Range Mgmt. & Agroforestry 38 (1) :96-99, 2017
ISSN 0971-2070

Fodder productivity influenced by various grass-legume combinations and planting methods in western Maharashtra

V. K. Kauthale*, P. S. Takawale and S. D. Patil
Central Research Station, BAIF Development Research Foundation, Pune-412 202, India
*Corresponding author e-mail: vkkauthale@gmail.com
Received: 24th August, 2016 Accepted: 16th April, 2017

Abstract
A field experiment was conducted at Central Research Station of BAIF Development Research Foundation, Urulikanchan, Pune during 2009-12 to study the effect of planting methods and grass legume combinations on fodder productivity. The experiment was conducted in light gravel soil having initial soil status of 0.35 dS/m EC, 7.36 pH and 0.30 per cent organic carbon. There were four combinations of grasses and legume *viz*. *Cenchurus ciliaris* + *Desmanthus virgatus, Cenchurus ciliaris* + *Stylosanthus seabrana, Dichanthium annulatum,* + *Desmanthus virgatus* and *Dichanthium annulatum* + *Stylosanthus seabrana* in 1:1 proportion planted with two planting methods *viz*. ridges and furrows, and flat bed. Based on four years pooled data, it was observed that green fodder, dry matter, and crude protein yields (763.1, 165.5 and 18.9 q/ha/year, respectively) were significantly increased due to planting perennial grass and legume combination of Cenchrus *ciliaris* + *Desmanthus virgatus* in 1:1 proportion on ridges and furrows. This combination and planting method also had higher net monetary returns of ¹ 55529 ha/year, maize fodder equivalent yield of 308 qha^{-1} and benefit cost ratio of 2.72. This grass legume production system maintained the soil fertility over a period of field experimentation under rainfed condition of western Maharashtra.

Keywords: Crop economics, Forage yield, Grass legume combination, Planting methods

Introduction

Out of an estimated 140.3 million ha of net cultivated area, 79.44 million ha (57%) is rain-fed, contributing 44% of the total food grain production. It is estimated that even after achieving the full irrigation potential, nearly 50% of the net cultivated area will remain dependent on rainfall (Sharma, 2011). Again the productivity of our animals is very low because of shortage of green fodder during different months of the year. Indeed, the poor feed quality and dry season feed shortage are the serious limitations for livestock production in rainfed areas and farmers maintain a large herd of animals to compensate for the low productivity of livestock, which adds to the pressure on land and fodder resources (Pathak, 2005). Hence, improvement of wastelands for sustainable forage production is a necessity to meet the ever increasing demand for quality forage to feed growing livestock population of India. In such a situation, introduction of suitable grass and legume mixture will be helpful in improving the production, quality and distribution of the forage (Basak *et al.,* 2003).

Western Maharashtra region suffers from very low rainfall with uncertainty and ill distribution. Occurrence of drought noticed once in three years. The water scarcity and delayed monsoon are major problems of crop production. The efforts needed to increase production through suitable agro forestry system, which will fit to the land, climate and resources. Incorporation of trees and bushes particularly of fodder values in agricultural production system through a systematic manner will help in providing sufficient fodder to the farmers without affecting arable crop yields (Deb Roy, 1994).

Cenchrus and Dichanthium are potential fast growing range grasses and they have good regeneration capacity and can withstand moisture stress for fairly long time. Desmanthes, Seratro and Stylosanthes are legume fodder species which provide nutritious fodder and could be grown under rainfed situations. Grasses and legumes also contribute to binding and stabilization of soils due to their extensive root systems. As overall impact, the soil conservation measures and pastoral systems result in increased infiltration rate, reduced soil loss and increased water stable aggregates. Therefore high productive, more palatable, perennial and persistent legumes like *Stylosanthes* and *Desmanthus* are thought to be the best suitable to overcome protein deficiency. Keeping the above points in view, the present study was

undertaken to develop appropriate fodder production system under rainfed conditions of Western Maharashtra.

Materials and Methods

Experimental site and designing: A field experiment was conducted at Central Research Station of BAIF Development Research Foundation, Urulikanchan, Pune during 2009-12 to study the effect of planting methods and forage crop combinations on fodder productivity. The experiment was conducted in light gravel soil having initial soil status of 0.35 dSm^{-1} EC, 7.36 pH, 0.30 % organic carbon, 128, 34 and 265 kg ha^{-1} N, P and K, respectively. There were four combinations of grasses with legume *viz*. *Cenchrus ciliaris + Desmanthus virgatus, Cenchrus ciliaris + Stylosanthes seabrana, Dichanthium annulatum + Desmanthus virgatus* and *Dichanthium annulatum + Stylosanthes seabrana* in 1: 1 proportion planted with two planting methods *viz*. ridges and furrows, and flat bed. Likewise, eight treatment combinations replicated three times in a randomized block design (RBD). The grasses were established by planting seedlings at a spacing of 90 cm x 45 cm and legumes sown in between the two rows of grass, *i.e*. 1: 1 proportion of 45 cm spacing maintained in between two rows. The grasses and legumes were cut at 45-50 days interval (Fig. 1).

Plate 1. Ridges and furrows, *Cenchrus ciliaris +Stylosanthes ceabrana*

Plate 2. Ridges and furrows, *Dicanthium annulatum + Desmanthus vergatus*

Fig 1. Combinations of grasses and legumes at experimental site

Observations and analytical methods: The data on growth, forage yield and quality parameters were collected and statistically analyzed following standard methods. Dry matter content was estimated by drying plant sample of each treatment and replication in hot-air oven at 70^0C, which led to computation of dry matter yield. Soil fertility status were analysed in laboratory by using standard analytical methods by AOAC (1995). The pooled data for four years (2009-12) was statistically analysed.

Results and Discussion

Crop yields: The pooled data on green fodder, dry matter and crude protein yields as influenced by different planting methods and forage crop combinations are given in Table 1. Based on the pooled data for four years (2009-12), it was revealed that there were significantly increase in the green fodder, dry matter and crude protein yields (763.11, 165.54 and 18.92 ha^{-1} per year, respectively) in treatment combination of planting *Cenchrus ciliaris* with *Desmanthus virgatus* in 1:1 proportion on ridges and furrows when compared to all the other crop combinations and planting methods. The ridges and furrow planting method was found better as compared to flat bed method due to more moisture conservation which enhances the crop growth after rainy season. Patel *et al.* (2007) reported that Marvel grass may be fertilized with 60 kg ha^{-1} and harvested once at the time of maturity to obtain higher dry fodder yield. The experiment conducted by Kumar and Faruqui (2009) recorded maximum dry matter yield of 4.55 tonnes ha^{-1} in Aonla + *Cenchrus ciliaris* + *Stylosanthes hamata* over the 3.92 tonnes ha^{-1} in pure *Cenchrus ciliaris* + *Stylosanthes hamata* pasture system when applied with highest doses of nitrogen (60 kg ha^{-1}). Chaplot (2014) reported that sowing of *Cenchrus ciliaris* with *Stylosanthes hamata* in 3:1 ratio gave maximum dry forage yield which was significantly higher over control (no introduction). Intercropping of guinea grass with *Stylosanthes hamata* in paired rows produced higher total dry forage yield of 5.01 tonnes ha^{-1} as compared to sole stand of both grass and legume and alternate rows (Hazra, 1995). Hazra and Tripathi (1986) observed that productivity of the *Cenchrus ciliaris* grassland could be improved by inclusion of range legumes like *Siratro*, *Stylosanthes* and *Clitoria.* An increase in grass yields where legumes were introduced was previously reported by Chauhan and Faroda (1979) and Rai (1989). Intercropping of *Stylosanthes seabrana* with Guinea grass produced significantly higher total green and dry forage yields than *Clitoria ternatea*, *Macroptilium atropurpureum* and *Stylosanthes hamata* (Ram, 2015; Ram and Trivedi, 2016).

Crop economics: The pooled data on economics of the crops as influenced by different planting methods and forage crop combinations are given in Table 2. Based on

Table 1. Effect of planting methods and forage crop combinations on green fodder, dry matter and crude protein yields

Treatment details	Yield (ha^{-1})		
	Green fodder	Dry matter	Crude protein
Ridges and furrows, *Cenchrus ciliaris* + *Desmanthus virgatus*	763.11	165.54	18.92
Ridges and furrows, *Cenchrus ciliaris* + *Stylosanthes seabrana*	664.78	139.51	16.18
Ridges and furrows, *Dichanthium annulatum* + *Desmanthus virgatus*	456.83	101.54	11.82
Ridges and furrows, *Dichanthium annulatum* + *Stylosanthes seabrana*	423.19	92.86	11.05
Flat bed, *Cenchrus ciliaris* + *Desmanthus virgatus*	724.34	156.75	17.75
Flat bed, *Cenchrus ciliaris* + *Stylosanthes seabrana*	649.53	141.41	16.66
Flat bed, *Dichanthium annulatum* + *Desmanthus virgatus*	413.31	89.67	10.62
Flat bed, *Dichanthium annulatum* + *Stylosanthes seabrana*	360.60	82.24	10.01
SE (m)±	5.66	1.14	0.16
CD at 5%	15.68	3.16	0.44
CV %	19.26	18.14	17.41

Table 2. Effect of planting methods and forage crop combinations on crop economics

Treatment details	Green fodder yield (qha^{-1})	Gross income (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net monetary returns (Rs. ha^{-1})	Maize fodder equivalent yield (qha^{-1})	Benefit: cost ratio
Ridges and furrows, *Cenchrus ciliaris* + *Desmanthus virgatus*	763.11	87757	32228	55529.21	308.50	2.72
Ridges and furrows, *Cenchrus ciliaris* + *Stylosanthes seabrana*	664.78	76449	31646	44803.50	248.91	2.42
Ridges and furrows, *Dichanthium annulatum* + *Desmanthus virgatus*	456.83	52535	30548	21987.07	122.15	1.72
Ridges and furrows, *Dichanthium annulatum* + *Stylosanthes seabrana*	423.19	48666	30000	18666.46	103.70	1.62
Flat bed, *Cenchrus ciliaris* + *Desmanthus virgatus*	724.34	83299	32228	51071.43	283.73	2.58
Flat bed, *Cenchrus ciliaris* + *Stylosanthes seabrana*	649.53	74696	31646	43050.20	239.17	2.36
Flat bed, *Dichanthium annulatum* + *Desmanthus virgatus*	413.31	47531	30548	16982.72	94.35	1.56
Flat bed, *Dichanthium annulatum* + *Stylosanthes seabrana*	360.60	41469	30000	11468.71	63.72	1.38
SE (m)±				651.07	3.62	0.02
CD at 5%				1803.46	10.03	0.05

the pooled data for four years (2009-12), it was revealed that planting *Cenchrus ciliaris* with *Desmanthus virgatus* in 1:1 proportion on ridges and furrows showed significantly higher net monetary return of Rs. 55529 ha^{-1} per year, benefit cost ratio of 2.72 and maize fodder equivalent yield of 308 q ha^{-1} over all the other crop combinations and planting methods. The ridges and furrow method enhanced the crop growth and thereby green fodder yields due to availability of moisture for longer period as compared to flat bed method which has directly reflected in higher returns.

Conclusion

It was concluded that the green fodder, dry matter and crude protein yields, net monetary returns, benefit cost ratio and maize fodder equivalent yields were significantly higher in planting *Cenchrus ciliaris* with *Desmanthus virgatus* in 1: 1 proportion on ridges and furrows. The grasses and legumes combinations along with different planting methods maintained the soil fertility status. This production system can be recommended for small and marginal farmers with light soil for cut and carry method of green forage cultivation under rainfed condition of Western Maharashtra.

Acknowledgement

The author is grateful to the Director, ICAR-Indian Grassland and Fodder Research Institute, Jhansi for providing necessary facilities and the Project Coordinator, All India Coordinated Research Project on Forage Crops & Utilization for encouragement and valuables suggestions.

References

AOAC 1995. *Official Methods of Analysis*, 16th Edn. Association of Analytical Chemists, Washington, USA.

Basak, N. S., M. K. Nanda and A. K. Mukherjee. 2003: Performance of *Stylosanthes* cultivars in the new alluvial zone of West Bengal. *Forage Research* 28: 223-227.

Chaplot, P. C. 2014. Introduction of different grasses mixed with legume on wastelands. *Forage Research* 40: 199-200.

Chauhan, D. S. and A. S. Faroda 1979. Studies on intercropping of pasture legume with *Cenchrus ciliaris* grass. *Forage Research* 5: 79-80.

Deb Roy, R. 1994. Principles and practices of Agroforestry for sustainable agriculture. In: Proceedings of Summer Institute on Advances in Agroforestry and its role. NRCAF, Jhansi. pp. 61-74

Hazra, C. R and S.B. Tripathi. 1986. Annual Report. Indian Grassland and Fodder Research Institute, Jhansi.

Hazra, C. R. 1995. Soil and water conservation in relation to land use and biomass production. In: R.P. Singh (eds.). *Forage Production and Utilization*, IGFRI, Jhansi. pp.286-308.

Kumar, S. and S. A. Faruqui 2009. Production potential and economic viability of food-forage based cropping system under irrigated conditions. *Indian Journal of Agron*omy 54: 36-41.

Patel, Pravin C., L. N. Baraiya, D. V. Patel and R. H. Patel. 2007. Effect of fertilizer and cutting management on dry fodder yield of Marvel grass (*Dichanthium annulatum*). *Range Management and Agroforestry* 28: 414-415.

Pathak, P. S. 2005. Importance of feed resources for livestock production improvement in India. Indian Grassland and Fodder Research Institute, Jhansi.

Rai, P. 1989. Effect of fertilizers and legumes on the productivity of *Cenchrus ciliaris* in the Bundelkhand region of Uttar Pradesh, India. *Tropical Grasslands* 23: 189-191.

Ram, S. N. 2015. Response of Guinea grass (*Panicum maximum* acq.) legumes intercropping to weed control. *Forage Research* 41: 15-18.

Ram, S.N. and B. K. Trivedi. 2016. Effect of range legumes intercropping and weed management on weed control and fodder productivity of Guinea grass (*Panicum maximum* Jacq.). *Range Management and Agroforestry* 37: 44-49.

Sharma, K. D. 2011. Rain-fed agriculture could meet the challenges of food security in India. *Current Science* 100: 1615-1616.