SHORT COMMUNICATIONS

NITRATE ACCUMULATION IN RELATION TO MOLYBDENUM DEFICIENCY LEAF SCORCH SYMPTOMS*

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The accumulation of nitrate in the leaf tissue of nitrate-supplied, molybdenum-deficient plants has been suspected as a cause of the scorching symptoms which frequently develop (e.g. Agarwala 1952; Agarwala and Hewitt 1952; Hewitt and McCready 1953). Quantitative studies of the relationship between nitrate content and the symptoms have, however, been inconclusive. The literature suggests (cf. Wilson and Waring 1948; Johnson, Pearson, and Stout 1952) that this may follow from the estimation of nitrate in whole leaf tissue rather than in damaged portions.

Molybdenum-deficient lettuce and tomatoes were available from other work (Wilson and Notley 1959) and some observations were made on nitrate contents and distribution in the leaf in relation to the scorch symptoms.

Methods and Results

Two series of determinations were made on lettuce and one on tomatoes, as scorch symptoms were available from plants of varying ages. Damaged tissue was removed as soon as the water-soaked appearance (which precedes the rapid drying out to give the papery scorch symptoms) was observed, and nitrate determined by a modified form of Horne and Denmead's (1955) brucine test. Content is expressed on a fresh weight basis and Table 1 shows the ranges of values obtained in these three series.

An experiment was designed to compare the nitrate contents in (1) injured interveinal areas; (2) uninjured interveinal areas; and (3) uninjured areas containing portion of a large vein. These last two classes of material were also taken from molybdenum-supplied control plants. Six replicates of material, on each of two occasions, were taken from each species. Mean nitrate contents are shown in Table 2, while the range of individual observations in the case of injured and uninjured interveinal areas from molybdenum-deficient plants is shown in Table 1 as series 4.

Discussion

The minimal nitrate contents in damaged tissue are close within each species: 2·2–2·9 per cent. in lettuce and 2·8–3·9 per cent. in tomatoes. Maxima in undamaged tissue are in close agreement with these minima for both species. Minima in undamaged tissue are of no significance here, merely representing earlier stages of accumulation. The high maxima in damaged tissue can be attributed to delay in taking samples from tissue which is rapidly drying out.

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TABLE 1

RANGE OF NITRATE CONTENT IN INJURED (SCORCHED) AND UNINJURED PORTIONS OF LAMINA FROM MOLYBDENUM-DEFICIENT LETTUCE AND TOMATO PLANTS

Plant	Series	No. of Observations	Nitrate Content (per cent. fresh wt.)	
			Uninjured	Injured
Lettuce	1	40		2·5 – 5·0
	2	44		2·2 – 6·2
	4 (1st date)	6	1·1 – 2·6	2·9 – 3·8
	4 (2nd date)	6	1·5 – 2·3	2·2 – 3·5
Tomato	3	50		2·8 – 5·5
	4 (1st date)	6	1·5 – 2·8	3·9 – 5·4
	4 (2nd date)	6	1·6 – 3·0	3·0 – 4·2

TABLE 2

COMPARISON OF MEAN NITRATE CONTENTS (PER CENT. FRESH WEIGHT) IN VARIOUS PORTIONS OF LEAVES FROM MOLYBDENUM-DEFICIENT AND CONTROL LETTUCE AND TOMATO PLANTS

Plant	Sampling Date	Molybdenum-deficient Plants			Least Significant Difference ($P = 0·05$)	Control Plants*	
		Injured Lamina	Uninjured Lamina	Uninjured Lamina with Large Vein		Lamina Only	Lamina with Large Vein
Lettuce	6.viii.56	3·26	1·92	1·06	0·51	0·0	0·5
	13.viii.56	3·19	1·55	1·15		0·0	0·5
Tomato	7.iii.56	4·61	2·26	1·20	0·70	0·0	0·6
	18.iv.56	3·72	2·48	1·02		0·0	0·6

* Not included in analyses.

The regular association between symptom appearance and nitrate level suggests, but does not prove, a cause and effect relationship. Scorch symptoms characterize a number of mineral deficiencies but some 3 per cent. nitrate on a fresh weight basis might well be toxic. The actual distribution of this ion may represent much higher concentrations again at certain sites.

The pattern of nitrate distribution in the leaves of molybdenum-supplied and molybdenum-deficient plants clearly indicates the inadequacy of whole leaf determinations in seeking relationships between nitrate contents and the appearance of symptoms in localized parts of leaves.

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