Urea Nitrogen as Foliar Spray

application to citrus studied for effects on plant growth, leaf burn, root activity, and fruit quality

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Basic aspects of urea nitrogen as a foliar spray for citrus are under study in laboratory and glasshouse investigations.

In two experiments conducted in solution culture in a glasshouse the growth of nitrogen deficient seedlings increased 64% and that of similar cuttings increased 96% in grams of dry weight per plant.

When sufficient nitrogen was supplied to the roots there was a tendency for growth to be reduced after foliage sprays were applied.

In solution culture experiments where deficient amounts of nitrogen were supplied to the roots and urea nitrogen was applied to the leaves, citrus cuttings did not grow so much as those cuttings whose roots were supplied adequate nitrogen.

Large areas of tipburned leaves were always observed after concentrations of 2%, 3%, or 4% urea were used in the sprays. When a 1% concentration was used there was very little tipburn. Wherever large droplets of spray accumulated—particularly at the tip of a leaf or at a curled edge—that portion of the leaf was burned.

Assimilation

In a laboratory test, the application of nitrogen as urea to green leaves resulted —in a 24-hour period—in an increase of nitrogen from about 2% to over 6% on the dry weight basis. At the end of the 24-hour period most of the absorbed nitrogen was present in nitrogen fractions other than urea, indicating that urea was readily assimilated.

By 10 applications of 2% urea spray—between June 28 and August 10—the nitrogen content of rough lemon leaves was increased from 2% to about 5% on the dry weight basis. Although most of the additional nitrogen remained in the leaves as alcohol-soluble nitrogen, none could be detected in the form of urea. Substantial amounts of the urea nitrogen appeared to have been converted to protein nitrogen.

The assimilation of nitrogen by plants involves the combination of nitrogen with carbohydrate material ultimately to form proteins or other nitrogenous compounds.

Greenhouse studies with rough lemon cuttings confirmed findings of earlier researchers that sugar in solution added to the urea spray for the purpose of making sufficient additional carbohydrates available for combination with urea is successful in preventing leaf burn. The actual absorption of sugar has not yet been demonstrated.

No leaf burn was present on the sugar and urea sprayed leaves, even though the nitrogen content of the mature leaves was increased from 1.8 to over 3%. Without sugar the nitrogen content was over 5%.

Girdling and Urea Burn

The practice of girdling—often used to increase the fruitfulness of trees—is believed to cause the carbohydrate level above the girdle to rise. It is possible that girdling can—like sugar-urea sprays—reduce leaf burn from urea sprays. Data from a duplicated experiment indicate the possibilities because nongirdled, urea sprayed trees had 34.6% and 27.2% leaf area burned in contrast to 18.9% and 12.9% on girdled, urea sprayed trees.

Girdling did not influence the amount of urea nitrogen absorbed or remaining in the leaves from the sprays but it can result in diminished nitrogen movement from roots to foliage.

Root Activity

It is accepted that nutrient elements are absorbed from the soil by the expenditure of energy derived from respired carbohydrates. If nitrogen is supplied directly to the leaves and if it combines with the available carbohydrates to form proteins or other nitrogenous compounds, fewer carbohydrates may be translocated to the roots. It would then be possible that less root activity would occur.

The following data for root weights indicate that urea sprays, when applied in large amounts—as in the solution culture experiment with rough lemon cuttings—may influence the growth of the roots.

Nitrogen in nutrient solution supplied roots	Root weights in grams of dry weight per cutting		
	Not sprayed	Urea sprayed	Difference %
Low	2.7	5.7	+111
Medium ...	5.2	4.9	− 6
High	9.1	6.2	− 32

This particular influence is somewhat like girdling in that carbohydrate movement to the roots is decreased.

Inconclusive data has been obtained thus far for any influence of nitrogen foliage sprays on the uptake of other elements.

Fruit Quality

Fertilizer elements are believed to influence citrus fruit quality. Nitrogen applied to the soil has a marked inverse effect on phosphorus in the leaves. Phosphorus in turn has a direct influence on fruit quality. Foliar applied nitrogen, then, should have no effect on fruit quality.

In some studies of urea nitrogen foliar sprays made with Valencia orange and Marsh grapefruit no apparent effects have been noted as indicated by the following values for grapefruit. The grapefruit trees were sprayed six times between fruit-set and maturity.

	Control	Spray
Nitrogen in leaves, per cent of dry weight ..	2.16	3.01
Soluble solids, per cent of juice	12.2	12.1
Citric acid, per cent of juice	2.5	2.6
Per cent juice of fresh fruit	40.5	40.0

Most of the problems concerning foliar application of nutrients to plants are not yet answered. Certain aspects of the studies are difficult but can be greatly facilitated by using the heavy isotope of nitrogen as a tracer. With this technique much smaller quantities of nitrogen can be determined, making absorption, assimilation, and translocation studies more rapid and more precise.

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