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Integrated nutrient management in alley cropped maize (*Zea mays*)–groundnut (*Arachis hypogaea*) system with *subabul (Leucaena leucocephala)*

Y. B. PALLED, B.K. DESAI AND A.S. PRABHAKAR

Department of Agronomy, College of Agriculture, Raichur, Karnataka 584 101

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ABSTRACT

An investigation conducted from 1990–91 to 1992–93 to study the response of *subabul* (*Leucaena leucocephala*) green manuring in alley cropped maize (*Zea mays* L.)–groundnut (*Arachis hypogaea* L.) system with alleys at 6 m distance having paired rows at 30 cm apart showed significant influence on yield of maize and groundnut. On an average, grain yield of maize and pod yield of groundnut with recommended dose of fertilizer and green-manuring were higher by 8.84% and 9.18% respectively over the recommended dose alone. The grain yield of maize at recommended dose of fertilizer alone was on a par with that of 75% N with green-manuring during the 3 years. The pod yield of groundnut differed significantly only during 1991–92. The pod yield at 50% recommended dose of fertilizer with green-manuring was on a par with that of recommended dose of fertilizer alone. On an average, organic nitrogen added from *subabul* to different treatments ranged from 35.01 kg to 41.37 kg/ha.

Key words : INM, Alley-cropped maize–groundnut system, *Subabul*

Escalating costs of inorganic fertilizers on the one hand and their undesirable impact on the physical condition of the soil on the other call for immediate inclusion of organic sources in crop production. Due to wider use of short-statured, higher-yielding varieties and hybrids in different crops, the availability of crop residues as organic matter to soil is very much limited. There is urgent need for on-farm generation and use of organic manures. Green-manuring is the most efficient agronomic practice for stimulating various biological transformations in the soil leading to improved soil fertility.

Due to wider use of organic sources and continuous imbalanced use of inorganic nutrients in Tungabhadra project (TBP) area, the yield levels of many crops are showing a declining trend in recent years. Alley cropping with *subaabul* hedge rows for green-manuring seems to be appropriate to augment on-farm generation of organic matter to improve soil productivity.

An effort was made in this investigation to study the effect of *subabul* green-manuring in alley cropped maize–groundnut system under irrigated red loam soil of TBP area.

MATERIALS AND METHODS

A field experiment was conducted at Raichur, on irrigated red soils from 1990–91 to 1992–93. The experiment was laid out in randomized block design with 7 treatments replicated 4 times. The plot size was 7.2 m × 6.0 m. *Leucaena* alleys (2 rows 30 cm apart) were established all along between the replications by direct sowing on 4 April 1990. Alleys were 6 m apart. During July second fortnight (10 July 1990) *Leucaena* plants from alleys were cut back to ground level and added to corresponding adjoining plots as per treatment, 15 days before sowing of maize (25 July 1990). Maize (cv. 'Deccan 103') was sown with a spacing of 60 cm × 30 cm. Subsequently *Leucaena* was harvested at an interval of 45–60 days and added to corresponding adjoining plots of maize. *Leucaena* was cut 3 times and added to soil during maize cropping period in all the 3 years. Groundnut was sown on 20 November 1990 after harvest of maize with a spacing of 30 cm × 10 cm. *Leucaena* was cut twice and added to soil during groundnut cropping period in all the 3 years. During 1991–92 and 1992–93 maize and groundnut were sown in first fortnight of July and second fortnight November respectively. A recommended fertilizer dose of 25, 75 and 37.5 kg N, P_2O_5 and K_2O/ha for groundnut and 150, 75 and 75 kg N, P_2O_5 and K_2O/ha for maize was applied during all the 3 years. The grain yield of maize and pod yield of groundnut/plot were recorded and expressed in terms of kg/ha. The fresh weight of *Leucaena,*

Table 2. Total dry matter added or removed from subabul alleys in different treatments

Treatments	Dry matter of *Leucaena* (kg/ha)			
	1990–91	19992–92	1992–93	Mean
Green-manuring (GM) alone for maize and groundnut	2,077	618	2,620	1,792.67
GM + 50% N for maize and 25% NPK for groundnut	2,028	581	2,370	1,659.67
GM + 50% N for maize and 50% NPK for groundnut	1,932	562	2,334	1,609.33
GM + 75% N for maize and 75% NPK for groundnut	2,002	697	2,131	1,610.00
GM + 100% N for maize and 100% NPK for groundnut	2,059	593	2,134	1,595.33
Recommended fertilizer dose alone for maize and groundnut (no *Leucaena)*				
Recommended fertilizer dose (*Leucaena* taken out for forage)	2,018	648	2428	1,698.00
CD (P = 0.05)	1.00	14.0	3.0	-

added to each treatment plot at each harvest by adjoining alleys, was recorded during 3 years. Total dry weight of *Leucaena* was worked out for all the 3 years. *Leucaena* samples at each harvest were analysed for N content and total organic N added to different treatments was computed and expressed in terms of kg N/ha. Soil sample of experimental area was analysed for organic carbon content before the experimentation from soil depth of 0–30 cm using wet oxidation method (Jackson, 1973). After third year of experimentation the soil samples from each treatmental plots were also analysed for organic carbon content from soil depth of 0–15 cm and 15–30 cm from the data of organic carbon content, the organic matter content was computed using the factor 1.72.

RESULTS AND DISCUSSION

The grain yield of maize differed significantly due to different treatments (Table 1). During 1990–91. *Leucaena* green-manuring with recommended dose of fertilizer resulted in significantly higher grain yield of maize over green-manuring alone and green-manuring with 25 and 50% recommended dose of N. Rest of the treatments were at par. Similar trend was observed during 1991–92 and 1992–93.

On an average, maximum grain yield of maize was realized by *Leucaena* green-manuring with recommended fertilizer dose, followed by green–manuring with 75% recommended N and recommended fertilizer dose alone. Minimum grain yield of maize was obtained by green-manuring alone. The average increase in grain yield

Table 3. Organic nitrogen added or removed during different years and soil organic matter content after third year

Treatment	Organic nitrogen (kg/ha)			Soil organic matter (%)		
	1990–91	19991–92	1992–93	Mean	0–15 cm	15–30 cm
Green-manuring (GM) alone for maize and groundnut	48.39	15.87	61.05	41.77	1.20	0.85
GM + 50% N for maize and 25% NPK for groundnut	47.25	13.54	55.22	38.67	1.20	0.84
GM + 50% N for maize and 50% NPK for groundnut	24.02	13.09	54.38	37.50	1.00	0.84
GM + 75% N for maize and 75% NPK for groundnut	46.65	16.24	49.65	37.51	0.98	0.71
GM + 100% N for maize and 100% NPK for groundnut	47.97	13.82	49.72	37.17	0.95	0.71
Recommended fertilizer dose alone for maize and groundnut (no *Leucaena)*					0.57	0.41
Recommended fertilizer dose (*Leucaena* taken out for forage)	47.02	15.09	56.57	39.56	0.64	0.41
CD (P = 0.05)	NS	0.56	1.81		0.05	0.01

of maize in *Leuaena* green-manuring with recommended fertilizer dose over recommended fertilizer dose alone was 8.84%. On an average, there was 46% reduction in maize grain yield with *Leucaena* green-manuring alone compared to recommended fertilizer dose without *Leucaena* alleys. Kang *et al.* (1981) and Defeliz and Nesbitt (1984) also obtained 2-fold increase in maize grain yield by the application of *Leucaena* loppings from alleys over the control.

Pod yield of groundnut differed significantly due to treatments during 1991–92 and there was no significant influence during 1990–91 and 1992–93.

During 1991–92, *Leucaena* green-manuring with recommended dose of fertilizer resulted in significantly higher pod yield of groundnut over green-manuring alone and green-manuring with 25% recommended fertilizer dose. Pod yields of groundnut with recommended fertilizer dose alone, *Leucaena* green-manuring with 75% and with 50% recommended fertilizer dose were at par. Similar trend was also observed during 1990–91 and 1992–93, though the treatment differences were not significant.

The maximum pod yield of groundnut was obtained under *Leucaena* green-manuring with recommended fertilizer dose, followed by *Leucaena* green-manuring with 75% recommended fertilizer dose and recommended fertilizer dose alone. The increase in pod yield of groundnut owing to *Leucaena* green-manuring with recommended fertilizer dose and 75% recommended fertilizer dose alone was 9.18 and 4.37% respectively. On an average there was 17% reduction in pod yield of groundnut with *Leucaena* green-manuring alone compared to recommended dose of fertilizers without *Leucaena* alley. Our findings confirm those of Adedire and Bada (1994).

The reduction in yield of maize and groundnut with green-manuring alone treatment compared to recommended fertilizer dose without *Leucaena* can be attributed to competition from *Leucaena* for moisture and nutrients in addition to low amount of applied nutrients. Application of recommended dose of fertilizers to both maize and groundnut with *Leucaena* green-manuring resulted in maximum production of groundnut compared to other treatments.

In general, the yield levels of both maize and groundnut were lower during 1991–92 because of shortage of irrigation water due to closure of canal, and as such both the crops experienced moisture stress during flowering and grain or pod-filling stages.

During 1990–91, the maximum yield *Leucaena* dry matter was recorded in alone green-manuring treatment and was significantly higher than other treatments. Similar trend was observed during 1991–92 and 1992–93. Dry-matter yields of *Leucaena* were lower during 1991–92 because of reduced number of irritations due to early closure of canal. The maximum *Leucaena* dry matter was recorded in green-manuring alone, followed by recommended fertilizer dose and *Leucaena* removed for forage.

The effect of different treatments on organic nitrogen added was not significant during 1990–91 but it was significant

Table 1. Grain yield of maize and pod yield of groundnut as influenced by different treatments

Treatment	Grain yield of maize (q/ha)				Pod yield of groundnut (q/ha)			
	1990–91	19992–92	1992–93	Mean	1990–91	19991–92	1992–93	Mean
Green-manuring (GM) alone for maize and groundnut	16.66	9.01	23.96	16.54	33.76	16.05	25.81	25.21
GM + 50% N for maize and 25% NPK for groundnut	19.04	13.34	28.16	20.18	39.99	16.44	26.48	27.64
GM + 50% N for maize and 50% NPK for groundnut	30.61	14.49	32.82	25.97	41.66	18.09	26.96	28.90
GM + 75% N for maize and 75% NPK for groundnut	38.99	18.62	39.08	32.23	42.79	20.08	28.16	30.34
GM + 100% N for maize and 100% NPK for groundnut	44.25	18.18	39.90	34.11	43.76	21.80	29.65	31.74
Recommended fertilizer dose alone for maize and groundnut (no *Leucaena)*	39.09	18.24	36.68	31.34	39.56	19.78	27.87	29.07
Recommended fertilizer dose (*Leucaena* taken out for forage)	41.66	15.87	37.14	31.56	39.16	18.94	27.91	28.67
CD (P=0.05)	7.41	4.35	5.32		NS	3.78	NS	

during 1991–92 and 1992–93. During 1991–92, organic nitrogen added from the green-manuring alone and green-manuring with 25% N to maize and 25% NPK to groundnut were at par and significantly higher than other treatments. Similar trend was also seen during 1992–93. On an average, green-manuring alone gave maximum organic nitrogen. This is mainly attributed to higher dry-matter production.

The effect of different treatments on soil organic matter was significant from 0–15 cm and 15–30 cm soil depth. The maximum soil organic matter (1.2%) was recorded in green-manuring alone at 0–15 cm soil depth. Similar trend was also observed in 15–30 cm soil depth. Organic matter content of soil after 3 years increased considerably in green-manuring treatments. Hazra (1993) and Prasad (1994) also made similar observations in *Leucaena*-based cropping systems.

REFERENCES

Adedire, M.O. and Bada, S.O. 1994. Alley cropping maize and okra with Leucaena. *Nitrogen Fixing Tree Research Reports* **12** : 80–82.

Defeliz, G. and Nesbitt, H. J. 1984. Increasing corn yields by mulching with leucaena. *Crop Science Society of the Phillipines Conference,* Batai, Phillipines, pp 120–153.

Hazra, C.R. 1993. Tree based rainfed forage production and its influence on soil fertility for the Bundelkhand region. *Indian Journal of Soil Conservation* **21** (3) : 1–7.

Jackson, M.L. 1973. *Soil Chemical Analysis.* Prentice Hall (India) Pvt. Ltd, New Delhi.

Kang, B.T., Wilson, G.F. and Spikens, L. 1981. Alley cropping maize and leucaena in south Nigeria. *Plant and Soil* **63** : 165–179.

Prasad, A. 1994. Soil fertility status under leucaena (In) : *Agroforestry Systems for Degraded Lands,* vol. 1, pp. 471–478. Singh, P., Pathak, P.S. and Ray, M.M. (Eds).