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Progressive Changes in Available Nutrient Contents in the Sandy Soils and their Effect on Yield and Uptake of Nutrients in Ragi (*Eleusine coracana* Gaertn.)

By

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ABSTRACT

A pot culture experiment was conducted to study the progressive variations in available nutrients in soil, yield of ragi (*Eleusine coracana* Gaertn.) and uptake of nutrients as affected by different carriers of nitrogen and phosphorus in the representative sandy soils of Tamil Nadu. Soils samples were collected at tillering, flowering and post harvest stages of the crop and analysed for avilable nutrients. There was rapid decrease in avilable nutrients, due to leaching. The yield and uptake of nutrients depended on the fine sand content of the soil.

INTRODUCTION

In recent times, sandy soils have been successfully cultivated in Israel and United Arab Republic, adopting methods of water conservation like sprinkler and drip irrigation systems. The potentialities of sandy soils mentioned above motivated the present study. In this study an attempt was made to evaluate the progressive changes in available nutrient status of soils, response to added fertilisers, crop performance and uptake of nutrients in representative sandy soils of Tamil Nadu.

MATERIALS AND METHODS

A pot culture experiment was conducted with Co 7 ragi as test crop in the sandy soils collected from Thiruthuraipoondi, Thiruchendur, Cuddalore a[nd] Coimbatore, the former two soil[s] senting the coastal sand a[nd] two representing inla[nd] ments included we[re]

T : Co[ntrol]

[T]$_6$: Sodium nitrate + Superphosphate

[T]$_7$: Sodium nitrate + Dicalcium phosphate

[T]$_8$: Groundnut cake + Superphosphate

[T]$_9$: Groundnut cake + Dicalcium phosphate

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The dosages of fertilisers adopted were 60 kg N/ha, 30 kg P_2O_5/ha and 30 kg K_2O/ha. Potassium was applied to all the pots uniformly as muriate of potash. Seven kilograms of soil were taken in each pot to which calculated quantities of the fertilisers were added according to the treatments. At tillering, flowering and post harvest stages of the crop, soil samples were collected from each pot and were analysed for available nitrogen by alkaline permanganate method, available phosphorus by Olsen's method and available potassium by ammonium acetate extraction followed by flame photometry. Yields of grain and straw were recorded. Grain and straw were analysed for total nitrogen, phosphorus and potassium. The triple acid extract of the plant samples was taken and phosphorus and potassium were estimated from the extract adopting colorimetry and flame photometry respectively.

RESULTS AND DISCUSSION

The data on analyses of soils are given in Tables 1 and 2. The yield data and uptate values are furnished in Table 3.

Available nitrogen : A marked progressive decrease in available nitrogen content was recorded after the 30th day synchronising with the tillering stage. The general trend of variation of available nitrogen with time was a steep decrease of the nutrient upto about the 60th day coinciding with the flowering stage and less marked changes thereafter. A comparison of the 30th day and the 60th day indicated that the decrease in the nutrient content was 50 per cent reflecting a large magnitude of initial

TABLE 1. Basic analytical data of the soils

Soil properties	Thiruthuraipoondi soil	Thiruchendur soil	Cuddalore soil	Coimbatore soil
A. Mechanical Composition (Percentage)				
1. Coarse sand	2.6	39.0	34.2	54.2
2. Fine sand	88.4	59.2	51.8	39.8
3. Silt + Clay + loss on solution	9.0	1.8	14.0	6.0
B. Total Nutrients (Percentage)				
1. Nitrogen (N)	0.03	0.02	0.02	0.02
2. Phosphorus (P_2O_5)	0.012	0.124	0.056	0.036
3. Potassium (K_2O)	0.11	0.06	0.09	0.07
C. Available Nutrients (kg/ha)				
1. Nitrogen (N)	148	106	131	134
2. Phosphorus (P_2O_5)	2.0	2.5	4.0	4.0
3. Potassium (K_2O)	160	310	107	87
D. Other propreties				
1. Organic carbon (per cent)	0.015	0.015	0.015	0.057
2. pH	7.3	6.0	9.0	8.2
3. E. C. (m.mhos/cm)	0.3	4.5	0.2	0.2
4. CEC (me/100 g)	4.9	1.7	3.1	2.5

TABLE 2. Available nutrients in soils during different stages of crop growth (kg/ha)

Treatment	Available nitrogen/ days			Available phosphorus (P_2O_5)/days			Available potassium (K_2O)/days		
	30	60	80	30	60	80	30	60	80
Thiruthuraipoondi Soil									
T_1	241	154	138	15	4	1	82	70	55
T_2	255	157	45	25	4	4	80	75	45
T_3	269	148	120	50	6	5	82	80	52
T_4	232	157	123	24	4	3	82	67	70
T_5	241	115	173	32	2	1	92	85	95
T_6	229	188	148	14	6	2	67	70	75
T_7	238	140	123	26	5	2	115	82	112
T_8	249	132	146	22	7	4	77	80	100
T_9	232	134	137	28	6	1	85	70	90
Tiruchendur Soil									
T_1	241	134	160	36	4	2	92	97	102
T_2	255	134	129	15	2	2	100	95	157
T_3	246	132	112	14	10	4	77	110	75
T_4	218	140	120	18	1	2	80	110	22
T_5	230	120	120	22	3	7	90	80	102
T_6	258	134	151	22	3	5	67	65	117
T_7	260	126	145	22	2	6	92	105	82
T_8	263	118	129	18	2	6	97	132	87
T_9	428	126	106	38	1	4	82	67	80

TABLE 2 (Contd)

Cuddalore soil									
T_1	252	154	202	14	1	14	67	75	162
T_2	224	143	157	28	2	6	60	67	130
T_3	225	140	176	30	3	4	65	77	87
T_4	255	143	168	20	2	4	67	80	175
T_5	269	154	148	56	1	16	57	65	165
T_6	286	132	185	25	1	5	67	70	170
T_7	232	185	87	88	3	12	65	80	162
T_8	202	154	70	24	4	17	97	105	182
T_9	258	154	109	50	3	4	77	80	90
Coimbatore soil									
T_1	252	156	56	36	1	1	62	67	145
T_2	202	112	134	40	1	2	60	55	90
T_3	364	120	48	52	2	2	60	65	147
T_4	280	132	34	70	2	1	57	67	107
T_5	291	132	50	80	1	1	55	67	122
T_6	353	140	56	46	4	1	67	77	117
T_7	414	168	45	92	2	2	57	67	150
T_8	280	118	39	38	2	2	55	75	170
T_9	272	134	151	40	2	2	57	62	210

TABLE 3. Yield and uptake of nutrients

Treatments	Yield (g/pot)		Uptake in grain (mg/pot)			Uptake in straw (mg/pot)		
	Grain	Straw	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Thiruthuraipoondi soil								
T_1	5.78	5.99	213	24	10	68	7	59
T_2	6.79	7.80	247	31	14	131	2	94
T_3	8.21	10.93	276	39	17	153	4	98
T_4	13.77	12.53	347	66	30	210	31	115
T_5	12.41	9.36	625	60	25	157	18	88
T_6	9.14	10.11	307	41	18	170	52	91
T_7	8.64	8.61	387	48	16	96	18	77
T_8	6.70	8.25	243	33	15	116	18	73
T_9	6.38	7.09	357	29	14	99	16	62
Tiruchendur soil								
T_1	2.28	1.88	70	10	4	21	2	16
T_2	4.29	3.77	156	19	9	53	15	34
T_3	3.03	2.80	102	12	6	39	6	25
T_4	10.75	8.50	331	52	22	119	60	77
T_5	2.94	3.08	123	11	6	52	6	25
T_6	6.37	5.59	268	24	12	63	8	49
T_7	5.39	5.15	196	19	10	72	13	46
T_8	4.12	4.24	150	12	6	47	21	36
T_9	4.44	7.16	633	15	6	80	24	64
Cuddalore soil								
T_1	4.24	2.98	589	13	6	51	15	26
T_2	10.46	9.39	408	28	24	131	23	84
T_3	10.19	7·91	357	32	23	111	17	75
T_4	9.79	6.92	96	34	23	78	29	62
T_5	4.70	4.13	197	9	11	92	9	35
T_6	9.36	8.25	394	31	22	139	26	70
T_7	6.62	6.01	278	22	15	84	20	52
T_8	8.48	6.98	285	31	23	78	38	60
T_9	8.16	8.15	205	30	22	114	37	68
Coimbatore soil								
T_1	4.19	3.28	235	16	8	46	11	28
T_2	5.31	4.65	268	20	12	52	16	38
T_3	5.37	4.38	211	20	13	61	14	35
T_4	6.00	4.92	286	19	13	69	12	43
T_5	9.91	8.13	561	39	20	91	10	75
T_6	5.88	4.93	165	21	10	69	17	42
T_7	3.44	3.86	116	12	7	65	10	33
T_8	5·76	4.75	258	18	10	67	15	41
T_9	5.60	4.39	188	11	11	37	7	39

loss of nitrogen. Available nitrogen and phosphorus at the 30th day were closely related (r = 0 709***) suggesting the regularity of variation of these two nutrients. As such split applications, if adopted, would mitigate such losses and conserve available nitrogen to a considerable extent.

Available phosphorus: Considering the effect of soils, Coimbatore and Cuddalore soils were on par and superior to Thiruthuraipoondi and Thiruchendur soils in the matter of availability of phosphorus. There was a sharp decrease of available phosphorus content from tillering to flowering stage after which there was no change. The values for the latter two periods were very low, indicating that an appreciable loss of available phosphorus occurs within a very short time. While it is possible that a part of the loss would have been due to removal by the crop, the major part of the loss is attributable to leaching losses. Neller's (1947) observation of such losses in Florida sandy soils corroborated this assumption. Split application of phosphatic fertilisers would cut down the losses and make the application more effective.

Intial available phosphorus of Thiruthuraipoondi and Thiruchendur soils was very similar (2.0 to 2.5 kg P_2O_5/ha) and might account for the similarity in the corresponding values for the 30th day. But the variability of these values for Cuddalore and Coimbatore soils inspite of the fact that their initial available phosphorus content was identical, was difficult to explain and requires further elucidation.

Available potassium: The trend of progressive changes of this constituent with time was contrary to that observed for available nitrogen and phosphorus. While for nitrogen and phosphorus there was a marked decrease at the beginning and stabilisation in later stages, for available potassium there was no change in the content of this nutrient at the 30th and the 60th day but a slight increase was observed thereafter. Such an increase at the last stage could not be readily accounted for.

Yield of grain and straw: Considering grain yield, statistical significance was registered by soils and treatments. In the case of soils, Thiruthuraipoondi and Cuddalore soils were superior to the remaining ones. Considering the treatments, urea with superphophate was observed to be superior to ammonium sulphate and groundnut cake combinations with super and decalcium phosphate. The trend for straw yield was similar to those for grain yield, considering the effects of soils.

Uptake of nutrients: Uptake values for nitrogen, phosphorus and potassium were found to be closely correlated. The uptake values for these elements between grain and straw were also closely related. Likewise, Chandra-