11. Boron

Boron is an essential nutrient for plants but not animals.

Boron deficiency in plants has been found occasionally in Victoria (North-Coombes 1982). Minimum boron requirements for plants cover a wide range. For example, these requirements are in the order of 5 ppm for maize and wheat and 40 ppm for sunflower. Vegetative growth, flowering and seed production may be reduced with boron deficiency.

11.1 Occurrence of boron deficiency in Victoria

Lucerne is the main crop in which boron deficiency has been identified in North East Victoria and East Gippsland. Fodder crops of turnips and horticultural crops have occasionally shown signs of boron deficiency or responses to boron application, but boron deficiency is rare in pastures. The earliest recorded occurrence of a pasture response to boron was in 1950. Only 10 pasture sites have shown positive responses to boron application (figure 11.1). Decreased growth due to boron application was reported at three sites (North-Coombes 1982).

Boron deficiency can occur in both acid and alkaline soils. A deficiency can be made worse by excessive liming. Leached sandy soils and soils devoid of organic matter can be deficient in boron.

Boron deficiency is seasonal, appearing in some years but not in others. In lucerne, deficiency occurs mainly during dry summers. Boron deficiency in pine trees was particularly prevalent in Victoria in the 1982 drought (D. Flinn, pers. comm.).

11.2 Signs of boron deficiency

In lucerne the signs of boron deficiency are yellow or purplish-red terminal leaves. The red coloration follows the yellowing, first developing on the back of the leaves, and being somewhat interveinal (Millikan 1958). There may also be a shortening of the terminal internodes resulting in a bunched appearance, and reduced seed production (Follett *et al*. 1981). In turnips and similar root crops, crown rots occur and a "brown heart" develops in the centre of the root. The leaves may be rough, curled and purplish-yellow (Sauchelli 1969, Stiles 1961).

In sub clover the oldest leaves develop a characteristic bright-reddish coloration along the outer margins. The color usually appears simultaneously on both sides of the leaf but may occur first on the back. The reddening first extends into the centre of the leaf along interveinal tissue. Later, light brown dead patches occur on the previously red margins on both sides of the midrib. The leaf dies after necrosis of the leaf edges. Young leaves have shortened petioles, are small and remain partly folded (Millikan 1953).

11.3 Diagnosis of boron deficiency

Critical concentrations of boron in pasture species have not been well-defined.

The boron concentration in clover in Victoria normally ranges from 20-40 mg/kg DM (Brown 1982). Analysis of 115 samples of whole tops of lucerne from across Victoria showed a range of 5-114 mg B/kg with 9% being 10 mg B/kg or less (Brown 1982).

In New Zealand, critical boron concentration ranges of 13-16, 15-18 and 17-18 mg/kg have been established for white clover, red clover and lucerne respectively. (Sherrell, 1983a). In perennial ryegrass, timothy and cocksfoot no yield responses or deficiency symptoms appeared at boron concentrations as low as 6-12 mg/kg (Sherrell, 1983b).

Deficiency signs in lucerne have been observed where whole tops had concentrations of less than 12 mg B/kg (Fleming 1965, Gupta 1972) and leaves at full bloom had less than 25 mg B/kg (10). A recent study of the boron status of lucerne in Victoria found that boron deficiency signs were evident where concentrations in apical leaves were less than 16 mg/kg U.A. Johnston, pers. comm.).

Soil analysis for hot water-soluble boron has recently shown a promising correlation with the boron concentration in lucerne leaves in a pot trial in New South Wales (Haddad and Kaldor 1981). However, under field conditions in Victoria this test was poorly correlated with plant concentrations of boron. It is suspected that soil moisture condition has a major effect on boron availability.

Analyses available

Plant analyses are carried out by the State Chemistry Laboratory but soil analysis for boron is not available.

11.4 Treatment

Fertiliser mixtures containing boron are sold in Victoria. They are used for horticultural purposes rather than on pastures or broadacre crops. Mixtures have been designed to apply borax at 10-20 kg/ha (borax is sodium tetraborate, 11% boron). Boron fertiliser mixtures should not be sown with seed as they are likely to damage or even kill developing seedlings.

Foliar sprays containing boron are sold in Victoria, but there is no Victorian efficacy data concerning their use.

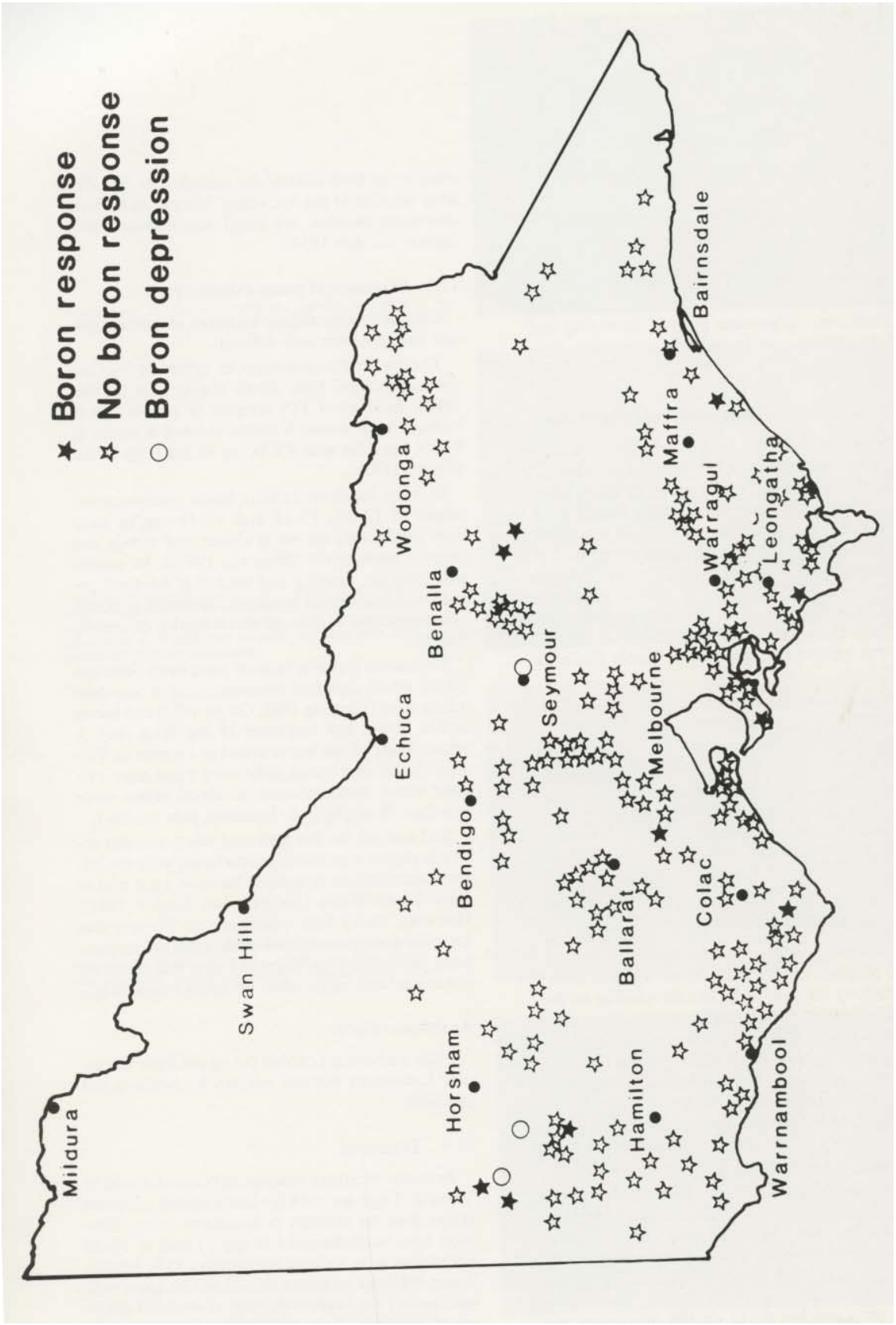

Figure 11.1: Location of pasture experiments with boron in Victoria indicating positive responses (★), depressions (o) or no response (☆) (North-Coombes 1982).

11.5 Toxicity

Excessive application of boron is toxic to plants and for this reason various borates are used as herbicides.

Signs of toxicity in lucerne have been observed, as "burned" margins of older leaves, with boron concentrations in whole tops greater than 99 mg/kg (Gupta 1972).

Sherrell (1983b) found ryegrass and timothy plants showed symptoms of toxicity with concentrations more than 39-42 and 47 mgB/kg respectively, while cocksfoot had no precise threshold but toxicity occurred between 34 and 63 mgB/kg.

References

Brown, A.J. (1982) Total boron in herbage from pasture and field crops, 1982-83. In "Trace Element Review papers, 1982". Agricultural Services Library, Department of Agriculture, Victoria.

Fleming, G.A. (1965) Trace elements in plants with particular reference to pasture species. In "Outlook on Agriculture", vol. IV, No. 6, pp 270-85.

Follett, R.H., Murphy, K.S. and Donahue, R.L. (1981) "Fertilisers and Soil Amendments". Prentice-Hall, New Jersey.

Gupta, U.C. (1972) Effects of boron and lime on boron concentration and growth of forage legumes under greenhouse conditions. Communications in Soil Science and Plant Analysis, 3(5):355-65.

Haddad, K.S. and Kaldor, C.J. (1981) Effect of parent material, natural available soil boron, and applied boron and lime on the growth and chemical composition of lucerne on some acidic soils of the Central Tablelands of New South Wales. Australian Journal of Experimental Agriculture and Animal Husbandry, 22:317-323.

North-Coombes, P. (1982) Review of pasture responses to boron in Victoria. In "Trace Element Review papers, 1982". Agricultural Services Library, Department of Agriculture, Victoria.

Millikan, C.R. (1953) Subterranean clover: symptoms of nutritional disorders. Journal of the Department of Agriculture, Victoria, 51:215-225.

Millikan, C.R. (1958) Nutrient deficiency symptoms in lucerne and some pasture legumes. Journal of the Department of Agriculture, Victoria, 56(8):511-531.

Sauchelli, V. (1969) "Trace Elements in Agriculture". Van Nostrand, New York.

Sherrell C.G. (1983a) Boron deficiency and response in white and red clovers and lucerne. New Zealand Journal of Agricultural Research 26:197-203.

Sherrell C.G. (1983b) Boron nutrition of perennial ryegrass cocksfoot and timothy. New Zealand Journal of Agricultural Research 26:205-208.

Stiles, W. (1961) "Trace Elements in Plants". Cambridge University Press.