

Magnesium Nitrate

leaf analyses showed foliage sprays corrected deficiency in Valencia oranges

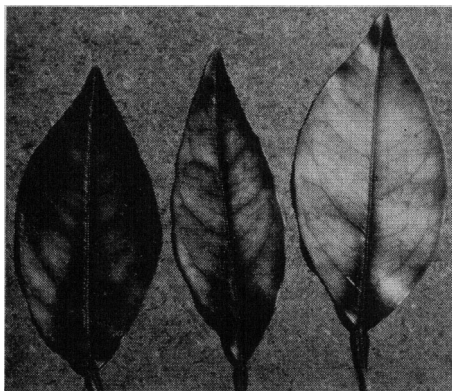
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Foliage sprays of magnesium nitrate at 10 pounds per 100 gallons of water—applied in citrus plots when the spring flush of growth was about two thirds expanded—substantially increased the magnesium concentrations in the leaves. After trees were sprayed, further development of magnesium deficiency symptoms was checked. Within six months, leaves with symptoms at the time of spraying had dropped and sprayed trees were then practically free of symptoms. Leaves which had shown no deficiency became deeper green than similar leaves on nonsprayed trees.

The first symptoms of magnesium deficiency appear as disconnected yellow areas along both sides of the midrib of mature leaves in late summer, fall, and early winter. The yellow areas become larger and coalesce, leaving a green area at the base and sometimes also near the tip of the leaf. Finally the entire leaf may turn yellow. One limb or one side of a tree may have symptoms while the remainder of the tree may appear healthy. Symptoms may disappear when the leaves that show characteristic patterns drop prematurely and only younger leaves, with no symptoms, remain.

Magnesium deficiency of citrus has been reported in Brazil, Florida, South Africa, Israel, Australia, Jamaica, and California. The only commercially acceptable treatment has been reported from Florida, where dolomitic limestone and magnesium sulfate soil applications have been effective on citrus growing in acid soils. Such soil applications have not given consistent results in California.

Progressive symptoms of magnesium deficiency on mature orange leaves.



The first of three foliage spray experiments—all on mature Valencia orange trees—was a test, in Orange County, of three applications of magnesium. The first spray was applied in the spring, on March 27, 1957; the second in the fall, on September 5, 1957; and the third the following spring, on April 23, 1958. Four trees composed a plot and each treatment was replicated six times.

Treatment No. 1 was the check, without any magnesium. Treatment 2 used 10 pounds of magnesium nitrate per 100 gallons of water. Treatment 3 received five pounds of magnesium chelate per 100 gallons of water the first spring and four pounds of magnesium chelate per 100 gallons in the fall—a reduced amount because of fruit injury from the spring spray. On Treatment 3 only, because of severe red mite infestation, the magnesium chelate was replaced with magnesium nitrate—five pounds per 100 gallons of water—for the spring, 1958, application.

For treatment 4 the spring, 1957, spray contained five pounds of magnesium chelate, one pound of zinc chelate, one-half pound of manganese chelate and one-half pound of iron chelate per 100 gallons of water. Instead of chelates, the fall, 1957 and spring, 1958 sprays contained 10 pounds magnesium nitrate, three-fourths pound zinc sulfate, and one-fourth pound manganese sulfate adjusted to pH 6.5 by the addition of soda ash.

Samples for all experiments consisted of nonchlorotic, spring-flush leaves from nonfruiting twigs. Leaves were washed for one minute in tap water containing 1% hydrochloric acid, rinsed in distilled

water, dried in a forced draft oven at 55°C, and ground. Magnesium was determined by flame spectrophotometry on a Beckman DU spectrophotometer with photomultiplier attachment.

Leaf samples for the first experiment were gathered on July 2, 1957, October 25, 1957, and May 14, 1958.

At the time of the March, 1957 application, the spring flush of growth was about one third expanded and the area of young leaf surface was still small. On July 2, three months later, the concentrations of magnesium in the leaves of sprayed trees were not significantly different from the check. In October, 1957, about seven weeks after the fall application, the trees sprayed with magnesium nitrate—Treatment 2—had a markedly higher concentration of magnesium in the leaves, and there was a 95% correction of the magnesium-deficiency symptoms. No detectable difference from the check, as to magnesium-deficiency symptoms, was observed in Treatments 3 and 4, although leaves of the check—Treatment 1—had significantly lower concentrations of magnesium than leaves from any of the sprayed plots. It appears that once magnesium-deficiency symptoms develop in orange leaves, they can not be corrected in those particular leaves by the treatments tested.

When sprays were applied in April, 1958, the spring flush of growth was about two thirds expanded. Leaf samples taken three weeks later showed that Treatment 2, which had received magnesium nitrate in all three sprays, had the highest concentration of magnesium in the leaves. Treatments 3 and 4 had significantly higher concentrations of magnesium in the leaves than did the check.

In August, 1958, practically no magnesium-deficiency symptoms could be found on Treatment 2, which received the three magnesium nitrate sprays. Treatment 4, which received one magnesium chelate and two magnesium nitrate sprays, showed about 85% correction, and Treatment 3, which received two sprays of magnesium chelate and

Effects of Magnesium Applications on the Concentration of Magnesium in Leaves of Valencia Oranges in Orange County, Experiment No. 1

Treatment No.	Spray applications Material and dates	Magnesium as percent of dry weight of leaves ¹		
		7/2/57	10/25/57	5/14/58
1	None	0.18	0.20 ^a	0.16 ^a
2	Magnesium nitrate 3/27/57; 9/5/57; 4/23/58	0.20	0.33 ^d	0.22 ^c
3	Magnesium chelate Magnesium nitrate 3/27/57; 9/5/57 4/23/58	0.18	0.24 ^{b,c}	0.18 ^b
4	Magnesium chelate with micronutrients Magnesium nitrate with micronutrients 3/27/57 9/5/57; 4/23/58	0.17	0.25 ^c	0.20 ^{b,c}
Significance ²		NS	**	**

¹ Each value is the mean from six four-tree plots.

² Subscript letters a, b, c, and d after mean values indicate populations at the 1% level of probability. Mean values are statistically different if they do not have a common subscript letter after the values.

** * indicates statistical significance at the 1% level or higher.

Field Windbreaks for Row Crops

inter-row plantings of grain in white asparagus fields gave protection against wind erosion during tests on peat soil

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Inter-row planting as a practical management practice for the protection of white asparagus fields from wind erosion has been intensively studied since 1955. Such erosion is sometimes costly to the growers and is an important factor in peat dust storms.

Interplanting asparagus ridges with rows of fast growing small grains does not take land out of production, as do tree windbreaks; lath fences—snow fences—appear to be too expensive under the conditions. Furthermore, investigations have shown that inter-row plantings of grain are highly effective even against winds moving parallel to the row directions. However, inter-row planting is restricted to row crops that are sufficiently spaced to permit a strip of taller, pro-

tecting plants in each row space. Also, inter-row plantings can give wind protection for a few months only.

Fortunately, on the islands in the San Joaquin Delta, these two restrictions do not exist for one of its important crops, white asparagus. This crop is planted in ridges 7'-8' apart, providing space for one to three rows of grain between ridges. The need for protection against wind erosion is usually greatest during May and June, the months of optimum development for several varieties of barley and wheat.

A further factor supporting the preference for inter-row planting is the row orientation of many asparagus fields, which is unsuited for tree rows or snow fences with regard to the prevailing wind

direction. At Terminous—the site of one of the two special wind survey stations used in these studies—the prevailing wind direction is straight west. From there on, the oceanic air masses fan out according to the valley shape. At Rindge Tract—the second survey station—the oceanic flow is just beginning to turn away from its west direction and is mostly between west and west-northwest. In such conditions, tree windbreaks or fences should be oriented in a north-south direction, and so should be, preferably, the asparagus rows to prevent the tree windbreaks and snow fences from interfering with the numerous cultivations and daily tractor harvesting of the crop. However, even when a new aspara-

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only one of magnesium nitrate, showed about 45% correction of the deficiency symptoms. Symptoms on the check trees had not improved.

The second experiment—in San Diego County—used only two applications of magnesium. The first spray was applied in the fall, on November 21, 1957, and the second on May 1, 1958. Single-tree plots were used, with the spray treatments and check replicated nine times. The fall application used five pounds of magnesium nitrate to 100 gallons of water and the spring application used 10 pounds to 100 gallons.

The second spray in this experiment was applied when the spring flush of growth was about two thirds expanded. Magnesium in leaf samples taken on May 22, 1958, three weeks after the spring spray, averaged 0.17% for the check and 0.23% for the sprayed trees. In each of the nine replications of the spray treatment, the concentration of magnesium in the leaves exceeded that of the check by more than 22%. The differences were highly significant.

The third experiment was a single application—in San Diego County, on May 1, 1958—using 10 pounds of magnesium nitrate per 100 gallons of water. The treatment was superimposed on a 3×2×2—dolomite × potash × phosphate—factorial soil fertilizer experiment, replicated five times with two-tree plots. The plots in the factorial experiment that had

received nitrogen, phosphorus, or potassium but no dolomite—that is, no magnesium—were split. One tree in each plot received a magnesium nitrate spray and the other was retained as a check. Additional plots, which had received a heavy mulch of steer manure every year since 1950, were split and sprayed in the same way. Leaf samples were gathered on May 22, 1958.

The trees of the factorial experiment had differential magnesium levels created in the leaves by past fertilizer treatments. Trees that had heavy applications of potash or manure in their prior fertilizer history had moderate to severe magnesium-deficiency symptoms. Regardless of previous fertilizer treatment, a single magnesium nitrate spray applied when the spring flush of growth was about two thirds expanded resulted in a substantial increase in magnesium concentration in leaves analyzed three weeks later.

When the spray was applied, deficiency symptoms had started to develop in leaves of the fall and winter flushes of growth. After two months, the sprayed trees had only about 40% as many leaves showing magnesium-deficiency symptoms as did the check trees. Apparently the sprays prevented further development of deficiency symptoms, but symptoms continued to develop in the check trees. The sprays did not correct symptoms that were present in the leaves at the time of spraying.

Magnesium nitrate spray at 10 pounds per 100 gallons of water applied to orange trees in San Diego County in August, 1958, gave little or no correction of the deficiency, suggesting that single summer applications are uncertain.

On some, but not all, light-textured citrus soils in California applications of Epsom salts—magnesium sulfate—have been effective, suggesting that a combination soil-spray program might be developed for such soils. No instance is known where applications of magnesium compounds to heavy-textured soils have corrected magnesium deficiency.

In earlier exploratory trials, foliage of orange trees was injured by magnesium nitrate at concentrations as low as 15 pounds per 100 gallons of water. Thus, 10 pounds of magnesium nitrate per 100 gallons approaches a maximum tolerable concentration. In Treatment 4, small quantities of zinc and manganese salts were combined with 10 pounds of magnesium nitrate per 100 gallons of water and no injury resulted from the treatment. However, as a precaution, magnesium nitrate sprays might be tested on a small number of trees before spraying an entire orchard.

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