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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 : A field experiment was conducted during *Kharif* season of 2010 at Main Forage Research Station, Anand Agricultural University, Anand to study the production potential of forage maize-cowpea intercropping system as influenced by row rations. Intercropping of maize and cowpea in 2:1 row ratio recorded significantly higher total (maize + cowpea) green forage (422.92 q /ha) and dry matter yield (98.92 q/ha). Cowpea as an intercrop helped to enhance crude protein content and total crude protein yield of intercropping system. The maximum (5.44 %) crude protein content of maize was achieved with the row ratio of 2 : 1 and this treatment also recorded higher total crude protein yield (7.73 q/ha).

Key Words : Forage, Maize, Cowpea, Row ratios

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Among the important cereal forages, maize ranks second position after sorghum. It is an ideal forage crop having quick growing habit, high yielding ability, palatability, nutritive value and acceptable to the cattle at any stage of growth. There is no risk of oxalic acid or ergot disease poisoning. The herbage yield of maize remains fairly uniform throughout the year. Cowpea, as fodder in the intercropping is useful in supplying nutritionally rich fodder. Besides, cowpea enriches the soil by environmental nitrogen fixation and improves the N status.

RESEARCH PROCEDURE

A field experiment was conducted during *Kharif* season of 2010 at Main Forage Research Station, Anand Agricultural University, Anand on sandy loam soil low in available nitrogen, medium in available phosphorus and available potassium with 6.8 pH and 0.14 dSm^{-1} EC. The experiment was laid out in Randomized Block Design and replicated four times, total twelve treatments comprised of T_1 : Maize sole, T_2 : Cowpea sole, eight row rations 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 (2:4), T_9 : Maize + cowpea (2:4), T_{10} : Maize and cowpea (4:2) and two treatment comprising seed mixture of maize and cowpea *viz.*, T_{11} : 50 per cent maize and 50 per cent cowpea seed of recommended dose mixed and sown in same row and T_{12} : 75 per cent maize and 25 per cent cowpea seed of recommended dose mixed and sown in same row were evaluated in present study. The crops were sown at 30 cm spacing as sole crop, in row proportion or mixed in same row as per treatments. Maize variety African tall and cowpea variety EC 4216 were used for present investigation. Both crops were fertilized with recommended dose of fertilizer. The recommended fertilizer dose of maize is 80: 40 kg N: P ha^{-1} and cowpea is 20: 40 kg N: P ha^{-1}. Fertilizer dose to each crop were applied separately as per ratios and as per area covered by respective crop. Other recommended cultivation practices were adopted time to time for both the crops. Maize crop was harvested at 50 per cent tasseling stage and cowpea was also harvested with maize.

RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Green forage and dry matter yields :

The total green forage and dry matter yields were significantly affected by row ratios of maize and cowpea in intercropping system (Table 1). Intercropping of maize and cowpea in 2:1 row ratio gave significantly higher total green forage (422.92 q/ha) and total dry matter yields (98.92 q/ha)

Table 1 : Green forage and dry matter yields of maize and cowpea as influenced by row ratios of maize + cowpea in intercropping system

Treatments	Green forage yield (q/ha)		Total green forage yield (q/ha)	Dry matter yield (q/ha)		Total dry matter yield (q/ha)
	Maize	Cowpea		Maize	Cowpea	
T_1	352.78	–	352.78	82.02	–	82.02
T_2	–	218.06	218.06	–	46.37	46.37
T_3	264.58	137.50	402.08	63.63	29.52	93.15
T_4	185.97	182.64	368.61	44.35	38.60	82.95
T_5	302.78	120.14	422.92	72.97	25.95	98.92
T_6	284.72	131.25	415.97	66.91	27.74	94.65
T_7	288.89	61.81	350.69	67.89	12.94	80.83
T_8	225.00	121.53	346.53	53.78	25.93	79.70
T_9	161.11	188.19	349.31	39.79	39.77	79.57
T_{10}	279.17	85.42	346.58	67.14	18.05	85.19
T_{11}	275.00	131.25	406.25	66.41	28.18	94.59
T_{12}	320.83	84.72	405.56	75.88	18.13	94.01
S.Em±	9.70	7.76	10.15	2.32	1.65	2.33
C.D. (P=0.05)	28.01	22.40	29.21	6.69	4.77	6.71
C.V. %	7.25	11.67	5.53	7.28	11.67	5.53

T_1 : Maize sole T_2 : Cowpea sole 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 and cowpea (4:2) T_{11} :50 % maize and 50 % cowpea seed T_{12}: 75 % maize and 25 % cowpea seed
Note: Selling price of maize and cowpea green forage were Rs. 1.00 kg/ha and Rs. 1.25 kg/ha, respectively

Table 2 : Crude protein content (%) and crude protein yield (q/ha) of maize and cowpea and net return (Rs./ha) as influenced by row rations of maize + cowpea in intercropping system

Treatments	Crude protein content (%)		Crude protein yield (q/ha)		Total crude protein yield (q/ha)	Net return (Rs./ha)	BCR
	Maize	Cowpea	Maize	Cowpea			
T_1	5.13	–	4.20	–	4.20	20342	2.4
T_2	–	13.84	–	6.40	6.40	14142	2.1
T_3	5.29	13.99	3.37	4.12	7.49	29620	3.1
T_4	5.34	13.91	2.37	5.37	7.74	28022	3.1
T_5	5.44	14.49	3.97	3.75	7.73	31599	3.3
T_6	5.31	14.19	3.55	3.94	7.49	30114	3.0
T_7	5.30	14.05	3.60	1.82	5.42	22846	2.7
T_8	5.33	14.10	2.87	3.65	6.52	23665	2.7
T_9	5.31	13.89	2.11	5.52	7.63	26230	3.0
T_{10}	5.16	14.22	3.46	2.58	6.04	24898	2.8
T_{11}	5.29	14.51	3.52	4.09	7.61	29497	3.0
T_{12}	5.25	14.24	3.99	2.58	6.56	28003	2.9
S.Em±	0.06	0.23	0.14	0.22	0.23	–	–
C.D. (P=0.05)	0.16	NS	0.40	0.63	0.65	–	–
C.V. %	2.12	3.22	8.22	10.97	6.71	–	–

T_1 : Maize sole T_2 : Cowpea sole 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 and cowpea (4:2) T_{11} :50 % maize and 50 % cowpea seed T_{12}: 75 % maize and 25 % cowpea seed

over the sole maize and cowpea, which remained at par with the treatments T_6: Maize and cowpea (2:2), T_{11}: Mixed maize and cowpea seed (50 % + 50 %), T_{12}: mixed 75 per cent Maize and 25 per cent cowpea and T_3: Maize + cowpea (1:1). Similar findings were reported by Khot *et al.* (1992), Manoharan and Subramanian (1993), Singh *et al.* (2004) and Singh *et al.* (2005). The increasing yield might be due to additional yield obtained from cowpea without reduction in yield of maize per unit area of land. The higher total green forage yield due to intercropping of maize with cowpea in 2:1 row ratio might be attributed to complement 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. The increasing in dry matter yield was due to increase green forage yield.

Crude protein content and yield :

Crude protein content of maize was significantly influenced due to cowpea intercropping in different row ration with maize (Table 2). Treatment T_5: maize + cowpea (2:1) recorded maximum crude protein content (5.44 %) of maize, and it was at par with treatments T_4: Maize + cowpea (1:2), T_8: Maize + cowpea (2:4), T_9: Maize + cowpea (2:4), T_6: Maize + cowpea (2:2), T_7: Maize + Cowpea (3:1), T_3: Maize + cowpea (1:1) and T_{11} : mixed maize and cowpea seed (50 % + 50 %). The result also confined with the finding of Singh *et al.* (2005) and Patel *et al.* (2008) They reported similar results when sorghum and cowpea intercropped with each other in 2:1 row ratio.

Crude protein content in cowpea was non-significantly influenced due to row ratios of maize and cowpea in intercropping system.

The significantly higher crude protein yield (7.74 q/ha) was found under the treatment T_4: maize + cowpea (1:2) which remained at par with treatments T_5: Maize + cowpea (2:1), T_9: Maize + cowpea (2:4), T_{11}: Mixed maize and cowpea seed (50 % + 50 %), T_6; Maize + cowpea (2:2) and T_3: Maize and cowpea (1:1). These findings are in consonance with the reports of Patel *et al.* (2003).

Economics :

Among different intercropping treatments T_5: Maize + Cowpea (2:1) fetched maximum net realization (Rs. 31599/ ha) and BCR (3.3), while minimum net realization (Rs. 14112/ha) and BCR (2.1) was noticed with treatment T_2: cowpea sole.

Based on the experimental results, it can be concluded that maize (African tall) should be intercropped with cowpea (EC-4216) in the proportion of 2:1 ratio to obtain higher green forage and dry matter yields with quality fodder and better monetary return during *Kharif* season under middle Gujarat agro-climatic condition.

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