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Performance of bajra napier hybrid grown on bunds in comparison to native grasses

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Abstract
To bridge the huge gap of green fodder demand and supply in eastern region of India, it is recommended to bring the more area under fodder cultivation *i.e*. up to 10% of total cropped area. Production of perennial forage crop on field bund may be an alternative for horizontal expansion that roughly occupies 7-10% of total area. Bund with the height of 70 cm was prepared along the boundary of one acre plot with base and top width of 100 and 70 cm, respectively. Pits were dug out on bund with distance of 50 cm from pit-to-pit. Each pit had 20-25 cm diameter and 20 cm depth. The mixture of FYM (200 kg), DAP (2.5 kg) and K_2O (1.5 kg) was added @ 250 g/pit and mixed with soil. Two root-slips of perennial bajra napier hybrid var. CO3 having 25-30 cm length were transplanted in each pit in the month of July after a shower. Fodder was harvested at 55, 115, 170, 265 and 320 days after transplanting. Similarly, bunds of one acre land were left for growth of native grasses. Other practices were at par with bajra napier hybrid. Digestion cum feeding experiment in crossbred cattle heifer was conducted to study the palatability and digestibility of nutrients. Annual cumulative fodder yield of 280 t/ha was obtained with DM content ranging from 12.72 to 19.26% and cost of fodder production of Rs. 0.15 per kg. The nutrients composition showed that quality wise bajra napier hybrid was at par with most of the cereal fodder crops. It also showed good palatability with average dry matter intake (DMI) of 2.24 kg/100kg body weight in crossbred cattle heifers with digestibility of DM (64.45 %) and CP (50.61%**).** So it was recommended that the smallholders must cultivate perennial fodder on bunds for supplying green fodder round the year and fodder available on 280 m^2 bund area of one acre land is sufficient to feed one livestock unit round the year @ 25 kg/day**.**

Keywords: Bunds, Fodder quality, Fodder yield, Palatability, Production cost

Introduction

Standing Committee on Agriculture (2016-17) predicted shortage of 32% green fodder in India during 2020 which may further be increased to 40% during 2025. The condition is alarming in eastern India as it faces fodder deficiency of about 75% ranging from 9.28% in Chhattisgarh to more than 90% in West Bengal and Bihar (Dey *et al*., 2012). Land holding of most of the farmers of small and marginal category varies from 0.2 to 1.0 ha. As a result they are not able to spare land for fodder production, rather they opt for cereal and cash crops production. Many farmers in the region maintain one or two dairy animals with significant numbers of small ruminants and poultry for sustaining their livelihood. Such farmers neither consider nor give importance to forage crop production for their livestock since they maintain their livestock on low input system only on crop residues with open grazing, which results in low productivity. Hence the researchers are facing the challenges of increasing green fodder availability in eastern India so that the target of milk production is fulfilled. Some researchers have recommended contour planting of fodder grasses as dual purpose for erosion control and fodder production (Leakey, 2017; Sparks, 2017). Considering these facts, a model was developed and tested for production of perennial forage crop on bund of one acre land along the boundary that roughly utilizes 7-10 percent of cropped area for balanced feeding to livestock for their better health and productive performance

Materials and Methods

***Land preparation and inter-cultural operation*:** Bund with a height of 70 cm was prepared along the boundary of one acre plot size (6 nos) with base and top width of 100 and 70cm, respectively at the farm of ICAR Research Complex for Eastern Region, Patna, India during 1st week of July, 2016. The initial soil samples were collected from bunds following standard procedure, thereafter samples were collected at monthly interval. Pits (25 cm diameter and 20 cm depth) were dug out on bunds of three plots with pit-to-pit distance of 50 cm. A mixture of fertilizers like FYM 200 kg, DAP 2.5 kg and K_2O 1.5 kg was prepared and added @ 250 g/pit and mixed with soil. Two rootslips

of 25-30 cm length of perennial bajra napier hybrid var. CO_3 were transplanted in each pit in the month of July after a shower. Fodder was harvested at 55, 115, 170, 265 and 320 days from the date of transplanting. Fodder yield was recorded by collecting whole biomass grown on the bunds. Subsequent fodder yield data was also recorded after a time interval. The numbers of tillers were also counted from same places during first and second cuts. Surface irrigation was provided after second and forth cuts of fodder. However, urea was added @ 60kg/ ha in the ring of all plants after third cut with spading and subsequent surface irrigation. Similarly, bunds of another three plots were allowed to grow local grasses and sampling of soils and biomass was done at the same time intervals followed for test plot bunds.

***Sample collection and analysis*:** The dry matter (DM) content in forage samples was estimated in each cut, however, proximate principles were estimated in pooled dried samples as per standard procedure (AOAC, 2005). Nutrients in soil samples were analyzed following a standard procedure (Tandon, 2009). A digestion cum feeding experiment was conducted in six crossbred cattle heifers (171±4.41kg body weight and 16±0.88 month age) for 5 days after preliminary feeding of 15 days to study the intake and digestibility of nutrients of bajra napier hybrid and local grasses by dividing the animals into two groups of three animals in each following completely randomized design. Animals in Group1 were fed bajra napier hybrid and Group 2 were fed local grasses *ad libitum*. The fodder offered, residue left and faeces voided were collected, dried and stored for estimation of DM and other nutrients. The data were analyzed statistically following the methods of Snedecor and Cochran (1994). Economics of fodder production was also calculated based on the rates available locally.

Results and Discussion

***Fodder productivity*:** Annual cumulative green fodder yield of 280 t/ha was recorded in five cuts with DM content ranging from 12.72 to 19.26% in different seasons with lowest values during moist season (August-September) (Table 1). The maximum growth of bajra napier hybrid was recorded during the month of July to October when soil contained sufficient moisture together with favorable ambient temperature ranging from 27-36^{O}C and relative humidity of more than 75 percent. Such high productivity was also attributed to good fertility of clay and loam soil of experimental site having initial neutral pH and 0.72% organic carbon (OC) with good amount of other nutrients (Table 2). The yield potential of bajra napier hybrid (CO3 variety) cultivated in field was reported as 300 t/ha (Kumar *et al*., 2012). However, it's biomass yield on field bunds was reported only 12.5 t/ha in a watershed of Bundelkhand from nine cuttings (Dwivedi *et al*., 2015). The yield of CO3 variety of bajra napier hybrid varied from 59.3 to 70.3 t/ha in 4 and 6 cuts, respectively (Biradar *et al*., 2014). The differences in yields were attributed to the high soil moisture and congenial environment in eastern parts of the country in comparison to Bundelkhand region which is rainfed, dry and hot. However, significant depletion in N, P and K concentration was recorded from soil when analyzed after fifth cut of forage. The N and P depletion was recorded to the tune of 15.31 and 37.35%, respectively; similarly K depletion was 31.92%. It was probably due to mining of large quantity of nutrients in fodder, hence, it is recommended to apply more N, P and K during inter-cultural operation for reserve pool and future use. Pathan and Bhilare (2009) reported that initial application of 62: 50: 25 kg NPK per ha and 25 kg N per ha after each cut had higher green forage as well as dry mater yields. Raj and Palled (2014) reported that bajra napier hybrid variety CO3 recorded significantly higher green fodder, dry matter and crude protein yields when supplied with 300 kg N per ha.

Moisture content of bund soil also had direct impact on fodder biomass yield. Moisture content was lower in bund soil as compared to field soil because of water stagnation in the field (Fig 1). It was observed that moisture content of bund soil varied from 8 to 46% lower than the field soil because of lower water stagnation capacity of bunds and higher evaporation rate due to exposure to sunlight at three sides. As a result the yield of green biomass was highest in moist season of the year.

Table 1. Productivity of bajra napier hybrid on field bunds

Attributes	Month	Forage yield (t/ha)	DM (%)
First cut (55 d)	August-September	60.40±0.49	12.72± 0.07
Second cut (115 d)	September-October	76.33±1.45	17.26± 0.16
Third cut (170 d)	November-December	45.00±1.15	17.09± 0.59
Forth cut (265 d)	March-April	43.33±0.88	18.25± 0.60
Fifth cut (320 d)	May-June	55.00±1.52	19.26± 0.66
Cumulative yield	—	280.06±1.29	—

Table 2. Fertility status of bund soil

Attributes	Initial	Final
pH	6.63±0.02	6.65±0.03
OC (%)	0.72± 0.02	0.71±0.02
N (kg/ha)	223.00±2.00	187.00±3.00
P (kg/ha)	25.65±0.25	16.05±0.15
K (kg/ha)	331.00±3.00	226.00± 3.00

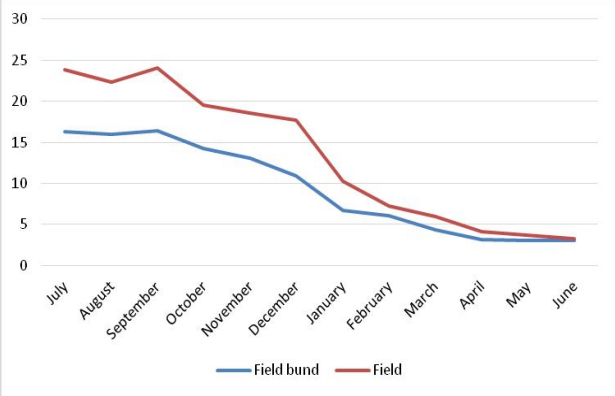

Fig 1. Moisture content (%) of soil of field and field bunds

Fodder biomass was harvested at about 55 day intervals except after third cut in December. The forth cut was taken up after a gap of 95 days in the month of March due to poor vegetative growth. The vegetative growth was affected by cold weather stress with less sun-shine hours from middle of December to end of February. Wangchuk *et al.* (2015) reported that total dry matter per plant was higher at 80 days cutting interval compared to 40 days but reverse was the case with crude protein content. The numbers of tiller was increased from 2 to 40 at 55 days of growth period and it further increased up to 55 numbers at 115 days and then became static. Biradar *et al.* (2014) observed 25 tillers per clump in irrigated condition of Karnataka. Increase in numbers of tillers contributed to yield more fodder in second and subsequent cuts. Dwivedi *et al*. (2015) also reported that first cut of bajra napier hybrid planted on field bunds was taken after 60 days and subsequent cuttings were at 40 days intervals.

***Fodder availability and nutritive value*:** So far as household fodder availability is concerned, growing this crop on bund area (280 m²) of one acre land (4000 m²) can support one adult dairy animal round the year when green fodder was offered @ 25 kg/d except during mid January to February (Table 3). If it is compared with the biomass availability of local grass as being traditionally practiced, it was observed that the bund area of 280 m² yielded 265kg of green biomass of local grasses i.e. 9.46 t/ha. This production cannot support any large animal but one small ruminant can be maintained round the year which requires 9.12 ton green fodder yearly.

The nutritive value of bajra napier hybrid was also recorded and compared with native grasses grown naturally on bunds (Table 4). It was observed that bajra napier hybrid contained 8.92% crude protein (CP), 24.50% crude fibre (CF) and 1.21% ether extract (EE). However, native grasses contained 7.46% CP, 26.43% CF and 1.65% EE. The compositions of native grasses were 68, 21 and 11% (w/w) of Motha (*Cyperus rotundus*), Dub (*Cynodon dactylon*) and other grasses, respectively. The nutrient composition of bajra napier hybrid fodder was at par with other cereal fodder crops (Gupta *et al.,* 2017; Kumar *et al*., 2012; Kadam *et al*., 2017) and local grasses were at par with the values reported by Dey *et al*. (2014). Bajra Napier hybrid fodder showed good palatability with dry matter intake (DMI) of 2.24 kg/100kg body weight in crossbred cattle heifers. Average digestibility of DM and CP was 64.45 and 50.61%, respectively which was at par to maize and better than multicut sorghum (Gupta *et al.,* 2016). However, the DM intake of local grasses was 2.03 kg/100 kg body weight with digestibility of DM, CP and OM at 62.57, 48.07 and 64.19%, respectively. Antony and George (2014) reported similar findings in hybrid napier cultivars grown under rainfed system. Hence, growing of fodder on field bunds could certainly help to resolve the issue of fodder scarcity as also suggested earlier by Dwivedi and Ramana (2002). Such type of efforts may be beneficial for sustainable land management to increase the economy of marginal and small farmers of eastern India.

Table 3. Household fodder availability (kg) in bunds (280 m^2 area)

Months	Hybrid napier biomass (kg)	Stocking density (Nos)	Local grass biomass (kg)	Stocking density (Nos)
August-September	1680	1.10	105	0.06
October-November	2128	1.40	72	0.04
December to mid-January	1260	1.12	26	0.02
Mid-January-February	0	0	12	0.01
March-April	1204	0.79	34	0.02
May-June	1540	1.01	16	0.01
Annual fodder availability	7812	—	265	—

Table 4. Chemical compositions and digestibility of bajra napier hybrid and native grasses in cattle

Parameters	Hybrid napier	Local grass
Chemical compositions (% DM basis)		
OM	90.70	87.18
CP	8.92	7.46
CF	24.50	26.43
EE	1.21	1.65
Digestibility of nutrients (%)		
DMD	64.45±1.31	62.57±1.28
CPD	50.61±1.22	48.07±0.82
OMD	67.39 ± 0.57	64.19±0.53

Economics of fodder production: The economics of production cost of bajra napier hybrid and native grasses were also recorded (Table 5). The cost of production of bajra napier hybrid was lower (Rs 153.57/t) than local grasses (Rs 837.69/t) by incurring total input cost of Rs. 43000 and Rs 8000 per ha, respectively. Biradar *et al*. (2014) reported the input cost of Rs 32842/ha for bajra napier hybrid (CO3 variety) with cost benefit ratio of 2.47 and production cost of Rs 505/t. The production cost might further be reduced in subsequent years, since later no cost is involved in bund preparation, root-slips purchase and labour for planting.

Table 5. Economics of napier and local grass production on bund area (Rs/ha)

Parameters	Hybrid napier	Native grasses
Field preparation (Rs)	12000	6000
Propagation material and planting (Rs)	6000	0
Fertilizer cost + FYM (Rs)	11000	2000
Irrigation (Rs)	4000	0
Labour and other cost (Rs)	10000	0
Total input cost (Rs)	43000	8000
Total green fodder production (t/ha)	280.06	9.46
Cost of production (Rs/t)	153.57	845.66

Conclusion

Smallholders in the eastern region of India can cultivate perennial fodder like bajra napier hybrid on field bunds with productivity of 280 t/ha. Bund area in one acre of field occupies 280 m^2 and produces 7.81 t of fodder which is sufficient to feed one livestock unit round the year. Bajra napier hybrid is a quality fodder in respect of nutrients content and dry matter intake by livestock. Cost of production of bajra napier hybrid on bunds was Rs 157.57/t.

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