

Kearney (*U.S. Dept. Agric. Farm. Bull.*, 496) states that if 0.5 per cent. soluble salts are found only decidedly resistant plants can be grown. In a classification he records the degree of "alkalinity" as follows:—

Medium	..	..	..	..	..	0.4-0.6 per cent.
Weak	..	..	..	..	..	0.1-0.4 per cent.
Negligible	..	..	..	..	..	0.1 per cent.

The Central Otago soils under review would thus come into the weak alkali class.

Hilgard (*Univ. of Cal. Bull.*, 128) records that apple-trees have done well on 0.25 per cent. total salts.

Tinsley (*New Mex. Bull.*, 42) gives 0.4-0.5 per cent. total salts as the maximum limit for growth, while 0.25 per cent. damages crop-growth to a great extent. Young apple-trees showed distress with a little over 0.30 per cent. total salts on 3 ft. to 5 ft. soil.

In Australia work has also been done on soluble salt effects.

Taylor, Penman, Marshall, and Leeper (*C.S.I.R. Bull.*, 73) imply that a detrimental effect from sulphate is to be expected when the concentration of the sulphate ion reaches 0.08 per cent.

Read (*Jour. Agric. Vic.*, 29, 1931, 551) presents the following table:—

TABLE III.

Depth.	Total Salts.	Cl'.	SO ₄ ".	CO ₃ ".	HCO ₃ ".
In.	<i>Type I: Good Growth of Trees.</i>				
0-6	.. 0.13	0.004	0.012	..	0.049
6-12	.. 0.124	0.012	0.024	..	0.055
12-24	.. 0.092	0.014	0.017	..	0.067
24-36	.. 0.100	0.008	0.016	0.006	0.061
	<i>Type II: Growth affected.</i>				
0-6	.. 0.306	0.087	0.032	..	0.072
6-12	.. 0.260	0.070	0.028	..	0.072
12-24	.. 0.190	0.038	0.018	..	0.08
24-36	.. 0.180	0.024	0.018	..	0.106

Marshall and Hooper (*C.S.I.R. Bull.*, 56) state that it is only above 0.1 per cent. total salts that soluble salts become of any concern. They give a number of figures dealing with salt injury to crop-growth, but the pH values are much higher than found in Central Otago, and it is therefore difficult to use their data. This point should also be mentioned in connection with the earlier data on salt injury. Many of the apparent anomalies would probably disappear if the workers had been able to record pH values as well as soluble salts on their soils toxic to growth.

To sum up, it is evident that no precise limit can be given beyond which certain crops do not make optimum growth. It is obvious that the limits will vary not only for different plants, but will depend also on the nature of the salts present and especially upon the water content of the soils at different times. The recorded figure for a soil gives only an indication of the effect likely to be produced in the field. A certain salt concentration may be harmless if the soil is kept sufficiently moist, but may be toxic if the soil dried out. There are indications that some orchards are always short of water in the summer, and this must intensify the problem.

Taking 0.15 per cent. total salts as an estimation of the limit for favourable growth, the suggestion must be made that a soil such as 1602 is definitely in the danger zone, and it appears probable that a thorough investigation of the use of irrigation water is necessary. A comparison with samples 1605-1606A-D suggests that soluble salts can be reduced to less dangerous limits under ordinary orchard conditions. It is not desired to overemphasize the problem, as the type concerned, that of deep fine sandy silt, is not the best represented in the district. More common types are shallow soils on sloping foothills or alluvial soils mixed with gravel; in these cases drainage may be sufficient to carry salts away permanently from the zone of root-penetration. Nevertheless, the deep sandy silt would be regarded as the most suitable for development purposes, since it is a deep soil and easily workable, and because of this and Mr. Lloyd Williams's report the possible interference by soluble salts assumes a greater significance.

SUMMARY.

- (1) A preliminary report has been presented on certain Central Otago orchard soils.
- (2) Analyses show that high pH values and soluble-salt contents are probably a detrimental factor in the growth of apple-trees in certain orchards.
- (3) Investigations are needed not only to show how to reduce the existing salt content by the suitable use of irrigation water, but also to demonstrate in what way water is best used in irrigation schemes to prevent soluble salts from becoming an injurious factor in tree-growth.

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