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Evaluation of fodder varieties for green fodder yield, quality assessment and its impact on farming community in southern Karnataka

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Abstract
A field experiment was conducted in farmers field during 2013-15 at Ramanagara district, Karnataka with an objective to evaluate and asses the performance of newly notified high yielding fodder varieties on growth, herbage yield, nutrient composition and farmer's perception. On the basis of pooled data of two years, significantly highest green fodder yield (GFY) 220.6 t/ha/year, stem height (249.8 cm), number of tillers per culm (25), leaf width (5.3 cm), stem circumference (7.2 cm) and more number of leaves per culm (190.5) was recorded in DHN-6. Significantly higher leaf stem ratio (1.0) was recorded in CO-3 and DHN-6. Among fodder crops tested, crude protein, crude fat and crude fiber contents varied from 6.80 to 7.31%, 0.8 to 1.1%, and 32.4 to 33.7%, respectively. Based on farmer's perception on qualitative parameters, DHN-6 was superior in quality, more acceptable to cattle (palatable), high yielding and less pubescence. Various extension activities like on farm testing, demonstrations, trainings and collaborative programmes with development departments adopted by KVK, created awareness about new fodder varieties, enhanced the availability of green fodder round the year to livestock and improved quality life in the farming community.

Keywords: Fodder varieties, Farming community, Green fodder yield, Quality parameters

Introduction

Continuous supply of quality fodder throughout the year is a key factor for successful dairy farming. In dairy farming, a regular supply of quality fodder is very essential for more production and economic returns (Brar *et al.,* 2016). Shortage of feed and fodder has been identified as one of the major constraints in achieving desired level of livestock productivity (Meena *et al.,* 2018; Shinde and Mahanta, 2020). In India, nutritional requirements of ruminants are mainly met by feeding green fodder and dry forages including post harvest crop residues. Contribution of forage in animal feed is more than 75% and is considered an inexpensive source of nutrients (Sarwar *et al*., 2002). However, inadequate supply of quality green fodder throughout the year has been identified as one of the reason for poor livestock productivity in India (Anjum *et al*., 2012; Kumar *et al*., 2016).

Fodder cultivation in the Ramanagara district is highly unorganized and the farmers are unaware of high yielding year round supply of green fodder varieties (Anon, 2013). Presently, farmers were growing fodder crops which are highly pubescent and low yielding. Though, many multicut perennial high yielding fodder varieties have been notified due to systematic research work by ICAR Institutes and State Agricultural Universities. These fodder varieties have been found to be superior in quality, more acceptable to cattle (palatable), nutritious, high yielding, quick growing, less hairy with better regeneration capacity (Antony and Thomas, 2014). The information regarding the performance of newly notified fodder varieties in southern Karnataka was, however, limited. With this background, the present field investigation was, therefore, undertaken to identify the best high yielding fodder variety, which is palatable and highly acceptable by the livestock.

Materials and Methods

***Study site*:** The field investigation programme was carried out under on farm testing (OFT) of different fodder varieties in Ramanagara district of Karnataka, India under subtropical conditions. It lies between 12° 24' and 13° 09' N latitude, and 77° 06' and 77° 34' E longitude. The soils of district are shallow to moderately deep red clay soils in texture with medium organic carbon status, fairly good in available N and P and low in available K (Anon, 2013). The climate of the district falls under Karnataka Plateau, hot moist semi arid eco sub region based on ICAR class-

-ification. During the summer months *i.e*., from March to May weather is very hot and dry. The weather becomes humid and cloudy during June to September. The average rainfall of the district is 823 mm. The south-west monsoon contributes 48%, while north east monsoon contributes 28%. The normal onset of south-west monsoon starts from 1st week of June and normal cessation is during 2nd week of October. The north east monsoon starts from 3rd week of October and cessation is at 2nd week of November.

***Crop management*:** A total of 5 dairy farmers were selected from three blocks of Ramanagara district. They were guided about the management of agronomic practices for raising quality fodder as per the recommendation of package of practices (Anon, 2011). Fodder varieties selected for evaluation during the study were COFS-29, CO-3, DHN-6 and local check (NB-21). Napier grasses **(**CO-3, DHN-6 and local check, NB-21) were sown with the onset of monsoon. Harrowing was done and rooted slip or stem cutting was planted at a depth of 3-5 cm on one side of the ridge at 90 × 60 cm spacing at the rate of 18, 000 rooted slips or stem cuttings/ ha in the month of mid June. FYM (20-25 t /ha) was well mixed in soil at the time of land preparation. At sowing time a basal dose of 60 kg N, 50 kg P_2O_5 and 40 kg K_2O/ ha was applied in bands prior to planting. Subsequently 20 kg and 10 kg N were top dressed just after and 20 days after the cut, respectively. The field was irrigated on 3rd day after planting and as and when required thereafter especially during winter and summer. First cut was made at 60-65 days after planting and subsequent cuts were made at 45-50 days interval. In a year 6 cuts were taken. In order to encourage quicker regeneration from the basal buds, stubbles of 10-15 cm was left out at harvest.

For fodder sorghum (COFS-29) cultivation, land preparation was also made as done in napier grass cultivation and recommended seed rate @ 12.5 kg/ha was followed. Optimum spacing 45 cm between rows and 15 cm seed to seed was maintained. FYM or compost (12.5 t/ha) and fertilizers (90 kg N, 50 kg P_2O_5 and 40 kg K_2O/ha) were applied. At the time of sowing 25% nitrogen and entire dose of phosphorus and potassium was applied, while remaining dose of nitrogen was divided in to five splits and applied after subsequent cut. First cutting was made 90 days after sowing and subsequent cuttings were made at an interval of 60 days. The plants were cut 5 cm above the ground level at the time of each cutting. It was ensured, harvesting for green forage was done when the crop attained 50 per cent flowering.

***Plant materials and experimental design*:** The field experiment was conducted during two consecutive years of 2013-14 and 2014-15 in farmer's field. The experiment was laid out in a randomized block design with five replications consisting of four treatments, T1: Check (NB-21), T2: CO-3, T3: Sorghum fodder (COFS-29) and T4: DHN-6. The soil of the experimental site was loam in texture with pH 6.7, EC 0.09 and organic carbon 0.56% (Anon, 2012). During 2013-14 and 2014-15 six harvestings were done at regular intervals. At each harvest, observations on growth attributes *viz.,* stem height (cm), number of tillers per culm, leaf length (cm), leaf width (cm), number of leaves per culm, stem circumference (cm), leaf to stem ratio (LSR) were recorded from two selected bunches from net plot area in each plot. Data were analyzed statistically at 5% level of significance as per Snedecor and Cochran (1994).

After harvest, fresh biomass yields of all treatment were recorded and 300 g of chopped fodder samples were dried in oven separately at 70° C. After drying the whole tiller was partitioned into leaf and stem, and then leaf to stem ratio (LSR) was worked out. Dried samples were also ground using grinder mill to a uniform mesh size and used for the estimation of crude protein, fibre and fat contents (AOAC, 1970). The OFT farmers were interviewed from the pre-tested questionnaire for qualitative parameters. Information on growth of the fodder crop, pubescence, palatability, preference, effect on health of animals by feeding these varieties, yield of the fodder and their acceptance for interventions in the farming systems was collected and analyzed based on the descriptive statistics.

Results and Discussion

***Growth attributes and fodder yield*:** Growth attributes like leaf length, leaf width, number of leaves per culm and stem circumference were recorded (Table 1). Significantly highest leaf length was recorded in CO-3 (123 cm) followed by local check (112 cm) and DHN-6 (96.5 cm). Least leaf length was recorded in COFS-29 (80.3 cm). Highest leaf width was noted in DHN-6 (5.3 cm) followed by COFS-29 (4.5 cm) and least in CO-3 (4.1 cm). Observations on leaf attributes revealed that though DHN-6 recorded less leaf length (96.5 cm) than CO-3 (123 cm) and local check (112 cm), leaf width was highest which can be correlated to more leaf stem ratio. DHN-6 had significantly more number of tillers per culm (25) and number of leaves per culm (190) than other fodder varieties, and this might attributed to better green fodder yields in this variety.

Table 1. Growth attributes and green fodder yield (GFY) of different fodder varieties

Fodder varieties	Stem height (cm)	Number of tillers/culm	Leaf length (cm)	Leaf width (cm)	Number of leaves/culm	SC (cm)	GFY (t/ha/year)
T1: Local check	204.4	23.0	112.6	4.2	135.6	5.8	85.8
T2: CO-3	217.5	22.8	123.0	4.1	163.6	5.6	120.2
T3: COFS-29	223.6	13.0	80.3	4.5	95.2	2.8	160.4
T4: DHN-6	249.8	25.0	96.5	5.3	190.5	7.2	220.6
SEM ±	2.4	0.7	1.6	0.2	6.8	0.2	4.2
CD (P<0.05)	7.4	2.2	5.00	0.6	21.1	0.6	13.1

SC: Stem circumference; GFY: Green fodder yield

Pooled data of two years revealed significantly higher annual green fodder yield (GFY; t/ha) in DHN-6 (220.6) followed by COFS-29 (160.4) and CO-3 (120.2). This higher green fodder yield in DHN-6 was probably attributed to higher stem heights (Chellamuthu *et al.,* 2000). Stem height in the tested fodder varieties varied from 204.4 to 249.8 cm and DHN-6 fodder variety had significantly higher stem height (249.8 cm) in comparison to remaining fodder varieties. Zhang *et al.* (2010) and Singh *et al.* (2018) also reported positive correlation between plant height and fodder yield in napier grasses. In fact, fodder yield is a function of genetic as well as the environmental factors, which plays a vital role in fodder growth and development. The plant height was significantly higher in DHN-6 and this might be due to genetic factor of the variety and also environmental factors of Ramanagara district that suited well for its adoption. The higher plant height was mainly attributed to more number of leaves per culm, which resulted in higher photosynthetic activity and uptake of nitrogen by crop that resulted in more vegetative growth and increase in protoplasmic constituent (Singh *et al*., 2005).

***Qualitative attributes*:** Average crude protein content was more than 7% in CO-3 and DHN-6 (Table 2), and this was probably due to higher leaf stem ratio (LSR-1.0.) in these two varieties. Shankar (1980) and Ekemini *et al*. (2012) reported that the usefulness of LSR and demonstrated that leafiness had a positive relationship with the total protein content in forages. Leaf stem ratio (1.0) was observed higher in CO-3 and DHN-6 and it varied from 0.5 to 1.0 among the fodder varieties. Singh *et al*. (2000) observed similar values on LSR, from 1.05 to 1.15 among treatments in two years study on fodder crops. The higher leaf stem ratio in CO-3 and DHN-6 was mainly due to more number of leaves per culm which could intercept and utilize the incident solar radiation in the production of photosynthesis and eventually resulting in higher meristamatic activity. This was also probably due to favorable influence on uptake of more nitrogen by these fodder varieties, which lead to increase in cell division and cell elongation to produce more functional leaves for a longer period of time. These findings were in conformity with the earlier studies (Singh and Gill, 1976; Gardner *et al*., 1988). Crude fat and crude fiber did not vary significantly among the tested fodder varieties. The crude fat varied from 0.8 to 1.2% and crude fiber from 32.4 to 33.9% among the varieties.

Table 2. Leaf stem ratio (LSR) and chemical composition (% DM basis) of different fodder varieties

Fodder varieties	LSR	Crude protein	Crude fat	Crude fibre
T1: Local check	0.50	6.90	1.1	33.0
T2: CO-3	1.00	7.31	1.1	32.4
T3: COFS-29	0.64	6.80	0.9	33.3
T4: DHN-6	1.00	7.01	0.8	33.7
SEM ±	0.01	0.12	0.13	1.17
CD (P<0.05)	0.05	0.38	NS	NS

***Perception of fodder varieties by farming community*:** Based on farmers' observation on qualitative attributes of fodder varieties on growth, pubescence, palatability and preference by livestock, DHN-6 was found superior for its luxuriant flourishing growth, abundant foliage, high palatability compared to other varieties (Table 3). The number of leaves per plant plays an important role in manufacturing and supply food material synthesized during photosynthesis. The success of any new demonstration or new variety depends on yield. In the present intervention, the performance of DHN-6 was better followed by COFS-29. An increase in number of leaves per plant had a direct effect on the green forage yield which probably influenced the farmers perception (Somashekar *et al.,* 2011). Local check and CO-3 had more pubescence (hairs) resulting in less palatability and poor acceptance by the livestock. Presence of hairs caused skin irritation and cuts at time of harvesting by the farmers.

Table 3. Farmers' perception on the performance of different fodder varieties

Parameters	Fodder variety			
	Local check	CO-3	COFS-29	DHN-6
Growth	Lush green	Luxuriant	Moderate	Flourishing green
Pubescence	More	Less	Absent	Absent
Palatability	Poor	Moderate	Moderate	High
Preference	Less	Moderate	Moderate	High
Effects on health	Poor	Good	Good	Very good

***Up scaling of extension activities on fodder varieties*:** Many extension activities were taken up through Krishi Vigyan Kendra (KVK), Ramanagara to promote awareness and cultivation of fodder crops (Table 4).The interventions included conducting on farm testing (OFT), front line demonstration (FLD), on campus and off campus training, method demonstration on preparations and planting of root or stem cuttings in farmer's field etc. For easy access and availability of fodder cuttings to the farming community, fodder cafeteria comprising of CO-3, COFS-29, DHN-6 and NB-21 was also established at KVK farm.

Table 4. Supportive extension activities (in numbers) taken up through KVK during 2013-15

Activities	2013-14	2014-15	Total
FLD	1	1	2
OFT	1	1	2
On-campus training	4	4	2
Off-campus training	6	8	14
Exposure visits	1	1	2
Field visits	8	12	20
Diagnostic visits	2	3	5
Field days	1	1	2
Guest lectures	8	12	20
Method demonstrations	2	2	4
Consultancy on fodder	23	20	43

***Impact analysis on fodder production*:** Impact analysis attempts to assess the changes that were attributed to a particular intervention of technology. Impact evaluation was structured to record changes in the existing situation. In other words, changes in outcome (s) that were directly attributable to improve socio-economic condition of the farmer were looked upon. Impact evaluation is usually measured under two categories namely, quantitative (numbers and statistics) and qualitative (words and meanings). In the present study, quantitative approach was followed through analysing growth and yield parameters of fodder crops, while qualitative approach was through farmers' perception on the introduction of fodder varieties. In both the approaches, DHN-6 was found superior followed by CO-3 and COFS-29 over traditional variety NB-21. More area was bought under newly introduced fodder varieties. This resulted in enhancing an area of 27 ha with average increase in milk yield of 0.50 to 0.70 litre per day of the participant farmers in the district.

Conclusion

Green fodder yields of recently released fodder varieties of DHN-6, CO-3 and COFS-29 were found at par, but better than local check (NB-21). On the basis of two years on farm study at Ramanagara district, DHN-6 variety was found more nutritious, high yielding, quick growing, less hairy, more acceptable to cattle (palatable) and with better regeneration capacity. Thus on farm testing extension activity was proved effective in evaluating and introducing new skill and knowledge of fodder varieties. Indeed, two fodder varieties, DHN-6 and COFS-29 were acceptable by the farmers in terms of fodder yield and quality, and could be recommended for fodder cultivation in southern Karnataka of India.

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