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Production Potential of Forage Maize (Zea Mays L.) - Cowpea (Vigna Unguiculata L.) Intercropping System as Influenced by Row Ratios

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Abstract

The field experiment was carried out on sandy loam soil at of Main Forage Research Station, Anand Agricultural University, Anand, Gujarat, during *kharif* season of 2010 to study the "Production potential of forage maize (*Zea mays* L.) - cowpea (*Vigna unguiculata* L.). Twelve treatments comprising T_1: Maize sole, T_2: Cowpea sole, eight row ratios of maize + cowpea intercropping *viz.* T_3: Maize + Cowpea (1:1), T_4: Maize + Cowpea (1:2), T_5: Maize + Cowpea (2:1), T_6: Maize + Cowpea (2:2), T_7: Maize + Cowpea (3:1), T_8: Maize + Cowpea (3:3), T_9: Maize + Cowpea (2:4), T_{10}: Maize + Cowpea (4:2) and two treatments comprising seed mixture of maize and cowpea *viz*. T_{11}: 50 % Maize and 50 % Cowpea seed of recommended dose mixed and sown in same row and T_{12}: 75 % Maize and 25 % Cowpea seed of recommended dose mixed and sown in same row intercropping system as influenced by row ratios". Plant height at the time of harvest in both crops, green forage yield, dry matter yields, maize equivalent yield, crude protein content of maize and the highest net realization with benefit cost ratio were recorded higher under treatment T_5: Maize + Cowpea (2:1). Available N in the soil after harvest of the crop was found the highest with treatment T_2: Cowpea sole.

Keywords: Forage maize, forage cowpea, row ratio, yield, quality and soil properties.

Introduction

Intercropping and row ratio are more conspicuous. Generally, intercropping of cereal forage with legume enhances the total productivity and improves the quality of forage as well as maintains soil fertility (Kumar and Prasad 2003). Fodder cowpea, besides supplying nutritious fodder; increases the yield of cereals by making additional nitrogen available to main crop. Maize intercropped with legumes at proper row ratios produced significantly higher green forage, dry matter and crude protein yield also. Thus, growing cereal forage with legumes in proper row ratio assumes great importance in providing stable production, ensuring profitability, enriching the quality of fodder and meeting variety of needs.

Material and Methods

The field experiment was carried out on sandy loam soil at of Main Forage Research Station, Anand Agricultural University, Anand, Gujarat, to study the "Production potential of forage maize (*Zea mays* L.) - cowpea (*Vigna unguiculata* L.) intercropping system as influenced by row ratios" during *kharif* season of 2010. The soil of experimental plot was representative of the region and had sandy loam texture. It was low in available nitrogen, medium in available phosphorus and available potash with pH 6.81 and EC 0.14 dSm^{-1}.

The experiment was laid out in Randomized Block Design and replicated four times, twelve treatments comprising of T_1: Maize sole, T_2: Cowpea sole, eight row ratios of maize + cowpea intercropping *viz.* T_3: Maize + Cowpea (1:1), T_4: Maize + Cowpea (1:2), T_5: Maize + Cowpea (2:1), T_6: Maize + Cowpea (2:2), T_7: Maize + Cowpea (3:1), T_8: Maize + Cowpea (3:3), T_9: Maize + Cowpea (2:4), T_{10}: Maize + Cowpea (4:2) and two treatments comprising seed mixture of maize and cowpea *viz*. T_{11}: 50 % Maize and50 % Cowpea seed of recommended dose mixed and sown in same row and T_{12}: 75 % Maize and 25 % Cowpea seed of recommended dose mixed and sown in same row were evaluated in present study.

Fertilizer dose to each crop should be applied separately as per row ratios and as per area covered by the respective crop and Common dose of P_2O_5 @ 40 kg ha^{-1} through SSP was given as basal to both crops. Nitrogen was given as per the treatment in two splits for maize crop *i.e.* 50 per cent as basal and 50 per cent at 30 DAS through Urea. While, whole dose of nitrogen as per treatment was applied as basal to cowpea. Where, Maize and cowpea were harvested at the time of 50 per cent tasseling of maize.

Result and Discussion

Treatment T_5: Maize + Cowpea (2:1) were recorded higher plant height at the time of harvest in both the crops. The increase in plant height of cowpea might be due to the favorable microclimate created by cowpea and better availability of nitrogen to maize plants and increase in plant height of cowpea might be due to better utilization of solar energy, space and nutrients from deep layer in the soil by cowpea. Same result was observed by Singh and Balyan (2000) in sorghum + guar intercropping system. The leaf: stem ratio of maize and cowpea was not influenced due to row ratios of maize + cowpea intercropping system.

However, treatment T_{11}: Mixed Maize and cowpea seed (50% +50%) showed numerically, the highest value of leaf: stem ratio (0.74) of maize and in cowpea treatment T_8: Maize + Cowpea (3:3) showed numerically, the highest value of leaf: stem ratio (0.69) of cowpea. Same treatment was secured maximum total green forage and total dry matter yields (422.92 q ha^{-1}) and (98.92 q ha^{-1}), respectively, showing its superiority over rest of the treatments. The higher total green forage yield due to intercropping of maize with cowpea in 2:1 row ratio might be attributed to complementary effect of cowpea, that supplemented nitrogen to maize and the better utilization of solar radiation, space and nutrients from the soil by maize + cowpea intercropping system. Similar findings have been reported by Khot *et al.* (1992).

Treatment T_5 also ranked top in the respect of maize equivalent yield (452.95 q ha^{-1}), crude protein content (5.44 %) of maize. Crude protein content of cowpea was not significantly affected due to the intercropping treatments. The results confirm with the findings of Patel *et al.* (2008). Higher crude protein content in maize was attributed to increased nitrogen absorption by plants and its transformation in the form of proteins. These results are in close conformity with the findings of Singh *et al.* (2005). Neutral Detergent Fiber (NDF) content of both the crops did not significantly influenced by intercropping (row ratios). Available N in the soil after harvest of the crop (Table. 2) was increased with increasing rows of cowpea and found the highest with treatment T_2: Cowpea sole and this treatment was at par with all intercropping treatments except the treatments T_{10}: Maize + Cowpea (4:2) and T_5: Maize + Cowpea (2:1). This might be due to the supplementation of nitrogen synthesized in root nodules of cowpea through the process of symbiotic nitrogen fixation and added soil organic matter in maize + cowpea intercropping technique. Thereby, resulted in the additive enrichment and enhanced soil fertility. where as the minimum value of available nitrogen was recorded in treatment T_1: Maize sole. The available P_2O_5 and K_2O in soil after harvest of the crop were not influenced due to the row ratios of maize and cowpea in intercropping system. The highest net realization of (Rs. 31,599 ha^{-1}) with 3.3 benefit cost ratio (Table. 2) were recorded in treatment T_5: Maize + Cowpea (2:1).

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Table 1 : Effect of row ratios of maize + cowpea intercropping on plant height, yields and quality of maize and cowpea crop.

reatments	Plant Height (cm) at harvest		Leaf : Stem ratio		Total green forage yield (q ha^{-1})	Total dry matter yield (q ha^{-1})	Maize equivalent yield (q ha^{-1})	Crude protein content (%)		NDF content (%)	
	Maize	Cowpea	Maize	Cowpea				Maize	Cowpea	Maize	Cowpea
T_1 : Maize (sole)	229.30	-	0.61	-	352.78	82.02	352.78	5.13	-	77.72	-
T_2 : Cowpea (sole)	-	239.21	-	0.67	218.06	46.37	272.27	-	13.84	-	68.87
T_3 : M + C (1:1)	232.35	276.67	0.65	0.63	402.08	93.15	436.46	5.29	13.99	78.08	69.94
T_4 : M + C (1:2)	244.60	263.40	0.62	0.61	368.61	82.95	414.27	5.34	13.91	75.55	69.71
T_5 : M + C (2:1)	282.30	294.83	0.70	0.67	422.92	98.92	452.95	5.44	14.49	76.74	69.28
T_6 : M + C (2:2)	267.00	263.68	0.62	0.67	415.97	94.65	448.78	5.31	14.19	75.80	70.51
T_7 : M + C (3:1)	258.00	282.65	0.62	0.63	350.69	80.83	366.15	5.30	14.05	76.81	67.05
T_8 : M + C (3:3)	244.55	246.72	0.70	0.69	346.53	79.70	376.91	5.33	14.10	78.08	68.37
T_9 : M + C (2:4)	253.75	267.58	0.70	0.62	349.31	79.57	396.35	5.31	13.89	75.37	70.87
T_{10} : M + C (4:2)	243.55	256.25	0.68	0.66	364.58	85.19	385.94	5.16	14.22	75.17	69.18
T_{11} : Mixed M and C (50% +50%)	265.45	273.42	0.74	0.64	406.25	94.59	439.06	5.29	14.51	77.76	68.19
T_{12} : Mixed M and C (75% +25%)	256.40	271.20	0.62	0.63	405.56	94.01	426.74	5.25	14.24	75.16	70.43
C.D. at 5%	30.19	7.25	NS	NS	29.21	6.71	32.05	0.16	NS	NS	NS

Table 2: Economics and soil nutrient status after harvest of the crop influenced by different intercropping treatments.

Treatments	Net Realization (Rs. ha^{-1})	BCR	Available soil nutrient (kg ha^{-1})		
			N	P_2O_5	K_2O
T_1 : Maize (sole)	20342	2.4	172.48	42.25	195.18
T_2 : Cowpea (sole)	14142	2.1	223.44	39.46	200.21
T_3 : M + C (1:1)	29620	3.1	207.76	42.12	199.61
T_4 : M + C (1:2)	28022	3.1	211.68	39.89	200.00
T_5 : M + C (2:1)	31599	3.3	203.84	40.91	197.32
T_6 : M + C (2:2)	30114	3.0	219.52	39.23	200.59
T_7 : M + C (3:1)	22846	2.7	203.84	40.71	198.81
T_8 : M + C (3:3)	23665	2.7	207.76	40.00	199.32
T_9 : M + C (2:4)	26230	3.0	215.60	40.10	200.28
T_{10} : M + C (4:2)	24898	2.8	196.00	42.18	198.87
T_{11} : Mixed M and C (50% +50%)	29497	3.0	215.60	41.38	197.55
T_{12} : Mixed M and C (75% 25%)	28003	2.9	207.76	42.30	198.06
C.D. at 5%	-	-	17.67	NS	NS

M : Maize, C: Cowpea