STUDY THE EFFECT OF JATROPHA CAKE AND ITS COMBINATION WITH FERTILIZER ON SOIL FERTILITY

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Abstract: The present investigation was carried out during *kharif* season of 2006-07 at the Instruction Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment was laid out in randomized block design (RBD) and replicated thrice with ten treatments consist of Jatropha cake and chemical fertilizer doses and there combinations to evaluate effect on rice productivity. N, P and K uptake by rice was the highest with application of 100% NPK + 2 t ha^{-1} cake. The micronutrients content (Fe, Zn, Cu and Mn) in grain and straw of rice were increased significantly with applications of full dose of fertilizer in combination with 1 or 2 t ha^{-1} cake over control and was maximum with 100% NPK + 2 t ha^{-1} cake. Total uptake of micronutrients by the crop was similar between 100% NPK + 2 t ha^{-1} cake, and 100% NPK + 1 t ha^{-1} treatments but significantly highest was observed with 100% NPK 2 t ha^{-1} cake compared to rest of the treatments. The Jatropha cake additions with recommended dose of chemical fertilizer also improved the soil organic carbon, soil available major (nitrogen, phosphorus and potash) and micronutrients (iron, copper zinc and manganese), thus sustainable soil health can be maintained by long term use of the cake in crop production.

Keywords: Rice, Jatropha cake, Fertilizer, Fertility status, nutrient uptake

INTRODUCTION

Jatropha curcas L. (JCL) is a plant of Latin American origin which is now wide spared through arid and semiarid tropical regions of the world. It is a member of the euphorbiaceae family, drought resistant perennial, grown on marginal soils and closely related to the castor plant. Jatropha plant not only bears oil rich seeds containing about 35 per cent non edible oil used as a fuel and production of soap but has some medicinal properties (oil as laxative, latex to stop bleeding and against infections, leaves against malaria). Apart from this farmer planted Jatropha in the form of hedges to protect gardens and fields from hungry livestock but also reduce damage and soil erosion from wind and water. The plant roots grow close to the ground surface, anchoring the soil like miniature dikes or earthen bunds. These dikes effectively slow surface run off during intensive down pores, thus causing more water to penetrate in to the soil and boo
sting harvests.

The cake with mineral composition of N (3.93), P_2O_5 (2.93), K_2O (1.73) and organic matter (87.84) per cent (Mapako 1998) can be used as a very good organic fertilizer and composted organic manure in agricultural and horticulture production. Thus, the Jatropha system assures a sustainable way of life for village farmers through land that support them by renewable energy, soil improvement, control of soil erosion and poverty reduction.

Presently, Jatropha plantation in the Chhattisgarh is increasing on marginal and sub marginal land to produce bio-diesel and thus huge quantity of de-oil cake will we available which can be used in integration with mineral fertilizer to sustain crop productivity and soil quality. The limited research work is available on the integrated use of the cake in rice based cropping system. Hence, to overcome the deficit, the research work is planned with the following objectives.

MATERIAL AND METHOD

The study was conducted in Instruction Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India for the year 2006-07. Randomized block design with three replications and ten treatments *i.e.* Control, 1 t ha^{-1} cake, 2t ha^{-1}, 50% NPK through fertilizer, 100% NPK through fertilizer (100: 60: 40) , 1 t ha^{-1} cake + 50 % NPK through fertilizer, 2 t ha^{-1} cake + 50% NPK through fertilizer, 50% NPK + 50% N through cake, 100% NPK + 1 t ha^{-1} cake and 100% NPK + 2t ha^{-1} imposed in experiment. The 'Indira-9' paddy cultivar was the test crop. The crop was sown at a spacing of 20 x10cm. The crop received one third N and full dose of P_2O_5 and K_2O as basal application and remaining N were applied at tillering and panicle initiation stages in two equal doses respectively. Nitrogen was applied through urea, phosphorus through diammonium phosphate (DAP) and potassium through muriate of potash.

Soil samples (0~0.15 m depth) were collected. Samples were dried and passed through 2 mm sieve and analyzed for physicochemical characteristics as described by Jackson The experimental soil was neutral in reaction, low in organic carbon, and low in available nitrogen, medium in available phosphorus and high in potassium.

Soil available nitrogen was determined by alkaline permanganate method as described by Subbiah and Asija (1956). Soil available phosphorus was extracted by $NaHCO_3$ (pH 8.5) and the amount was determined by ascorbic acid method using spectrophotometer. Available potassium was extracted by neutral normal ammonium acetate (pH 7.0) and determined with the help of flame photometer.

Available iron, copper, zinc and manganese contents of soil was extracted by shaking with 20 ml of diethylene triamine penta-acetic acid (DTPA) for two hours and analyzed through atomic adsorption spectrophotometer.

RESULT AND DISCUSSION

Effect of jatropha cake and its combination with fertilizer on soil fertility:

The soil pH showed in Table 1 Indicated that the effect of jatropha cake alone and in combination with fertilizer on soil reaction was not significant. Application of treatments reduced the soil pH might be due to formation of acid during decomposition of organic matter. The result of electrical conductivity indicated that effect of the treatments was non significant. The organic carbon content was significantly affected by the different treatments. The table indicated that the highest organic carbon content was observed in T_{10} (100% NPK+2 t ha^{-1} cake). The lowest organic content is observed in control.

The increase in organic carbon content may be attributing to addition of organic material in soil which improved soil physical condition. The decomposition of roots of the crop might have also resulted in increase organic carbon content in the soil. The increase in organic carbon status is also due to direct addition of cake under the treatments. Similarly results of organic carbon content were also observed by Vijay Kumar *et al.,* (2001) and also conformity with the agreement Bokhitar *et al.*, (2004) and Chakradhar *et al.*, (2004).

Soil available nitrogen

The effect of different treatments on soil available nitrogen presented on table 2. Significantly higher soil available nitrogen was recorded by T_{10} (100% NPK + 2 t ha^{-1} cake) followed by T_9 (100% NPK + 1 t ha^{-1} cake) and T_7 (2t ha^{-1} cake + 50% NPK through fertilizer). The reason for increase in soil available N might be due to the conjunctive use of jatropha cake with fertilizer. The lowest available N was found in control plot. Similar results were reported by Chakradhar *et al.*, (2004) and more *et al.*, (2005)

Soil available phosphorus

The soil available phosphorus presented in Table 2 indicate that the application of increase doses of jatropha cake either alone or in combination with fertilizer doses increased available soil P status significantly over control.

The highest soil available P was recorded with T_{10} (100% NPK+2 t ha^{-1} cake). Increase in available P state of the soil with application of the treatments may be attributed to P content of jatropha cake and chemical P fertilizer over control. Similar results were also observed by Bokhtiar *et al.,* (2000), Bokhtiar *et al.,* (20004) and Devadas *et al.,* (2005).

Soil available potassium

The effect of different treatment on soil available K presented in Table 2. The variation of soil available K was not significant. However, applications of various treatments helped to increase soil K status compared to control.

Soil available micronutrients

The DTPA extractable available micronutrients i.e. Fe, Zn, Cu and Mn were increased significantly with application of the treatments. Maximum increase in available Fe, Zn, Cu and Mn was recorded by 100% NPK+ 2 t ha^{-1} cake over control, but applications of 100% NPK + 1 t ha^{-1} and 100% NPK through fertilizer was statistically similar in soil Fe, Zn, Cu and Mn status(Table 3). The availability of micro nutrients in soil increased with increasing doses of jatropha cake and its integration with different doses of fertilizer might be due to the fact that jatropha cake contains the micro nutrients, hence good source of micro nutrients. The above results are also is conformity as reported by mutharaju *et al.*, (2005), Bokhtiar *et al.*, (2000) and Goramnagar *et al.*, (2001).

CONCLUSION

The results discussed earlier in form the summary given above, it is concluded that the Jatropha cake addition with chemical fertilizer improved the physico- chemical properties and nutrients status of the soil, thus sustainable soil health can be maintained by long term use of the cake in crop production. The applications of 100% NPK + 2 t ha^{-1} or 100% NPK + 1 t ha^{-1} were beneficial in increasing the rice productivity.

Table 1. Effect of Jatropha cake and fertilizer doses on pH, electrical conductivity and organic carbon content of soil.

Treatments	pH	Electrical conductivity (dSm^{-1})	Organic carbon (%)
T_1 : Control	7.50	0.11	0.53
T_2 : 1 t ha^{-1} cake	7.53	0.11	0.63
T_3 : 2 t ha^{-1} cake	7.30	0.11	0.64
T_4 : 50% NPK through fertilizer	7.43	0.10	0.59
T_5 : 100% NPK through fertilizer	7.40	0.09	0.59

T_6 : 1 t ha^{-1} cake + 50% NPK through fertilizer	7.40	0.10	0.61
T_7 : 2 t ha^{-1} cake + 50% NPK through fertilizer	7.33	0.09	0.61
T_8 : 50% NPK + 50% N through cake	7.43	0.10	0.61
T_9 : 100% NPK + 1 t ha^{-1} cake	7.40	0.09	0.65
T_{10} : 100% NPK + 2 t ha^{-1} cake	7.36	0.10	0.64
SEm±	0.087	0.009	0.018
CD (5%)	NS	NS	0.050

Table 2. Effect of Jatropha cake and fertilizer doses on available N, P and K contents of soil.

Treatments	Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Available potash (kg ha^{-1})
T_1 : Control	145.83	10.73	228.57
T_2 : 1 t ha^{-1} cake	158.88	12.68	237.25
T_3 : 2 t ha^{-1} cake	162.53	14.25	241.95
T_4 : 50% NPK through fertilizer	176.80	15.08	248.26
T_5 : 100% NPK through fertilizer	177.72	19.56	251.28
T_6 : 1 t ha^{-1} cake + 50% NPK through fertilizer	177.41	17.92	249.04
T_7 : 2 t ha^{-1} cake + 50% NPK through fertilizer	183.97	19.12	251.72
T_8 : 50% NPK + 50% N through cake	180.72	18.79	256.32
T_9 : 100% NPK + 1 t ha^{-1} cake	184.90	20.36	256.55
T_{10} : 100% NPK + 2 t ha^{-1} cake	191.35	21.64	260.71
SEm±	8.15	0.62	8.30
CD (5%)	24.20	1.85	NS

Table 3. Effect of jatropha cake and fertilizer doses combinations on micro nutrients and total uptake.

Treatments	Iron content (mg kg $^{-1}$)		Total Fe uptake (g ha-1)	Zink content (mg kg $^{-1}$)		Total Zn uptake (g ha-1)	Copper content (mg kg $^{-1}$)		Total Cu uptake (g ha-1)	Manganese content (mg kg $^{-1}$)		Total Mn (g ha-1)
	Grain	straw		Grain	Straw		Grain	Straw		Grain	Straw	
T_1 : Control	34.21	197.17	1458.81	19.30	23.80	167.94	4.19	4.08	40.40	39.10	276.11	2028.08
T_2 : 1 t ha^{-1} cake	37.80	282.40	2193.00	22.00	32.55	312.2	4.29	4.37	46.21	43.58	338.10	2622.71
T_3 : 2 t ha^{-1} cake	39.28	285.82	2378.97	25.71	34.89	362.56	4.33	4.40	49.60	45.26	338.99	2790.79
T_4 : 50% NPK through Fertilizer	41.10	294.25	2461.22	28.32	37.12	397.04	4.39	4.42	50.82	48.28	361.34	3011.11
T_5 : 100% NPK through Fertilizer	49.70	312.76	3348.69	35.78	82.90	467.97	5.06	4.70	70.17	56.33	398.30	4239.39
T_6 : 1 t ha^{-1} cake + 50% NPK through fertilizer	43.19	289.12	2870.99	32.28	39.29	494.26	4.47	4.71	61.34	52.38	372.22	3678.88
T_7 : 2 t ha^{-1} cake + 50% NPK through fertilizer	44.12	298.22	3056.56	34.12	41.11	541.54	4.68	4.66	116.68	54.98	377.50	3864.16
T_8 : 50% NPK + 50% N through cake	43.77	296.45	2642.58	30.43	38.29	445.82	4.44	4.46	55.28	53.17	366.57	3268.59
T_9 : 100% NPK + 1 t ha^{-1} cake	55.10	336.25	3841.66	36.52	43.40	632.18	5.08	4.73	74.16	59.61	422.52	4778.61
T_{10} : 100% NPK + 2 t ha^{-1} cake	58.78	342.98	4197.07	39.67	46.55	720.39	5.11	4.75	78.43	63.19	431.80	4935.68
SEm±	1.71	8.66	167.40	1.72	1.34	45.61	0.19	0.12	16.41	2.93	8.89	189.66
CD (5%)	5.09	25.72	497.38	5.10	3.98	135.51	0.57	0.37	NS	8.70	26.43	563.51

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