Indian Journal of Agronomy **48** (2) : 89–92 (June 2003)

Influence of planting pattern and nitrogen and phosphorus fertilization on maize (*Zea mays*) and groundnut (*Arachis hypogaea*) in intercropping

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Received : September 2002

ABSTRACT

Results of an experiment conducted during the rainy seasons of 1999 and 2000 with maize (*Zea mays* L.) and groundnut (*Arachis hypogaea* L.) intercropping revealed that planting of component crops in 1:2 ratio recorded significantly higher yield of groundnut, whereas productivity of maize remained unchanged due to planting pattern. Recommended doses of fertilizers to component crops showed higher yield attributes of component crops. Productivity of maize and groundnut, and N and P uptake by these crops were highest with 100% dose of fertilizers. However, 75+100% of recommended doses applied to component crops remained at par with 100+100% dose in respect of productivity and nutrients uptake by maize and groundnut. This indicated 25% saving of fertilizers (N and P) applied to maize in association of groundnut in intercropping.

Key words : Planting pattern, Intercropping, N and P fertilization, Maize groundnut

Intercropping is an approach which offers the opportunity to increase the productivity per unit area and per unit time by efficient utilization of natural resources (Ahmed and Rao, 1982). Among cereals, maize being a widely spaced crop offers such an opportunity of intercropping where legumes of short stature and requiring different fertilizer dose like groundnut can be grown. Fertilizer requirement (nitrogen and phosphorus) for maize and groundnut separately has been worked out. But how much fertilizer dose has to be applied when these crops are grown together in intercropping has not been standardized. Keeping this fact in view, present investigation was carried out to study the effect of N and P fertilization on growth and yield of maize and groundnut grown under different planting pattern in intercropping.

MATERIALS AND METHODS

The experiment was conducted at research farm, New Delhi, during rainy season (*kharif*) of 1999 and 2000. The soil of experimental site was sandy loam with low inorganic carbon (0.35%) and available nitrogen (120.6 kg/ha) and medium in available phosphorus (24.3 kg) and potassium (137.5 kg/ha), with pH 8. The experiment was laid out in split-plot design with 3 replications. Treatments comprised 2 planting patterns (1:1 and 1:2 row ratio) of maize and groundnut in main plots and 9 fertilizer combination (100+100, 100+75%, 100+50%, 75+100%, 75+75%, 75+50%, 50+100%, 50+75% and 50+50% of recommended dose of N and P) in subplots. It was started on 4 and 5 July in 1999 and 2000 respectively. Maize cv 'Ganga Safed 2' was sown in rows 75 cm apart and between 2 rows of maize, groundnut cv 'SG 84' was grown as per treatments. Recommended dose of N and P were applied @ 120 kg N and 60 kg P_2O_5/ha to maize and 20 kg N and 50 kg P_2O_5/ha to groundnut, respectively, as per treatment. A basal of 40 kg K_2O and 25 kg $ZnSO_4$/ha was supplied to maize uniformly. Four irrigations were given in each year to meet the water need of the crops.

RESULTS AND DISCUSSION

Effect of planting pattern

Maize : Planting pattern did not bring any change in the yield attributes of maize, viz weight of cob, grains/cob and shelling (%) (Table 1). Since yield attributes of maize remained unchanged, grain and stover yields were also not affected by planting pattern, in either of the years (Table 1). The main reason for this was that plant density of maize under 2 planting patterns remained constant and crops under both situations might have utilized the resources equally. This is supported by the data on N and P uptake by maize which remained statistically at par under both planting patterns in 2 years.

Groundnut : Planting of crops in 1:1 ratio recorded significantly higher number of developed pods and their weight in 2 years (Table 2). This might be due to less competition between plants for resources under low density. Contrary to the number and weight of pods, pod and haulm yields of groundnut were significantly higher under

1:2 ratio of planting. This is ascribed to the fact that plant density of groundnut under this planting pattern was just double of the 1:1 ratio. This indicated that increase in yield attributes under 1:1 ratio could not compensate the effect of lower density (Table 2). Hence higher density with lesser pods and their weight/plant proved to be more productive. As a result of higher pod and haulm yields, uptake of N and P by groundnut was also significantly higher in 1:2 ratio of planting (Table 3).

Effect of fertilizer application

Maize : Application of 100% fertilizer to maize resulted in significantly higher yield attributes, viz. weight of cob, grains/cob, test weight and shelling (%) (Table 1). There was significant reduction in these parameters with the reduction in fertilizer dose up to 50% in both the years. Reduction in fertilizer dose to groundnut also significantly suppressed the weight of cobs and test weight but only when maize was supplied with 75% dose of fertilizer. At this level, reduction in fertilizer dose of groundnut to 50% reduced these yield attributes of maize in both years.

Fertilizer combination significantly influenced the grain and stover yields of maize during both the years. The maximum yield was recorded when100 +100% fertilizer dose was applied to both maize and groundnut in intercropping. However, grain and stover yields recorded with 100+100%, remained on a par with 100+75%, 100+50%, and 75+100% fertilizer dose. Further eduction in fertilizer dose to either of the component crops caused reduction in grain and stover yields of maize. Thus, lowest yields were recorded with 50+50% fertilizer application to component crops. This was because of the fact that 100% fertilizer dose might have met the nutrients need of the crops and encouraged the growth and development of individual plant. Hence grain and stover yields of maize were more with 100% fertilizer application. These findings are corroborative of the results of Rao *et al.* (1987) and Thanki *et al.* (1997).

Recommended dose of fertilizer registered the highest uptake of N and P by maize which was significantly reduced with reduction in fertilizer dose. Thus lowest removal of N and P by maize was recorded due to 50% dose of fertilizer (Table 3). Total N uptake recorded with 100+100% dose remained statistically on par with that of 75+100% doses of fertilizers applied to respective crops in intercropping. Similarly, P uptake (35.88 kg/ha) recorded with 75+75% dose of fertiliers was statistically on a par with 100+75% dose during 1999. Increases in N and P uptake due to higher doses of fertilizers was due to higher productivity (Table 1).

Groundnut : Application of fertilizer to component crops showed significant influence on the yield attributes of groundnut in both the years. Highest number and weight of pods and shelling (%) were recorded with 100% dose of fertilizers applied to groundnut under various doses of fertilizer applied to maize (Table 2). Pod and haulm yields (Table 2) were also significantly influenced by fertilizer application. The highest yields were recorded when 100% dose of fertilizer was applied to groundnut in combination with different levels applied to maize in both years. However, the pod and haulm yields obtained from 75 and 100% dose of fertilizers applied to groundnut un-

Table 1. Effect of planting patterns and fertilizer levels on yield attributes and yield of maize

Treatment	Weight of cob (g)		Grains/ cob		Test weight (g)		Shelling (%)		Grain yield (q/ha)		Stover yield (q/ha)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Planting pattern												
1 : 1 ratio	88.4	98.6	373.1	415.6	131.91	145.80	69.7	71.5	36.63	4.770	62.14	68.17
1: 2 ratio	86.7	97.1	374.1	412.7	135.73	148.50	6.48	70.5	36.70	40.90	62.57	68.58
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Fertilizer application												
100+100%	97.3	107.3	400.8	441.0	136.42	149.68	74.6	76.6	40.46	44.90	66.57	73.08
100+75%	93.3	105.0	396.8	439.8	138.26	151.60	73.8	75.6	39.47	44.31	65.75	72.31
100+50%	93.7	103.7	400.7	44.70	138.63	151.84	73.1	75.5	40.20	44.73	66.53	72.97
75+100%	92.3	102.2	379.3	423.2	140.11	153.71	71.0	73.6	38.97	43.76	65.35	71.60
75+75%	89.6	99.6	380.5	423.2	134.60	149.03	70.8	72.5	38.03	42.36	63.60	69.43
75+50%	82.5	92.5	378.3	422.2	131.89	145.69	70.3	72.1	36.46	40.58	60.67	66.56
50+100%	83.0	93.0	336.3	378.3	127.93	139.46	63.7	65.6	32.06	35.63	57.48	63.09
50+75%	77.5	88.2	342.8	377.8	129.15	141.91	62.2	64.2	32.29	35.96	58.02	53.60
50+50%	79.0	89.0	346.8	381.5	127.39	138.74	61.8	63.8	31.74	35.28	57.28	62.72
CD (P = 0.05)	7.3	7.4	4.7	7.3	1.23	1.19	1.4	1.8	2.10	1.18	2.38	2.40

Table 2. Effect of planting patterns and fertilizer levels on yield attributes and yield of groundnut

Treatment	No. of pods developed		Pod weight/ plant		Shelling (%)		Test weight (g)		Pod yield (q/ha)		Haulm yield (q/ha)	
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Planting pattern												
1:1 ratio	21.8	25.9	21.41	22.64	65.92	68.42	33.74	34.44	7.15	7.48	12.57	13.39
1:2 ratio	20.5	23.4	17.19	19.00	66.83	70.57	34.70	35.32	9.79	10.39	21.01	21.73
CD (P=0.05)	1.0	1.2	0.75	1.50	NS	NS	NS	NS	1.23	1.20	2.35	3.07
Fertilizer combination												
100 + 100%	24.4	29.3	21.57	22.66	73.21	77.65	34.68	35.33	9.49	9.78	17.84	18.89
100 + 75%	26.7	26.7	20.50	21.67	71.54	71.17	34.05	34.58	8.38	8.76	16.81	17.67
100 + 50%	20.8	25.3	20.08	21.27	65.59	69.32	32.82	33.52	7.75	8.11	15.19	15.83
75 + 100%	23.4	26.7	24.90	21.50	68.09	71.89	34.58	35.37	9.38	9.72	17.26	18.00
75 + 75%	21.1	24.9	19.45	20.53	66.20	69.93	34.32	34.77	8.29	8.61	16.40	17.06
50 + 100%	21.0	22.3	18.82	19.83	66.28	70.00	35.63	36.06	9.63	10.37	18.65	19.67
50 + 75%	19.8	21.6	17.89	18.50	63.06	66.50	34.53	35.19	8.23	8.96	17.03	18.44
50 + 50%	18.2	21.3	18.98	18.00	60.87	30.06	34.13	34.75	7.29	7.89	16.30	17.00
CD (P=0.05)	0.4	0.4	0.19	0.64	4.21	4.26	0.30	1.89	0.39	0.46	1.16	1.42

Table 3. N and P uptake by maize and groundnut as affected by planting patterns and fertilizer combinations

Treatment	Total uptake (kg/ha) by maize				Total uptake (kg/ha) by groundnut			
	N		P		N		P	
	1999	2000	1999	2000	1999	2000	1999	2000
Planting pattern								
1:1 ratio	84.96	101.73	33.99	40.47	39.00	41.81	4.76	5.38
1:2 ratio	84.73	105.84	34.68	40.65	37.83	60.89	7.79	8.73
CD (P=0.05)	NS	NS	NS	NS	6.18	11.56	1.13	0.54
Fertilizer application								
100 + 100%	97.50	111.38	39.67	46.45	53.52	51.77	7.69	8.61
100 + 75%	96.36	118.66	38.06	45.57	48.30	51.69	6.44	7.14
100 + 50%	92.39	118.71	38.74	45.92	43.92	46.99	5.33	5.85
75 + 100%	92.00	115.80	36.27	42.93	52.55	56.14	7.16	7.93
75 + 75%	88.94	110.30	35.88	42.46	47.57	50.79	6.01	66.68
75 + 50%	84.48	91.08	33.04	39.25	45.07	45.21	5.18	5.93
50 + 100%	70.97	93.69	29.43	34.46	54.53	59.80	7.52	8.60
50 + 75%	71.26	87.67	29.50	34.26	47.72	53.04	6.02	7.01
50 + 50%	69.71	86.75	28.45	33.74	42.54	46.72	5.11	5.75
CD (P=0.05)	7.11	4.44	3.32	1.77	1.17	5.63	0.35	0.2

der various doses of fertilizer applied to maize remained at par. This may be ascribed to better development of groundnut plant at higher dose of fertilizer application. Increase in pod yield was owing to increased number and pod weight and shelling (%). These findings confirm those of Patel and Patil (1990) and Gupta *et al.* (1998).

Fertilizer dose of 50+100% applied to maize and groundnut, respectively, recorded the highest N uptake by groundnut which was statistically on a par with 100 + 100% dose. The lowest N uptake was recorded with 50%

doses applied to both crops. The total uptake of phosphorus by groundnut was the highest when crop was supplied with 100% dose of fertilizers under different dose of fertilizers to maize. Application of 50% of recommended dose recorded lowest P uptake in 2 years. This was because of the fact that better nutrition due to higher dose of fertilizer might have ensured availability of nutrients in plant parts and increase in yield resulted in more uptake of N and P under 100% dose of fertilizers. This findings are in accordance with Giridhar and Giri (1990) and Patel and Patil (1990).

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