A COMPARISON OF TREATMENTS FOR CHLOROSIS OF PIN OAK AND SILVER MAPLE[1]

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Abstract. Chlorosis symptoms of pin oak were effectively corrected by Medi-Ject and Medicap FE treatments. Nine other treatments failed to give satisfactory results during the first year after treatment. No treatments were completely effective in correcting chlorosis of silver maple.

Chlorosis caused by nutrient deficiency can be a problem for plants growing in calcareous soils (1, 11). In parts of Nebraska the problem is so severe that pin oak cannot be grown as a healthy tree without treatment. Much the same is true also for silver maple and other trees and shrubs.

Many products are commercially available for treating chlorosis in oak and maple. These products generally contain one or more of the micronutrients iron, manganese, and zinc, or a combination of micronutrients with the macronutrients nitrogen, phosphorus, and potassium. Many of the products have been used in Nebraska for a number of years with varying degrees of success. The purpose of this study was to evaluate the products and treatment methods that are currently available to homeowners and to identify new treatments that are effective in correcting the chlorosis problem in trees.

Methods

Prior to the selection of treatments, samples of foliage and soil from pin oak, *Quercus palustris,* and silver maple, *Acer saccharinum,* ranging from healthy to very chlorotic were analyzed. Foliage samples were rated for color on a scale of 1 (very chlorotic) to 10 (healthy) and then analyzed for levels of N, P, K, Fe, Mn, Zn, Mg, Cu, Ca, and S. Soil samples were analyzed for the same elements as well as pH and organic matter. Data from the foliage and soil analyses were examined for correlations with foliage color.

The treatments chosen for evaluation in this study were selected because they: 1) were available to homeowners; 2) were new products or methods that were generally untested; and 3) were suggested as possible treatments for the results of the initial foliage and soil analyses. The treatments selected for pin oak or silver maple or both were:

Medi-Ject: Fischbach Tree-Lawn Service, Lincoln, NE. Trunk injection of ferrous sulfate solution (2) applied at label rates; used on pin oak and silver maple.

Medicap FE, Medicap MN, Medicap MD: Creative Sales Inc., Fremont, NE. Trunk implants containing ferric ammonium citrate, manganese sulfate, and a combination of nutrients (N, P, K, Fe, Mn, and Zn), respectively, applied using standard capsules at label rates; used on pin oak and silver maple.

Zinc Stemix, Iron-zinc Stemix, Stemix, Stemix HV, Fungisol: J.J. Mauget Co., Burbank, CA. Trunk injections containing chelated zinc, chelated iron and zinc, a combination of nutrients (N, P, K, Cu, Fe, Mn, and Zn), the same nutrient level as Stemix but in a greater amount of liquid, and a fungicide effective in the treatment of Verticillium wilt, respectively, applied at label rates; used on pin oak and silver maple.

Iron Sul: Duvall Sales Corporation, Houston, TX. Granules containing 16% Fe, 30% S, with sulphuric acid; applied at 1.5 kg/10 m^2 (3 lbs./100 sq. ft.) with approximately 0.2 kg (0.5

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lbs.) in each hole 20 cm (8 in.) deep made with a shovel evently spaced around the drip line of the tree; used on pin oak only.

FeHEDTA: Liquid chelated iron, 5% Fe; applied at the rate of 125 ml/10 m^2 (4 oz./100 sq. ft.), diluted with water and either put into holes 20 cm (8 in.) deep around the drip line or spread evenly on the surface under the tree; used on pin oak and silver maple.

$FeSO_4$ + S: A mixture of equal parts ferrous sulfate and sulfur applied at the rate of 0.35 kg/cm (2 lbs./in.) diameter of trunk, either placed in holes 20 cm (8 in.) deep around drip line or spread evenly on the surface under the tree; used on pin oak only.

N P K fertilizer: Granular fertilizer containing 24% available nitrogen, 6% available phosphoric acid, and 10% soluble potash; applied at the rate of 12 kg/100 m^2 (25 lbs./1000 sq. ft.), and placed into holes 20 cm (8 in.) deep around the drip line and under the tree; used on pin oak only.

High P fertilizer: Granular ammonium phosphate fertilizer containing 18% total nitrogen, 46% available phosphoric acid, and 0% soluble potash; applied at the rate of 0.75 kg/10 m^2 (1.5 lbs./100 sq. ft.), placed into holes 20 cm (8 in.) deep around the drip line and under the tree; used on silver maple only.

$MnSO_4$ + N: Tecmangam, Eastman Chemical Products, Inc., Rochester, NY. Soil injection of a solution containing 2.5% total nitrogen, 75% anhydrous manganese sulfate applied at the rate of 0.2 kg/cm (1.25 lbs./in.) of trunk diameter into the soil under the tree with a water lance; used on silver maple only.

$MnSO_4$: Manganese sulfate; applied at the same rate recommended for Medicap MN (0.8 g at 4-inch spacing) but injected into the trunk using the Medi-Ject method; used on silver maple only.

Citric acid: Foliage application of citric acid at the rate of 120 g/100 l(91 lb./100 gal.) sprayed to run-off; used on pin oak only.

Aeration: Holes in the soil under the tree made with a turf aerator or with a shovel at approximately 0.75 m (2.5 ft.) spacing and 20 cm (8 in.) deep; used on pin oak and silver maple.

Control: No treatment; used with pin oak and silver maple. Treatments were assigned randomly to the trees except where occasional substitutions had to be made because a tree was too small for a trunk treatment or extensive pavement under a tree prevented a soil treatment.

The study involved 102 pin oaks and 97 silver maples ranging from moderately to severely chlorotic. All pin oaks used in the summer (July) treatments and 32 pin oaks used in the spring (April, May, and June) treatments were located in Lincoln, Nebraska. All silver maples and the remaining 40 pin oaks used in the spring treatments were located in Omaha, Nebraska. Most pin oaks and silver maples were growing in street easements. All trees were in an urban environment. The pin oaks ranged in size from 4.3 cm (1.7 in.) to 69.6 cm (27.4 in.)in diameter. The silver maples ranged in diameter from 40.1 cm (15.8 in.) to 121.7 cm (47.9 in.).

Initial foliage color ratings for the trees treated in the summer of 1982 were made approximately one week prior to the treatments (July). For trees treated in the spring of 1983, initial color ratings were made in August of the previous year. After-treatment color ratings were made in August 1983 for the spring 1983 treatments and August 1982 and 1983 for the summer 1982 treatments.

Color ratings used in the treatment evaluations were based on a 10-point scale that differed somewhat from the one used with the previous foliage and soil analyses. Ratings of 10 through 4 indicated increasing degrees of chlorosis with 10 being the darkest green and 4 being the most chlorotic. Ratings of 3, 2, and 1 indicated a color of 4 with increasing degrees of necrosis in the leaves. Color plates in the Munsell Book of Color (5) were used as standards. The color plates corresponding to the ratings of 10 through 4 are, respectively: 5.0 GY 5/6, 5.0 GY 5/6, 5.0 GY 6/6, 2.5 GY 7/8, 2.5 GY 8/8, 10.0 Y 8/8, and 7.5 Y 8/8. Foliage color was determined for trees as a whole or for large portions of trees. If more than one color was present in large amounts, color averages were calculated. If two color ratings were recorded, a weighting of 60%:40% or 80%:20% was used. If three colors were recorded, a weighting of 50%:30%:20% was used. Color changes occurring after treatment were determined by subtracting the initial color rating from the after-treatment rating. Differences in the degree of color change among treatments were determined using the Student-Newman-Keuls test.

Results and Discussion

Foliage color (greenness) of pin oak was found to be inversely correlated with soil pH (r = −0.8511, n = 6, p 0.05) and directly correlated with foliage nitrogen (r = 0.9155, n = 6, p 0.05). No correlation was found with foliage iron. The absence of correlation between foliage color and iron content has been discussed by Neely (7). The explanation for the absence is that healthy and chlorotic leaves do not differ in the amount of total iron but do differ in the amount of iron present in a form that is usable by the plant.

Foliage color for silver maple was inversely correlated with soil pH (r = −0.5596, n = 13, p 0.05), and directly correlated with soil phosphorus (r = 0.6981, n = 13, p 0.05), soil manganese (r = 0.6878, n = 13, p 0.05), and soil iron (r = 0.6315, n = 13, p 0.05). No correlation was found between foliage color and any foliage mineral.

Trunk injections and implants using iron materials gave the greatest improvement in color for the treatment of chlorosis in pin oak over the period of this study (Tables 1 and 2). Similar results have been reported for some of the treatments by Neely (6, 8) and Himelick and Himelick (3). Spring treatments generally gave a better response than summer treatments. The average final color of the pin oaks treated in the spring with Medi-Ject was 9.3. The summer treatment with the greatest carry-over effect was Medi-Ject with a color rating of 9.5 one year after treatment.

For chlorosis in silver maple, the treatment that gave the greatest color improvement was Medi-Ject in the spring (Table 1). However, no treatment gave a response that was statistically different from the untreated control (Tables 1 and 2).

Table 1. Foliage color change following treatment in the spring for chlorosis.

Treatment *Treatment*		*No. of trees*	*Date of treatment*	*Color change at 8/83*
Pin oak				
Medi-Ject	injection	8	6/83	3.5 a*
Medicap FE	implant	8	4-5/83	3.2 a
Iron-zinc Stemix	injection	8	5/83	1.5 b
Citric acid	foliar spray	4	6/83	1.0 b
$FeSO_4$ + S	soil, deep	4	5/83	0.8 b
FeHEDTA	soil, surface	8	4-5/83	0.8 b
Control	— — — — —	8	— —	0.7 b
NPK fert.	soil, deep	4	5/83	0.4 b
Aeration	soil, surface	4	6/83	0.0 b
Aeration	soil, deep	4	5/83	0.0 b
$FeSO_4$ + S	soil, surface	4	4/83	−0.2 b
Iron Sul	soil, deep	8	5/83	−0.5 b
Silver maple				
Medi-Ject	injection	5	6/83	1.3 a*
Medicap FE	implant	5	4/83	0.8 ab
High P fert.	soil, deep	5	5/83	0.6 ab
Medicap MD	implant	5	4/83	0.6 ab
Fungisol	injection	5	5/83	0.5 ab
Medicap MN	implant	5	4/83	0.5 ab
Stemix HV	injection	5	5/83	0.4 ab
Control	— — —	5	— — —	0.2 ab
FeHEDTA	soil, surface	5	5/83	−0.4 b
Aeration	soil, surface	3	6/83	−0.7 b

* Color change values not followed by the same letter are significantly different from each other (p ◄ 0.05, Student-Newman-Keuls test.)

Table 2. Foliage color change following treatment in the summer for chlorosis.

Treatment		*No. of trees*	*Date of treatment*	*Color change at 8/82*	*8/83*
Pin oak					
Medi-Ject	injection	5	7/82	1.6 a*	3.1 a
Iron-zinc Stemix	injection	5,4**	7/82	1.6 a	1.9 ab
Medicap FE	implant	5	7/82	1.6 a	1.7 ab
$FeSO_4$ + S	soil, deep	5	7/82	0.2 b	0.3 b
Control	— — — —	5	— — —	−0.2 b	−0.1 b
FeHEDTA	soil, deep	5	7/82	−0.2 b	−0.6 d
Silver maple					
Stemix + Zinc Stemix	injection	5	7/82	0.6 a*	0.5 a
Stemix HV	injection	5,4**	7/82	0.4 a	0.4 a
Stemix	injection	5	7/82	0.3 a	0.1 a
Medicap MN	implant	5	7/82	0.3 a	0.3 a
$MnSO_4$ + N	soil, deep	5,4	7/82	0.2 a	0.3 a
Control	— — — —	5,4	— — —	0.2 a	−0.3 a
Medicap FE	implant	5	7/82	0.0 a	−0.3 a
$MnSO_4$	injection	5	7/82	0.0 a	−0.1 a
Medicap MD	implant	5	7/82	−0.4 a	−0.1 a
Aeration	soil, surface	4,3	7/82	−0.5 a	0.4 a

* Color change values not followed by the same letter are significantly different from each other (p ◄ 0.05, Student-Newman-Keuls test.)

** Number of trees in the first and second year of study. Some trees were removed or were not useable after treatment.

Manganese treatments have been reported to be effective in controlling chlorisis in sugar, red, and silver maple (4, 9, 10), but the treatments used in our study gave no response. Foliage color was found to be correlated with soil phosphorus, but no response occurred from the phosphorus treatment. The relative success of iron treatments in the spring suggests that the chlorosis problem of silver maple in Nebraska may be related to a deficiency of iron.

This report has covered only the short-term effects of treatments for pin oak and silver maple chlorosis. The fastest-acting treatments were expected to be the trunk injections and implants, and this was confirmed. However, while the soil treatments may not show immediate response, some may begin to produce effects in the next few years and continue for a period longer than that for the trunk treatments. This study will continue for several additional years to determine how long the successful treatments will be effective, and to determine if any of the other treatments will become effective at a later time.

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ABSTRACT

CHAPMAN, D.J. 1983. **Cutting propagation for shade tree cultivars encourages development of regional plants.** Am. Nurseryman 158(4): 39-40, 42, 44.

Propagation by cuttings offers the potential to develop outstanding tree cultivars adapted to specific regions, overcoming significant graft incompatibility problems. Nursery production must shift as new technology provides solutions. The real reason to propagate trees asexually (budding or grafting) was to develop cultivars or superior trees. These cultivars were more uniform and lacked the genetic variation one would expect from seed propagation. Over the past four years, our studies focused on cultivars of red maple, sugar maple, hedge maple, common horsechestnut, crabapple, hornbeam, oak, and linden. The results show that cuttings are a viable propagation technique for red, sugar and hedge maples, 'Mary Potter,' 'Snowdrift,' 'Candied Apple,' and 'Red Jewel' crabapple, 'Fastigiata' European hornbeam, small-leaved European linden cultivars, and pin oak with at least 70 percent success. Propagating trees by cuttage gives nurserymen the flexibility to more fully use native trees and develop regional cultivars. It can allow them to add unique selected trees with outstanding aesthetic or disease-tolerant characteristics to their production.