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Production Performance and Economics of Forage Cropping Systems under Irrigated Condition of Western Maharashtra

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ABSTRACT

Background: Green forages have important role in livestock sector as they are the main source of nutrition. Even then there is always deficit in green fodder supply as against the demand. Out of the total cultivated land at national level, area under fodder crops is about 4%. Under these circumstances the only way is to increase the productivity of fodder crops by adopting best forage cropping system. Growing of cereal-legume fodder crops, as intercrop, mixed crop and sequence crop increase the fodder production and also help to meet the balanced diet for livestock.

Methods: A field study was conducted at Central Research Station of BAIF Development Research Foundation, Urulikanchan in three successive years from 2013-14 to 2015-16. The experiment was laid in a randomized block design with four replications and six different forage cropping systems. The experiment was conducted in light gravel soil.

Result: Among the six different cropping systems studied, significantly higher green fodder yield of 792 q/ha/year, net monetary returns of Rs. 92891/ha/year and benefit-cost ratio of 1.92 was recorded in intercropping sequence of maize + cowpea (*kharif*), oat + berseem (*rabi*) and bajra + cowpea (summer). This cropping system has confirmed more fodder production from the cereal and legume inter crops with further additional benefits of provision of high quality fodder and net monetary returns.

Key words: Benefit-cost ratio, Cropping systems, Green fodder yield.

INTRODUCTION

Perennial and annual forage as well as legumes and cereals are important components of sustainable forage cropping systems. Forages are the primary source of proteins, carbohydrates and fibers for livestock ration. The productivity of dairy animals depends upon the availability of nutritious and adequate quantities of feed and fodder. Due to the constant increase in the cost of concentrate feed, it is not affordable for the farmers to purchase such feed and therefore generally feed the animals on available green and dry fodder. In India, cultivated fodder is limited to 4.5 per cent of the total cropped area reported by Kumar *et al.* (2012). There is less scope for increasing area under fodder cultivation and the only way is to enhance the productivity of fodder crops from the inadequate land. The task could be achieved to greater extent by adopting suitable cropping systems. The cropping system with forage crops provides a potential alternative to overcome the fodder problem as it utilizes the resources more efficiently.

Intercropping, sequence cropping, alley cropping, mixed cropping are various types of cropping systems in forage crop production. Fodder cereals and legumes, perennial cultivated grasses and legumes are grown under different cropping systems as per the agro-climatic conditions and soil types. Intercropping of a legume with grasses gives advantage in higher fodder production over sole cropping. It provides efficient utilization of environmental resources, reduces risk of the cost of production, provides greater financial stability for farmers, decreases pest damages, suppresses weed growth more than monocultures, improves soil fertility through increased N content and improves forage yield and quality. The present study was undertaken to identify the best forage cropping system for efficient and balanced green fodder production.

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MATERIALS AND METHODS

A field study was conducted at Central Research Station of BAIF Development Research Foundation, Urulikanchan under All India Coordinated Research Project on Forage Crop and Utilization in three successive years from 2013-14 to 2015-16. The experiment was laid in a randomized block design with four replications and six different forage cropping systems (Table 1). The experiment was conducted in light gravel soil having initial soil status of 0.52 dS m^{-1} EC, 7.85 pH, 0.30 per cent organic carbon, 138, 22.67 and 285 kg ha^{-1} N, P and K respectively. The treatment combinations included intercropping of seasonal cereal and legume fodder crops, perennial legumes with B × N hybrid and seasonal legumes with B × N hybrid. The ratio of cereal to legume

was 2:1 for seasonal crops. In B × N hybrid + Lucerne, B × N Hybrid + *Stylosanthus* and B × N hybrid + *Desmanthus* two rows of B × N hybrid spaced at 3 m and in between 10 lines of legumes at 30 cm spacing.

RESULTS AND DISCUSSION

The pooled data on green fodder, dry matter and crude protein yields as influenced by different forage crop combinations are presented in Table 2. It was revealed from the Table 2 that significantly highest green fodder yield of 792 q/ha/year was recorded in forage intercropping sequence of maize + cowpea (*Kharif*) - oat + berseem (*Rabi*)- bajra + cowpea (Summer), however, dry matter yield of 128 q/ha/year was recorded in intercropping of sorghum + cowpea (*Kharif*)-maize + berseem (*Rabi*)- bajra + cowpea (Summer) and crude protein yield of 12 q/ha/year was recorded in combination of B × N hybrid + Lucerne and B × N hybrid + cowpea - berseem - cowpea treatments. This may be because of the cereal legume crop combinations as intercropping enhanced the soil P and N acquisition by root activity. Combination of cereal and legume increases the growth of the plant as well as yield of the main crop. Sapana *et al.* (2017) reported that intercropping of legumes with grasses gives higher green fodder yield. Dwivedi *et al.*, (2015), also reported that a combination of cereal fodder crop with legume fodder crops gives higher green fodder yield from the same piece of land and also helps to improve soil through addition nitrogen fixation. Kumar and

Table 1: Season wise cropping systems adopted during three season of each year.

Kharif	*Rabi*	Summer
Maize + Cowpea	Oat + Berseem	Bajra + Cowpea
Sorghum + Cowpea	Maize + Berseem	Bajra + Cowpea
B × N hybrid + Cowpea	B × N hybrid + Berseem	B × N hybrid + Cowpea
B × N hybrid + Lucerne	B × N hybrid + Lucerne	B × N hybrid + Lucerne
B × N hybrid + *Deshmanthus*	B × N hybrid + *Deshmanthus*	B × N hybrid + *Deshmanthus*
B × N hybrid + *Stylosanthus*	B × N hybrid + *Stylosanthus*	B × N hybrid + *Stylosanthus*

Table 2: Green fodder, dry matter and crude protein yield under different cropping systems.

Treatments	Treatment details	Green fodder yield q/ha/year	Dry matter yield q/ha/year	Crude protein yield q/ha/year
T-1	Maize + cowpea - oat + berseem - bajra + cowpea	792	123	11
T-2	Sorghum + cowpea - maize + berseem - bajra + cowpea	740	128	10
T-3	B × N hybrid + cowpea - berseem - cowpea	689	101	12
T-4	B × N hybrid + Lucerne	705	97	12
T-5	B × N hybrid + *Deshmanthus*	508	80	9
T-6	B × N hybrid + *Stylosanthes*	504	79	9
SEm ±		15.13	3.76	0.43
CD at 5%		46.04	11.45	1.31
CV %		8.88	9.32	8.18

Table 3: Effect of different cropping systems on plant height, leaf stem ratio.

Treat.	Crops	Plant height (cm)			L:S ratio		
		Kharif	*Rabi*	Summer	*Kharif*	*Rabi*	Summer
1	Maize (K*), oat (R) and bajra (S)	236.00	71.33	184.80	0.79	0.49	0.54
	Cowpea, berseem and cowpea	222.25	46.58	171.27	0.83	0.62	1.15
2	Sorghum, maize and bajra	219.55	201.83	194.33	0.38	0.52	0.59
	Cowpea, berseem and cowpea	204.11	41.11	174.25	0.94	0.72	1.13
3	B × N Hybrid	130.33	204.89	155.91	0.77	0.77	0.71
	Cowpea- berseem-cowpea	184.39	35.44	190.52	0.83	0.80	1.19
4	B × N Hybrid	120.50	190.47	141.22	0.75	0.67	0.65
	Lucerne	38.50	34.13	38.69	0.77	1.17	1.31
5	B × N Hybrid	122.36	191.33	151.30	0.80	0.81	0.83
	Deshmanthus	66.77	60.22	50.50	0.82	0.74	0.71
6	B × N Hybrid	130.55	175.66	123.75	0.73	0.77	0.66
	Stylosanthes	40.50	41.50	35.52	1.11	1.16	1.00

*K: *Kharif,* R: *Rabi,* S: Summer.

Table 4: Economics in terms of net monitory returns and B:C ratio of different cropping systems.

Treatments	Treatment details	Cost of cultivation (Rs/ha/year)	Gross monetary returns (Rs/ha/year)	Net monetary returns (Rs/ha/year)	Benefit: cost ratio
T-1	Maize + cowpea - oat + berseem - bajra + cowpea	101389	194280	92891	1.92
T-2	Sorghum + cowpea - maize + berseem - bajra + cowpea	98742	182352	83609	1.85
T-3	B × N hybrid + cowpea - berseem - cowpea	89621	162290	72669	1.81
T-4	B × N hydrid + Lucerne	92113	170597	78483	1.85
T-5	B × N hydrid + *Deshmanthus*	58881	107346	48465	1.82
T-6	B × N hybrid + *Stylosanthes*	58568	107024	48456	1.83
SEm ±		-	-	3336.64	0.04
CD at 5%		-	-	10149.43	0.12
CV %		-	-	11.59	5.93

Bhanumurthy (2001) reported that pearl millet, maize and sorghum intercropped with cowpea produced higher fresh and dry weight per plant than their sole crops. Mixed cropping especially with legumes improves the forage quality and yield was reported by Ahmed *et al.* (2007).

Results of different cropping system on plant height and leaf stems ratio are presented in Table 3. It was observed that maximum average plant height of 236 cm was recorded by fodder maize followed by the fodder sorghum 219.55 cm whereas; in legume fodder maximum average vine length of 222.25 cm was recorded by cowpea during *kharif* season. During *rabi* season, maximum plant height of 201.83 cm was recorded in maize followed by oat with 71.33 cm. Maximum plant of 194.33 cm was recorded in fodder Bajra during summer. Leaf stem ratio of legume fodder was higher as compared to cereal fodder crops.

The economics of net monitory returns and the benefit cost ratio in different cropping systems is given in Table 4. It is found that among the various cropping systems, significantly higher net monetary returns of Rs. 92891/ha/year and benefit-cost ratio of 1.92 was observed in the cropping system of maize+ cowpea-oat + berseem- bajra + cowpea followed by sorghum + cowpea-maize + berseem-bajra + cowpea cropping system with net monetary returns of Rs 83609/ha/year and benefit-cost ratio of 1.85. Patil *et al.* (2018) reported that intercropping of cereal and legume fodder gave maximum net monetary returns as well as higher benefit cost ratio. Kauthale *et al.* (2017) also reported that combination of perennial grasses with legume leads to higher net monetary returns and benefit ratio.

CONCLUSION

Among the different cropping systems studied, the intercropping of Maize + cowpea (*Kharif*)- oat + berseem (*Rabi*)-bajra + cowpea (*Summer*) in the proportion of 2:1 is the best cropping system for highest green fodder production of legume and cereals and is also more remunerative.

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Conflict of interest

All authors declared that there is no conflict of interest.

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