SOILLESS GROWING MEDIA AND MICRONUTRIENT NUTRITION[1]

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The omission of soil from growing media has reduced many management problems and improved plant growth but it has introduced some problems that require further investigation.

When evaluating factors that affect the propagation and growth of plants in soilless growing media, the physical characteristics of the medium are well known (4). However, the chemical activity of the medium is often overlooked or underestimated.

This situation has arisen partly because of the early work with container growing media in California where it was suggested that soilless media components should be of low fertility and not release or fix any plant nutrients (1). Where the growing medium is inert and of nil fertility it should be relatively easy to provide the required level of plant nutrition. If, however, the media components were supplying or withholding some nutrients then it would be difficult to maintain a particular nutritional status, unless the media components were characterised chemically.

It is well known that peats commonly have a strong acid reaction which may be reduced by the use of lime. Peats are also known to bind strongly copper, zinc, iron and manganese in a fairly irreversible manner (7).

Up until recently, perlite and pumice have been taken to be relatively inert, but user experience with these materials has shown that some plants growing in similarly fertilized soilless growing media can show marked differences in the quality of the saleable plant. The foliar symptoms observed often appear like a micronutrient deficiency.

This paper is concerned with the results of two experiments that show micronutrient nutrition of chrysanthemum plants can be influenced by soilless growing media components.

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Experiment I.

METHODS

Rooted cuttings of *Chrysanthemum* 'Nob Hill' were grown for 10 weeks in four different media made from equal parts of either New Zealand peat or Irish peat and either pumice or perlite. The nutrients added to each 10 litres of growing medium are shown in the following table.

Table 1. Standard nutrient supplement per 10 litres of medium

Nutrient				Weight (g)
	N	P	K	
Osmocote	18	2.6	10	25
Osmocote	14	6	11.6	10
superphosphate				15
dolomite lime				15
agricultural lime				15

At the end of the growing period plant growth was assessed and fully expanded upper leaves were removed for micronutrient analysis by atomic absorption spectroscopy.

RESULTS AND DISCUSSION

After the seventh week of growth, differences in foliar pigmentation were visible. These differences become progressively more obvious by the tenth week.

All plants grown in the perlite-based media, irrespective of the type of peat, showed pronounced interveinal chlorosis in the upper leaves. In contrast, plants grown in the pumice-based medium appeared to be a much healthier green colouration, but a mild interveinal chlorosis was visible in plants grown in the Irish peat-pumice mixture.

It was originally considered that reduced copper availability may be inducing the iron chlorosis symptoms observed in the chrysanthemum leaves (2). Copper deficiency in chrysanthemum is characterised by increased internode length, decreased axillary bud development and chlorosis of the middle leaves. However no differences in internode length, axillary bud development or dry matter production were observed in plants grown in the four media.

The acidity of each medium was determined to ensure micronutrient availability was not being limited by the pH value.

As the optimal pH for organic soil and peats is in the pH range 5.0 to 5.5 (5) it was concluded that pH was not limiting micronutrient availability.

If the media components were unreactive then, given that all other factors were the same, equal nutrient concentrations

Table 2. The initial pH of the growing medium.

Medium	*pH*
N.Z. Peat-Perlite	4.8
N.Z. Peat-Pumice	5.2
I.Peat-Perlite	5.0
I.Peat-Pumice	5.4

could be expected in the leaves of plants grown in the different media.

The levels of iron, manganese, zine and copper are shown in Figure 1.

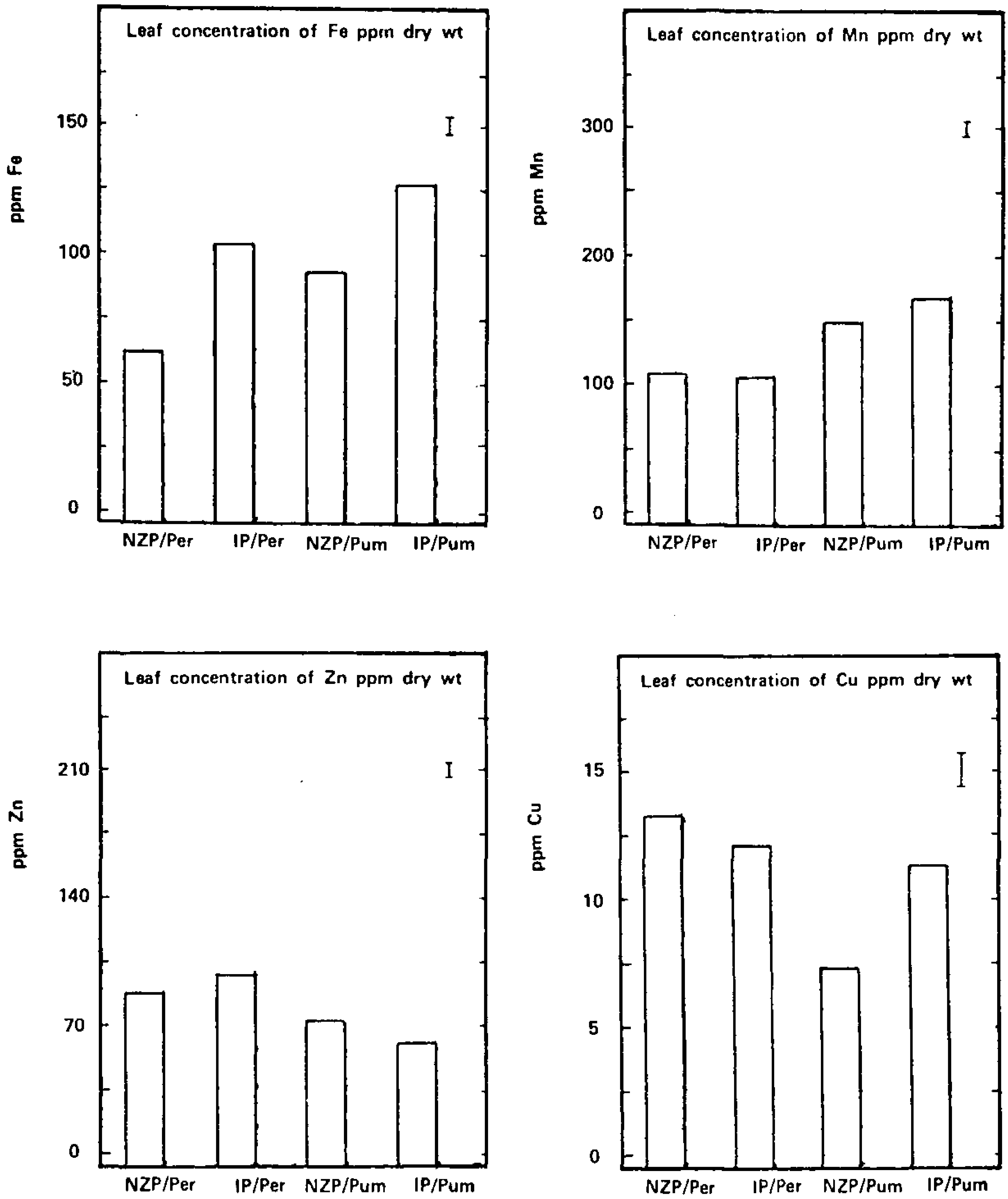

Figure 1. The influence of the growing medium on the foliar micronutrient levels in *Chrysanthemum* 'Nob Hill'. NZP = New Zeland Peat; Per = Perlite; IP = Irish Peat; Pum = Pumice; I = LSD(0.05)

Foliar levels of iron are higher in the pumice based medium compared with perlite, and are higher when Irish peat is used rather than New Zealand peat.

With foliar manganese little difference was detected between the two peats, but manganese levels are higher in leaves from pumice based media compared with perlite.

In contrast, foliar zinc levels were higher in plants grown in perlite compared with pumice. Again only small difference between the two peats were observed.

Foliar copper levels from all treatments were similar, except for foliage from the New Zealand peat-pumice mixture which contained significantly less copper. As the lowest copper level is not associated with the iron chlorosis symptoms, the validity of the original hypothesis is questioned.

However, it is clear that the media components used here show a chemical reactivity that can alter the levels of at least four elements in chrysanthemum leaves. The statistical analysis of the leaf analysis data suggested the two peats had less effect on the foliar micronutrient levels than the perlite and pumice components in the growing medium.

Experiment II.

METHODS

Rooted *Chrysanthemum* 'Nob Hill' cuttings were grown for 10 weeks in perlite or pumice with the same nutrient supply as in experiment I, except the lime rates were halved. Two fritted trace elements, FTE 503 and FTE 36, were applied at the rate of $100 g/m^3$ of medium and compared with a nil FTE control treatment for iron chlorosis control.

RESULTS AND DISCUSSION

After one month the plants grown in the pumice medium were dark green and apparently healthy. In contrast, the new growth of plants in the perlite medium showed vivid interveinal chlorosis whilst the oldest leaves remained a healthy green.

When sampled after 10 weeks the leaves from all pumice media were non-chlorotic irrespective of the FTE source. The upper leaves from all perlite treatments were highly chlorotic. The most severely affected plants were those grown in the FTE 503 treatment.

Chlorotic expanding leaves greened-up in response to foliar application of 1% w/v Fe EDTA. This indicates an iron deficiency was observed.

The pH of each medium was determined, perlite (6.2) and pumice (6.7). These values are higher than the pH values measured in the peat based mixtures, but are not considered to be limiting micronutrient availability (5). Plants grown in pumice with the higher medium pH did not show any micronutrient deficiencies.

In Figure 2 large differences in foliar nutrient levels have been detected between plants grown in perlite and pumice. These differences were enhanced by the use of fritted trace elements.

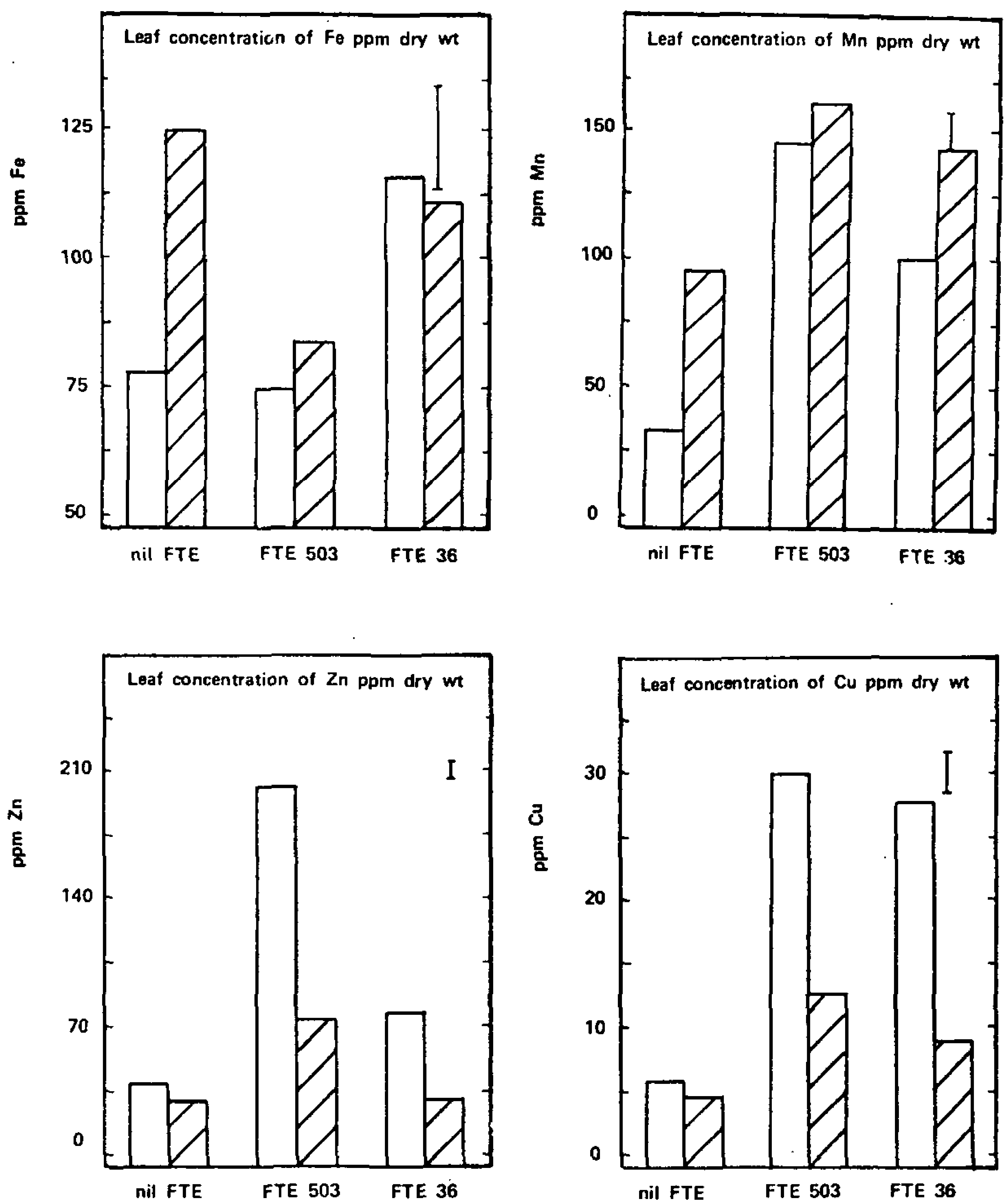

Figure 2. The influence of the growing medium and frit type on the foliar micronutrient levels in *Chrysanthemum* 'Nob Hill'. □ = Perlite; ▨ = Pumice; I = LSD(0.05).

The foliar iron levels in plants grown in pumice tended to be higher than if grown in perlite. Similarly foliar manganese levels were higher in plants grown in pumice rather than perlite. Foliar levels of copper and zinc were higher in plants grown in perlite rather than pumice, particularly where fritted trace elements were added.

Both frits increased the foliar levels of copper, zinc and manganese. Each frit differed in its effect on foliar iron, FTE 36 increased iron levels in perlite-grown plants and FTE 503 decreased iron levels in both perlite and pumice media.

Neither frit prevented or reduced iron chlorosis symptoms in the perlite based medium.

GENERAL DISCUSSION AND CONCLUSION

When the foliar analysis data collected in the experiments are compared with standard critical and optimal nutrient levels (3,6), it is apparent that the micronutrient levels present in these plants should have been high enough to prevent deficiency symptom expression, even without the use of fritted trace elements.

Table 3 Standard values for micronutrient content of chrysanthemum leaves (ppm dry weight)

Level	Copper	Zinc	Manganese	Iron
Optimal	10-50	7.26	195-375	100+
Critical	5	7	25	50-100

source (3, 6)

As the expanding chlorotic leaves responded to iron chelate application, this indicates there is insufficient physiologically active iron present in spite of adequate total iron levels. Either the perlite alone or its combination with the fertilizers has altered the availability of the iron within the chrysanthemum plant.

In summary, it is clear that the components of the growing medium can have an important effect on the nutrition of some plants. The foliar micronutrient levels appear adequate to prevent deficiency symptom expression in both perlite and pumice amended growing media.

Fritted trace elements have not prevented the expression of foliar chlorosis where perlite was used in the growing medium.

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NEW TECHNIQUES FOR PEACH TREE PROPAGATION IN AUSTRALIA

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With the trend towards higher density planting of peach trees, low cost methods of rapidly producing large numbers of trees are desirable. Earlier this year I visited the Irrigation Research Institute, Tatura, Victoria, Australia, where they have developed two techniques for commercial production of saleable trees from cuttings in one season. Both techniques are simple; however there are several critical requirements which must be fulfilled if they are to be used with success.

Hardwood Cuttings. Pencil thick basal cuttings 25 to 30 cms long are taken from one-year-old laterals borne on branches that carried fruit the previous summer. The cuttings are typified by short internodes and are only harvested from healthy, vigorous trees less than six years old. Care in selection of cutting material is important to ensure a good strike and rapid growth in the nursery. Cuttings are taken from late June to mid-July (mid-winter).

The cuttings are then treated with the rooting hormone, indolebutyric acid (1000 ppm in 50% alcohol), the base of the cuttings being dipped for 10 seconds then air dried. Treatment must be done within 10 hours of harvesting the cuttings.