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Adult Cattle Unit based Fodder Model for Supplementing Round the Year Green Fodder in Irrigated Subtropics of Jammu and Kashmir: A Review

Swati Mehta[1], Neetu Sharma[2], Kanik Kumar Bansal[2], Navjot Rana[1], Shilpa[1], Naorem Diana Devi[1], Ravi Verma[1], Pankaj Dahiya[1]

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ABSTRACT

Ensuring year-round provision of green fodder for a single adult cattle unit poses a significant challenge, especially in regions with distinct seasons. However, with careful planning and the use of a variety of forage crops including legumes, grains and perennial grasses, it is possible to maintain a consistent supply of green fodder. Factors such as cattle type, weight, activity levels and the nutritional quality of the fodder all influence the amount of green fodder required by adult cattle. Adequate green fodder intake is crucial for meeting their nutritional needs and maintaining optimal health and productivity. This underscores the importance of exploring sustainable strategies for year-round green fodder provision highlighting the vital role of forage crop diversity in meeting the dietary needs of adult cattle. The research experiment took place at the Research Farm of the Division of Agronomy, SKUAST-Jammu spanning two consecutive years from 2020-2021 to 2021-2022. The experimental layout consisted of eight treatments arranged in three staggered configurations during both *kharif* and *rabi* seasons alongside perennial fodders planted along the borders. The design employed a randomized block design (RBD) and was replicated three times. Significantly higher system productivity was recorded with Multicut Bajra + Cowpea - Berseem + Oats with Root slips of Napier planted in July. Multicut Sorghum + Cowpea - Lucerne + Oat with stem cuttings of Setaria planted in January recorded maximum land requirement for 1 ACU and 10 ACU's whereas minimum land requirement for 1 ACU and 10 ACU's was observed in Multicut Bajra + Maize - Berseem + Barley with root slips of Napier planted in July.

Key words: Adult cattle unit, Cereal crops, Legume crops, Perennial grasses.

Forage and livestock are integral components of India's agricultural landscape (Ghosh *et al*., 2016). Despite having just 2.2 per cent of the world's geographical area, India supports nearly 20 per cent of the global livestock population, making it the world's largest livestock owner (Patil *et al*., 2018). With a total bovine population of approximately 302.79 million and a cattle population of about 192.49 million, along with 125.34 million milch animals, India's milk production stands at around 176.34 million tonnes (DACFW, 2018). However, despite its vast livestock numbers, India's livestock productivity remains significantly lower (20 to 60 per cent) than the global average due to inadequate access to quality fodder (Halli *et al*., 2018). The availability of green forage is crucial for the success of dairy enterprises and is essential for maintaining livestock health and milk production (Kumar *et al*., 2017). Presently, cultivated fodder occupies less than 4.5 per cent (8.6 million hectares) of the country's total cultivated area with an annual total forage production of 846 million tonnes (IGFRI, 2018). This falls short of meeting the green forage requirement of 1061 million tonnes and the dry fodder requirement of 589 million tonnes, leaving a significant deficit. The country faces a net deficit of 63.5 per cent in green fodder, 23.5 per cent in dry crop residues and 64 per cent in feed (DES, 2022). Moreover, there are seasonal and regional disparities in fodder production with plenty of fodder available during the monsoon season but scarcities during winter and summer months, particularly in May-June and September-October. To address this challenge, there is a need to not only enhance fodder production but also ensure year-round accessibility to quality fodder for all dairy animals. This can be achieved through agronomic interventions such as staggered planting of annual cereal fodders, incorporating legumes with cereals and utilizing alternative sources of perennial fodders to provide high-quality fodder consistently throughout the year (Hindoriya *et al*., 2019). Farmers can achieve year-round green fodder availability by strategically

[1]Lovely Professional University, Phagwara-144 411, Punjab, India.
[2]Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu-180 009, Jammu and Kashmir, India.

Corresponding Author: Swati Mehta, Lovely Professional University, Phagwara-144 411, Punjab, India.
Email: swatimehta1909.sm@gmail.com

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planning fodder production based on available resources, soil type, agro-climate and cropping year requirements.

Jammu and Kashmir region

Jammu and Kashmir, acknowledged for its tremendous agricultural potential and production, comprises of mostly small and fragmented landholdings owned by the farmers. Over 70 per cent of the population in the region depends on agriculture and related activities for their livelihood, either directly or indirectly. Over the years, livestock husbandry has emerged as a vital growth engine for sustainable and equitable development, which is imperative for uplifting the socio-economic status of farming communities in J & K. J & K UT has a precious wealth of livestock in the form of cattle, buffalo, sheep, goats, horses/mules *etc*. Cattle and sheep amongst all the livestock are considered the most important tool for the development of the rural economy. The agricultural sector (including livestock) contributes 16 per cent to the Gross State Domestic Product (GSDP) of UT at constant prices. Livestock sector alone contributes 11 per cent of the GSDP which is about 40 per cent of the contribution of the agricultural and allied sector. Total geographical area of the erstwhile UT of J & K was 2,22,240 km out of which 2 78,114 km (35.15%) area lies under the illegal occupation of Pakistan and 42,735 km (19.23%) under the illegal occupation of China. Only 4 per cent of the total cultivable land is under fodder production at present. Jammu and Kashmir has livestock population of 1.79 crores with cattle population and buffalo population of about 34.43 lakhs and 10.50 lakhs respectively (DES, 2022) and has milk production of about 1486.65 metric tonnes (DES, 2022). Annual requirement for green fodder in Jammu and Kashmir is approximately 139 lakh metric tons, while the dry fodder requirement is around 58.53 lakh metric tons. Whereas, the total fodder production of Jammu and Kashmir is 86.5 lakh tonnes of which green fodder contributes 61.4 and dry fodder 25.1 lakh tonnes (Ahmad *et al*., 2016).

Unfortunately, the availability of green and dry fodder is insufficient to meet the demand. In particular, there is a deficit of 40.93 per cent in fodder availability in the region, with a higher deficit of 48.63 per cent in the Kashmir division compared to 32.27 per cent in Jammu division. Therefore, increased production of fodder is essential to meet the nutritional requirements of the livestock. Further, the agro-climatic conditions of the major portion of the region also warrants the need of cultivating even additional fodder that can be dried to hay or stored as silage for lean periods.

Adult cattle unit

An adult cattle unit is often defined based on the weight of a mature, non-lactating cow. The weight chosen for this standard may vary, but it's usually in the range of 1,000 to 1,200 pounds (450 to 550 kilograms) (Fig 1). It is often used to compare and quantify the productivity of different cattle farms or ranches.

Adult cattle unit based fodder model

An adult cattle unit-based fodder model is a systematic approach to determine the nutritional and forage requirements of adult cattle. This model aims to ensure that adult cattle receive a consistent and balanced diet, especially in areas with seasonal variations during lean period (Fig 2) and during *kharif* and *rabi* seasons (Fig 3 and 4) in forage availability. Hence, an experiment was conducted at the Research Farm, Division of Agronomy, Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu, Chatha for two consecutive years from 2020 to 2022.

Fodder requirement for 10 adult cattle units

- One adult cattle unit requires 20 kg green fodder with concentrate per day.
- Ten adult cattle units require 200 kg green fodder with concentrate per day.
- One adult cattle unit requires 40 kg green fodder without concentrate per day.
- Ten adult cattle units require 400 kg green fodder without concentrate per day.

Methodology

The experiment was laid out in randomized-block design with three replications. This model comprised of *kharif*

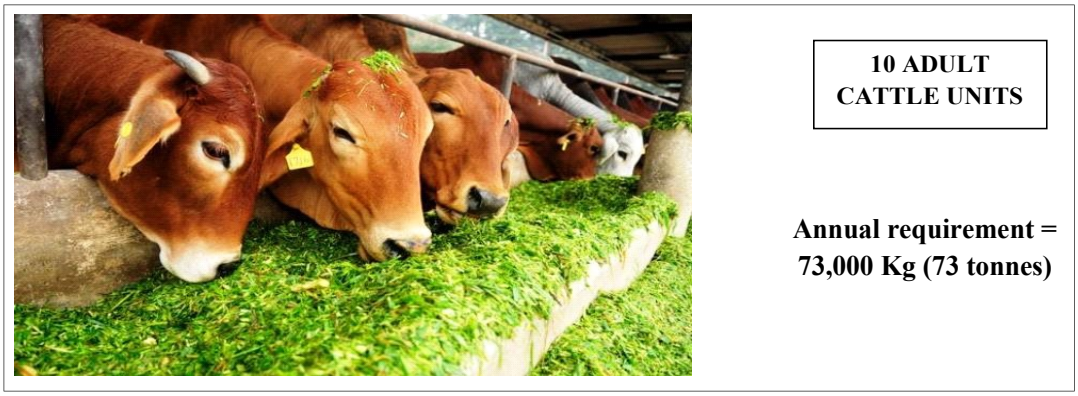


Fig 1: An adult cattle unit-based fodder model.

annual fodder crops (Multicut sorghum, multicut bajra, cowpea and maize) followed by *rabi* annual fodder crops (Berseem, lucerne, barley and oats) along with perennial grasses (Napier and Setaria) sown on the boundaries of the field with the plant to plant spacing of 50 cm.

Salient findings of the experiment

Green forage yield of *kharif* and *rabi* annual fodder with perennial grasses

Significantly higher green forage yield of *Kharif* fodder crops (Fig 5 and 6) was recorded with multicut sorghum + maize with root slips of Napier planted in July sown on April 30 which was statistically at par with multicut sorghum + maize with root slips of Setaria planted in July, multicut sorghum + maize with stem cuttings of Napier planted in January and multicut sorghum + Maize with stem cuttings of Setaria planted in January during both the years of experimentation. This might be due to the fact that Multicut sorghum and maize both has high yield potential compared to other *kharif* annual fodders being cultivated. Moreover, another reason might be inclusion of perennial grasses with *kharif* annual cereal fodders provides continuous supply of green fodder round the year (Gupta *et al*., 2022). These results are in close conformity with the finding of Lodhi *et al*. (2009) and Ayub *et al*. (2013). Among the different forage cropping systems, significantly higher green forage yield of *rabi* fodder (Fig 7 and 8) was recorded with berseem + oat with root slips of Napier planted in July sown on



Lean period: May - June and September - October.

Fig 2: Fodder (Napier) for lean period.

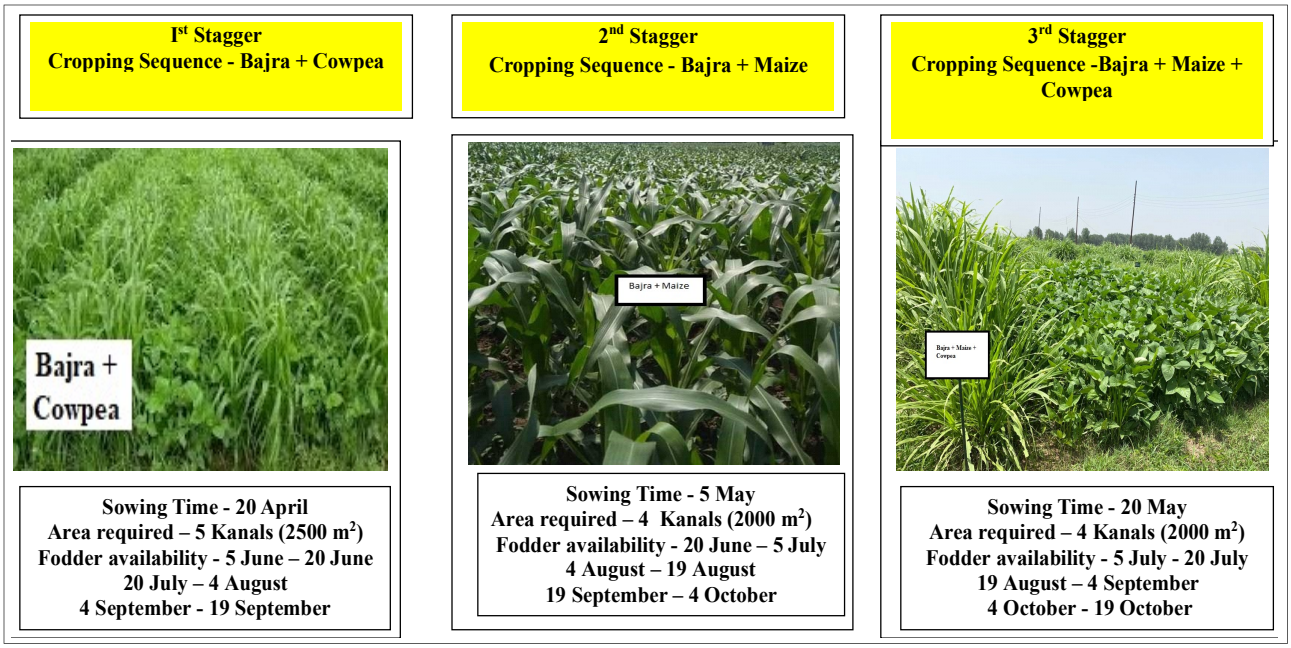


Fig 3: *Kharif* annual fodder model.

September 20 which was found to be statistically at par with Berseem + Oat with root slips of Setaria planted in July, Berseem + Oat with stem cuttings of Napier planted in January and berseem + oat with stem cuttings of Setaria planted in January during both the years of experimentation. This might be attributed to the fact that



Fig 4: *Rabi* annual fodder model.

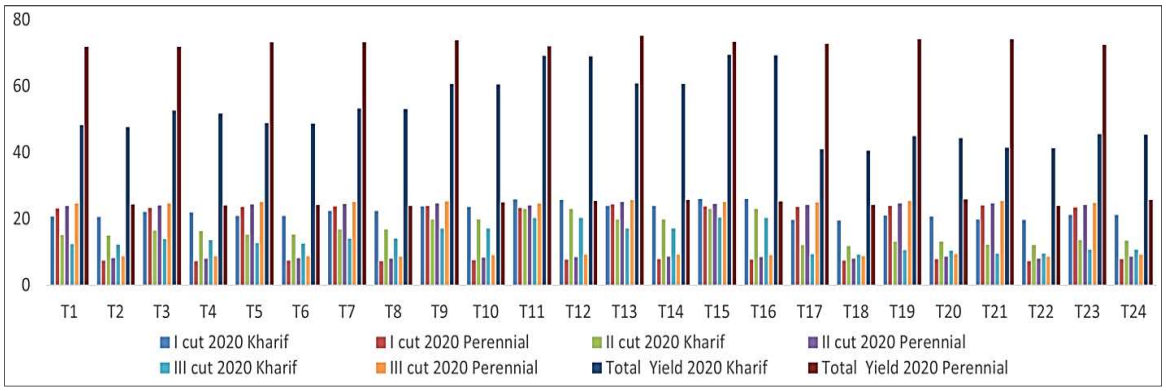


Fig 5: Effect of *kharif* annual fodder with perennial grasses on green forage yield (t/ha) during 2020.

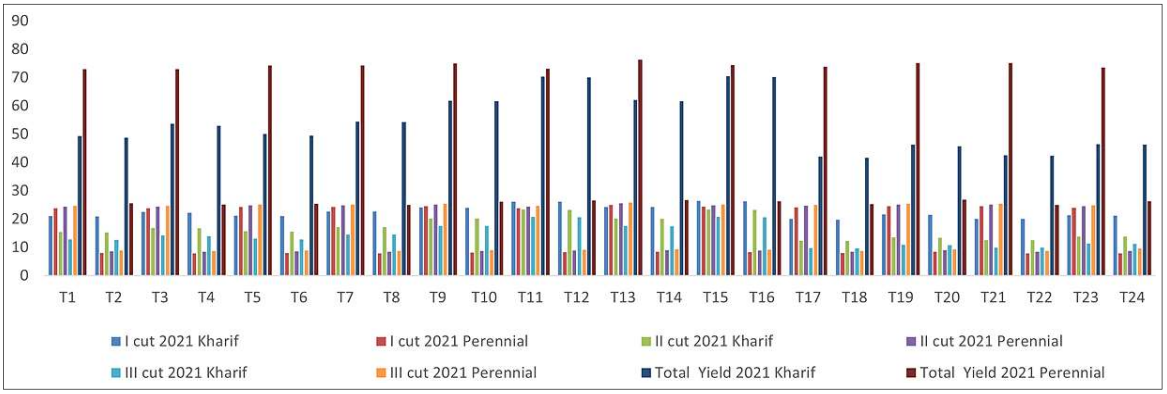


Fig 6: Effect of *kharif* annual fodder with perennial grasses on green forage yield (t/ha) during 2021.

Berseem mixed with cereal crop led to more efficient absorption of nutrients from the soil, maximum interception of light energy at different layers and finally better photosynthetic rate which resulted in higher green forage yield (Kumar and Sarlach, 2020) Another reason might be the fact that inclusion of berseem with oats have several benefits such as production of greater yield by making more efficient use of available resources, improvement of soil fertility through the addition of nitrogen by fixation (Patil *et al.,* 2018). Almost a similar trend with respect to green forage yield was observed during second year of experimentation except for that a slight increase in green forage yield.

System productivity of *kharif* and *rabi* annual fodder with perennial grasses for round the year green fodder supply

Significantly higher system productivity (Fig 9 and 10) was recorded with multicut bajra + cowpea - berseem + oats with Root slips of Napier planted in July and Napier used to cover the lean period during May-June and September

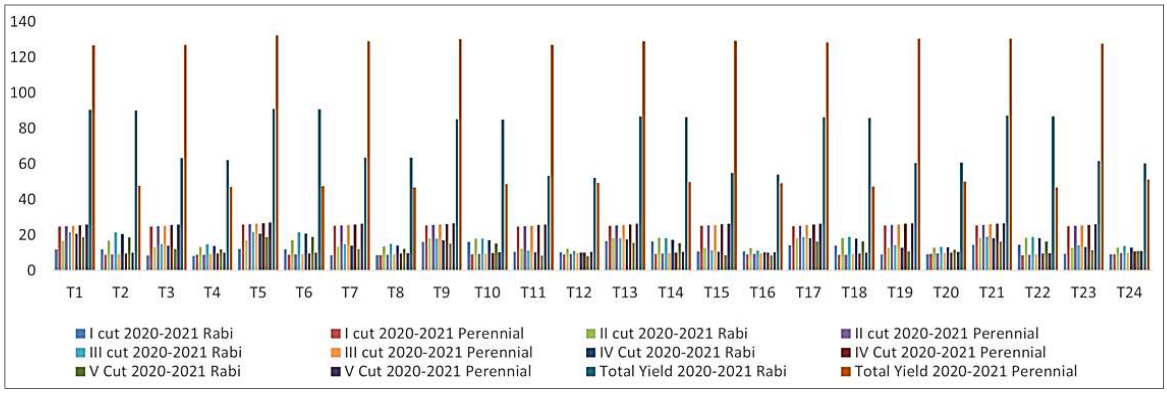


Fig 7: Effect of *rabi* annual fodder with perennial grasses on green forage yield (t/ha) during 2020-2021.

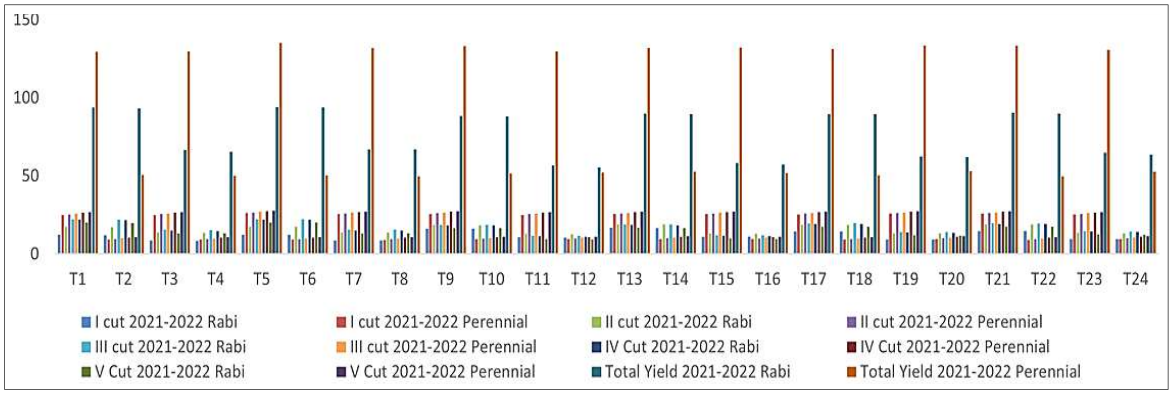


Fig 8: Effect of *rabi* annual fodder with perennial grasses on green forage yield (t/ha) during 2021-2022.

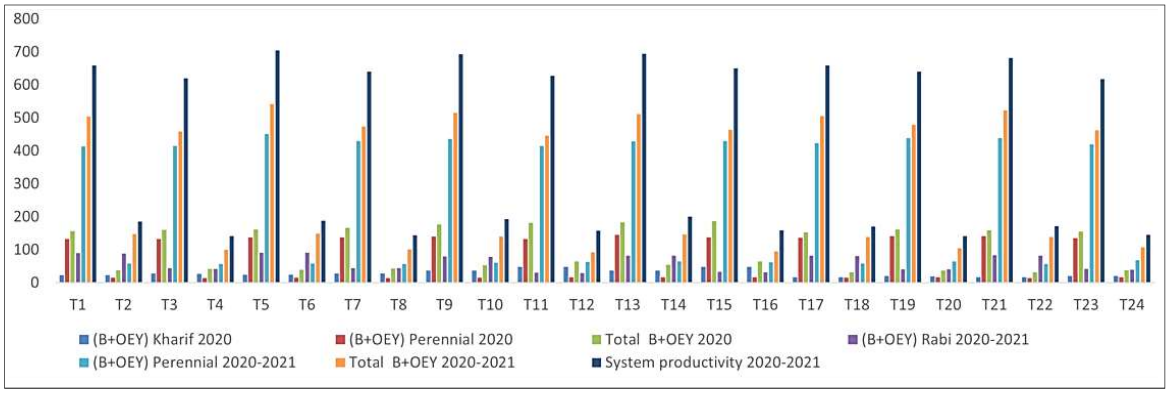


Fig 9: Berseem + Oat equivalent yield (B+OEY) (t/ha) of *kharif* and *rabi* annual fodders with perennial grasses during 2020-2021.

Table 1: Land requirement (metre square) of annual forages with perennial grasses for 1 ACU and 10 ACU's.

Treatments		I ACU	10 ACU	I ACU	10 ACU
		2020-2021	2020-2021	2021-2022	2021-2022
T_1	Multicut bajra + Cowpea - Berseem + Oat + Stem cuttings of napier planted in January	221.28	2212.83	220.52	2205.17
T_2	Multicut bajra + Cowpea - Berseem + Oat + Stem cuttings of setaria planted in January	785.58	7855.80	750.37	7503.73
T_3	Multicut sorghum + Cowpea - Lucerne + Oat + Stem cuttings of napier planted in January	235.60	2355.98	234.99	2349.91
T_4	Multicut sorghum + Cowpea - Lucerne + Oat + Stem cuttings of setaria planted in January	1029.33	10293.29	972.04	9720.37
T_5	MSulticut bajra + Cowpea - Berseem + Oat + Root slips of napier planted in July	214.29	2142.87	213.83	2138.29
T_6	Multicut bajra + Cowpea - Berseem + Oat + Root slips of setaria planted in July	777.55	7775.47	745.85	7458.49
T_7	Multicut sorghum + Cowpea - Lucerne + Oat + Root slips of napier planted in July	227.90	2279.01	227.48	2274.82
T_8	Multicut sorghum + Cowpea - Lucerne + Oat + Root slips of setaria planted in July	1010.38	10103.81	955.25	9552.47
T_9	Multicut bajra + Maize - Berseem + Barley + Stem cuttings of napier planted in January	210.62	2106.17	210.30	2102.99
T_{10}	Multicut bajra + Maize - Berseem + Barley + Stem cuttings of setaria planted in January	755.22	7552.24	723.06	7230.59
T_{11}	Multicut sorghum + Maize - Lucerne + Barley + Stem cuttings of napier planted in January	232.48	2324.77	232.05	2320.48
T_{12}	Multicut sorghum + Maize - Lucerne + Barley + Stem cuttings of setaria planted in January	927.46	9274.55	882.76	8827.62
T_{13}	Multicut bajra + Maize - Berseem + Barley + Root slips of napier planted in July	203.63	2036.35	203.44	2034.42
T_{14}	Multicut bajra + Maize - Berseem + Barley + Root slips of setaria planted in July	729.02	7290.16	699.97	6999.71
T_{15}	Multicut sorghum + Maize - Lucerne + Barley + Root slips of napier planted in July	224.55	2245.53	224.28	2242.81
T_{16}	Multicut sorghum + Maize - Lucerne + Barley + Root slips of setaria planted in July	918.18	9181.81	874.93	8749.33
T_{17}	Multicut bajra + Cowpea + Maize - Berseem + Oat + Barley + Stem cuttings of napier planted in January	221.43	2214.34	220.87	2208.71
T_{18}	Multicut bajra + Cowpea + Maize - Berseem + Oat + Barley + Stem cuttings of setaria planted in January	855.55	8555.52	811.07	8110.66
T_{19}	Multicut sorghum + Cowpea + Maize - Lucerne + Oat + Barley + Stem cuttings of napier planted in January	228.09	2280.93	228.35	2283.46
T_{20}	Multicut sorghum + Cowpea + Maize - Lucerne + Oat + Barley + Stem cuttings of setaria planted in January	1027.66	10276.62	985.29	9852.88
T_{21}	Multicut bajra + Cowpea + Maize - Berseem + Oat + Barley + Root slips of napier planted in July	214.27	2142.71	213.90	2139.01
T_{22}	Multicut bajra + Cowpea + Maize - Berseem + Oat + Barley + Root slips of setaria planted in July	851.61	8516.10	810.62	8106.16
T_{23}	Multicut sorghum + Cowpea + Maize - Lucerne + Oat + Barley + Root slips of napier planted in July	236.31	2363.11	235.81	2358.07
T_{24}	Multicut sorghum + Cowpea + Maize - Lucerne + Oat + Barley + Root slips of setaria planted in July	1002.61	10026.10	883.67	8836.70

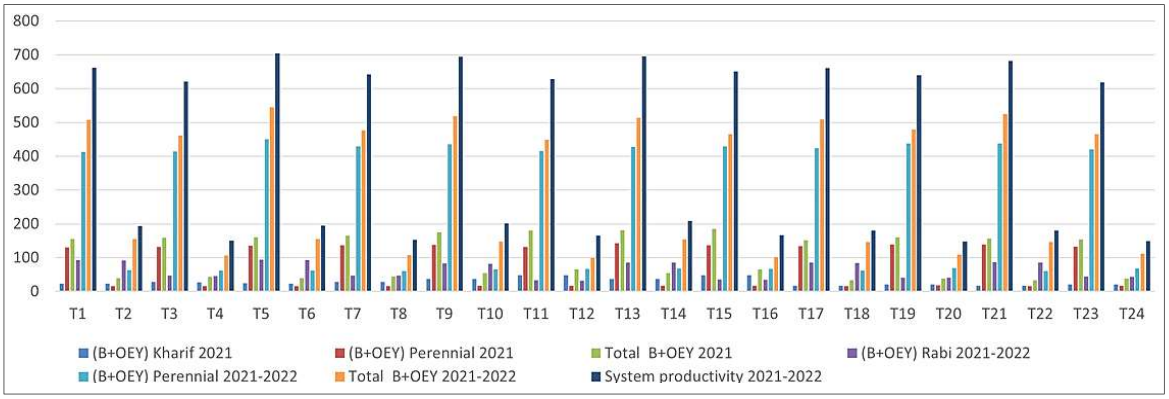


Fig 10: Berseem + oat equivalent yield (B+OEY) (t/ha) of *kharif* and *rabi* annual fodders with perennial grasses 2021-2022.

-October (Fig 2). It was found to be statistically at par with multicut bajra + maize - berseem + barley with root slips of Napier planted in July, multicut bajra + maize - Berseem + Barley with stem cuttings of Napier planted in January and multicut bajra + cowpea + maize - berseem + oat + barley with root slips of Napier planted in July. This might be owing to fact that inclusion of legumes and cereal fodders resulted in increased production efficiency.

Land requirement of annual forages with perennial grasses for ACU

Among the different treatments, multicut sorghum + cowpea - lucerne + oat with stem cuttings of Setaria planted in January recorded maximum land requirement for 1 ACU (Table 1) to the tune of 1029.33 metre square whereas minimum land requirement for 1 ACU was observed in multicut bajra + maize - berseem + barley with root slips of Napier planted in July (203.63 metre square). This could be attributed to the fact that this combination resulted in a lower yield of green forage from the fodder crops, necessitating a larger area to meet the desired yield. Almost a similar trend with respect to 1 ACU was observed during second year of experimentation. By and large, 10 ACU's also showed similar trend with respect to land requirement of annual forages with perennial grasses.

CONCLUSION

On the basis of two years study, it was concluded that Multicut bajra + cowpea - berseem + oats with root slips of Napier planted in July was found to be the best feasible sustainable forage cropping system for round the year availability of quality fodder with the maximum yield. However, multicut bajra + maize - berseem + barley with root slips of Napier planted in July was found to be the most feasible forage cropping system as it realized minimum land requirement to feed 10 ACU's.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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