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EVALUATION OF INTENSIVE FODDER CROPPING SYSTEMS FOR ROUND THE YEAR GREEN FODDER PRODUCTION IN CHHATTISGARH

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SUMMARY

A field experiment was conducted to evaluate the intensive fodder cropping systems for round the year green fodder production in Chhattisgarh under irrigated condition during 2014-15 to 2016-17. The soil of the experimental field was *vertisols* clayey in texture, low in nitrogen, medium in phosphorus and high in potassium with the low organic carbon. Experiment was carried out in randomized block design with eight cropping system with the objective to find out appropriate annual cropping system for maximum fodder production and economic feasibility. Pooled result of three year indicated that among different cropping system maize + rice bean (2:1) – oat multi cut - sorghum multi cut + cowpea (2:1) cropping system proved higher green fodder yield, 1180 q/ha. The next combination was pearl millet multi cut + rice bean (2:1) + oat multi cut + maize + cowpea (2:1) (1129 q/ha). With regards to dry matter yield maize + rice bean (2:1) – oat multi cut - sorghum multi cut + cowpea (2:1) cropping system recorded 247 q/ha which was at par with the pearl millet multi cut + rice bean (2:1) –oat multi cut – maize + cowpea (2:1) (235 q/ha). Pearl millet multi cut + rice bean (2:1) – berseem – maize + cowpea (2:1) recorded significantly higher crude protein yield (25.84 q/ha) which was at par with maize + rice bean (2:1) – berseem – sorghum multi cut + cowpea (2:1) cropping system (25.30 q ha^{-1}). Maximum system productivity of green fodder (4.15 q/ha) and dry fodder (.86 q/ha) was recorded with the cropping system of maize + rice bean (2:1) – oat multi cut - sorghum multi cut + cowpea (2:1). The mean data of different cropping system over the year revealed that maize + rice bean (2:1) – oat multi cut - sorghum multi cut + Cowpea (2:1) system gave significantly higher gross return (Rs 134943/ha) , net return (Rs 89108/ha), economic efficiency (Rs 313/ha day) and B:C ratio (1.94). It clearly indicated that maize - oat - sorghum multi cut based production system proved higher biomass of superior quality for livestock and net return under agro climatic situation of Chhattisgarh.

Key words : Intensive fodder cropping system, round the year green fodder production, Economics

India supports nearly 20 per cent of the world's livestock population on just 2.2 per cent of the world's geographical area. This puts a pressure to increase fodder production for a healthy livestock population. Only way to meet the fodder needs of livestock is to look for increased productivity per unit land area and also through integration of fodder crops in the cropping system. It has been established that the cost of milk production can be significantly lowered by improving feeding system based on green fodder and replacing ingredients of concentrate with leaf meal and enriched complete feed block. But, cultivated fodder is limited to less than 4.5 per cent of the area under cultivation in country. Present area under fodder crops in India is around 8.6 million hectare (IGFRI, 2012). The country faces a net deficit of 61.1% green fodder (IGFRI, 2011). Total livestock population in Chhattisgarh consisting of cattle, buffalo, sheep, goat, pig, horses & ponies, mules, donkeys and camels, in the state is 150.40 lakhs number in 2012. Addition of legumes in cropping systems as intercrop enhanced the quality of fodder also minimizes the use of chemical fertilizers and improves soil health. Inclusion of legumes in cropping systems also improves fertility status of soil and helps in increasing the yield of succeeding cereal crops (Balyan, 1997). Crop mixtures involving legumes and non-legumes provide a balanced diet for animals as legumes are rich in protein and non-legumes are rich in energy (PAU, 2013).

Under Chhattisgarh condition there is little possibility to increase the fodder area over 90%

farmers being marginal (69.4%) and small holders (21.75%) owning over 90-95% livestock, are not able to devote their small holdings for cultivation of fodder crops, as their priority is to produce food grains so that intensive fodder production cropping system are needed to supply the green fodder round the year. Cultivated fodder is only three percent in the state. Farmers are only dependent on paddy straw. Therefore, Identification of suitable fodder crops and varieties and suitable cultivation practices are necessary to boost fodder production on marginal and wastelands in the state. Fodders are 5-14 times cheaper source of important feed ingredients like digestible crude protein and total digestible nutrients than concentrates (Agrawal *et al.,* 2008). The present study was undertaken to evaluate the performance of different cropping systems, to get the year-round fodder availability under Chhattisgarh condition.

MATERIALS AND METHODS

A field experiment was carried out at Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur during 2013-14, 2014-15 and 2016-17. The experimental farm is located between 21°4´ N Latitude and 81°39´ E Longitude at an altitude of 298 meters above the mean sea level. The soil of the experimental field was *vertisols* clayey in texture, low in nitrogen, medium in phosphorus and high in potassium with the low organic carbon. Experiment was carried out in randomized block design with eight treatments in three replicationwith the objective to find out appropriate annual cropping system for maximum fodder production. The treatments consisted of eight cropping system *viz.*, (T_1) Sorghum multi cut +Cowpea (2:1)- Lucerne, (T_2) Maize+ Cowpea (2:1)- Lucerne, (T_3) Pearl millet multi cut + Cowpea (2:1) – Lucerne (T_4) Maize + Rice bean (2:1) – Berseem – Sorghum multi cut + Cowpea (2:1) (T_5) Maize + Rice bean (2:1) – Oat multi cut - Sorghum multi cut + Cowpea (2:1) (T_6) Pearl millet multi cut + Rice bean (2:1) –Oat multi cut – Maize + Cowpea (2:1) (T_7) Pearl millet multi cut + Rice bean (2:1) – Berseem – Maize + Cowpea (2:1) (T_8) Pearl millet multi cut + Rice bean (2:1) – Berseem – Sorghum multi cut + Cowpea in (2:1). Full agronomic package and practices adopted for main crops to harvest the full potential of fodder crop. During *Kharif* sorghum multi cut, pearl millet multi cut and maize was taken as main crop and sown in mid-July with inter crop as per the treatment in row ratio of 2:1 of cowpea and rice bean. In *Rabi* season berseem, lucerne and oat multi cut was grown in early November as sole crop and during summer sorghum multi cut and maize intercropped with cowpea in 2:1 row ratio was grown in first week of April. Variety African tall (Maize), giant bajra (Pearl millet), EC-4216 (Cowpea), Bidhan rice bean-2 (Rice bean), Anand-3 (Lucern) RO-19 (Oat) JB-5 (Berseem) and MFSH-4 (Sorghum) was taken during the study. Harvesting schedules and other package of practices were as per recommendation for individual crops of the sequence in the region.

Data on green-forage yield plot^{-1} were recorded for each cut and total system yield was calculated. For dry matter yield 100 g sample was collected from each plot and kept in oven at 85^{o}C temperature to constant weight for estimating dry matter accumulation. Cost of cultivation for each cropping system was calculated separately. Gross return was obtained by converting the harvested produce into monetary term at prevailing market rate during the course of studies for each cropping system. Net return was obtained by deducting cost of cultivation from gross return. The benefit cost ratio was calculated by the division of gross return by cost of cultivation. Production efficiency (Rs. ha^{-1} day^{-1}) was calculated by dividing pooled green forage yield by respective days of the system taken for one cycle. Pooled stability index was computed using the formula (Singh *et al.,* 1990): SI = Y-S/ Y max Where, Y is the pooled total yield of the rotation, S is standard deviation of yield and Y max is maximum pooled yield of the sequence. The data on different crops and other parameters for individual years were pooled and statistically analyzed by using statistical methods described by Gomez and Gomez (1984)

RESULT AND DISCUSSION

Fodder yield : Among different cropping system maize + rice bean (2:1) – oat multi cut - sorghum multi cut + cowpea (2:1) cropping system proved higher green fodder yield, which was significantly superior over other cropping system. This cropping system gives total 1180 q ha^{-1} green fodder yield. The better performance of maize based cropping system may be attributed to the higher green fodder yield by the intercropping of maize + rice bean (2:1) in *kharif* and better performance of multi cut oat in *rabi*, multi cut oat gives two cut in Chhattisgarh condition and in summer intercropping of sorghum multi cut + cowpea (2:1) performers better. The next

combination was pearl millet based cropping system inter cropping of pearl millet multi cut + Rice bean (2:1) in kharif oat multi cut in Rabi and maize + Cowpea (2:1) in summer gives 1129 q ha^{-1}green fodder yield .Similar findings were also reported by the Bhilare *el al*. (2002) However, the minimum green fodder yield was recorded under the combination of sorghum multi cut + Cowpea (2:1) – Lucerne system. Under Chhattisgarh condition the performance of Lucern was not satisfactory. However, minimum green fodder yield was recorded under Sorghum multi cut +Cowpea (2:1)- Lucerne (716 q ha^{-1}) in this cropping system lucerne was not performed under Chhattisgarh condition. The trend for dry matter was similarly to that of green fodder yield. With regards to dry matter yield maize + rice bean (2:1) – oat multi cut - sorghum multi cut + cowpea (2:1) cropping system recorded 247 q ha^{-1} which was at par with the pearl millet multi cut + rice bean (2:1) –oat multi cut – maize + cowpea (2:1) (235 q ha^{-1}). Tripathi and Agrawal (2003), Sahoo (2009) and Meena and Shivay (2010) also reported higher yield of dry matter in maize based production systems.

Fodder quality : Fodder quality of year round forage production system has been quantify in term of crude protein (Table 1) Among the different cropping system pearl millet multi cut + rice bean (2:1) – berseem – maize + cowpea (2:1) recorded significantly higher crude protein yield (25.84 q ha^{-1}) which was at par with maize + rice bean (2:1) – berseem – sorghum multi cut + cowpea (2:1) cropping system (25.30 q ha^{-1}). However, green fodder yield was maximum with maize based cropping system with oat multi cut in *rabi* but crude protein recorded maximum with maize and pearl millet cropping system with berseem in *rabi*. Berseem is legume crop having high crude protein which reflect in total crude protein yield. Higher crude protein yield was obtain maximum due to inclusion of legume component in each season , thus combined effect of crude protein content and dry matter yield reflected in enhancement in crude protein yield. Kumar *et al.* (2010) who found higher crude protein yields with sole legumes than cereal legume mixtures.

System productivity : Total duration of the cropping system presented in Table -1. Different cropping system take different duration to complete the one cycle of system according to duration system productivity of green and dry fodder was calculated and presented in q ha^{-1} productivity. Maximum system productivity of green fodder (4.15 q ha^{-1}) and dry fodder (.86 q ha^{-1}) was recorded with the cropping system of maize + rice bean (2:1) – oat multi cut - sorghum multi cut + cowpea (2:1) due to higher green and dry fodder yield in due course of time. In regards to sustainability index maize pearl millet bases cropping system show more sustainable among other cropping system.

TABLE 1
Green fodder dry matter, crude protein system productivity and Sustainability index of different annual fodder crop based cropping system (2014-15, 2015-16, and 2016-17)

Treatment	Yield (q/ha Cropping sequence)			Total duration of the cropping system	System Productivity (q/ha/day)		Sustainability index
	Green	Dry	Crude		Green	Dry	
Sorghum multi cut+Cowpea (2:1)-Lucerne	716	148	19.02	248	2.89	0.59	0.43
Maize+Cowpea (2:1) - Lucerne	785	168	21.24	242	3.25	0.69	0.45
Pearl millet multi cut+Cowpea (2:1)-Lucerne	765	161	20.18	248	3.09	0.65	0.47
Maize+Rice bean (2:1)-Berseem-Sorghum multi cut+Cowpea (2:1)	1046	217	25.30	296	3.53	0.73	0.76
Maize+Rice bean (2:1)-Oat multi cut-Sorghum multi cut+Cowpea (2:1)	1180	247	20.75	284	4.15	0.86	0.79
Pearl millet multi cut+Rice bean (2:1)-Oat multi cut-Maize+Cowpea (2:1)	1129	235	21.44	289	3.91	0.81	0.77
Pearl millet multi cut+Rice bean (2:1)-Berseem-Maize+Cowpea (2:1)	1101	227	25.84	299	3.68	0.76	0.75
Pearl millet multi cut+Rice bean (2:1)-Berseem-Sorghum multi cut+Cowpea (2:1)	1056	213	23.83	303	3.49	0.70	0.72
SEm+	10.12	4.11	0.93	--	0.04	0.02	--
CD (P=0.05)	30.70	12.45	2.83	--	0.11	0.05	--

TABLE 2
Economics and economic efficiency of different fodder crop based cropping system (2014-15, 2015-16, and 2016-17)

Treatment	Mean cost of cultivation	Gross return	Net return	B : C ratio	Economic efficiency (Rs./ha/day)
	Rs/ha Cropping system				
Sorghum multi cut+Cowpea (2:1)-Lucerne	29828	68628	38800	1.28	157
Maize+Cowpea (2:1)-Lucerne	31360	78454	47094	1.47	195
Pearl millet multi cut+Cowpea (2:1)-Lucerne	30537	81095	50558	1.64	204
Maize+Rice bean (2:1)-Berseem-Sorghum multi cut+Cowpea (2:1)	44645	114052	69407	1.55	234
Maize+Rice bean (2:1)-Oat multi cut-Sorghum multi cut+Cowpea (2:1)	45835	134943	89108	1.94	313
Pearl millet multi cut+Rice bean (2:1)-Oat multi cut-Maize+Cowpea (2:1)	45770	129590	83820	1.83	290
Pearl millet multi cut+Rice bean (2:1)-Berseem-Maize+Cowpea (2:1)	47144	124221	77077	1.64	258
Pearl millet multi cut+Rice bean (2:1)-Berseem-Sorghum multi cut+Cowpea (2:1)	46199	122423	76224	1.65	252
SEm+	--	1426.79	1427	0.04	--
CD (P=0.05)	--	4327.72	4328	0.12	--

Economics

The mean data of different cropping system over the year (Table 2) revealed that maize + rice bean (2:1) – oat multi cut - sorghum multi cut + Cowpea (2:1) system gave significantly higher gross return (Rs 134943 ha^{-1}) , net return (Rs 89108 ha^{-1}) and economic efficiency (Rs 313 ha^{-1} day^{-1}) than other cropping system and was followed by pearl millet multi cut + rice bean (2:1) – berseem – maize + cowpea (2:1) (Rs 129590 ha^{-1} and 83820 ha^{-1}). Lowest gross and net return and economic efficiency were obtained with sorghum multi cut + cowpea (2:1) - Lucerne. The trend for B: C ratio was similarly to that of net return. Highest B:C ratio (1.94) was found with maize + rice bean (2:1) – oat multi cut - sorghum multi cut + Cowpea (2:1) system. Singh *et al.*, (2002) reported that forage based system were more remunerative than concentrate based feeding systems to dairy cattle.

REFERENCES

Agrawal, R. K., Sunil Kumar, S. B. Tripathi, R. K. Sharma and K. A. Singh. 2008**.** Agro-economic analysis of fodder based cropping system. *Indian J. Fert.* **4** (4): 121 – 122 & 125-131.

Balyan JS, 1997. Production potential and nitrogen uptake by succeeding wheat (*Triticumaestivum*) under different cropping sequences. Indian Journal Agronomy **42**: 250-252.

IGFRI, 2011.Vision 2030.Indian Grassland and Fodder Research Institute. Jhansi, pp. 2-6.

IGFRI, 2012.Forage production technology for arable lands.Indian Grassland and Fodder Research Institute. Jhansi, pp. 1

Kumar, B., U. S. Tiwana and M. L. Mehra. 2010. Fodder yield and quality as influenced by different seed rates of oats, sarson and rye grass in mixture with berseem. *Range Mgmt. & Agroforestry* Symposium Issue (A), 2010 : 9-10.

Meena, H. N. and Y. S. Shivay. 2010. Productivity of short duration summer forage crops and their effect on succeeding aromatic rice in conjunction with gypsum-enriched urea. *Indian J. Agron.* **55**(1): 11-15.

PAU, 2013. Package of Practices for Crops of Punjab (*kharif*). Punjab Agricultural University, Ludhiana, Punjab, India, pp. 106-122.

Singh, R. P., J. F. Parr and B. A. Stewart. 1990. Dryland agriculture – strategies for sustainability. *Advances Soil Sci.* **13** : 340.

Singh, R. A., N. P. Shukla, M. S. Sharma, R. N. Dwivedi and P. Sharma. 2002. Profitability analysis of some intensive fodder production systems. *Range Mgmt. & Agroforestry.* **23** (1): 35-37.

Sahoo, S. C. 2009. Yield and economics of sweet corn (*Zea mays* L.) – vegetable intercropping system. *Range Mgmt. & Agroforestry.* **30** (2) : 155-158.

Tripathi, S. N. and R. K. Agrawal. 2003. Intensive fodder production systems In: *Sustainable Animal Production* (eds. Jakhmola, R. C. and Jain, R .K.) Pointer Publisher, Vyas Building, Jaipur: 325-342.