

# Use of a Slow Release Triazone based Nitrogen Fertilizer on Lemon Trees<sup>1</sup>

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## Abstract

*Trisert CB replaced conventional foliar applied low-biuret urea and liquid urea ammonium nitrate in a typical N fertilization regime, a urea triazone based N source. There was no yield decrease, change in fruit size or grade with the use of the Trisert CB. There were no differences in leaf P, K, Ca, Mg, Cu, Fe, Mn or Zn concentration. Occasionally, leaf N concentration of trees supplied with foliar applied Trisert CB was higher than that of the control treatment.*

## Introduction

Citrus producers in Arizona and California often apply between 1 and 3 lbs. N per mature tree per year, as a nitrogen solution in the water run or in a low volume irrigation system. Embleton and Jones (1974) found that pound for pound, foliar applied N was just as effective as soil applied N for producing citrus. Nonetheless, 100% foliar N application programs are not common because of their perceived cost. However, Embleton *et al.*, (1986) also found that foliar nitrogen in combination with soil-applied nitrogen can be beneficial for maintaining production and quality.

Low biuret urea (LBU) sources have been typically applied as the foliar component of a typical N application program. Application of these N sources will limit leaching into the groundwater. Embleton *et al.* (1980) estimated that only 10% of the foliar spray reached the ground, and 75% of that was volatilized as ammonia. Winter foliar application of LBU sources has also been shown to significantly increase yield as compared to soil applied LBU (Ali and Lovatt; 1994).

Although many studies have been conducted in the San Joaquin valley on the benefits of a combination foliar and soil applied N program on oranges, citrus fertilizer programs in the Arizona and California desert face additional challenges that have not yet been answered through research. Desert citrus acreage is increasingly planted to lemons, which have a higher N requirement than do oranges. Desert citrus soils are often sandier than those in the San Joaquin, meaning that the potential for N leaching is higher. High air and soil temperatures lead to volatilization of soil applied granular N. Conventional foliar N sources cannot be applied when temperatures are high, since water evaporation occurs and leads to the formation of a crystalline residue. Some conventional N sources can also lead to leaf burn.

Urea-triazone N sources overcome the difficulties of using conventional foliar N fertilizer. Clapp and Parham (1991) report that urea-triazone N has slow release N properties, provides leaf burn protection, will not crystallize on the leaf, and offers more uniform coverage and superior absorption when compared to conventional N sources. Additionally, Lovatt at the University of California at Riverside reports that urea-triazone foliar applications at 12.5 lbs. N per acre were just as effective as 25 lbs. N per acre conventional LBU applications for navel orange yields.

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<sup>1</sup> We would like to thank Tessengerlo Kerley, Inc. for partial financial support of this project. We would also like to thank Scheu Properties, Mr. Mark Mc Broom, and Richard Bagdasarian Inc., for their technical assistance in completing this work.

Therefore, our objectives in this study are to determine if a combination of foliar applied urea-triazone nitrogen (Trisert CB, Tessenderlo Kerley Inc., Phoenix, AZ) and water-run urea ammonium nitrate can maintain or enhance lemon leaf nitrogen status, fruit yield, packout and quality as compared to the current production practices of applying all or part of the nitrogen as UAN solution via the irrigation water and the remainder as conventional LBU solution.

## Materials and Methods

This project was initiated at a citrus grove owned by Scheu properties, near Calipatria, California. Trees included in the project are mature 'Limoneira 8A Lisbon' (*Citrus limon* Burm.) on *Citrus volkameriana* rootstock. For 1998, there were 124 trees per acre. The grower removed 50% of the trees during winter 1999, leaving 62 trees per acre. Trees were subject to normal grower practices, including regular microsprinkler irrigation, foliar application of both macro- and micronutrients, and applications of insecticides (chiefly for thrips) as needed.

For this experiment, total annual tree N requirements were met through the application of one of four treatments as follows:

- Control – Low biuret urea (46-0-0) applied as a foliar spray in 3 (1999) or 4 (1998) split applications annually (mid January, early March, early April and early May). For 1998, a total of 1.15 lb. N per tree or 143 lb. N per acre was applied. In 1999, a total of 46 lb. N per acre was applied.

Also, liquid urea ammonium nitrate 32-0-0 was applied through the irrigation system in 24 split applications. For 1998, a total of 1.47 lb. N per tree or 182 lb. N per acre was applied. For 1999, a total of 124 lb. N per acre was applied. Also, N-furic acid (15-0-0-49S) applied semi-weekly through the irrigation system in both 1998 and 1999, at a rate of 0.5 lb. N per tree.

Total N applied in this treatment for 1998 was 387 lb. N per acre, and for 1999 was 201 lb. N per acre.

- Liquid urea ammonium nitrate and N-furic acid applied as in the control treatment.

Also, for 1998, 43 gallons/acre Trisert CB (26-0-0-0.5B) was applied as a foliar spray in 3 split applications annually (mid January, early March, and early April) for a total of 0.94 lb. N per tree or 116 lb. N per acre. For 1999, 18 gallons/acre Trisert CB were applied as a foliar spray, providing 49 lb. N per acre.

Total N applied in this treatment in 1998 was 360 lb. N per acre, and in 1999 was 197 lb. N per acre.

- Low biuret urea and N-furic acid applied as in the control treatment.

Also, for 1998, 51 gallons/acre Trisert CB applied through the irrigation system in 24 split applications for a total of 1.11 lb. N per tree, or 138 lbs. N per acre. For 1999, 47 gallons per acre Trisert CB was applied through the system, for a total of 127 lb. N per acre.

Total N applied in this treatment in 1998 was 343 lb. N per acre, and in 1999 was 204 lb. N per acre.

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Also, N-furic acid applied as in the control treatment.

Total N applied in this treatment in 1998 was 316 lb. N per acre, and in 1999 was 207 lbs. N per acre.

All foliar fertilizers were applied using a high-pressure air-blast sprayer in 100 gallons of water per acre in 1998 and 125 gallons of water per acre in 1999.

For this study, the experimental design was randomized complete block, with four blocks. Experimental units are double rows. Data are reported as cartons per tree, since the orchard had rows of varying length, and since 50% of the trees were removed in winter 1999.

Fruit were harvested on 13 October 1998 and 18 October 1999. For the 1998 harvest, trees were stripped, and fruit from the four treatments was kept in separate bins for transport to the packinghouse. There are 960 lbs. of fruit in a bin. At the packinghouse, fruit from each treatment, within each block were processed separately. Computer systems at the packinghouse generated a report showing the fruit yield and packout (fruit size and grade) for each of the four treatments.

For the 1999 harvest, the trees were stripped, and fruit from each treatment were kept in separate bins. From each bin, a 70 lb. sub-sample was collected. Fruit from the subsample was processed at the experimental site, through an automatic, portable fruit sorter (Autoline, Inc., Reedley, CA). The fruit sorter provided fruit weight, size, color and grade information.

Leaf samples for mineral nutrient analysis were taken once a month from February through August. Thirty-two leaves from each experimental unit were collected, and were dried at 60C for 48 hr and were ground with a Wiley mill. Samples were digested using a method developed by Parkinson and Allen (1975). Nitrogen and phosphorus were determined colorimetrically at using a spectrophotometer. Potassium, Ca, Mg, Fe, Cu, Mn and Zn were determined using atomic absorption spectrophotometry.

## **Results and Discussion**

Application of Trisert CB in combination with foliar LBU, in combination with water-run urea ammonium nitrate, or without additional N source did not suppress or improve overall yield, fruit size or fruit grade compared to the control treatment (Tables 1 and 2). While there were occasional differences among fruit sizes or fruit grades, no discernible trend was evident.

The treatments had a greater effect on leaf nitrogen level (Figure 1). Although there was no continuous trend, for five of the 14 dates leaf N concentration of the foliar Trisert CB and water-run 32-0-0 treatments was significantly higher than that of at least one of the other treatments. Likewise, for five of the 14 days, the leaf N concentration of trees receiving the control treatment was significantly lower than at least one of the other treatments, often within the deficient range.

Treatments with Trisert CB had little effect on leaf P, K, Ca, Mg, Cu, Fe, Mn and Zn concentrations (data not shown).

In conclusion, Trisert CB may prove to be an alternative to foliar LBU applications or water-run urea-ammonium nitrate applications, particularly if point-source nitrate contamination of the ground water is an issue. Our research shows that for at least 2 years, application of Trisert CB will lead to equivalent lemon yields and packouts compared with conventional N fertilization regimes.

## **Literature Cited**

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Table 1. 1998 Yield and Packout of lemons treated with foliar and water-run nitrogen sources.

Treatment <sup>z</sup>	Yield <sup>y</sup> (Cartons per tree)	Fruit Size <sup>x</sup> (%)						Fruit Grade <sup>w</sup> (%)		
		95	115	140	165	200	235	#1	#2	#3
Foliar Low Biuret Urea + Water -run 32-0-0	4.31 a	1.2 a	9.8 a <sup>l</sup>	20.7 <sup>ε</sup>	37.6 a	16.4 c	14.3 a <sup>l</sup>	49.8 a	18.9 a	29.4 ab
Foliar Trisert CB + Water-run 32-0-0	3.43 a	0.7 a	10.6 a	21.1 a	37.1 a	16.9 c	13.6 b	48.2 a	18.8 a	31.1 a
Foliar Low Biuret Urea + Water-run Trisert CB	4.43 a	1.5 a	9.5 a	19.8 b	30.2 b	23.3 b	15.7 a <sup>l</sup>	55.0 a	19.1 a	23.9 b
Foliar Trisert CB + Water-run Trisert CB	4.29 a	0.9 a	8.5 b	18.3 c	30.9 b	25.3 a	16.1 a	49.3 a	21.6 a	27.2 ab

<sup>z</sup> Mean separation by Duncan's Multiple Range Test,  $\alpha=0.05$

<sup>y</sup> Yield expressed as numbers of 37.5 lb. cartons of fruit per tree.

<sup>x</sup> Fruit size expressed as the percentage of fruit in each size category as a portion of the total number of fresh-packed cartons. The size categories are indicative of the number of fruit per carton.

<sup>w</sup> Fruit grade expressed as the percentage of fruit in each size category as a portion of the total number of cartons. Grade categories #1 and #2 are fresh-packed fruit, and #3 are fruit destined for juice. The three values may not add up to 100% because about 2% of the fruit was discarded.

Table 2. 1999 Yield and Packout of lemons treated with foliar and water-run nitrogen sources.

Treatment <sup>z</sup>	Yield <sup>y</sup> (Cartons per	Fruit Size <sup>x</sup> (%)							Fruit Grade <sup>w</sup> (%)			
		63	75	95	115	140	165	200	235	#1	#2	#3
Foliar Low Biuret Urea + Water -run 32-0-0 Foliar Trisert CB +	3.80 a	0.5 a	2.4 a	23.4	40.0 a	20.5	4.9 a	6.2	2.3 a	48.5 a	19.9 ab	31.6 al
Water-run 32-0-0 Foliar Low Biuret Urea + Water-run Trisert CB Foliar Trisert CB +	4.20 a	0.4 a	2.6 a	25.3	41.1 a	18.7	4.9 a	6.0	1.2 a	49.5 a	20.5 a	30.0 b
Water-run 32-0-0 Foliar Low Biuret Urea + Water-run Trisert CB Foliar Trisert CB +	4.18 a	0.8 a	3.1 a	24.7	35.8 b	19.9	5.5 a	8.1	2.0 a	46.6 a	20.0 ab	33.4 al
Water-run Trisert CB	4.38 a	0.8 a	2.7 a	20.7	39.1 a	20.4	6.0 a	8.4	2.1 a	47.5 a	17.1 b	35.4 a

<sup>z</sup> Mean separation by Duncan's Multiple Range Test,  $\alpha=0.05$

<sup>y</sup> Yield expressed as numbers of 37.5 lb. cartons of fruit per tree.

<sup>x</sup> Fruit size expressed as the percentage of fruit in each size category as a portion of the total number of fresh-packed cartons. The size categories are indicative of the number of fruit per carton.

<sup>w</sup> Fruit grade expressed as the percentage of fruit in each size category as a portion of the total number of cartons. Grade categories #1 and #2 are fresh-packed fruit, and #3 are fruit destined for juice. The three values may not add up to 100% because about 2% of the fruit was discarded.

Figure 1. Effect of Trisert CB and Low Biuret Urea Application Methods on Lemon Leaf N Concentration

