Depletion and Accumulation of TRACE ELEMENTS *In Irrigated Soils*

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TABLE 1. DEPLETION OR ACCUMULATION OF ZINC, COPPER, MOLYBDENUM, AND BORON FROM SOILS IN LYSIMETER TANKS

Element	Added in water	Removed in crops	Removed in drainage	Depletion (d) or accumulation (a)
	Pounds per acre			
Zinc	0.30	4.4	0.05	4.15 (d)
Copper	0.40	0.93	0.02	0.55 (d)
Molybdenum	0.33	0.085	0.05	0.24 (a)
Boron	9.54	2.8	1.25	5.49 (a)

TABLE 2. PERCENTAGES OF ACCUMULATION OR DEPLETION IN SOIL OF ZINC, COPPER, MOLYBDENUM, BORON, PHOSPHORUS, AND POTASSIUM

Element	Total pounds/acre foot	Depletion (d) or accumulation (a) pounds/acre	Change in 5 years %	Change per year* %
Zinc	380	4.15 (d)	1.1	0.22 (d)
Copper	70	0.55 (d)	0.78	0.16 (d)
Molybdenum	7	0.24 (a)	3.4	0.68 (a)
Boron	400	5.5 (a)	1.4	0.28 (a)
Phosphorus	4,000†	380 (d)	9.5	1.90 (d)
Potassium	80,000†	3,840 (d)	4.8	0.96 (d)

* Assuming all the depletion or accumulation was from or in an acre foot of soil.

† Assuming 0.1% P and 2% K in the soil.

THIS REPORT presents data showing depletion of zinc and copper and accumulation of molybdenum and boron in four soils during a five-year (1958 to 1963) lysimeter experiment at Riverside. For each element the net change in the soil was calculated as the amount added in the irrigation water minus the amount removed in crops and leachate (drainage water). The lysimeter tanks, which were 4 ft in diameter and 6 ft deep were filled with soil during the winter of 1957–58. Six tanks were used for each soil to provide three treatments, including ammonium sulfate, calcium nitrate, and aqua ammonia as nitrogen sources, and two replications. Phosphorus as dicalcium phosphate was added to all tanks.

The winter crop was Swiss chard and the summer crop was sweet corn, harvested when the ears were sufficiently mature for marketing. All plant materials were removed from the soil and a sample was taken for moisture determination and chemical analysis. All samples of plant materials were washed to remove surface contamination prior to drying and grinding.

The soils used were: Moreno sandy loam from the South Coast Field Station, Vista silt loam from the Citrus Research Center and Agricultural Experiment Station at Riverside, Altamont clay loam from the Boy's Republic near Chino, and Holtville clay loam from near Holtville in Imperial County. Drainage or leachate was collected every year before the planting of corn in May. Leaching averaged 7.3% of the irrigation water with a range of from 6.6 to 8.0%.

The average annual dry weight yield of Swiss chard was 0.68 kilogram per tank or 2.6 tons per acre. The average annual dry weight of corn (stover plus ears) was 2.46 kilograms per tank or 9.4 tons per acre. The per-acre yields were high because high rates of fertilizers were used, and because each tank had a large border effect.

Data for zinc, copper, molybdenum, and boron added in the irrigation water, removed by crops and leaching and the accumulation or depletion in or from the soil, are presented in table 1. The removal of zinc, copper, molybdenum, and boron was 99, 98, 63, and 69%, respectively, of the total removal in crops plus drainage water.

The soil was depleted of zinc and copper, whereas molybdenum and boron were accumulated. The molybdenum accumulation was about three-fourths of the amount added in the irrigation water. If the molybdenum content of the irrigation water used in this experiment was typical of waters in California, there should be no deficiencies of this element in irrigated districts.

Data showing the accumulation or depletion of the trace elements, phosphorus, and potassium, expressed as a percentage of the total amounts in an acre-foot of soil are presented in table 2. The data for phosphorus and potassium were included as a basis for comparison with macro-elements. The depletion rates for zinc and copper were slow in comparison to phosphorus and potassium. Since the rates of depletion, in proportion to the totals in the soil, were higher for phosphorus and potassium than for zinc and copper, deficiencies of phosphorus and potassium might be expected to develop faster, assuming the ratios of available-to-total amounts are the same for all elements and no fertilizers are used.

Because yields were higher and all crop materials were removed, the depletion by cropping in this experiment was perhaps 50 to 100% higher than would be found in field operations. Thus, the rates of depletion of zinc and copper in field operations are probably about half the values found in this study, and the accumulation of molybdenum and boron would be higher.

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