MICRONUTRIENT SOURCES FOR GREENHOUSE CROPS

Paul V. Nelson

Products and Methods of Application

Cultural procedures for greenhouse crops have been refined to the point where the probability of micronutrient deficiency is great if these are not periodically applied. Micronutrients may be applied in three general manners.

Products such as FTE (Fritted Trace Elements) and Esmigran® may be incorporated into the root medium while it is being formulated. These products will release micronutrients over a considerable period of time, as long as 10 months in the former product. FTE 503 PS has been the standard product used in greenhouse and nursery media but is now being replaced by FTE 555 for this use. These products are used at the rate of 2 oz. per cu. yd. of root medium. Micronutrients in FTE are actually contained in finely ground soft glass. As the glass dissolves in the root medium over time these micronutrients are released.

Esmigran® is a product in which clay granules are impregnated with inorganic micronutrient salts. The granules are suffieciently large (16-30 US standard sieve mesh) to permit rapid and stable blending with root media components. The clay granule retards release of the micronutrients into the soil solution. Esmigran is a relatively new product and a suggested rate at this time would be 5 lbs. per cu. yd. of root medium.

A second method for applying micronutrients is that of a single, relatively concentrated liquid application immediately following or shortly after planting. Peters® product, STEM (Soluble Trace Element Mix), serves this prupose well. It consists of a mixture of inorganic micronutrient salts plus chelating agent and dye. STEM is readily soluble and is applied once at the rate of 8 oz. per 100 gal. of water. A single application should have a residual effect of 3 to 4 months.

The third method of application is that of metering a low concentration of micronutrients into the nutrient solution each time fertilizer is applied to a crop. There are several sources of micronutrients for this purpose. The Peters® complete fertilizers contain micronutrients. Representing most of that line of fertilizers is the micronutrient formulation listed in Table 1 for Peters® 20-20-20 General Purpose fertilizer. Peters® Peat-Lite Special complete fertilizer formulations also contain a complete compliment of micronutrients but at much higher levels due to the extensive tie-up of most micronutrients in peat moss and bark root media. Growers who formulate their own fertilizer often use either STEM or Peters® Compound 111 as a micronutrient source for constant fertilizer injection. For use with each fertilizer application STEM is incorporated at the rate of 1 lb. per 100 lbs. of complete fertilizer (N-P-K) while Compound 111 is used at the rate of 1 lb. per 40 lbs. of complete fertilizer.

Quantities of Micronutrients Applied

The micronutrient content of all products discussed in this paper are tabulated in Table 1. For those products applied as a liquid, the micronutrient concentrations occurring in the solution applied to the root medium are listed in Table 2.

Table 1. The micronutrient content (%) of various micronutrient products

	STEM[a]	Compound 111[a]	20-20-20[a]	15-16-17 Peat-Lite Special	FTE503PS[b]	FTE555[b]	Esmigran[c]
Iron Fe	7.50	1.50	0.05	0.10	14.0	18.0	2.00
Manganese Mn	8.15	0.12	0.003046	0.056	5.0	7.5	0.50
Zinc Zn	4.50	0.07540	0.002468	0.0162	5.0	7.0	1.00
Copper Cu	3.20	0.11362	0.003587	0.0100	1.5	3.0	0.30
Boron B	1.45	0.23242	0.006711	0.0560	0.8	1.5	0.02
Molybdenum Mo	0.046	0.10757	0.004023	0.0100	0.07	0.2	0.0006

[a]Product of Robert Peters Co., Inc., 2833 Pennsylvania St., Allentown, PA. 18104

[b]Product of Frit Industries, Inc., P. O. Box 1324, Ozark, AL. 36360

[c]Product of Mallinckrodt, Inc., St. Louis, MO. 63147

Table 2. Concentration (ppm) of micronutrients obtained after dissolving various Peters® micronutrient products at recommended rates for greenhouse crops

	STEM[a]		Compound 111[b]	20-20-20[c]	15-16-17 Peat-Lite Special[d]
	single application	with weekly fertilizer			
Fe	45.0	1.13	1.125	1.500	4.00
Mn	48.9	1.22	0.090	0.091	2.24
Zn	27.0	0.68	0.057	0.074	0.65
Cu	19.2	0.48	0.085	0.108	0.40
B	8.7	0.22	0.174	0.201	2.24
Mo	0.28	0.0069	0.081	0.121	0.40

[a]STEM is applied at the rate of 8 oz. per 100 gal. water for a single application designed to last 3 to 4 months. When applied with every fertilization, STEM is used at the rate of 8 oz. per 100 lbs. of fertilizer. For the purposes of this table a weekly program of 2.5 lbs of a fertilizer containing 20% N per 100 gal. was assumed.

[b]Compound 111 is used at the rate of 1 lb. per 40 lbs. of fertilizer. For these calculations it was applied weekly with 2.5 lbs. of a 20% N fertilizer per 100 gal.

[c]Based on a weekly application rate of 2.5 lbs. per 100 gal.

[d]Based on a weekly application rate of 3.33 lbs. per 100 gal. This has the equivalent N that would be supplied by 2.5 lbs. of 20-20-20 in 100 gal.

In order to compare products, a typical situation for pot mum culture was assumed. The crop was fertilized weekly with the equivalent of 2.5 lbs. of a complete fertilizer containing 20% N per 100 gal. Ten fluid ounces of nutrient solution was applied to each 6.5 inch azalea pot each time. Since 12 applications were made and 15 of these pots constitute a cubic foot of volume a total of 1,800 fluid ounces of nutrient solution was applied to each cubic foot of root medium over the whole crop. The total amounts of micronutrients applied per cubic foot of root medium over the whole crop for each product source are listed in Table 3.

Interpretation

The ratio of micronutrients within a product differs from one product to another. This could be a factor in selecting one product over another for a specific root medium or crop. Poinsettia, for instance, is prone to Mo deficiency. Since the Mo content in Compound 111, 20-20-20 General Purpose fertilizer and especially 15-16-17 Peat-Lite Special is comparatively high these sources might be preferred over the others. Copper deficiency is becoming more prevalent in rose crops and is particularly difficult to correct. STEM in this respect would appear to be a better source of Cu for application after the crop is planted and Esmigran® prior to planting. Root media containing soil with moderate to high levels of Mn will tend toward undesirably high levels of available Mn after steam or chemical pasteurization. For these media Compound 111, with a relatively low level of Mn would be desirable.

Table 3. The total quantity (mg) of each micronutrient applied to a cubic foot of root medium during a 12 week pot mum crop when commercial recommendations are followed for each of 7 micronutrient sources

	STEM[a]		Compound 111[a]	20-20-20[a]	15-16-17 Peat-Lite Special[a]	FTE503PS[b]	FTE555[b]	Esmigran[c]
	single application	with weekly fertilizer						
Fe	202.5	60.8	60.80	81.00	216.0	378	294	1682.0
Mn	220.0	66.0	4.86	4.91	121.0	158	105	420.5
Zn	121.5	36.5	3.08	4.00	35.0	147	105	841.0
Cu	86.4	25.9	4.59	5.84	21.6	63	31.5	252.3
B	39.1	11.8	9.40	10.85	121.0	31.5	16.8	16.8
Mo	1.25	0.38	4.38	6.54	21.6	4.2	1.5	0.5

[a]See Table 2 for rate of application.

[b]Incorporated into the root medium during formulation at the rate of 2 oz. per cubic yard of medium.

[c]Incorporated into the root medium during formulation at the rate of 5 lbs. per cubic yard of medium.

The overall amounts of micronutrients provided over a crop by each product also vary considerably. Peat-Lite Special provides a high dose of micronutrients compared to the other continuously applied products. This is necessary for peat moss and pinebark base media since these tie-up inordinate quantities of Fe, Mn, Zn, Cu, and B. (Fe, Cu, and B in particular).

Upon decomposition, organic matter yields smaller substances with a high density of negative electrical charges for bonding to Fe++, Mn++, Zn++ and Cu++. These substances also bond readily to B (Bo_3-3). When the decomposition substances are soluble in the soil solution these micronutrients remain for the most part available to plants. When they are not soluble, micronutrients bound to them are rendered mostly unavailable to plants. These insoluble decomposition substances are characterized by humic acids and they abound in peat moss and pinebark media.

Needless to say, one needs to be familiar with the micronutrient tendencies of his or her crops and media. With such information a more rational choice of micronutrient source can be exercised. Not all of the information needed, however, exists at this time. The best system of application is not known; be it incorporation into the root medium, a single liquid application or multiple liquid applications. Also unknown is the effect of FTE products and Esmigran® on the available root media levels of micronutrients at any point in time and over a long period. These are topics we are currently studying in our research program.

Correction of Specific Deficiencies

Our discussion thusfar has concerned complete micronutrient applications to avert deficiencies. Should one also apply a complete micronutrient mixture when a deficiency becomes apparent? If all micronutrients are low then this is permissible. This could be determined through a foliar analysis test or from the nutritional history of the medium and crop. If on the other hand one or more micronutrients are present in moderately high concentration then correction of a deficiency of another micronutrient should be accomplished by application of that nutrient only. Application of a complete mix may possibly accentuate the deficiency.

There are several antagonizing pairs of micronutrients. High root media levels of Fe reduce the uptake of Mn and thereby induce a deficiency of Mn. High levels of Mn have the same effect on Fe. High levels of Mo antagonize Cu uptake. If you have a deficiency of one micronutrient caused by an undesirably high level of another micronutrient, then application of all micronutrients will generally further suppress uptake of the deficient nutrient by adding to the concentration of the antagonizing nutrient.

Again, a foliar analysis test would give an assessment of the situation. To avoid a delay in correction of a micronutrient deficiency necessitated by the time required for a foliar analysis test, one should periodically have his crop tested.

Summary

(1) A preventative micronutrient deficiency program should be employed in the greenhouse.

(2) Micronutrient mixtures may be incorporated into root media during formulation for a longevity up to 10 months, applied as a single liquid drench after planting for a longevity of 3 to 4 months, or applied with each fertilization.

(3) The Peters line of complete fertilizers and Compound 111 contain all known essential micronutrients.

(4) Micronutrient products vary in their ratio of micronutrients and in the total amount of micronutrients delivered during a crop.

(5) Peat moss and pine bark base media tie-up large quantities of Fe, Mn, Zn, Cu, and B thus requiring a heavier micronutrient program such as use of the Peat Lite Special fertilizers.

(6) A complete micronutrient mixture can only be used to correct a micronutrient deficiency when all micronutrients are present in low quantity otherwise the deficiency may be further accentuated.