

## Companion Cropping of Maize with legumes for forage

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Results of the field experiment conducted at Rajasthan College of Agriculture, Udaipur, showed that companion cropping of maize with legumes resulted in significant increase in the production of animal feed units, viz. total dry matter (30.91 %), T. D. N. (29.36 %), D.E. (29.36 %), D.D.M. (29.20 %) and S. E. (32.09 %); and quality of forage, viz. crude protein (67.02 %), crude fiber (22.03 %), N. F. E. (25.64 %), crude fat (53.48 %) and mineral matter (66.35 %), when compared to growing of maize alone. Amongst different methods of planting, Cross-planting of maize with legumes at right angle was superior to other methods in respect to production of animal feed units and quality. Out of two companion crops tested, cowpea was better in terms of animal feed units and quality.

Natural grazing lands and by-products of farming do not provide adequate fodder of good quality. To meet this short-fall in quantity and quality of fodder required for the vast cattle population in the country, it is necessary to evolve agro-techniques by which the animal feed units could be stepped-up along with quality of forage without diverting land from grain production. Maize is an important grain crop grown in India but it provides relatively inferior quality of forage. Planting maize with other crops in variable proportions either leads to an increased total grain production with inferior fodder quality or to a lowered grain production with relatively superior fodder out-turn. It was, therefore, thought worth while to work out a method of companion cropping with maize to provide greater quantity of fodder with good quality.

### MATERIALS AND METHODS

A field experiment comprising two companion crops, viz., cowpea and

clusterbean and six methods of inter-cropping, viz., (i) cross-planting (maize planted at 60 cm x 25 cm spacing and legume planted at 30 cm x 10 cm spacing across maize rows at right angle), (ii) multiple parallel planting (maize planted at 60 cm x 25 cm, inter-cropped with single row of legume), (iii) mixed planting (recommended seed rates of maize and legume were mixed and sown at 60 cm row spacing), (iv) paired planting of companion crops (maize planted at 60 cm x 25 cm spacing with a pair of legume rows in the inter-row space), (v) paired planting I (maize planted with 30 cm in the rows and 120 cm between rows with a pair of legume rows in the inter-space) and, (vi) paired planting II (maize planted with 45 cm in the row and 90 cm between rows with a pair of legume rows in the interspace) along with an additional treatment of solitary maize at 60 cm x 25 cm spacing as control, thereby making thirteen treatment combinations was conducted during *kharif* season, 1977-78 at Agronomy farm of

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Rajasthan College of Agriculture, Udaipur (Rajasthan) in randomized block design with four replications. Uniform plant density of maize was maintained in all the treatments. Cultivars, Ganga 5 of maize, p-2 of cowpea and FS-277 of the clusterbean, were grown. Physico-chemical properties of the soil of the experimental field were ascertained by physical and chemical analysis of composite soil sample and the results are presented in Table I. Treatments

were evaluated on the basis of production of total grain (maize plus legume), animal feed units, viz., total dry matter, total digestible nutrients (T.D.N.), digestible Energy (D.E.), digestible organic matter (D.O.M.) and starch equivalent (S.E.); and quality characters of forage, viz., crude protein, crude fiber, nitrogen free extract (N.F.E.), crude fat and mineral matter in terms of quintals per hectare.

Table I Physico-chemical characteristics of the soil of experimental field

Characteristics	Content	Characteristics	Content
<b>A Mechanical analysis:</b>			
1. Coarse sand (%)	14.76	<b>C. Chemical analysis:</b>	
2. Fine Sand (%)	22.84	1. Total nitrogen (%)	0.074
3. Silt (%)	30.29	2. Available phosphorus (%)	0.00190
4. Clay (%)	32.11	3. Available potash (%)	0.00798
<b>B Physical composition:</b>			
1. Bulk density (g/cc)	1.49	4. Organic carbon (%)	0.92
2. Particle density (g/cc)	2.64	5. E. C. of saturation extract (mmhos/cm)	0.90
3. Porosity (%)	41.51	6. C. E. C. (meq/100 g soil)	17.30
4. Infiltration rate (cm/min.)	0.34	7. pH	8.4
5. Saturation percentage	40.19	8. Calcium carbonate (%)	3.20

## RESULTS AND DISCUSSION

### (i) Effect on the production of total grain (maize + legume):

Data in Table II show that multiple parallel planting of maize with legume resulted in significantly higher produc-

tion of total grain (maize + legume), closely followed by cross planting. In general, companion cropping produced greater total grain (33.73 q/ha) compared to the total grain yield of 28.35 q/ha obtained in solid cultivation of maize. This represented 5.38 q/ha increase.

(ii) *Effect on the production of animal feed units :*

Cross-planting of maize with legumes resulted in significantly higher production of all the animal feed units. *i. e.* total dry matter (80.07 q/ha), T.D.N. (44.00 q/ha.), D.E. (193.60 Kcal  $\times 10^5$ ) D.O.M. (43.15 q/ha) and S. E. (30.99 q/ha). Comparing all other methods, planting of maize and legume across to each other at right angle produced 12.10 to 24.62 q greater total dry matter, 6.36 to 13.09 q T. D. N., 27.99 to 57.60 Kcal  $\times 10^5$  greater D.E., 6.48 to 12.95 q greater D.O.M. and 4.60 to 9.75 q greater S.E./ha. Such increase might have resulted due to better plant spread in this method which in turn, probalaly led to lower weed infestation. Also the canopy might have intercepted more solar radiation thereby resulting in enhanced dry matter accumulation. The reduction in total dry matter yield in other methods of planting may be partly due to heavy competition offered by legumes to maize which suppressed maize growth. These findings are in close conformity with those of Singh (1968) and Sharma and Singh (1972).

Companion cropping of maize with cowpea produced significantly higher total dry matter (68.50 q/ha), T.D.N. (38.34 q/ha), D.E. (168.74 Kcal  $\times 10^5$ ), D.O.M. (37.42 q/ha) and S.E. (26.85 q/ha) compared to growing of maize in association with clusterbean. The respective increases of these units were 10.23 q, 6.29 q, 28.56 Kcal  $\times 10^5$ , 6.26 q and 4.81 q/ha. The higher animal feed unit production due to companion cropping with cowpea was because of higher fodder production potential of cowpea compared to clusterbean.

When compared with solid maize companion cropping significantly increased total dry matter, T. D. N., D. E. D. O. M., and S. E. by 14.97 q, 7.97 q, 35.07 Kcal  $\times 10^5$ , 7.75 q, and 5.94 q, respectively. This increase in animal feed unit production due to companion cropping was due to additional yield of the companion crops in the interspace between rows of maize. It is also possible that part of nitrogen fixed by the legume might have been made available to maize. These results are in agreement with those obtained by Dey (1963) and Gorlitz (1963).

(iii) *Effect on the quality of forage :*

Data in Table III show that cross planting of maize with legume significantly increased all the quality characteristics of forage compared to all other methods tried. Planting of maize and legume across to each other at right angle produced 1.77 to 3.17 q, more crude protein, 2.85 to 5.37 q, more crude fiber, 5.63 to 12.00 q, more N. F. E., 0.30 to 0.68 q, more crude fat and 1.55 to 3.41 q, more mineral matter/ha compared to other methods of planting. Companion cropping of maize with cowpea significantly increased crude protein, crude fiber, N. F. E., crude fat and mineral matter by 1.11, 2.65, 4.66, 0.44 and 1.38 q/ha, respectively, compared to that obtained by growing of maize with clusterbean. The increases in quality characteristics in cross planted maize with cowpea was due to additive effect of increased dry matter production concomitant with higher crude protein, crude fat and mineral matter content of cowpea. This view is supported by Singh (1968), Tomar (1971) and Sharma and Singh (1972).

TABLE II Effect of companion cropping and methods of planting on the production of total grain and animal feed units

Treatments	Total grain yield (q/ha)	Total dry matter (q/ha)	Total digestible nutrients (T.D.M.) (q/ha)	Digestible energy (D.E.) (Kcalx 10 <sup>5</sup> )	Digestible organic matter (D.O.M) (q/ha)	Starch equivalent (S.E.) (q/ha)
<b>Methods of planting :</b>						
Cross-planting	35.87	80.07	44.00	193.60	43.15	30.99
Multiple parallel planting	38.37	67.97	37.64	165.61	36.67	26.39
Mixed planting	31.61	55.45	30.91	136.00	30.20	21.24
Paired planting of companion crops	31.14	60.40	33.49	147.35	32.67	23.34
Paired planting I	32.83	58.95	32.70	143.88	31.90	22.69
Paired planting II	32.58	57.46	31.91	140.40	31.14	22.04
S.E.m. $\pm$	0.367	0.934	0.560	2.464	0.512	0.335
C.D. at 5%	1.054	2.681	1.606	7.066	1.501	0.962
<b>Companion crops :</b>						
Cowpea	28.66	68.50	38.35	168.74	37.42	26.85
Clusterbean	38.81	58.27	31.86	140.18	31.16	22.04
S.E.m. $\pm$	0.212	0.539	0.323	1.421	0.299	0.193
C.D. at 5%	0.608	1.548	0.927	4.078	0.827	0.554
Maize solid	28.35	48.42	27.14	119.41	26.54	18.51
Companion cropping	33.73	63.39	35.11	154.48	34.29	24.45
S.E.m. $\pm$	0.540	1.376	0.824	3.625	0.803	0.493
C.D. at 5%	1.097	2.790	1.672	7.356	1.626	1.002



TABLE III. Effect of companion cropping and methods of planting on the quality of forage

Treatments	Crude protein (q/ha)	Crude fiber (q/ha)	Nitrogen free extract (q/ha)	Crude fat (q/ha)	Mineral matter (q/ha)
<b>Methods of planting :</b>					
Cross-planting	8.39	21.45	40.87	1.76	7.60
Multiple parallel planting	6.62	18.60	35.24	1.46	6.05
Mixed planting	5.22	16.08	28.87	1.08	4.19
Paired planting of companion crops	5.71	16.82	31.57	1.26	5.01
Paired planting I	5.50	16.63	30.76	1.21	4.85
Paired planting II	5.33	16.41	29.91	1.16	4.65
S.E.m. $\pm$	0.131	0.268	0.447	0.024	0.105
C.D. at 5%	0.377	0.769	1.282	0.069	0.301
<b>Companion crops :</b>					
Cowpea	6.68	19.00	35.20	1.54	6.08
Clusterbean	5.57	16.35	30.54	1.10	4.70
S.E.m. $\pm$	0.759	0.154	0.258	0.013	0.070
C.D. at 5%	0.218	0.444	0.740	0.040	0.200
Maize solid	3.67	14.48	26.36	0.86	3.24
Companion cropping	6.13	17.67	32.87	1.32	5.39
S.E.d. $\pm$	0.193	0.394	0.658	0.035	0.152
C.D. at 5%	0.392	0.800	1.334	0.072	0.336

Compared to growing of solid maize, companion cropping of maize with legumes produced 2.46, 3.19, 6.71, 0.46 and 2.15 q, more crude protein, crude fiber, N. F. E. crude fat and mineral matter/ha, respectively. This remarkable increase in the quality was due to the legume effect.

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