

Timing of Urea on Citrus Foliage Influences Yield, Fruit Size and Scarring by Citrus Thrips

By Carol J. Lovatt
Associate Professor of
Plant Physiology
Department of Botany and
Plant Sciences, UC-Riverside
and

By Joseph G. Morse
Professor of Entomology
Department of Entomology,
UC-Riverside

The authors acknowledge grant support from the Fertilizer Research and Education Program of the California Department of Food and Agriculture and Citrus Research Board, the gift of Unocal PLUS from the Unocal Corporation, and the generous cooperation of Paramount Citrus. The authors express their appreciation to the individuals who participated in this project: Franco Bernardi, Jim Hadaketa, Jim Stewart, Dr. Elizabeth Grafton-Cardwell, Anthony Urena, Chris Reagan, Pamela Watkins, O.L. Brawner, Dale Handley, Dr. Anwar Ali, Dr. Calixto Protacio, Yusheng Zheng, Anita O'Brien, Larry Summers, Dr. Yoa-Ren Dai, and Dr. Langtao Xiao.

Introduction

Foliar-applied urea was demonstrated in the early 1960's to be as efficacious as nine other sources of nitrogen supplied to the soil in maintaining yield of orange trees (Leonard et al., 1961). Embleton and Jones (1974) provided evidence that maximum nutritionally-attainable yields for sweet oranges were obtained with annual nitrogen rates of 0.45 to 0.65 kg per tree, regardless of the method of application. Foliar application of nitrogen fertilizer to citrus has not been widely adopted commercially. Due to the limits in the amount of nitrogen that can be applied in a single application, up to five foliar sprays may be required each year to provide the recommended annual rate of nitrogen, creating the perception that foliar nitrogen fertilization is more expensive because several applications are required to maintain yield. Thus, it is necessary to demonstrate that foliar nitrogen fertilization is cost-effective in order to encourage citrus growers to abandon the use of soil-applied nitrogen in favor of foliar-applied urea.

Earlier results of Sharples and Hilgeman (1969) suggested that urea applied to the foliage at the proper time might have a beneficial effect on yield. They were able to obtain yields of 'Valencia' oranges over a seven year period with only 0.23 kg N total per tree split between two foliar applications of urea, one in February and a second in late April to early May, that were statistically equal to yields obtained with 0.45 or 0.91 kg N per tree as ammonium nitrate supplied to the soil. Similarly, recent research (Ali and Lovatt, 1994) demonstrated that a properly-timed winter prebloom (mid-January or mid-February) application of low-biuret urea to the foliage of the 'Washington' navel orange (0.16 kg N per tree) significantly increased yield and fruit number per tree each year compared to control trees receiving soil-applied nitrogen for the three consecutive years of the study. The number of commercially valuable fruit with diameters 6.1 to 8.0 cm increased significantly as yield increased ($r^2=0.88$). Without taking into account the increase in the number of fruit of packing carton sizes 88 and 72, which have a greater dollar value, and despite the loss in yield due to a freeze in December of year two of the study, the average net dollar return per acre per year for trees receiving foliar low-biuret urea versus soil-applied low-biuret urea was approximately \$450 and \$400 for applications made in mid-January and mid-February, respectively (Ali and Lovatt, 1992). Consistent with the hypothesis that timing is important, mid-November and mid-December sprays were less effective. Of additional benefit, Embleton and Jones (1978) and Embleton et al. (1986) documented that foliar application of nitrogen substantially reduced nitrate pollution of ground water, even when used to only partially replace soil-applied nitrogen.

Growers in the San Joaquin Valley comprise a majority (59 percent; 91,000 acres) of California's citrus

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.²

Date Urea Applied to Foliage	% Severely Scarred Fruit		% Severely Scarred Fruit	
	Year 1	P≤0.10	Year 2	P≤0.10
early April	20.65	a	11.93	a b
late April	21.99	a	14.03	a
early May	20.89	a	11.09	a b
late May	16.09	a	9.67	b
control-soil applied N	18.94	a	11.08	a b

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

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 the May 28 and July 9 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 percent 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 percent 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 was significantly less at the 10 percent level for trees receiving the late May application of low-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 percent 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 percent 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 percent level. At the 10 percent 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 percent level on the kg and number of fruit per tree. There was, however, a statistically sig-

Maz-Zee Agricultural Products

SERVING GROWER NEEDS
Field Proven on all Trees & Vines

ORGANIC

NON-TOXIC

NON-POLLUTING

BIO-DEGRADABLE

SUPER  TRON

6-0-4
PLUS 8% CALCIUM
PLUS 2% ZINC

CONTAINS HUMIC ACIDS

AS AN AID TO IMPROVE
PLANT CONDITIONS
& INCREASE PRODUCTION
ON AGRICULTURAL CROPS
THROUGH A BETTER
NUTRITION SYSTEM

APPLY SUPERTRON & FROST SHIELD
TOGETHER IN AN EFFICIENT,
COST-EFFECTIVE APPLICATION

FROST  SHIELD

ORGANIC FROST PROTECTION
FOR ALL TREES AND VINES

FIELD PROVEN AS COST EFFECTIVE MICRO-THIN
PROTEIN PRO POLYMER COATING. AS AN AID TO
HELP PROTECT TREES, BUDS, BLOOMS AND FRUIT
FROM FROST AND FREEZE DAMAGE
WITH ONE OR TWO APPLICATIONS. WILL NOT
WASH OFF BARRING 10" OF RAIN.

Drip-A-Tron

FIELD-PROVEN, FULL-STRENGTH
ORGANIC DRIP IRRIGATION
CLEANER & MAINTAINER

CLEANS AND LUBRICATES DRIP SYSTEMS
FREES EMITTERS OF ALL MINERAL DEPOSITS
REDUCES COSTLY EMITTER REPLACEMENT
BALANCES pH, BREAKS-UP CALCIUM
CARBONATES & ALKALINE-SALTS

PENA  TRON

ORGANIC LIQUID SOIL TREATMENT

BREAKS-UP SURFACE TENSION OF
WATER & SOIL, ALLOWING GREATER WATER
PENETRATION PER CUBIC FOOT, BY
RETAINING MORE MOISTURE & ALLOWING
LESS WATER TO BE USED PER IRRIGATION

AS AN AID TO IMPROVE
HYDROPHOBIC SOIL CONDITIONS
& INCREASE WATER PENETRATION

AS AN AID TO INCREASE CROP
PRODUCTION THROUGH BETTER WATER
UTILIZATION & PLANT NUTRITION

Contact your local Ag-Chem Dealer
or Call Toll Free

1-800-775-6123

for a free sample & test for yourself.
Seeing is Believing.

Maz-Zee S.A. International
P.O. Box 82717, San Diego, CA 92138-2717

Proc. Experts' Meet./ Acireale/26-29 March 1985. A. A. Bal kema. Boston, pp. 533-543.

Morse, J. G. and T. S. Bellows. 1986. Toxicity of major citrus pesticides to *Aphytis melinus* (Hymenoptera: Aphelinidae) and *Cryptolaemus montrouzieri* (Coleoptera: Coccinellidae). *J. Econ. Entomol.* 79:311-314.

Sharples, G. C. and R. H. Hilgeman. 1969. Influence of differential nitrogen fertilization on production, trunk growth, fruit size and quality and foliage composition of 'Valencia' orange trees in central Arizona. Proc. 1st Intl. Citrus Symp. 3:1569-1578.

Tanigoshi, L. K. and J. Griffiths. 1982. A new

look at biological control of citrus thrips. *Citrograph* 67:157-158.

Tanigoshi, L. K., J. Fargerlund, J. Y. Nishio-Wong, and H. J. Griffiths. 1985. Biological control of citrus thrips, *Scirtothrips citri* (Thysanoptera: Thripidae), in Southern California citrus groves. *Environ. Entomol.* 14:733-741.

Tanigoshi, L. K., J. Y. Nishio-Wong, and J. Fargerlund. 1984. *Euseius hibisci*: its control of citrus thrips in Southern California citrus orchards. In D. A. Griffiths and C. E. Brown (eds.), *Acarology VI, Vol. 2*. Ellis Horwood, Chichester, England, pp. 717-724. □

Tristeza Poll Results Talled

By Marni Katz
Assistant Editor

More than two-thirds of citrus growers responding to a survey on future tristeza eradication in the San Joaquin Valley voted against raising assessments to boost the reimbursement level for growers of infected trees.

Some growers who have had virus infected trees pulled by the California Citrus Tristeza Eradication Agency, called for an increase in the level the agency reimburses them for eradicated trees. However, according to the CDFA-conducted poll of San Joaquin Valley growers, only 29 percent supported raising assessments to fund the increase.

In all, 60 percent of the 6,473 registered citrus growers in the San Joaquin Valley responded to the poll. Those growers represent 126,235 acres.

More than half the growers responding to the survey supported continuing the tristeza eradication program at an assessment level of \$28 per 100-tree acre. Nearly 60 percent of the 3,896 polled citrus growers participated in the survey, accounting for 68 percent of the citrus acreage in Fresno, Tulare and Kern counties, where infestation is most predominant. If approved, the proposal would raise assessments to \$36 to boost grower reimbursements from the current level of \$50 a tree to \$90 a tree.

CCTEA officials will use results of the straw poll in formulating the decisions agency directors make in future eradication plans. Directors were to meet March 29 to evaluate the poll's findings and plan the agency's direction.

In general, though, Project Director Jim Burr said results of the survey showed support for the current program.

"All pest control districts did have a majority vote in favor of the program," he said.

Five pest control districts comprise the agency. Support in some districts was stronger than in others. In Fresno and Kern counties support ranged from 65 to 70 percent. That support dropped to 53 percent in Tulare County, where most "hot spots" of severe tristeza infestation exist. □

Foundation to Study Organic Farming

The Organic Farming Research Foundation announced the beginning of a two-year project to study federal research support for organic farming methods.

The National Organic Research Policy Project will analyze United States agricultural programs to establish baseline figures for research applicable to organic farms. The project will go on to develop recommendations for increasing research that is useful to organic farmers and others interested in organic methods. The study's findings will be presented in a series of publications and presentations for policy-makers.


According to OFRF President Mark Nielson, "There is a lot of talk in Washington about moving away from chemicals in agriculture. We want to see what is being funded that actually is relevant to organic farming systems and contribute to the dialogue about future priorities."

The OFRF is dedicated to "promoting the widespread adoption of organic farming practices." Its primary focus is funding on-farm research projects that address organic solutions for specific

production problems. Since 1992, the foundation has made 44 grants. Organic farming is the production of food and fiber without the use of synthetic agricultural chemicals. Organic farmers rely on natural sources of fertility and ecological pest controls.

The board of directors of OFRF initiated the new project in response to its national survey of certified organic farmers' research needs. Robert Scowcroft, OFRF's executive director said, "We have found very little research information that meets the needs expressed by the growers. Our board recognized the need to play a role in the development of federal research priorities. OFRF's new policy project will represent organic growers and other farmers who need information about non-chemical practices. We can offer some very specific, constructive advice about moving in this direction."

The new project will be coordinated by Mark Lipson. He is a working organic farmer with a background in environmental policy and extensive experience in developing organic certification systems. □




WE'VE GROWN

In fact, since 1948 Willits & Newcomb has grown to become one of the most respected names in the citrus industry. Our trees are the finest quality — our seed selection is second to none.

- Field Grown Nursery Trees
- All Materials Grown in Tristeza Free Area
- CDFA Registered Seed & Budwood
- Rootstock Seedlings • Export Specialists

For unsurpassed quality you can always count on, grow with the leader...Willits & Newcomb.



WN, INC.
WILLITS & NEWCOMB INC.

P.O. Box 428, Arvin, CA 93203 • (805) 327-9345 • FAX (805) 366-6419