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Influence of Soil Moisture Regimes and N Levels on the Content and Uptake of K by Ragi

Pot and field experiment were carried out at the Tamil Nadu Agricultural University, Coimbatore with the ragi variety Co. 10 as test crop to investigate the influence of soil moisture reigmes and N levels on the content and uptake of potassium by the crop during 1974—75.

The experimental soils were neutral in pH. Red and black soils of experiment I had the initial available K content of 135 and 285 ppm respectively and that of experiments II and III had 148 ppm. Experiment I. A pot experiment was conducted in glass house with red and black soils. The treatments consisted of four levels of N viz., 0 (N0), 45 (N1), 90 (N2) and 135 (N3) kg/N/ha as ammonium sulphate with a constant dose of 45 kg/ha each of P_2O_5 and K_2O as super phosphate and muriate of potash respectively. Five levels of soil moisture were maintained through out the crop growth at 100 (M1), 75(M2), and 50 per cent (M3) field capacity, irrigating to field capacity whenever the surface layer dried up (M4) corresponding to farmers practice and at the appearance of first perceptible symptoms of wilting (M5). There were three replications with 120 pots in all. Twenty one days old seedlings were transplanted at the rate of five plants per pot. After the life irrigation moisture regimes were established as per the treatments and the same were maintained throughout by weighing the pots daily and adding calculated quantity of water to replenish the moisture loss. Plant samples collected at tillering, flowering and post-harvest stages were analysed for the total K content by the use of a flame photometer (Jackson, 1967) and from the K content the K uptake values were computed. Experiment II. A second pot experiment was conducted with the soil collected from the University farm. The fertilizer treatments were the same as in Experiment I. The moisture treatments consisted of irrigating to field capacity at 20(M1) 40(M2) 60(M3), 80(M4) and 100 per cent (M5) available soil moisture depletion. Each treatment was replicated thrice. Field capacity was estimated as per the mathod of Dastane (1967) and the moisture content at 15 atmospheric pressure was determined with a pressure membrane apparatus. Plant samples collected at various stages were analysed for their total K content and their uptake values computed as in Experiment I.

In the field experiment conducted with the same treatments as in Experiment II moisture regimes and N levels formed the main and sub plot treatments respectively. There were three replications with 20 plots of 5.0 × 1.5m in each. Seedlings were planted with

TABLE I Yield of grain and straw

Treatment	Grain yield				Straw yield			
	Experiment I (g/pot) Black soil	Red soil	Experiment II (g/pot) Mean value	Experiment III (kg/ha) Mean value	Experiment I (g/pot) Black soil	Red soil	Experiment II (g/pot) Mean value	Experiment III (ha/kg) Mean value
N0	7.6	2.0	10.8	2832	22.7	16.6	34.9	3318
M1 N1	11.2	4.2	11.4	3743	35.4	39.4	39.7	4323
N2	15.1	12.4	14.8	4480	55.9	64.2	52.6	4558
N3	22.0	13.6	24.8	4786	67.7	83.3	67.6	6211
N0	4.8	3.4	11.3	3109	19.1	20.4	34.8	3165
M2 N1	10.2	13.4	14.5	3634	35.7	43.9	42.0	3754
N2	18.7	16.1	17.9	3422	65.0	69.7	46.8	4569
N3	24.2	26.6	23.5	3924	76.5	96.5	49.7	4495
N0	3.1	6.3	9.8	2777	11.4	23.9	36.1	2742
M3 N1	6.1	11.6	12.1	3251	33.0	48.1	36.3	3692
N2	11.0	9.7	14.6	3515	45.6	50.4	50.9	4295
N3	16.2	17.7	18.6	2845	59.7	69.5	52.1	3605
N0	0.9	7.5	12.5	1966	8.7	27.1	36.1	2703
M4 N1	7.8	6.9	12.6	2385	28.9	24.5	46.9	3181
N2	11.0	22.1	17.4	3278	36.5	62.5	54.6	4083
N3	17.4	19.0	19.1	3537	54.4	69.4	47.6	4216
N0	11.0	4.8	4.7	1715	16.8	14.5	33.9	2984
M5 N1	10.3	10.1	8.7	2592	36.3	39.2	40.0	2781
N2	11.1	21.0	13.0	2389	40.7	63.9	48.2	3609
N3	18.3	25.7	14.7	2318	55.2	75.2	61.3	3490

	SE	CD	SE	CD	SE	CD	SE	CD	SE	CD	SE	CD
N levels	1.07	3.30	0.35	1.05	115.25	332.77	1.30	4.02	1.38	4.08	126.49	365.23
Moisture regimes	—	—	0.4	1.07	228.28	774.36	1.46	4.49	—	—	—	—

a spacing of 15 cm on either side and after giving the life irrigation moisture regimes were maintained by gravimetric method. Required quantity of water to bring the soil moisture content to field capcity to a depth of 30 cm was applied by regulating the flow through a 'V' notch. Total K uptake at various growth stages was evaluated as in the previous experiments.

In general various soil moisture regimes employed did not show marked effect on the K content of plants. As the experimental soils were high in their initial available K content and further an additional dose of K at the rate of 45 kg/ha was added to all the plots there might have been luxury consumption of K and as such soil moisture effect on K content of plants could not be observed. This result substantiated the earlier reports of Satyanarayana and Ghildyal (1970) who could not observe much variation in the K content of plants due to various soil moisture regimes in soils well supplied with available potassium.

Marked variations in the K content of plants could be observed due to the increments of added N at all stages of crop growth. However, the K content of grain was not influenced by the added N. Higher K concentration was recorded under the highest rate of N application. The N is the element that enhances the vegetative growth, foraging capacity of the plants and consequently the intake of other nutrients, and hence increased K content of plants under higher levels of N.

In cereals generally, the grain K composition is low compared to that in straw. Hence naturally any possible variation in the plant composition for K will be exhibited in the vegetative parts of the plant and in the present experiments also appreciable variations in the K content of plants were observed only in the vegetative parts.

K uptake : Soil moisture regimes in general did not influence the K uptake by the crop (Tables III and IV). This might be due to the fact that the soils were rich in their available K content.

This unlimited supply of K resulted in the luxury consumption of this element as was evident in the higher K content of plants. Hence, variation in soil moisture levels could not effectively alter the K uptake by the plants.

Significant influences due to increments of added N on the K uptake by the plants could be seen at all growth stages of the crop in all the three experiments. Significantly higher K uptake was observed at the highest levels of N addition viz., 135 kg N/ha. It is generally recognised that K uptake will be increased by most practices that increase yield as long as the K supplying power of the soil is not limiting (Bennett et al., 1964). In the present study also there was a defenite trend of yield increases (Tables I and II) with increased N addition. The K supplying power of the soil was non limiting as could be seen from the higher initial available K content of soils, since there

TABLE II Total dry matter yield

Treatment	Experiment I (g/pot)		Experiment II (g/pot)		Experiment III (g/pot)	
	Black soil	Red soil	Mean	Value	Mean	Value
N0	22.7	16.6	45.7		6150	
M1 N1	35.4	39.4	51.1		8065	
N2	55.9	64.2	67.4		9039	
N3	67.7	83.3	92.4		10998	
N0	19.1	20.4	46.1		6273	
M2 N1	35.7	43.9	57.1		7388	
N2	65.0	69.7	64.7		7991	
N3	76.5	96.5	73.2		8419	
N0	11.4	23.9	45.9		5518	
M3 N1	33.0	48.1	48.4		6942	
N2	45.6	50.4	65.5		7811	
N3	59.7	69.5	70.7		6450	
N0	8.7	27.1	48.6		4669	
M4 N1	28.9	24.1	59.5		5565	
N2	36.5	62.5	72.0		7361	
N3	54.4	69.4	66.7		7753	
N0	16.8	14.5	38.6		4700	
M5 N1	36.3	39.2	48.7		5373	
N2	40.7	63.9	61.2		5907	
N3	55.2	75.2	76.0		5809	
	SE	CD	SE	CD	SE	CD
Nitrogen levels	2.02	6.23	1.51	4.48	118.8	342.9
Moisture regimes	2.26	6.97	1.69	5.00	495	1615

TABLE III K uptake by Ragi at different growth stages (mg/pot) Experiment I

Treatment	Tillering		Flowering		Straw		Grain		Total	
	Black soil	Red soil	Black soil	Red soil	Black soil	Red soil	Black soil	Red soil	Black soil	Red soil
N0	263	277	305	480	269	241	68	19	337	263
M1 N1	465	589	922	1082	581	862	106	40	687	902
N2	504	655	1238	1565	920	1191	143	143	1063	1328
N3	862	1025	2090	1867	1074	1394	220	122	1294	1516
N0	270	324	439	610	250	362	29	22	279	384
M2 N1	523	893	682	1066	599	766	71	114	670	880
N2	710	776	1498	1558	1065	1286	159	161	1224	1447
N3	845	817	1668	2012	1360	832	206	213	1566	1045
N0	406	426	393	614	191	361	28	53	219	414
M3 N1	507	519	822	1232	721	978	49	104	770	1082
N2	533	772	1280	1508	952	997	88	58	1040	1055
N3	703	904	1558	1403	1196	1191	129	124	1325	1315
N0	308	230	338	305	129	382	9	71	138	453
M4 N1	328	513	967	746	565	440	66	65	631	505
N2	462	456	866	1206	612	929	99	221	711	1150
N3	558	449	1225	1435	925	1209	148	171	1073	1380
N0	234	241	262	315	124	165	77	34	201	199
M5 N1	410	474	806	1026	676	757	92	86	768	843
N2	659	468	1296	1314	770	1051	100	147	870	1198
N3	676	547	1370	1529	1107	1163	165	244	1272	1407
	SE	CD	SE	CD	SE	CD	SE	CD	SE	CD
Moisture regimes	30.32	93.43	52.68	162.33	—	—	—	—	—	—
N levels	27.12	83.57	47.12	145.19	47.90	147.61	23.46	72.29	50.86	156.72
Soils	—	—	33.32	102.67	33.87	104.37			35.96	110.82

TABLE IV K uptake by Ragi — Mean values

Treatment		Experiment II (mg/pot)			Experiment III (kg/ha)		
		Straw	Grain	Total	Straw	Grain	Total
M1	N0	885	65	950	66	23	89
	N1	1049	69	1118	101	26	127
	N2	1576	89	1665	113	30	143
	N3	2096	149	2245	151	32	183
M2	N0	890	74	964	62	23	85
	N1	1306	95	1401	83	28	111
	N2	1359	143	1502	112	23	135
	N3	1537	142	1679	114	28	142
M3	N0	1009	61	1070	54	20	74
	N1	1053	91	1144	76	20	96
	N2	1296	131	1427	101	25	126
	N3	1614	149	1763	97	20	117
M4	N0	1011	93	1104	52	14	66
	N1	1527	89	1616	65	18	83
	N2	1748	126	1874	95	25	120
	N3	1422	134	1556	94	22	116
M5	N0	965	31	996	60	14	74
	N1	1222	61	1283	59	18	77
	N2	1516	91	1607	77	23	100
	N3	1901	111	2012	87	20	107

	SE	CD	SE	CD	SE	CD	SE	CD	SE	CD	SE	CD
Moisture regimes	49.50	146.50	4.10	12.00	—	—	—	—	—	—	—	—
N levels	44.30	131.00	3.60	10.70	45.30	134.10	3.55	10.26	1.25	3.62	3.98	11.48

was luxury consumption of K by the plants and every increment of added N increased the crop yield there was increase in the K uptake by the plant with increased rates of N application.

In Experiment I, the K uptake was higher in red soils as compared to balck soils and this was due to the fact that the total dry matter yield was higher in red soil. Consequent to the higher dry matter yield the total K uptake was higher in red soil eventhough the black soil was richer in its available K content as compared to red soil.

P. MUTHUVEL
K. K. KRISHNAMOORTHY

Department of Soil Science
and Agrl. Chemistry,
Tamil Nadu Agricultural University.
Coimbatore 641 003.

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