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CITRUS GROWERS CAN REDUCE NITRATE GROUNDWATER POLLUTION AND INCREASE PROFITS BY USING FOLIAR UREA FERTILIZATION

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OBJECTIVES

The objective was to test the hypothesis that foliar urea applied within the period April 1 to June 1 can do triple duty as:

1. A "non-pesticide" to control citrus thrips and reduce fruit scarring,
2. A "growth regulator" to improve fruit set and increase yield without reducing fruit size or quality, and
3. 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 specific goal of our research was to determine whether there is an optimal time for cost-effective foliar application of urea that will successfully improve fruit set and yield and control citrus thrips to reduce fruit scarring. The results of our research will not only help improve citrus productivity and grower profits, but will also help reduce nitrate groundwater pollution and reduce the amount of chemical pesticides currently used to control citrus thrips.

DESCRIPTION

The research was conducted on 17-year-old 'Frost nucellar' navel orange trees on Trifoliolate orange rootstock under commercial production by Paramount Citrus in the Ivanhoe area of the San Joaquin Valley. The research was replicated for three years due to alternate bearing.

There were five treatments each replicated as eight randomized blocks (six rows wide by 15 trees long). Data was collected from six individual trees per block for a total of 48 data trees per treatment. Foliar low-biuret urea was applied each year on approximately April 7, April 21, May 5, or May 20 for treatments 1 through 4, respectively. Treatment 5, the control, was Paramount Citrus' best management practice. Total nitrogen analyses were done annually in September on each of the 240 data trees in order to monitor the total nitrogen status of the tree (as is currently done commercially) and to determine the contribution to total N made by each treatment over the three years of the field trial.

Harvest was in March of each year. Fruit weight per tree, fruit number per tree, fruit size for all fruit on each of the 240 data trees, and degree of thrips scarring on all fruit on 120 data trees were determined.

RESULTS

The results of the study provided clear evidence that a spring foliar application of low-biuret urea had no negative effect on the population densities of the beneficial predatory mite, *Euseius tularensis* (hibisci). There was no significant difference in the number of *E. tularensis* mites per leaf for trees on which 500 mites had been released on March 19, 1992—regardless of whether these trees were left as controls or subsequently sprayed with low-

biuret urea on the date indicated. The number of mites per leaf was not due to a natural increase in the population by immigration during the course of the study, since the control trees on which no mites were released had significantly lower numbers of mites per leaf on both sampling dates.

Spring foliar applications of low-biuret urea had no statistically significant effect on the population densities of *Scirtothrips citri*. The high degree of variability in the number of thrips in each of the replicate samples made it impossible to detect statistically significant differences due to any of the treatments.

Spring foliar applications of low-biuret urea had no statistically significant effect on fruit scarring determined as either on-tree evaluations of fruit on the outside of the tree in September or evaluation of total fruit per tree at harvest in March. While not significant at the 5% level, it is interesting to note that for both years of the study the late May (May 20, 1992 and May 25, 1993) foliar application of low-biuret urea resulted in the lowest degree of fruit scarring, especially severe scarring (Table 1). This trend was observed for both the on-tree and harvest evaluations for both years of the study. Although not significant at the 5% level, it is also worth noting that for both years of the study, the second date of foliar application of urea (April 21, 1992 and April 27, 1993) had the highest percent scarring, especially severe scarring. In year two, the mean

percent of fruit severely scarred by citrus thrips biuret urea compared to trees receiving the late April application (Table 1). Neither value was significantly different from the control or from trees receiving urea to the foliage in early April or early May.

In the first year of the study, which was an "on" year, there were statistically significant differences at the 5% level between dates of urea application to the foliage in terms of total weight of fruit per tree and the number of fruit of packinghouse carton size 56 (fruit with diameters between 8.1 and 8.8 cm). The date of foliar urea application had no statistically significant effect on other sizes of fruit. The May 20, 1992 foliar application of low-biuret urea had the highest total fruit weight and the highest number of fruit of packinghouse carton size 56. In both cases, the May 20, 1992 low-biuret urea application was statistically better at the 5% level than the April 7 and May 5 spray dates. However, the April 7, April 21, and May 5 treatments were not statistically different from the control at the 5% level. At the 10% level, the May 20, 1992 foliar application of urea resulted in significantly more total weight of fruit per tree and more fruit per tree of packinghouse carton size 56 than the control and all other treatments, except the April 21, 1992 urea application.

In the second year of the study, which was an "off" year, there was no significant effect at the 5% level on the kg and number of fruit per

Table 1. Effect of Time of Application of Low-Biuret Urea to the Foliage of the 'Washington' Navel Orange on the Percent of Fruit at Harvest Severely Scarred by Citrus Thrips^z

Date Urea Applied to the Foliage	% Severely Scarred Fruit Year 1		% Severely Scarred Fruit Year 2	
Early April	20.65	a	11.93	ab
Late April	21.99	a	14.03	a
Early May	20.89	a	11.09	ab
Late May	16.09	a	9.67	b
Control: soil-applied N	18.94	a	11.08	ab

^z Average yield for all treatments was 269±13 and 141±4 kg fruit per tree in years 1 and 2, respectively.

tree. There was, however, a statistically significant increase in the kg of fruit of packinghouse carton size greater than 56 (fruit with diameters greater than 8.8 cm) for trees receiving the May 25, 1993, foliar application of low-biuret urea compared to the control trees receiving soil-applied nitrogen. Trees receiving the May 25, 1993, foliar application of low-biuret urea had significantly more fruit of packinghouse carton size 56 than trees receiving the early April 13 foliar application of urea.

Repeated Measure Analysis was used to test the effect of the time of foliar-urea application on fruit yield, number and size over the two years of the study. The late May foliar application of low-biuret urea significantly (P 0.05) increased yield (kg) and both the kg and number of fruit of packinghouse carton size 56 per tree compared to trees receiving foliar applications of low-biuret urea in early April or early May, but was not significantly different from the control trees receiving soil-applied nitrogen or from trees receiving a foliar application of low-biuret urea in late April (Table 2). There was no significant effect on the kg or number of fruit in any other size category.

CONCLUSION

Our results suggest that urea will not have much impact in preventing scarring of fruit when thrips pressure is great. The performance of urea in reducing the percentage of fruit scarred by thrips in a light thrips year remains to be determined. The results provide evidence that a properly-timed spring (late

May) foliar application of low-biuret urea significantly increased yield by increasing both the weight and number of large-sized fruit (packinghouse carton size 56) with some reduction in the degree of severe fruit scarring by citrus thrips. Trees receiving the late May foliar application of low-biuret urea averaged 11 kg more fruit than the control trees receiving soil-applied nitrogen over the two years of the study. This represents an additional 0.65 17-kg carton of fruit per tree. At a typical planting density of 96 trees per acre, the late May foliar application of low-biuret urea would yield 63 additional cartons per acre. For the cost/benefit analysis, we used the following values:

Profit was calculated at a price of \$8.00 per 17-kg carton (despite the fact that the late May foliar application of urea increased the number of fruit per tree of packinghouse size 56 and had no effect on any other fruit size) minus \$2.29 per carton for packinghouse handling of the extra cartons (per Connelly Melling; Dole).

Expenses were calculated at 56.8 liters (15 gallons) Unocal PLUS per acre (\$16.50 per acre), and spray rig at \$25.00 per acre, with all other expenses being the same, although there is the expense of a soil application of nitrogen to the control trees which we did not include. Net return to the grower for the late May foliar application of low-biuret urea was an average of \$318 per acre per year.

A copy of the final report is available through FREP's Resource Guide.

Table 2. Effect of Time of Application of Low-Biuret Urea to the Foliage of the 'Washington' Navel Orange on Yield for the Two Years of the Study^Z

Date Urea Applied to the Foliage	Yield kg/tree	56s kg/tree
Early April	197 b	53 b
Late April	210 ab	60 ab
Early May	201 b	56 b
Late May	215 a	65 a
Control: soil-applied N	204 ab	60 ab

^ZYield data in Vertical columns followed by different letters are significantly different at P ≤ 0.05.