

# BENEFICIAL EFFECTS OF CARBOFURAN IN SOME IMPORTANT SOIL GROUPS OF ORISSA WITH RICE CULTURE

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Graded doses of carbofuran were applied to three important rice growing soils of the state to observe the effect on nitrogen status of soils influencing the growth and yield of rice. A pot culture experiment was designed with different soils viz. laterite soil of Bhubaneswar, alluvial soil of Phulnakhara and black soil of Balugaon of Orissa having different soil reactions. Rice variety *khandagiri* (105 days in rabi) was taken as the test crop. The carbofuran with recommended dose of 1 kg a.i ha<sup>-1</sup> was found suitable for increasing the growth and yield attributing characters, available nitrogen status of the soil, nitrogen uptake of the plant and finally the yield of the crop. The highest yield of 11.2 t ha<sup>-1</sup> was obtained with available nitrogen status of 321.3 kg ha<sup>-1</sup> and total nitrogen uptake of 112.6 kg ha<sup>-1</sup> (450.5gm./pot) in alluvial soil of Phulnakhara applied with recommended dose 1 kg ha<sup>-1</sup> of carbofuran.

**Keywords:** Carbofuran; Nitrogen status; Rice; Soils.

## Introduction

Rice (*Oryza sativa* L) is the staple food of more than 60 per cent of the world's population and is grown in an area of about 145 million ha. Though India has the largest area under rice, its production per unit area of the farm is very low by world standards. One of many production factors, supply of plant nutrients is a must to boost the grain yield. The high cost involved in fertilizers sometimes prevents the farmers to apply the full dose. The major rice pests like stem borer, gull midge and brown plant hopper cause yield reduction upto 15%. Application of systemic insecticides like phorate, carbofuran and dursban not only control the pests but also activate growth of soil micro-organisms, which in turn helps in nitrogen fixation by inducing nitrogenase activity in the rice rhizosphere. Application of increased level of carbofuran (4µg g<sup>-1</sup>) stimulates azospirillum and anaerobic nitrogen fixers population in alluvial as well as acid sulphate saline pokkali soils<sup>1</sup>. In a field trial at Coimbatore applying 0.75 kg a.i. ha<sup>-1</sup> carbofuran in rice it was concluded that, nitrogen, insecticide interaction was synergistic in all seasons with the greatest effect in the summer<sup>2</sup>. The present investigation was undertaken to observe the effect of carbofuran on nitrogen status of soils influencing the growth and yield of rice.

## Materials and Methods

A pot culture experiment was conducted with laterite, alluvial and black soils of Bhubaneswar, Phulnakhara and Balugaon, respectively taking rice variety *Khandagiri* (105 days) as the test crop. Each pot was filled with 8 kg processed (sieved through 2 mm. sieve)

soil and two numbers of twenty five days old seedlings were transplanted. The fertilisers were applied at the recommended doses of 100:50:50 kg ha<sup>-1</sup> N: P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. All the phosphatic and potassic fertilizers along with fifty per cent of nitrogenous fertilizer were applied at the time of transplanting as basal application. Rest fifty per cent of the nitrogenous fertilizer was top dressed after one month of transplanting. Irrigation was monitored by addition of extra water whenever necessary. The carbofuran 3G was applied 30 days after transplanting at schedule doses as per specific treatments. There were nine treatments which were fitted in a CRD with 3 replications.

The treatments were:

1. S<sub>1</sub>D<sub>0</sub>, 2. S<sub>1</sub>D<sub>1</sub>, 3. S<sub>1</sub>D<sub>2</sub>, 4. S<sub>2</sub>D<sub>0</sub>, 5. S<sub>2</sub>D<sub>1</sub>, 6. S<sub>2</sub>D<sub>2</sub>, 7. S<sub>3</sub>D<sub>0</sub>, 8. S<sub>3</sub>D<sub>1</sub>, 9. S<sub>3</sub>D<sub>2</sub>

Where S<sub>1</sub> - Laterite soil, S<sub>2</sub> - Alluvial soil, S<sub>3</sub> - Black soil, D<sub>0</sub> - 0 kg a.i. / ha, D<sub>1</sub> - 1 kg a.i. / ha, D<sub>2</sub> - 2 kg a.i. /ha. The composite soil samples were analyzed following the methods of Jackson<sup>3</sup>. The characteristic of 3 soils were presented in Table 1.

The growth attributing characters viz. plant height, tiller number and number of active leaves were observed (Table 2) 15, 30, 45 and 80 days after transplanting. The yield attributing characters viz. number of panicle per pot, length of panicle, number of fertile grain per panicle, number of chaff per panicle, 1000 grain weight and the yield of grain and straw were observed during the harvest period. The soil samples from the treated pots including control were collected at 30, 80 days after planting and processed for analysis of oxidisable fraction of organic nitrogen in soil which

**Table 1.** General characteristics of the soil.

Characteristics	Laterite (Bhubaneswar) Rhodic Paleustalfs	Alluvial (Phulnakhara) Typic ustorthents	Mixed red and Black (Balugaon) Vertic ustochrepts
Mechanical composition	70.00	57.50	60.24
Sand (%)			
Silt (%)	12.00	12.00	7.20
Clay (%)	18.00	30.50	32.56
Textural class	Sandy loam	Sandy clay loam	Sandy clay loam
WHC (%)	35.00	41.00	43.00
B.D. (Mg M <sup>-3</sup> )	1.65	1.41	1.40
P.D. (Mg m <sup>-3</sup> )	2.65	2.51	2.60
Porosity (%)	37.40	43.80	45.00
pH	5.50	5.90	7.70
E.C. (dS m <sup>-1</sup> )	0.33	0.37	0.40
O.C. (g kg <sup>-1</sup> )	4.20	5.10	2.40
Organic N (g kg <sup>-1</sup> )	0.37	0.47	0.21
C:N ratio	10.8	10.6	11.40
CEC {(cmol (p <sup>+</sup> ) kg <sup>-1</sup> soil)}	5.72	12.32	34.76
Available N (kg ha <sup>-1</sup> )	168	266.00	165.00
Available P (kg ha <sup>-1</sup> )	14.00	25.00	27.00
Available K (kg ha <sup>-1</sup> )	101.00	162.00	269.00

correlates to the available nitrogen by alkaline KMnO<sub>4</sub> method<sup>4</sup>. The total nitrogen of harvested grain and straw samples were estimated as per the method advocated by Jackson<sup>3</sup> and the uptake of nitrogen by grain and straw was expressed as kg per hectare (kg ha<sup>-1</sup>).

The data obtained were subjected to statistical analysis following the method advocated by Gomez and Gomez<sup>5</sup>.

### Results and Discussion

The initial soil status for organic carbon, total and available nitrogen and C:N ratio (Table 1) revealed that, the organic carbon content was 4.2, 5.1 and 2.4 g.kg<sup>-1</sup>, the total N content was 0.37, 0.47 and 0.21 g kg<sup>-1</sup> and C:N ratio was 10.8, 10.6 and 11.4 and available nitrogen content was 168, 266 and 165 kg ha<sup>-1</sup> in laterite, alluvial and black soils, respectively. The alluvial soil of Phulnakhara contained higher quantities

Table 2. Effect of carbofuran on growth attributing characters of rice.

Sl. No.	Parameters	DAT																						
		15				30				45				80										
		D <sub>0</sub>	D <sub>1</sub>	D <sub>2</sub>	S	D <sub>0</sub>	D <sub>1</sub>	D <sub>2</sub>	S	D <sub>0</sub>	D <sub>1</sub>	D <sub>2</sub>	S	D <sub>0</sub>	D <sub>1</sub>	D <sub>2</sub>	S	D <sub>0</sub>	D <sub>1</sub>	D <sub>2</sub>	S			
1.	Height (cm)	S <sub>1</sub>	32.5	33.3	31.6	31.6	66.3	75.6	72.3	74.0	84.0	86.0	85.0	86.0	85.0	86.0	90.0							
		S <sub>2</sub>	30.3	31.0	31.3	31.3	67.0	69.6	70.6	70.3	74.0	76.3	82.7	82.7	85.7	84.7								
		S <sub>3</sub>	31.3	33.0	29.3	29.3	70.3	69.3	63.0	81.3	79.3	68.3	82.0	82.0	82.7	78.0								
		SEm±	0.66	0.66	1.15	1.15	1.58	1.58	2.74	1.83	1.83	1.83	3.17	1.81	1.81	3.13								
		CD(0.05)	2.00	2.00	3.47	3.47	4.75	4.75	8.23	5.49	5.49	5.49	9.50	5.43	5.43	9.4								
2.	Tiller No.	S <sub>1</sub>	6.0	7.6	7.0	7.0	25.6	30.0	28.6	28.3	32.3	30.0	27.6	27.3	26.6									
		S <sub>2</sub>	6.6	6.3	6.3	6.3	26.6	26.3	26.6	28.3	28.6	31.3	27.3	27.3	30.0	24.0								
		S <sub>3</sub>	4.3	4.3	4.3	4.3	15.6	17.0	17.3	19.6	22.4	21.3	20.3	20.3	23.3	22.6								
		SEm±	0.23	0.23	0.40	0.40	1.29	1.29	2.24	0.88	0.88	0.88	1.54	0.96	0.96	1.67								
		CD(0.05)	0.71	0.71	1.22	1.22	3.88	3.88	6.72	2.67	2.67	2.67	4.62	2.91	2.91	5.03								
3.	No. of active leaves	S <sub>1</sub>	20.3	22.7	22.0	22.0	77.0	90.0	86.0	117.6	116.6	128.0	54.7	68.3	81.0									
		S <sub>2</sub>	20.0	20.0	20.3	20.3	80.0	79.0	80.0	109.3	115.3	120.0	56.7	72.3	70.0									
		S <sub>3</sub>	16.3	17.0	16.3	16.3	63.0	68.0	66.0	116.3	113.0	112.0	46.7	37.3	42.3									
		SEm±	0.54	0.54	0.94	0.94	3.08	0.38	5.33	1.54	1.54	1.54	2.67	3.93	3.93	6.81								
		CD(0.05)	1.64	1.64	2.84	2.84	9.23	9.23	16.00	4.62	4.62	4.62	8.00	11.8	11.8	20.43								

DAT - Days after transplanting

S<sub>1</sub> - Laterite soil

S<sub>2</sub> - Alluvial soil

S<sub>3</sub> - Black soil

D<sub>0</sub> - 0 kg a.i.ha<sup>-1</sup>

D<sub>1</sub> - 1 kg a.i.ha<sup>-1</sup>

D<sub>2</sub> - 2 kg a.i.ha<sup>-1</sup>

**Table 3.** Effect of carbofuran on yield and yield attributing characters of rice.

Treatment	No. of panicle/pot	Length of panicle (cm)	No. of fertile grain/panicle	No. of chaff/panicle	1000 grain weight (g)	Yield of grain (g/pot)	Grain yield (t ha <sup>-1</sup> )	Yield of straw (g/pot)	Straw yield (t ha <sup>-1</sup> )	Harvest Index (%)
S <sub>1</sub> D <sub>0</sub>	18.7	22.0	53.2	19.9	21.8	28.4	7.1	34.6	8.65	45.0
S <sub>1</sub> D <sub>1</sub>	24.0	23.4	93.0	26.9	22.6	37.0	9.25	37.9	9.47	49.4
S <sub>1</sub> D <sub>2</sub>	22.3	23.8	101.6	21.6	23.6	33.3	8.32	35.1	8.77	48.7
S <sub>2</sub> D <sub>0</sub>	22.7	21.9	85.9	22.0	23.0	37.2	9.3	33.6	8.40	52.5
S <sub>2</sub> D <sub>1</sub>	25.3	22.8	90.2	23.0	23.2	44.8	11.2	43.1	10.75	50.9
S <sub>2</sub> D <sub>2</sub>	26.6	23.0	86.6	23.6	23.8	41.6	10.4	38.4	9.60	52.0
S <sub>3</sub> D <sub>0</sub>	17.6	22.0	81.4	21.4	24.3	24.0	6.0	24.1	6.02	49.9
S <sub>3</sub> D <sub>1</sub>	20.0	22.8	86.0	22.5	23.3	34.6	8.65	36.1	9.02	48.9
S <sub>3</sub> D <sub>2</sub>	22.3	23.7	84.4	23.7	21.6	30.8	7.7	34.6	8.65	47.1
SE(m)	2.16	0.98	10.01	3.42	-	1.72	-	1.54	-	-
C.D (0.05)	6.50	2.96	30.01	10.25	-	5.16	-	4.64	-	-

**Table 4.** Effect of carbofuran on available N status of soils and uptake of N by rice.

Treatments	Available Nitrogen status of Soil (kg ha <sup>-1</sup> )			N uptake (mg pot <sup>-1</sup> )		
	30 DAT	80 DAT	Mean	Grain	Straw	Total
S <sub>1</sub> D <sub>0</sub>	189.0	176.4	182.7	142.0	166.1	308.1
S <sub>1</sub> D <sub>1</sub>	249.5	189.0	219.2	209.0	142.0	351.0
S <sub>1</sub> D <sub>2</sub>	201.6	178.4	190.0	188.0	124.5	312.0
S <sub>2</sub> D <sub>0</sub>	315.0	201.6	258.3	187.5	126.0	313.5
S <sub>2</sub> D <sub>1</sub>	352.8	289.8	321.3	295.5	155.0	450.5
S <sub>2</sub> D <sub>2</sub>	340.2	252.0	296.1	274.5	144.0	418.5
S <sub>3</sub> D <sub>0</sub>	147.5	189.0	168.2	105.5	103.0	208.5
S <sub>3</sub> D <sub>1</sub>	226.8	239.4	233.1	195.5	135.0	330.5
S <sub>3</sub> D <sub>2</sub>	200.8	201.6	201.2	192.0	119.0	293.0

of organic carbon, total and available nitrogen indicating higher nitrogen status in comparison to laterite and black soils. The application of recommended dose (1 kg a.i. ha<sup>-1</sup>) of carbofuran resulted in increasing the growth attributing characters.

The highest plant height 90 cm, 128 number active leaves in double the recommended dose and 32.3 number of tillers per pot in recommended dose at 80, 45 and 45 days after transplanting, observed (Table 2) in laterite soil.

Similar results were also reported by Singh *et al.* where they have observed with application of carbofuran @ 0.75 kg a.i. ha<sup>-1</sup> increased plant height. The recommended dose of carbofuran resulted in increase of yield and yield attributing characters viz. number of panicle per pot, length of panicle, number of fertile grain and chaff per panicle, 1000 grain weight, grain and straw yield (Table 3). The highest grain yield of 11.2 t ha<sup>-1</sup> and straw yield of 10.75 t ha<sup>-1</sup> was obtained in alluvial soil with recommended dose (1 kg a.i. ha<sup>-1</sup>) of carbofuran. Sadasivan *et al.*, Balsuvramanian and Thangamuthu and Salam observed increase in grain yield of rice with application of carbofuran.

The available nitrogen status of soil was observed at 30 and 80 days after transplanting of crop. It was observed (Table 4) that with application of carbofuran the available nitrogen content of soil was increased at 30 day, the highest value of 352.8 kg ha<sup>-1</sup> being obtained in alluvial soil applied with recommended dose of carbofuran. The corresponding highest amount of nitrogen uptake in this particular treatment was 450.5 mg pot<sup>-1</sup>.

In all the soils, the recommended dose resulted in higher values than double the recommended doses

of carbofuran. Comparing the soil types it was also observed that carbofuran treatment was much effective in alluvial soils followed by laterite and blacksoils.

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