Effect of Potassium Fertiliser on Sodium, Magnesium, and Calcium in Plant Tissues

SOME interesting results have been obtained in rates of potash trials on a potassium-deficient area of Horotiu sandy loam at Rukuhia.

WITH increasing rates of potassium chloride, the potassium levels in the leaf tissues increased progressively as indicated in Table 1. The fertiliser was applied in the spring before planting.

TABLE 1—MEAN PER CENT OF POTASSIUM (K) IN THE DRY MATTER

Plant	Sampling date	Potassium chloride per acre 0	½ cwt	1 cwt	2 cwt	4 cwt
Cocksfoot ..	25/11/57	1.7	2.6	4.0	4.4	4.9
Ryegrass ..	26/11/57	1.3	1.8	2.5	3.8	4.3
	25/3/58	1.1	2.1	1.7	3.1	3.9
Paspalum ..	4/3/58	1.4	2.1	2.8	3.4	3.6
Potatoes ..	17/11/54	2.3	3.2	4.0	4.9	5.5
Cabbages ..	19/12/55	1.3	1.8	2.6	3.3	4.0
Sugar beet ..	10/12/56	1.8	2.6	3.9	4.4	5.9

Uptake increased rapidly up to 1 cwt of potassium chloride per acre, but the increase was much less at higher rates. These trends are quite normal and similar in the different plants.

Sodium, on the other hand, showed an extraordinary difference in behaviour according to the plant type (Table 2).

TABLE 2—MEAN PER CENT OF SODIUM (Na) IN THE DRY MATTER

Plant	Sampling date	Potassium chloride per acre 0	½ cwt	1 cwt	2 cwt	4 cwt
Cocksfoot ..	25/11/57	0.91	0.70	0.16	0.11	0.04
Ryegrass ..	26/11/57	0.65	0.51	0.43	0.18	0.11
	25/3/58	0.82	0.46	0.72	0.40	0.13
Paspalum ..	4/3/58	0.12	0.09	0.06	0.05	0.04
Potatoes ..	17/11/54	0.07	0.07	0.07	0.07	0.07
Cabbages ..	19/12/55	1.20	0.91	0.43	0.24	0.14
Sugar beet ..	10/12/56	1.80	1.62	1.35	1.51	1.05

In potatoes the sodium level remained low and constant throughout, though the plants in the plots without potash later developed severe potassium deficiency symptoms. Paspalum (*Paspalum dilatatum*) showed low levels throughout and only a very slight absolute decrease with increasing applications of potash. By contrast, the other two grasses, cocksfoot (*Dactylis glomerata*) and perennial ryegrass (*Lolium perenne*), and cabbage showed very large depressive effects of potassium chloride on the sodium levels in the leaf tissues. Sugar beet showed high sodium levels throughout, but some reduction with potash applications.

Magnesium levels were influenced in varying degrees (Table 3).

TABLE 3—MEAN PER CENT OF MAGNESIUM (Mg) IN THE DRY MATTER

Plant	Sampling date	Potassium chloride per acre 0	½ cwt	1 cwt	2 cwt	4 cwt
Cocksfoot ..	25/11/57	0.22	0.23	0.16	0.17	0.17
Ryegrass ..	26/11/57	0.30	0.19	0.21	0.14	0.15
	25/3/58	0.39	0.34	0.37	0.36	0.29
Paspalum ..	4/3/58	0.57	0.43	0.35	0.23	0.25
Potatoes ..	17/11/54	1.25	1.13	0.92	0.76	0.58
Cabbages ..	19/12/55	0.68	0.62	0.59	0.55	0.47
Sugar beet ..	10/12/56	1.16	1.13	0.96	1.05	0.83

In this experiment magnesium uptake in all plants was depressed, especially in potatoes, paspalum, and early summer growth of ryegrass, after potash applications in spring. The effect was relatively small in cocksfoot, cabbage, and sugar beet. It was negligible in subsequent autumn growth of ryegrass with applications of potassium chloride up to 2 cwt per acre. In pastures, clovers usually have a much higher magnesium content than associated grasses. Potash applications to deficient pastures may therefore result in little change in magnesium concentration in the herbage because of an increase in the percentage of clovers.

Calcium levels were depressed to a similar extent in five of the six plants (Table 4). The effect on cabbage was small.

TABLE 4—MEAN PER CENT OF CALCIUM (Ca) IN THE DRY MATTER

Plant	Sampling date	Potassium chloride per acre 0	½ cwt	1 cwt	2 cwt	4 cwt
Cocksfoot ..	25/11/57	0.52	0.49	0.34	0.35	0.33
Ryegrass ..	26/11/57	0.69	0.55	0.54	0.43	0.39
	25/3/58	0.82	0.81	0.85	0.78	0.67
Paspalum ..	4/3/58	0.89	0.85	0.67	0.64	0.58
Potatoes ..	17/11/54	2.16	2.02	1.81	1.58	1.35
Cabbages ..	19/12/55	3.95	3.79	3.44	3.51	3.35
Sugar beet ..	10/12/56	1.48	1.43	1.31	1.39	1.14

The trends of all these results have been confirmed from analytical data from other experiments on the same soil type. The evidence from other soil types, though less extensive, is consistent, and it appears that the differences in behaviour of different kinds of plants are due to inherent differences in their abilities to take up certain ions rather than to properties peculiar to a soil type.

Many workers have concluded that there is an approximate constancy in the sum of the potassium, sodium, magnesium, and calcium in plant tissues, because of inter-relationships of the kind illustrated in the above tables, but the magnitude of differences in behaviour of different plant groups has not always been realised.

Plants may be classified into two groups: (a) those which make up for any deficiency of potassium mainly by increased absorption of sodium; for example, brassicas and most grasses; (b) those which take up increased amounts of magnesium and calcium but make little or no use of sodium; for example, potatoes and *Paspalum dilatatum*. Plants in group (a) utilise magnesium and calcium as well as sodium, but usually to a less extent than plants in group (b).

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