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# CITRUS GROWERS CAN REDUCE NITRATE GROUNDWATER POLLUTION AND INCREASE PROFITS BY USING FOLIAR UREA FERTILIZATION IN THE SPRING TO INCREASE FRUIT SET AND YIELD AND REDUCE CITRUS THRIPS POPULATIONS AND FRUIT SCARRING

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The overall goal of this research is to reduce pollution of groundwater from soil-applied nitrogen fertilizer and thripicides used in citrus production.

The results of Embleton *et al.* (1986) demonstrated that even if growers used soil applications of nitrogen at the minimal level required for citrus production (225 kg NO<sub>3</sub><sup>-</sup>/ha/yr), nitrate pollution of the groundwater would result. Most citrus growers fertilize with significantly higher rates of nitrogen. Worse still, Ca(NO<sub>3</sub>)<sub>2</sub> applied to the soil at rates from as low as 100 to 300 kg/ha/yr increased soil salinity from 0.93 to 1.56 dS/m (Embleton *et al.*, 1986). Thus, the continued use of soil-applied nitrogen in citrus production is a real and significant threat to both water and soil quality in California and in other citrus-producing states in the United States. In addition, the potential exists that the citrus industry is contributing to the degradation of water and soil quality in California through the use of chemical pesticides to control citrus thrips (*Scirtothrips citri* [Moulton]). Since the early 1900s, one to four chemical sprays have been applied during the pre-bloom and post-petal fall period to control this pest in much of California's citrus (Horton, 1981; Morse and Brawner, 1986). According to the California Department of Food and Agriculture, over the years 1983-1986, pesticide use for control of citrus thrips in California was 174.6, 190.5, 271.6, and 387.3 (thousand) lbs. active ingredient per year, respectively (Atkins *et al.*, 1989). Because even the potential degradation of water and soil quality by chemical pesticides is a sensitive issue, we need to provide citrus growers with a non-pesticide alternative to control citrus thrips. The growers in the San Joaquin Valley, which comprises a majority (54%) of the state's citrus acreage, have historically used chemicals to control citrus thrips which precludes the use of biological control for other insect pests. With a non-pesticide strategy to control citrus thrips, it would be possible to convert the San Joaquin Valley citrus acreage to biological control (Luck *et al.*, 1986). Our preliminary results and those of others suggest that foliar-applied urea may be efficacious as a non-pesticide option to control citrus thrips.

Our objective is to test the hypothesis that foliar urea applied April 1 to June 1 can do triple duty (i) as a "non-pesticide" to control citrus thrips and reduce fruit scarring; (ii) as a "growth regulator" to improve fruit set and increase yield without reducing fruit size or quality; and (iii) as a nitrogen fertilizer by supplying a portion of the nitrogen to be applied in a given year thus reducing the amount applied to the soil. The goal of our research is to provide citrus growers with the optimal time and rate of foliar-urea application needed to successfully improve fruit set and yield and control citrus thrips to reduce fruit scarring. If our research is successful in improving yield and/or reducing the economic loss due to fruit scarring caused by citrus thrips, our research will provide an economic incentive for citrus growers to reduce their use of soil-applied nitrogen in favor of a spring foliar application of urea. Thus, if successful, the results of our research will not only improve citrus productivity and grower profits, but it will also

reduce pollution to the groundwater from nitrate and reduce the amount of chemical pesticides currently used to control citrus thrips which results in less potential pesticide pollution of the soil and groundwater. The project is a success if a spring foliar-application of urea increases yield and/or reduces economic losses due to fruit scarring by citrus thrips.

The research employs 17-yr-old 'Frost nucellar' navel orange trees on Trifoliate orange rootstock under commercial production by Paramount Citrus in the Ivanhoe area of the San Joaquin Valley. The research will be replicated for two years due to alternate bearing.

There are five treatments each replicated as eight randomized blocks (six rows wide by 15 trees long). Data are being collected from six individual trees per block for a total of 48 data trees per treatment. Trees used for leaf  $\text{NH}_3\text{-NH}_4^+$  content, yield, and fruit scarring assessment are separate from those used to determine population levels of *Scirtothrips citri* and *Euseius tularensis* because the sampling technique in each case is destructive to the tree and might impact yield. Foliar low-biuret urea was applied on April 7, April 21, May 5, or May 20 for treatments 1 through 4, respectively. Treatment 5, the control, is Paramount Citrus' best management practice. The  $\text{NH}_3\text{-NH}_4^+$  content of leaves was determined the day before the foliar application of urea and on day 1, 8, and 15 after the treatment to determine to what level leaf  $\text{NH}_3\text{-NH}_4^+$  content increased and how long it remained elevated. Total nitrogen analyses will be done by Paramount Citrus each September in order to monitor the total nitrogen status of the tree as is currently done commercially.

Citrus thrips population levels were assessed the day before the foliar application of urea and on day 1, 3, 8, and 15 after the urea spray from the inside of rows 2 and 5 of at least four of the eight treatment blocks. Sampling employed 20 data trees number 1-10 in row 2 and 11-20 in row 5 to collect four jar samples per block as follows: jar 1 - start on tree 1, make 20 D-Vac entries, low on odd trees, high on even; jar 2 - start on tree 20, make 20 D-Vac entries, low on odd trees, high on even.

For leaf  $\text{NH}_3\text{-NH}_4^+$  content and citrus thrips populations, control trees were sampled simultaneously with each treatment. Odd-numbered trees were sampled for the April 7 and May 5 treatments and even-numbered trees for the April 21 and May 19 treatments.

*Euseius tularensis* (hibisci) population levels were assessed weekly starting March 23 through May 25 (nine weeks) for the control and starting the week before the foliar application of urea for each treatment through May 25 on rows 3 and 4 in each treatment block. Five leaves were collected in each of four quadrants from each of four data trees per block. The results of this part of the study provided clear evidence that foliar application of low biuret urea had no negative effect on the population levels of the beneficial predatory mite *Euseius tularensis*.

Harvest will occur sometime in March 1993. Fruit weight per tree, fruit number per tree, fruit size distribution on 75 randomly selected fruit, and degree of thrips scarring will be determined.

Progress reports on the results of the first and second year of research will be provided at the specified times. The final report will present in detail the effect of urea sprays on leaf content of  $\text{NH}_3\text{-NH}_4^+$  and *Scirtothrips citri* and *Euseius tularensis* populations and a cost/benefit of the use of a spring foliar urea spray.