

Efficacy and Economics of Forage Production Potential of Maize and Cowpea Intercropping System

S. Krishnaprabu*

Department of Agronomy, Faculty of Agriculture, Annamalai University - 608 002

*Corresponding Author E-mail: prabu1977krishna@gmail.com

Received: 15.06.2018 | Revised: 21.07.2018 | Accepted: 4.07.2018

ABSTRACT

A field experiment was conducted during the summer season 2014 at Experimental Farm, Annamalai University, to study the production potential and economic feasibility of maize (*Zea mays* L.) + cowpea [*Vigna unguiculata* (L.) Walp] intercropping under rainfed conditions. Pooled analysis of data indicated that intercropping of maize and cowpea in the row proportion of 2:2 recorded significantly higher total green fodder (338.3 q/ha), dry matter (83.0 q/ha) and crude protein yield (10.3 q/ha) as well as net return (Rs 8,346/ha) over other treatments. However, benefit: cost ratio for maize (sole) was higher (1.78) than the other treatment except maize+cowpea planted in the row ratio of 2:1 (2.04), 2:2 (2.21) and mixed seed in the same row (1:1) (1.89). Monetary advantage ranged from Rs 38 with intercropping of maize and cowpea in the row ratio of 1:4 to Rs 2,427 (check) under maize + cowpea (2:2) and was negative with intercropping of maize and cowpea in a row ratio of 1:1 and 1:2 land-equivalent ratio was more than 1 in all intercropping systems except maize and cowpea planted in the row ratio of 1:1 and 1:2 maximum being with maize + cowpea (2:2) intercropping system (LER 1.41).

Key words: Forage, Maize, Cowpea, Intercropping, Economics, Land-equivalent ratio.

INTRODUCTION

Supply of forages is inadequate in the country not only in terms of quantity but quality as well. Since the scope of area expansion under cultivated fodder (5% of cultivable area) is limited, the productivity of fodder crops is to be raised through best utilization of the resources of the prevailing production systems. Intercropping of botanically diverse forage species like cereals and legumes appears to be one of the feasible approaches for increasing the herbage yield, utilization of land more

efficiently, improving the forage quality and providing stability to production⁴. Maize and cowpea, the potential forage crops, are adaptable to wide range of environment and can provide nutritious fodder under rainfed conditions when grown in association. Hence, in order to get the best results, a rational approach is required for agronomic information on appropriate row proportion of forage maize and cowpea in an intercropping system.

Cite this article: Krishnaprabu, S., Efficacy and Economics of Forage Production Potential of Maize and Cowpea Intercropping System, *Int. J. Pure App. Biosci.* 6(4): 766-769 (2018). doi: <http://dx.doi.org/10.18782/2320-7051.7258>

Since information on intercropping of forage maize with cowpea is not adequate under rainfed conditions in semi-arid regions, this study was undertaken to determine the effect of intercrop, i.e. cowpea, on main crop, i.e. maize, and total herbage and crude pi in yield vis-a-vis economic viability of the system under rainfed conditions.

MATERIAL AND METHODS

The soil was sandy loam in texture, having pH 7.6, low in initial organic carbon (0.42 %) and available nitrogen (200.2 kg/ha) and medium in available phosphorus (13.2 kg /ha) and potash (264.5 kg/ha). The experimental site is characterized by semi-arid climate in Bundelkhand region and it recorded 970,660 and 865 mm rainfall during the crop growth period of 2014 respectively.

Twelve treatments consisting of different row ratio of maize + cowpea and mixed seed of maize+cowpea in the same row (1:1) with sole stand of maize and cowpea (Tables 1, 2). These treatments were evaluated in randomized block design with 3 replications. For mixed seed in the same row, the ratio represented 50 % of the recommended seed rate of each component. However, for other intercropping treatments, the ratio indicated the number of row of each component and seed rate calculated on its basis. Forage maize ('African Tali') and forage cowpea (VBN2) were sown, 40 cm apart in different row ratio of treatments. The seed maize and cowpea was 60 and 40 kg/ha, respectively.

The fertilizers were applied as per row ratio of component crops in the intercropping systems. Both the forage crops were harvested at 50% flowering stage in the last week of August. The plant samples were oven dried for computation of dry matter and crude protein content of forage maize and forage cowpea. Dry matter and crude protein yield were calculated by multiplying dry-matter content to green fodder yield and protein content to dry liter yield, respectively. For assessing the economic viability of the system, land-equivalent ratio (LER) and net monetary return (Rs/ha) were

computed. Monetary advantage was also calculated to find out the absolute value of genuine yield advantage as suggested by Willey⁵.

$$\text{Monetary advantage} = \frac{\text{Value of combined intercrop yield} \times \text{LER} - 1/\text{LER}}$$

RESULTS AND DISCUSSION

Forage yield

Green fodder and dry matter yields were significantly affected by different intercropping treatments (Table 1). The total green fodder and dry matter yields were highest dry maize + cowpea in 2:2 row ratio and significantly superior to the other intercropping systems and sole stand maize and cowpea. The increase in total green fodder and dry matter yield with maize +cowpea intercrop combination in 2:2 row proportion was 23.1 and 25.0% over sole maize, respectively. The planting of mixed seed of maize and cowpea (1:1) in the same row recorded significantly higher total green fodder and dry matter yield over maize (sole) and was inferior to maize + cowpea in row ratio of 2:1 and 2:2. In general, forage yield of both component crops, viz. maize and cowpea, in intercropping system was reduced compared to their respective sole stands. The forage yield reduction in component crops was compensated by contribution of both in total intercrop yield. Maximum contribution of cowpea in total intercrop yield was 34.7% under intercropping of maize in the row ratio of 1:4, followed by intercropping systems where row proportion of cowpea was more. However, total forage yield was greater because of contribution of maize. The increase in total green fodder and dry matter yields in the intercropping systems might be owing to better utilization of space and light interception coupled with nutrient contribution of leguminous fodder to cereal. The results are in agreement to those of Tripathi⁴ and Sunitha and Sreekantan³.

Crude protein yield

The influence of intercropping of maize-with cowpea was clearly evident in total crude protein yield of the system (Table 1). The significantly higher total crude protein yield was recorded with maize+ cowpea (2:2) than the other treatments. The results indicated

superiority of 35.5 and 68.9% in crude protein yield with maize + cowpea (2:2) to sole stands of maize and cowpea, respectively. It closely followed intercropping of maize and cowpea in the row ratio of 2:1. The difference in crude protein yield of all the treatments was due to variation in dry matter yield of maize and cowpea. The intercropping systems with more number of cowpea rows recorded higher crude protein yield. However, the total crude protein yield in intercropping system was the reflection of contribution from both the component crops. Crude protein yield was equal in cowpea (sole), maize + cowpea (1:1 and 1:2) as well as with maize + cowpea (3:3) and (4:1). Mixed seed in the same row (1:1) was inferior to maize + cowpea intercropped in the row ratio of 2:2 and 2:1 with respect to crude protein yield. Sudhakar *et al.*² also reported the pronounced effect of intercropping of forage legumes with cereals on crude protein yield.

Economics

The mean gross return (Rs 15,236/ha), net return (Rs, 8,346/ha) and benefit: cost ratio (2.21) were significantly higher with maize + cowpea (2:2) than other treatments (Table 2) which was closely followed by intercropping

of maize and cowpea in the row proportion of 2:1. Sowing of mixed seed of maize and cowpea in the same row ratio of 1: 1 exhibited superiority in net monetary return and benefit : cost ratio over rest of the treatments except intercropping of maize + cowpea in the row ratio of 2:2 and 2:1. Maize (sole) recorded significantly higher net return and benefit: cost ratio than intercropping of maize and cowpea in the row ratio of 1:1, 1:2, 1:3, 1:4, 3:3 and 4:1 and cowpea (sole). Similarly, monetary advantage was also highest with maize + cowpea (2:2) intercropping system. Maize + cowpea planted in the row ratio of 1:1 and 1:2 recorded negative values of monetary advantage which clearly indicate the suitability of the system with appropriate assessment of intercropping in terms of increased value per unit area of land.

Land-equivalent ratio

Land-equivalent ratio (LER) calculated from combined intercrop yield was higher in all intercropping system, than either of the sole crops, i.e. maize and cowpea, except maize + cowpea (1:1 and 1:2). This clearly indicated greater biological efficiency of the intercropping treatments (Table 2).

Table1. Component-wise and total green fodder, dry matter and crude protein yield of maize and cowpea intercropping system (pooled mean of 1999 to 2001)

Maize	Cowpea	Total	Contribution of cowpea (%)	Maize	Cowpea	Total	Contribution of cowpea (%)	Maize	Cowpea	Total	Contribution of cowpea (%)
293.1		293.1		66.4		66.4		7.6		7.6	
	179.2	179.2			36.5	36.5			6.1	6.1	
202.8	45.3	248.1	18.3	43.1	9.1	52.2	17.4	4.6	1.5	6.1	24.6
188.7	61.7	250.4	24.6	40.5	12.4	52.9	23.4	4.4	1.7	6.1	27.9
178.4	75.8	254.2	29.8	39.3	15.3	54.6	28.0	4.5	2.5	7.0	35.7
159.1	84.6	243.7	34.7	35.9	17.3	53.2	32.5	4.0	2.8	6.8	41.2
293.2	45.1	338.3	13.3	66.5	9.1	75.6	12.0	7.5	1.5	9.0	16.7
280.8	80.1	360.9	22.2	66.1	16.9	83.0	19.4	7.6	2.7	10.3	26.2
260.7	34.4	295.1	11.7	60.4	6.7	67.1	10.0	7.0	1.1	8.1	13.6
207.5	56.7	264.2	21.5	45.6	11.4	57.0	20.0	5.1	1.9	7.0	27.1
246.3	29.8	276.1	10.8	57.8	5.7	63.5	9.0	6.2	0.9	7.1	12.7
280.3	31.9	312.2	10.2	64.0	6.2	70.2	8.8	6.9	1.1	8.6	13.8
		18.5				7.3				0.6	

Treatment

Maize (sole)

Cowpea (sole)

Maize + cowpea (1:1) Maize + cowpea (1:2) Maize + cowpea (1:3) Maize + cowpea (1:4) Maize + cowpea (2:1) Maize + cowpea (2:2)

Maize + cowpea (3:1) Maize + cowpea (3:3) Maize + cowpea (4:1) Mixed seed of maize and cowpea in the same row (1:1)

CD (P=0.05)

Green fodder yield Dry-matter yield Crude protein yield

(q/ha) (q/ha) (q/ha)

Table2. Economic monetary advantage and land-equivalent ratio of forage-based maize + cowpea intercropping system

Treatment	Cost of cultivation (Rs/ha)	Cross return (Rs/ha)	Net return (Rs/ha)	Benefit: cost ratio	Monetary advantage	Land-equivalent ratio
Maize (sole)	6,590	11,725	5,135	1.78		
Cowpea (sole)	6,608	8,972	2,364	1.36		
Maize + cowpea (1:1)	6,800	10,380	3,580	1.53	(-)228.5	0.94
Maize + cowpea (1:2)	6,775	10,634	3,859	1.57	(-)78.8	0.98
Maize + cowpea (1:3)	6,764	10,926	4,162	1.62	121.2	1.03
Maize + cowpea (1:4)	6,725	10,594	3,869	1.58	38.3	1.01
Maize + cowpea (2:1)	6,870	13,983	7,113	2.04	1,422.6	1.25
Maize + cowpea (2:2)	6,890	15,236	8,346	2.21	2,426.9	1.41
Maize + cowpea (3:1)	6,885	12,068	5,183	1.75	383.9	1.08
Maize + cowpea (3:3)	6,894	11,138	4,244	1.62	123.6	1.03
Maize + cowpea (4:1)	6,920	11,336	4,416	1.64	86.6	1.02
Mixed seed of cowpea in maize and the same row (1:1)	6,915	13,047	6,132	1.89	753.1	1.14
CD (P=0.05)		1,230	710			

CONCLUSION

The significantly highest mean LER (1.41) was recorded in intercropping of maize and cowpea planted in the row ratio of 2:2, followed by maize + cowpea (2:1) (LER=1.21) and mixed seed in same row (1:1) (LER=1.22). It showed that to produce combined mixture yield by growing sole stand would require 41% more land. Land-equivalent ratio for intercropping where it was more than 1, indicating suitability of the practice in quantitative term. The present findings are in accordance with those of Patel and Rajgopal¹.

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