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ORGANIC MANURE AND THEIR INTERACTIONS WITH INORGANIC FERTILIZERS ON NUTRIENT AVAILABILITY UPTAKE AND YIELD OF RAGI CROP

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ABSTRACT

Greenhouse experiment conducted with ragi Co.11 as a test crop showed that application of compost along with 75% NPK fertilizers recorded the highest grain yield followed by biogas slurry. Grain yield was higher in black soil when compared to red soil. Application of 100% NPK fertilizers along with organic materials generally resulted in higher availability of N, P, K, Ca, Mg, Fe, Mn, Zn, and Cu in soil and their respective uptake in the plant. The results showed that combined application is beneficial in terms of increased nutrient availability which resulted in higher crop yields.

Key words: Organic manure, inorganic fertilizers, nutrient availability, uptake, ragi yield

Eversince the phenomenon of soil fertility in crop production was noticed, the use of organic manure was immediately thought of and have been put into use in cultivated soils. Most of the manures used till now have been the materials available within the farm. But there are enormous quantities of organic wastes like coirpith (Clarson, 1986) available from coastal areas where coconut cultivation is prevalent, available free but yet to be used economically in crop production (Nagarajan *et al.*, 1985)

MATERIALS AND METHODS

A greenhouse experiment was carried with red (S_1) (Typic Haplustalf) and black soil (S_2) (Typic Chromustert). The experiment was carried out in completely randomised block design with 11 treatments involving three organic manures viz., biogas slurry, compost and coirpith at 10 ton/ha with and without NPK fertilizers at 75% and 100% optimum levels besides having an absolute control. The soil and plant samples were collected at three stages viz., tillering, flowering and post-harvest and analysed for N, P, K, Ca, Mg, Fe, Mn, Zn, Cu as per the procedures described by Jackson (1973) and Piper (1966).

Treatments

T_1 .. Control
T_2 ..100% recommended NPK - 90:45:45 ha^{-1}
T_3 ..Coirpith at 10 ton ha^{-1}
T_4 ..Biogas slurry at 10 ton ha^{-1}
T_5 ..Compost at 10 ton ha^{-1}
T_6 ..Coirpith 10 ton ha^{-1}, +75% recommended NPK
T_7 ..Biogas slurry 10 ton ha^{-1} +75% recommended NPK
T_8 ..Compost 10 ton ha^{-1} +75% recommended NPK
T_9 .. Coirpith 10 ton ha^{-1} + 100% recommended NPK
T_{10} .. Biogas slurry 10 ton ha^{-1} + 100% recommended NPK
T_{11} ..Compost 10 ton ha^{-1} + 100% recommended NPK

Table 1. Initial micronutrient status of the soil

	Red soil	*Black soil*
Total iron (%)	1.83	2.01
Total manganese (ppm)	480	528
Total zinc (ppm)	48	54
Total copper (ppm)	14	18
Available iorn (ppm)	1.5	1.0
Available manganese (ppm)	12	11.8
Available zinc (ppm)	2.8	2.5
Available copper (ppm)	1.0	1.8

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Table 2.N,P,K and micronutrient contents of the various organic manures

Sl. No.	Organic manure/ waste	N	P (per cent)	K	Fe	Mn (ppm)	Zn	Cu
1.	Coirpith	0.2	0.07	0.80	1800	350	100	35
2.	Biogas slurry	1.6	1.40	1.20	4200	550	150	52
3.	Compost	1.7	1.46	1.24	4500	580	200	60

The initial status of the nutrients analysed in the 2 soils revealed the following results. Red soil pH = 7.8, available alkaline permanganate N 140 ppm, Olsen-P 11.0 ppm, ammonium acetate K 300 ppm, black soil pH = 8.0, available N 150 ppm, Olsen-P 7.0 ppm, ammonium acetate K 315 ppm (Neutral N. NH_4OAc).

RESULTS AND DISCUSSION

1. Soil Available Nutrient

Application of compost in combination with 100% NPK registered the highest available N followed by biogas slurry with 100% NPK. The organic matter may undergo faster mineralisation in the presence of inorganic N fractions thus in faster release of N from the organic to the available pool (Nair *et al.*, 1973). Black soil recorded the highest available N.

Addition of coirpith with 100% NPK recorded the highest available P (7.2ppm). The lowest being 5.3 ppm when coirpith was applied alone. The effect of compost and farmyard manure addition in increasing soil available P was reported by Krishnasamy and Ramasamy (1984). Less available P by coirpith alone due to the absence of ready supplement of required nutrients to microorganisms for decomposition, the native available P might have been immobilised.

Higher available K (220 ppm) was found when compost was applied along with 100% NPK, followed by coirpith with 100% NPK and biogas slurry with 100% NPK. Control recorded the lowest available K (146 ppm). Increase in available K with *Pleurotus* sp. inoculated coirpith addition was reported by Jesylin Vijaya Kumari(1986).

Secondary Nutrients

Significant differences were observed at post-harvest stage and application of compost with 100% NPK registered higher available Ca (285 ppm) followed by biogas slurry with 100% NPK. The range of magnesium was between 114 and 220 ppm by control and compost with 100% NPK. Higher content of Ca under manurial treatments by solubility action effect was observed by Olsen *et al.* (1970).

Micronutrients

All the micronutrients viz., Fe, Mn, Zn, Cu registered increased availability in the compost + 100% NPK treatment leading to the conclusion that the organic and inorganic combination gives more effective result (Mathan *et al.*, 1978)

Uptake of Nutrients

Major Nutrients Uptake

The treatment compost + 100% NPK gave higher N mg/pot, and K uptake in straw. This was followed by the treatment biogas slurry + 100% NPK and coirpith + 100% NPK. The lowest uptake for N, P, K was recorded by the control. This was in conformity with the findings of Narayanamma *et al.* (1985).

Secondary Nutrients Uptake

The treatments compost + 100% NPK recorded the highest Ca uptake and the lowest by Control. Compost + 100% NPK treatment gave the highest uptake for Mg, with control treatment recording the lowest uptake.

Table 3. Changes in available nutrients in the soil (Post-harvest stage)

Treatments	N		P		K		Ca		Mg		Fe		Mn		Zn		Cu	
	(kg/ha)										(ppm)							
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Control	135	157	6.0	6.3	156	136	210	240	106	122	3.76	2.00	7.80	4.40	1.10	1.60	1.78	2.23
100% NPK	153	168	6.6	6.0	152	179	230	240	120	142	3.92	2.48	9.30	4.60	1.20	1.70	1.83	2.22
Coirpith	139	181	5.8	4.9	185	190	270	250	132	146	4.19	2.45	10.50	4.60	1.30	1.80	1.84	2.24
Biogas slurry	173	195	5.6	5.0	213	202	230	240	146	157	3.91	2.69	9.80	4.60	1.60	1.80	1.88	2.31
Compost	155	144	5.6	6.4	193	203	260	240	152	168	4.16	2.73	11.30	4.40	1.60	2.00	1.93	2.32
C.P+75% NPK	149	207	6.4	5.8	185	211	280	240	156	176	4.26	2.91	11.80	4.30	1.70	1.90	2.00	2.37
BGS+75% NPK	177	230	6.7	5.4	202	211	260	260	156	182	4.38	3.00	12.70	3.80	2.00	2.00	2.10	2.36
Compost+ 75% NPK	177	220	6.6	4.8	203	212	240	260	164	192	4.45	3.16	13.70	3.90	1.90	2.20	2.20	2.45
C.P.+100% NPK	214	235	7.8	6.6	226	213	210	300	172	199	4.52	3.16	13.70	4.00	2.00	2.50	2.31	2.38
BGS+100% NPK	220	249	7.6	6.5	225	213	260	310	194	207	4.61	3.26	15.80	4.10	2.50	2.30	2.52	2.40
Compost+ 100% NPK	235	256	7.5	6.5	229	211	260	310	214	226	4.66	3.40	10.80	4.90	2.60	3.30	2.64	2.43
Mean	175	204	6.7	5.8	197	198	246	263	156	174	4.26	2.84	11.70	4.30	1.80	2.00	2.09	2.34

Table 4. Uptake of nutrients by ragi straw (mgm pot^{-1})

Treatments	N		P		K		Ca		Mg		Fe		Mn		Zn		Cu	
	(kg/ha)										(ppm)							
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Control	350	402	103	265	328	476	116	134	113	126	1.20	1.41	1.73	2.08	1.38	1.71	0.16	0.15
100% NPK	959	1009	251	531	708	898	231	259	212	233	2.70	2.89	3.74	4.54	3.36	3.30	0.49	0.42
Coirpith	907	531	280	471	752	602	276	181	180	160	3.12	2.10	4.24	3.05	3.78	2.33	0.51	0.27
Biogas slurry	946	513	280	454	759	575	294	166	218	161	3.42	2.18	4.74	2.96	4.00	2.38	0.55	0.20
Compost	947	487	263	434	794	561	313	151	252	161	3.79	2.21	5.22	2.98	4.52	2.40	0.69	0.26
C.P+75% NPK	863	747	323	563	933	698	335	198	347	209	4.56	2.86	6.28	4.09	5.18	3.13	0.79	0.36
BGS+75% NPK	1220	986	386	704	991	901	396	252	337	247	5.45	3.74	7.50	6.07	5.81	4.03	0.97	0.50
Compost+75% NPK	1378	978	437	735	1100	979	376	276	273	262	5.73	4.15	8.59	6.67	6.26	4.20	0.94	0.54
C.P.+100% NPK1673	696	439	664	1318	657	451	204	281	180	7.30	3.01	11.34	5.07	7.37	2.87	1.19	0.43	
BGS+100% NPK	1765	825	478	719	1465	734	482	219	292	203	7.81	3.36	12.75	5.81	7.51	3.22	1.14	0.47
Compost + 100% NPK	1833	898	575	840	1553	839	487	231	299	219	8.00	3.52	13.82	5.86	7.85	3.39	1.15	0.47

Table 5. Uptake of nutrients by ragi grain (mgm pot^{-1})

Treatments	N		P		K		Ca		Mg		Fe		Mn		Zn		Cu	
	(kg/ha)										(ppm)							
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
Control	83	181	16	36	54	98	37	88	20	46	1.15	1.92	0.83	1.52	0.30	0.61	0.05	0.10
100% NPK	137	360	27	86	76	193	56	192	33	95	1.53	3.75	1.12	2.93	0.48	1.21	0.08	0.22
Coirpith	174	250	37	60	101	129	81	119	42	66	2.10	2.59	1.56	2.03	0.64	0.87	0.10	0.12
Biogas slurry	205	234	38	51	111	122	89	126	45	58	2.27	2.54	1.68	1.92	0.66	0.81	0.11	0.16
Compost	221	239	40	53	117	115	95	122	48	66	2.39	2.36	1.79	1.80	0.71	0.79	0.09	0.13
C.P+75% NPK	358	333	63	82	171	170	156	183	83	90	3.81	3.57	2.81	2.67	1.16	1.14	0.15	0.24
BGS+75% NPK	285	394	57	94	140	194	131	212	70	98	3.03	3.97	2.20	2.91	0.93	1.30	0.14	0.26
Compost+ 75% NPK	340	412	71	100	172	207	159	216	86	84	3.79	4.27	2.60	3.15	1.09	1.32	0.17	0.27
C.P.+100% NPK	228	304	45	74	109	149	112	148	59	77	2.51	3.06	1.77	2.25	0.70	0.87	0.11	0.19
BGS+100% NPK	255	334	50	85	113	168	105	178	55	85	2.68	3.41	1.89	2.63	0.75	0.97	0.11	0.19
Compost+ 100% NPK	312	366	56	86	146	183	151	190	72	91	3.32	3.71	2.43	2.86	0.98	1.04	0.11	0.20
Mean	236	319	46	68	120	157	107	161	56	80	2.60	3.20	1.88	2.42	0.76	0.99	0.11	0.19

Micronutrients uptake

The treatment compost + 100% NPK gave the highest micronutrient uptake. This was also supported by Prasad *et al.* (1984).

Table Grain and straw yield (g/pot)

Treatments	Straw		Grain	
	S1	S2	S1	S2
Control	16	17	9.4	16.7
100% NPK	34	32	13.4	31.5
Coirpith	35	21	17.4	20.8
Biogas slurry	35	20	18.2	19.9
Compost	36	18	18.6	18.4
Coirpith +75% NPK	39	26	29.4	26.5
Biogas slurry+75% NPK	43	29	22.9	28.9
Compost + 75% NPK	45	30	27.8	29.4
Coirpith + 100% NPK	53	21	17.8	20.9
Biogas slurry + 100% NPK	55	23	18.4	23.2
Compost + 100% NPK	56	24	22.8	24.9
	41	24	19.63	23.81
CD at 5% level Soil			1.16**	0.19**
Treatments			3.69**	0.60**
Soil x treatments			3.69**	0.60**

Among the treatments, addition of compost with 100% NPK recorded higher yield. Further, the grain and straw yields increased when inorganic fertilizers where added, in increasing levels with organic materials. However, application of 100% NPK alone resulted in the highest yield in black soil but not in red soil.

The influence of 100% NPK treatment as that of organic and inorganic combinations, in black soil, might be due to the nature of the soil which offered good physical conditions thereby increasing the efficiency of the fertilizer should also be high compared to sandy red soil.

Grain yield was higher for the different treatments in black soil. Higher availability of N, Ca and Mg with sufficient available P, K and micronutrients in black soil might have facilitated efficient grain filling and maturity of the crop. Similar results were obtained by Sankaran and Kothandaraman (1979).

It may be concluded that coirpith a ligno cellulosic waste has higher adaptability in increasing the yield than biogas slurry and compost with optimum combination of NPK.

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