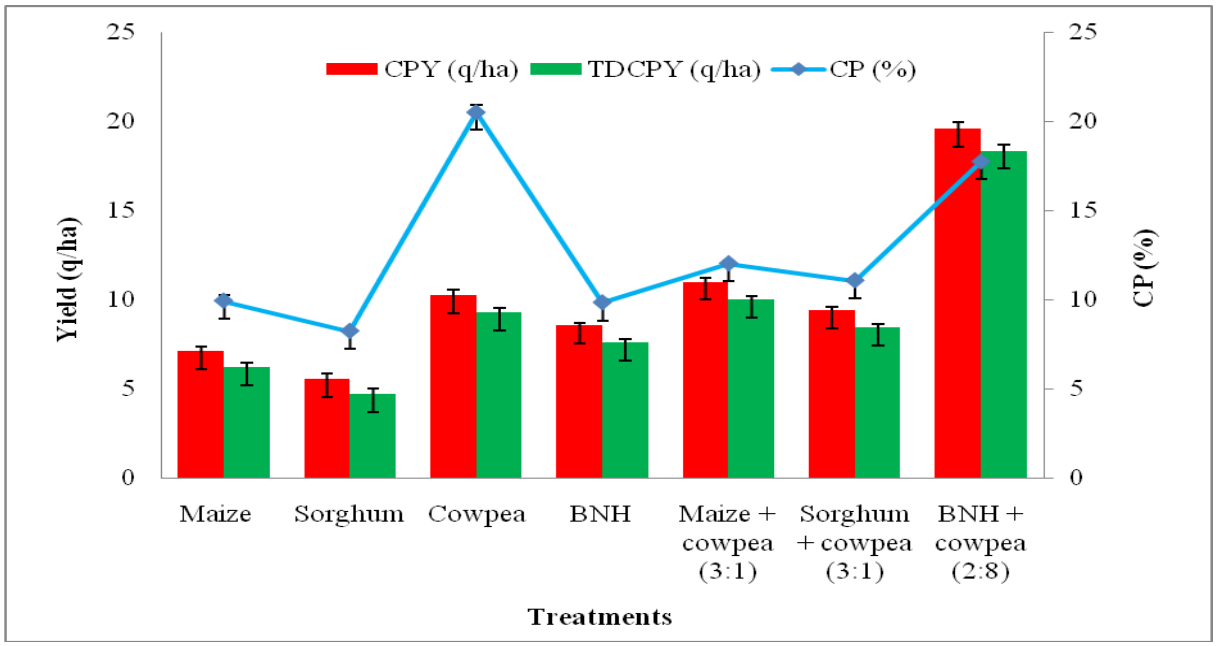
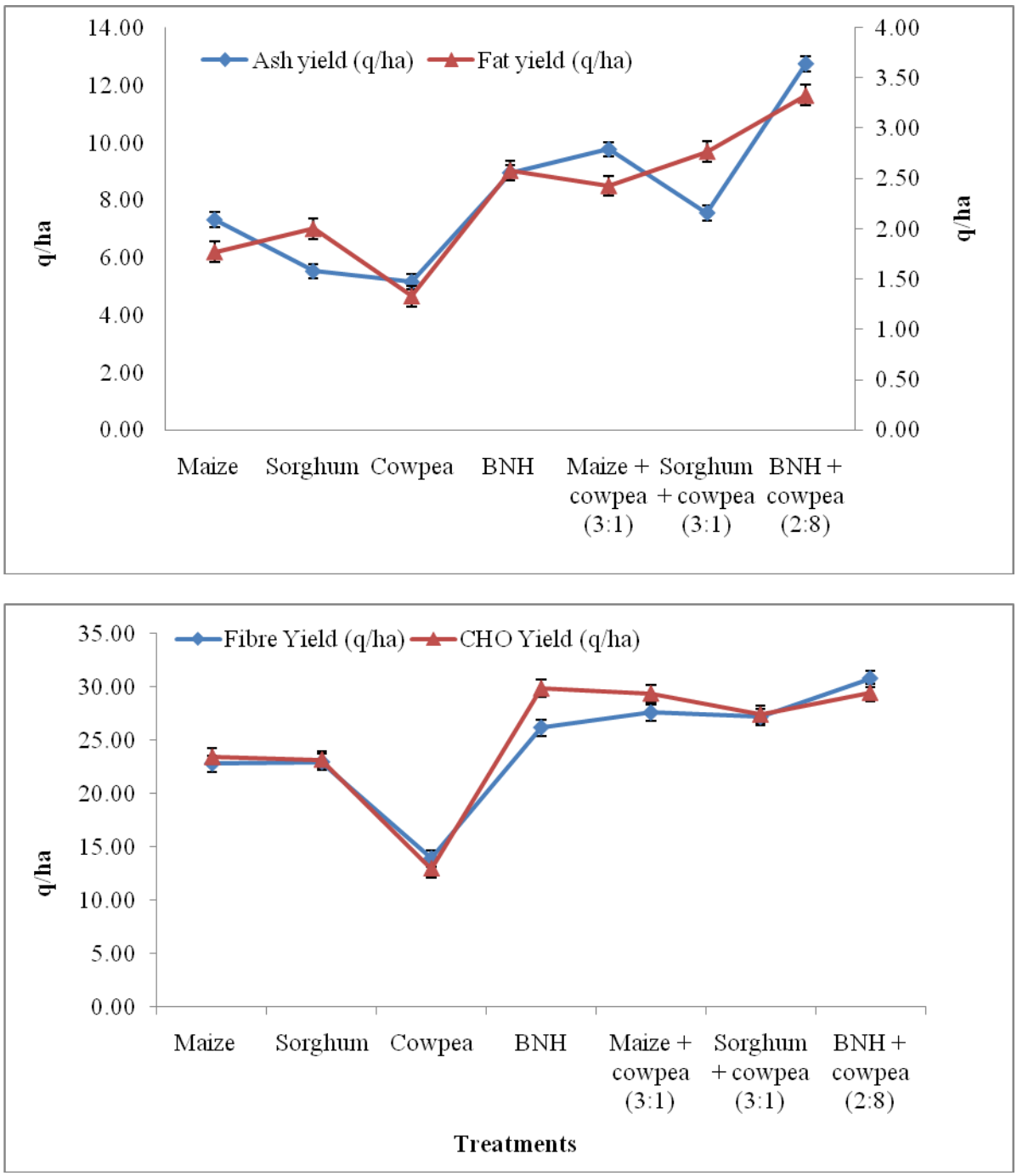


Fig.2 Quality parameters yield of fodder as influenced by cereal-legume intercropping systems



The higher non-fibre carbohydrate content was recorded in sole cereal crops like sorghum (34.43 %) and BNH (34.43 %) followed by maize (32.72 %) while lower carbohydrate content was noticed in sole cowpea (25.93 %) and BNH intercropped with cowpea (26.70 %) (Table 2). This might be attributed to the higher values of above

mentioned quality parameters of the fodder crops. On the other hand, higher non-fibre carbohydrate yield was found in sole BNH (29.87 q/ha) followed by BNH intercropped with cowpea (29.46 q/ha) and maize intercropped with cowpea (29.39 q/ha) which was mainly due to higher drymatter yields while lower carbohydrate yield was recorded in sole cowpea (12.94 q/ha) (Figure 2).

In this study intercropping systems resulted in higher green and dry fodder yields compared to sole crops. Similarly higher yield of quality parameters also observed in the same intercropping systems compared to sole crops. Among the intercropping systems, BNH intercropped with cowpea at the row ratio of 2:8 performed well both in terms of quantity and quality of fodder.

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