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Intercropping in Maize (*Zea maize* (L.) with Pigeon pea under Different Spacing and Fertility Levels

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Studies were undertaken at the Maize Research Station, Gujarat Agricultural University, Godhra from 1988 to 1990 on intercropping in maize with pigeon pea to different spacing and fertilizer levels under the rainfed condition. The maize var. Farm Sameri intercropped with pigeon pea (BDN-2) in the ratio of 1:1 with a row spacing of 45 cm and 80 kg N/ha and 40 kg P_2O_5/ha gave maximum net returns of Rs. 7333/- per ha.

Intercropping has proved to be as effective tool in increasing the production of field crops. Maize is an important food crop in Gujarat. Usually farmers intercrop maize with pigeon pea to minimise risk in *kharif* crop production.

The pattern of maize + pigeon pea intercropping is highly variable and no information is available as what should be the exact pattern for maize + pigeon pea intercropping system for maximum net returns. Row arrangement and intercropping with legumes like pigeon pea has an added advantage over sole cropping. Planting geometry not only help in the maximum utilization of natural resources like sunlight and airation but also helps in arranging higher plant population which in turn contributes to higher yields of crops (Willey, 1979). Maize intercropped with pigeon pea (legume) might have been benefitted through nitrogen fixation specifically in the condition when nearly half of the recommended dose of nitrogen was given to the crop (Chauhan and Dungarwal, 1982). Intercropping in maize not only gave higher production but also minimised weed growth (Pandey *et al.* 1981).

The present experiment was conducted to generate information on intercropping in maize with pigeon pea with proper method of sowing, spacing and fertilizer requirement to achieve higher productivity and net profit under rainfed farming in middle Gujarat Agro-climatic zone of Gujarat.

An experiment was conducted during *kharif* 1988, 1989 and 1990 at the Main Maize Research Station, Gujarat Agricultural University, Godhra, in split-plot design with four replications. The two spacings viz. 45 cm and 60 cm and two fertilizer levels viz. 40 kg N : 20 kg P_2O_5/ha and 80 kg N : 40 kg P_2O_5/ha were taken as main plot treatments, while four methods of sowing Maize + Tur (1 : 1), Maize + Tur (2 : 1), Maize + Maize and Tur mixture and Mixture of Maize and Tur in every row were taken as sub-plot treatments. The crops were sown with the onset of monsoon and harvested when maturity was attained for each crop.

TABLE 1

Grain yield and maize equivalent of maize and pigon pea intercropping.

Treatments	Maize grain (kg/ha)				Pigeon-pea (intercrop) (kg/ha)				Maize equivalent (kg/ha)			
	1988-89	1989-90	1990-91	Average	1988-89	1989-90	1990-91	Average	1988-89	1989-90	1990-91	Average
Spacing												
S_1 (60 CM.)	744	788	740	758	635	98	803	512	2311	1111	3171	2198
S_2 (60 CM.)	1020	851	991	956	702	118	929	583	2777	1146	3783	2568
CD at 5%	16	N.S.	66	N.S.	N.S.	19	58	N.S.	164	N.S.	253	N.S.
Fertilizers												
F_1 (80:40:0)	1029	938	1014	994	761	114	1030	635	2930	1221	4103	2751
F_2 (40:20:0)	734	701	723	720	577	102	702	460	2157	1036	2851	2014
C.D. at 5%	46	194	66	110	67	N.S.	58	N.S.	164	N.S.	253	N.S.
Methods												
M_1	726	980	717	820	762	122	1007	630	2619	1444	3738	2600
M_2	929	807	729	888	654	98	899	550	2565	1051	3671	2429
M_3	1189	556	1152	966	547	111	599	419	2557	832	2950	2113
M_4	648	938	676	754	712	101	959	591	2434	1187	3549	2390
C.D. at 5%	144	177	136	N.S.	63	N.S.	69	N.S.	N.S.	237	280	N.S.

The soils of the location is sandy loam to clay loam in texture with PH 7.5 and orgenic carbon 0.3 per cent. The available soil phosphorus and potash were 61 and 444 kg/ha, respectively. The total output of components of intercropping system (maize and pigeon pea) was converted in to maize equivalent by using the following formula :

$$\text{Maize Equivalent (kg/ha)} = \text{Weight of maize grain (kg/ha)} + \frac{\text{Weight of intercrop grain (kg/ha)} \times \text{price of intercrop grain (Rs/kg)}}{\text{Price of maize grain (Rs/kg)}}$$

In general, grain yield in 1989-90 was poor as compared to those of in the other seasons (Table 1). This may be attributed to uneven distribution and occurance of high rainfall in the months of July and August 1989 (384.0 and 596.5 mms) that adversely affected plant growth and grain formation.

Maize yield

Maximum reduction in maize yield was recorded when it was intercropped with pigeon pea grown in wider spacing (60 cm) and lower fertility levels (40 : 20 NP kg/ha). Highest grain yield (956 kg/ha) was obtained when intercropped with pigeon pea at closer spacing (45 cm). This may be attributed to higher plant density per unit area. Sawhney *et al.* (1989) also reported similar results. Application of 80 : 40 NP kg/ha gave 38% higher yield as compared to 40 : 20 NP kg/ha. Method of sowing did not contribute significantly in grain yield improvement (Table 1).

Piegeon Pea Yield

Yield data showed that average seed yield of pigeon pea increased in closer spacing (45 cm) and resulted in 13.9% higher yield as compared to wider spacing (60 cm). As regards the effect of fertilizer levels on the grain yield it increased significantly with the application of higher level (80 : 40 NP kg/ha) in two years (1988-89 and 1990-91). In one year the difference was non-significant (1989-90). Significantly higher seed yield of pigeon pea (635 kg/ha) was obtained in 80 : 40 NP kg/ha when compared to half of the recommended dose. Pooled analysis showed that pigeon pea yield in Maize + Tur in 1:1 row was highest (630 kg/ha) among all the methods of intercropping.

Maize Equivalent

The Maize equivalent was affected by planting geometry during all the three years. Pooled analysis showed that, sowing the crop at closer spacing (45 cm) gave 16.8% higher yield as compared to wider spacing (60 cm) when intercropped with pigeon pea. This may be attributed to nitrogen fixing behaviour of legumes and higher conopy cover resulting in the reduced evapotranspiration (Shah *et al.* 1991). Application of 80 : 40 NP kg/ha recorded 36.6% higher yield as compared to half of the recommended dose of fertilizers i.e. 40 : 20 NP kg/ha. The results clearly indicate that during all the three years maize and pigeon pea sown in the ratio of 1 : 1 always gave higher yield (2600 kg/ha).

Economics

Results (Table-2) indicate that the highest net realization of Rs. 7333/- per ha and CBR (2-93) was recorded with the use of 45 cm spacing, 80 : 40 NP kg/ha and 1 : 1 ratio of Maize + Tur planting. Maize productivity is known to be increased by inter cropping (Mittal *et al.* 1985). These results also confirm the fact that intercropping is a risk covering approach under rainfed conditions (Giri, 1990).

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TABLE 2

Mean data realization as influenced by different treatments.

Sr. No.	Treatment	Maize grain yield (kg/ha)	Inter crop yield kg/ha	Maize equiv-alent yield (kg/ha)	*Gross realiz-ation (Rs/ha)	Cost of produc-tion (Rs/ha)	Net realiz ation (Rs/ha)	CBR
1.	$S_1F_1M_1$	783	601	2477	6729	2450	4279	1.75
2.	$S_1F_1M_2$	887	645	2647	7396	2242	5954	2.44
3.	$S_1F_1M_3$	1058	468	2330	6299	2438	3861	1.58
4.	$S_1F_1M_4$	755	637	2541	7056	2450	4606	1.88
5.	$S_1F_2M_1$	607	488	2057	5611	1990	3621	1.82
6.	$S_1F_2M_2$	678	496	2110	5778	1982	3796	1.90
7.	$S_1F_2M_3$	737	322	1609	4347	1978	2369	1.20
8.	$S_1F_2M_4$	592	440	1803	4854	1990	2864	1.44
9.	$S_2F_1M_1$	1259	898	3656	9833	2500	7333	2.93
10.	$S_2F_1M_2$	1067	620	2773	7697	2492	5205	2.08
11.	$S_2F_1M_3$	1245	496	2624	7247	2488	4759	1.99
12.	$S_2F_1M_4$	983	609	2936	8006	2500	5506	2.20
13.	$S_2F_2M_1$	781	534	2242	6049	2040	4009	1.96
14.	$S_2F_2M_2$	913	441	2315	5852	2032	3820	1.88
15.	$S_2F_2M_3$	809	389	1885	5185	2028	3157	1.56
16.	$S_2F_2M_4$	689	579	2278	6259	2040	4219	2.06

*Note : Gross realisation has been worked out by taking maize grain and pigeon-pea prices as Rs. 2.50 and Rs. 3.75 per kg. of grain respectively.

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