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Effect of agronomic management practices on soil fertility under jute (*Corchorus capsularis*)–groundnut (*Arachis hypogaea*)–blackgram (*Phaseolus mungo*) cropping system

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ABSTRACT

A 2-year experiment conducted on jute (*Corchous capsularis* L.)–groundnut (*Arachis hypogaea* L.)– blackgram (*Phaseolus mungo* L.) with varying management practices revealed that jute depleted organic carbon, total nitrogen, available phosphorus and potash contents of soil, whereas legumes like groundnut and blackgram improved the same in rotation. Application of fertilizers in varied doses to crops increased the organic carbon, total nitrogen, available phosphorus and potash contents of soil after 2 years of rotation. Farmers' practice and weed-free method of weed control helped in building up of organic carbon, total nitrogen and available potash status but lowered the available phosphorus content compared with chemical, chemical + mechanical and unweeded control. Wider row spacings in crops helped in accumulating higher organic carbon and total nitrogen but lowered the available phosphorus and potash contents compared with closer row spacing after 2-year rotation of jute–groundnut–blackgram.

Growing of crops in rotation affects the physical and chemical properties of the soil by their varied absorption of nutrients and root exudates. Inclusion of legumes in a rotation increases organic carbon, nitrogen, available phosphorus and potash contents of soil, whereas continuous cultivation of non-legume like jute (*Corchorus capsularis* L.) reduces the yield (Dargan, 1969). Inclusion of legume like groundnut (*Arachis hypogaea* L.) along with jute in a rotation increases total nitrogen content of soil (Sandandan and Mohapatra, 1973). The present study was conducted to find out the effect of various agronomic management practices on soil fertility in jute–groundnut–blackgram (*Phaseolus mungo* L.) cropping system.

MATERIALS AND METHODS

An experiment was conducted at Bhubaneshwar during 1988–89 and 1989–90 in a split-split-plot design with 3 fertility levels (F_1, 50; F_2 100; and F_3 150% dose) in main plots, 5 weed-control methods [W_1, chemical (fluchoralin @ 1.0 kg a.i/ha pre-

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plant application 1 DBS); W_2, chemical + mechanical (fluchloralin 1.0 kg a.i./ha + 1 hoeing and weeding); W_3, farmers' method (twice hoeing and weeding); W_4, Weed-free; and W_5, unweeded control] in subplots and 3 row spacings (R_1, 10; R_2, 20; and R_3, 30 cm) in sub-subplots with 3 replications.

The treatments were tested in the common cropping system of jute–groundnut–blackgram. The soil of the experimental site was loamy (Haplustulf) with organic carbon 0.09%, total nitrogen 287 kg/ha, available phosphorus 40 kg/ha, potash 145 kg/ha and moderately acidic (pH 5.8). The seeds were sown in the second fortnight of April for jute (cv. 'JRC 212'), second fortnight of October for groundnut (cv. 'AK 12-24') and first fortnight of February for blackgram (cv. 'T 9') with respective doses, the optimum being 60, 30 and 30; 20, 40 and 40; 20, 40 and 0 kg/ha of N, P and K respectively. The weather was favourable in 1988–89 with humid rainy season (*kharif*), cool winter and dry summer in contrast to moderately dry rainy season and moist summer of 1989–90.

RESULTS AND DISCUSSION

Increased application of fertilizers (50 to 150% dose) enhanced the residual organic carbon and total nitrogen contents of the soil after jute, which was due to the increased biomass addition to the soil through leaves and roots owing to increased biomass of the crops. This was in agreement with the findings of Anand Swarup and Ghosh (1979). It was further noticed that in groundnut and blackgram where the crops were harvest by manual uprooting of plants, increased level of fertilization reduced the organic carbon and total nitrogen, which may be due to removal of plant residues besides reduced nodulation at higher level of fertilization and consequently less nitrogen fixation. After 2-year rotation there was an improvement in organic carbon status by 0.06, 0.04 and 0.03 and total nitrogen by 10.8, 8.01 and 5.57% due to application of 50, 100 and 150% recommended doses, respectively to crops in jute, groundnut and blackgram cropping system. The results confirm the findings of Sadanandan and Mohapatra (1973).

Increasing levels of fertility (50 to 150%) increased the residual P and K contents of soil after each crop due to residual effect of said nutrients. On the whole there was improvement in available phosphorus by 26.65, 31.65 and 38.32% and available potassium by 62.64, 73.90 and 78.24% with 50, 100 and 150% doses respectively to crops in rotation after 2 years. Anand Swarup and Ghosh (1979) also reported similar results

The pooled yield of crops (Table 1) in both the years (1988–89 and 1989–90) did not show any significant difference due to application of increased doses which may be due to building up of phosphorus and potassium status of soil due to increased application of these nutrients. Mandal *et al.* (1983) had also pointed out that there was no beneficial effect of application of 150% dose.

Weed-control method

The organic carbon and total nitrogen contents of soil were increased when intercultural operation was provided to the crops in chemical + mechanical, farmers' method and weed-free treatments owing to increased biomass addition through better growth of crops in these treatments both in leaves and roots compared with unweeded and chemical alone treatment. After 2-year rotation, there was maximum improvement in the organic carbon and nitrogen (%) with farm-

Table 1. Effect of management practices on total dry-matter accumulation by weeds and economic yield of crops in jute–groundnut–blackgram cropping system

Treatment	Dry weight of weeds (g/0.5 m^2)*						Economic yield (q/ha)							
	1988–89			1989–90			1988–89				1989–90			
	Jute	Ground-nut	Black-gram	Jute	Ground-nut	Black-gram	Jute	Ground-nut	Black-gram	Pooled	Jute	Ground nut	Black-gram	Pooled
Fertility level														
F_1	4.2	3.4	3.7	5.3	3.6	4.3	24.6	19.7	6.2	16.8	21.8	17.3	5.4	14.8
F_2	3.4	3.6	4.1	8.0	4.0	4.9	30.2	21.3	5.2	18.8	21.7	23.3	5.3	16.8
F_3	3.3	3.5	3.8	7.4	3.9	5.9	29.8	20.8	6.5	19.0	22.6	24.4	5.0	17.3
CD (P = 0.05)	0.1	NS	0.04	0.1	0.1	0.1	4.6	NS	NS	NS	NS	3.2	NS	NS
Weed-control method														
W_1	4.9	4.5	3.4	9.0	5.4	6.1	25.5	18.7	7.3	17.2	16.8	14.3	3.2	11.4
W_2	2.6	2.1	2.8	7.3	2.5	3.3	33.8	23.9	7.3	21.7	22.0	28.8	6.2	19.0
W_3	2.6	2.9	3.5	6.0	3.4	5.0	35.6	21.5	5.1	20.7	30.4	25.4	5.9	20.6
W_4	1.0	1.0	1.0	1.0	1.0	1.0	36.5	25.5	6.8	22.9	24.6	30.6	7.9	21.0
W_5	7.1	7.2	8.7	10.6	7.0	9.3	9.6	13.4	3.2	8.7	16.4	9.2	2.9	9.8
CD (P = 0.05)	0.1	0.1	0.1	0.2	0.1	0.1	3.2	3.2	1.4	5.2	5.1	3.2	0.8	5.9
Row spacing														
R_1	3.5	3.3	3.8	6.4	3.6	4.6	28.3	24.6	7.2	20.0	20.2	2.26	4.9	15.9
R_2	3.6	3.6	4.0	7.1	4.0	5.1	29.0	20.1	5.1	18.0	21.6	22.2	4.9	16.2
R_3	3.8	3.7	3.8	7.2	4.0	5.1	27.4	17.0	5.6	16.7	24.2	20.3	5.8	16.8
CD (P = 0.05)	0.04	0.1	0.03	0.1	0.1	0.03	NS	1.9	0.7	1.4	2.2	1.6	0.5	NS

* Values in $\sqrt{X+1}$

Details of treatments are given under Materials and Methods

ers' practice and the least in the unweeded control.

The residual available phosphorus content of the soil also increased with the increase in intercultural operation in jute, which might be due to restriction of moment of air into soil in the wet season (*kharif*) which favoured the increased availability with reduced fixation of phosphorus. But in groundnut and blackgram opposite effect was observed, as the crops were grown in comparatively aerated conditions in dry seasons. On the whole, the available P content was found maximum in the unweeded control (38.7%) and the minimum in weed-free (22.5%).

The residual available potassium content of soil increased with increasing intensity of interculture due to greater mineralization of the soil potash along with lower removal by weeds. On the whole, increase in the available K content was maximum under weed-free (80.1) and least under unweeded control (61.3%). The pooled yield data (Table 1) showed significant improvement in yield of crops owing to different weed-control practices. Weed-free system gave significantly maximum yield in both the years and the effects were at par with that of chemical + mechanical and farmers' practice due to lower crop–weed competition in treatments.

Row spacing

Increasing row spacing reduced the residual organic carbon, total nitrogen contents of the soil after jute due to decreased addition of crop biomass, whereas in groundnut and blackgram opposite effect was observed due to increased nitrogen fixation with greater nodulation. The available phosphorus and potassium contents of soil were decreased with the increase in row spacing due to greater removal by weeds and lesser crop biomass addition. On the whole, after 2-year rotation the available phosphorus and potassium contents were increased maximum in closer, followed by optimum and wider spacing. On an average the closer row spacing gave the maximum yield, followed by optimum and wider in decreasing order due to greater plant stand in the former (Gupta and Bhattacharya, 1978).

Effect of individual crop

The mean value showed that jute reduced organic carbon by 0.01–0.02 units, total nitrogen by 42–55 kg/ha available phosphorus by 10.1–17.4 kg/ha and available potassium by 42.2–47.5 kg/ha, whereas groundnut and blackgram increased the same with respective values of 0.02–0.03 units and 0.01–0.02, 22–46.0 kg/ha and 15.6–16.0 kg/ha, 4.6–10.8 kg/ha and 12.6–12.8 kg/ha and 87.8–93.1 kg/ha and 3.8–8.8 kg/ha.

It was concluded that cultivation of non-legumes like jute depletes the soil while inclusion of legumes like groundnut and blackgram in rotation helps maintain soil fertility.

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