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SUMMARY AND RECOMMENDATION

The present investigation was conducted during 1997/1998 and 1998/1999 experimental seasons in order to examine the influence of elevated levels of leaf ammonium on flowering, fruit set and yield in two citrus species; namely: Washington Navel orange (*Citrus sinensis,* Osbeck) and Balady mandarin (*Citrus reticulata,* Balanco) trees. Besides, the relationship between leaf macronutrients as well as the different carbohydrate fractions and flowering, fruits set and yield was also undertaken. The trees of both species were mature, budded on sour orange rootstock and planted five meters apart. Thirty trees from oranges and mandarins were chosen for this study. The experimental trees of each citrus species were divided into 6 groups; each of 5 trees, and each group received one of the following urea spray treatments:

1. Control (sprayed with water).
2. November urea spray treatment; sprayed once on November, 15.
3. December urea spray treatment; sprayed once on December, 15.
4. January urea spray treatment; sprayed once on January,15.
5. November plus December urea spray treatment; sprayed twice on November, 15 and December, 15.
6. November plus December plus January urea spray treatments; sprayed thrice on November, 15, December, 15 and January, 15. The rate of urea sprays was 2.5% and each tree received 125 gm urea in every spray. The experimental trees of either citrus

species were arranged in Randomized Complete Block Design, with five replicates for each spray treatment. Leaf samples were collected from the experimental trees after 20 days and 30 days from the application of each urea spray treatment. Ammonium, carbohydrates and macronutrients were determined in the leaf samples. Besides, arginine was determined in a compound leaf sample for each spray treatment. Flower and fruit ammonium was determined in samples collected at full bloom and June, respectively. The number of leafy and leafless floral inflorescences born per two branches per tree was recorded in each season. In addition, during both experimental seasons, the percentages of setted fruits in both inflorescence types were calculated. Besides, the fruit yield in numbers and kilograms per tree was also recorded for each experimental trees in December of each season. The relationships between flowering, fruit set and yield with leaf ammonium, carbohydrates and macronutrients were examined by calculating the correlation, regression and determination coefficients. The results of the present study, as an overall average of both years of study, could be summarized as follows:-

1. Leaf ammonium and arginine in both Washington Navel orange and Balady mandarin trees were positively affected by all the urea spraying treatments, compared with water sprayed control trees. Nevertheless, the highest leaf ammonium and arginine content was observed in orange trees sprayed with urea only once in December or thrice in November plus December plus January. In Balady mandarin trees, January spray treatment was the most

efficient treatment in elevating the concentration of ammonium and arginine in the leaves.

2. The highest flower and fruit ammonium was observed in orange trees sprayed with urea only once in December or thrice in November plus December plus January and in mandarin trees sprayed only once in January. On the contrary, the least flower and fruit ammonium levels were noticed in water sprayed orange and mandarin trees.

3. The flowering behaviour in Washington Navel orange and Balady mandarin trees showed that the same urea spraying treatments that caused the production of the highest number of floral inflorescence (Leafy, leafless and total) were also the same treatments that caused the accumulation of the highest levels of ammonium and arginine in both orange and mandarin leaves, i.e. December or November plus December plus January urea spray treatments for oranges and January spray treatment for mandarins. In most cases, if not all, positive and significant correlation and regression coefficients were observed between leaf ammonium and the number of leafy, leafless and total floral inflorescence born on the trees.

4. The highest fruit set percentages were noticed in orange trees sprayed with urea only once in December or thrice in November plus December plus January and in mandarin trees sprayed thrice with urea in November plus December plus January. Positive and significant correlation and regression coefficients were noticed in Washington Navel orange trees between leaf ammonium and fruit

set percentages. In Balady mandarin trees, this relation was much apparent, in the off-year, while insignificant in the on-year, however.

5. Waster sprayed orange and mandarin control trees produced the least fruit yield per tree; expressed either as weight or number. As for the influence of the different urea spraying treatments, the yield of orange trees, as weight and number, could be arranged in the following descending order: December, November plus December plus January, November plus December, January and then November. With mandarin trees, the highest fruit yield per tree (weight and number) was obtained from January urea spray treatment.

6. Although urea foliar sprays increased the tree's yield (weight and number) it did not greatly affect the average fruit weight. In other words, the average weight of orange and mandarin fruits obtained from the five urea spray treatments were not statistically reduced though the concomitant increase in fruit number born on the trees. The highest average fruit weight was obtained from orange trees receiving December and November plus December urea spray treatments. With mandarin trees, November plus December urea spray treatment gave the highest average fruit weight, followed by January treatment.

7. Orange and mandarin trees sprayed thrice with urea; in November plus December plus January, had the highest concentrations from the different leaf carbohydrate fractions; reducing sugars, non-reducing sugars total soluble sugars and starch. Noteworthy,

January urea spray treatment in mandarins also showed relatively high percentages from the different carbohydrate fractions, in comparison with the other urea spray treatments. A positive and significant correlation and regression coefficients between leaf total soluble sugars and the number of floral inflorescence oranges was noticed. Yet, the relationships between the number of total floral inflorescences and leaf starch or total carbohydrate were not significant, however. With mandarin trees, insignificant correlation or regression coefficients were observed between the different leaf carbohydrate fractions and the number of total floral inflorescences. As for the relation between fruit set percentages and the different carbohydrate fractions in the two experimental citrus species, positive and significant correlation and regression coefficients were noticed with leaf total soluble sugars, starch as well as total carbohydrates. Moreover, the relation between the different carbohydrate fractions and orange fruit yield showed a positive and significant correlation and regression coefficients only with leaf total soluble sugars, while it was insignificant with either leaf starch or total carbohydrates. With mandarin trees, however, the relationship between fruit yield and all the different carbohydrate fractions was positive and significant.

8. In general, the different urea spraying treatments did not greatly influence the leaf nitrogen content neither in orange nor in mandarin trees. The only exceptional case from this general trend was noticed with mandarin trees sprayed thrice with urea. They had markedly higher leaf nitrogen content than those sprayed once either in November or January. Noteworthy, the different

urea spray treatments displayed distinctive influence on the other different leaf macronutrients. After November urea spray treatment, a higher leaf phosphorus and potassium content was observed in both orange and mandarin trees. For calcium, leaf samples collected from orange and mandarin trees sprayed thrice with urea; in November plus December plus January, showed the highest levels, with no great differences between the other urea spray treatments. Meanwhile, the highest leaf magnesium was noticed in orange tree sprayed with urea in January and in mandarin trees sprayed in November plus December. The results also indicated that there was a positive and significant relation between flowering and fruit set in oranges and leaf nitrogen, phosphorus and calcium. With orange trees yield, the only significant relation was noticed with leaf nitrogen. In mandarin trees, flowering was positively related to the levels of leaf phosphorus and magnesium, fruit set positively to nitrogen and calcium and negatively to potassium, whereas the mandarin tree's yield was not markedly affected by any of the leaf macronutrients.

In conclusion, the results of the foregoing research highly suggested that leaf ammonium greatly affected the flowering and fruiting behaviour of both Washington Navel orange and Balady mandarin trees. A single winter urea spray in December for Washington Navel orange and in January for Balady mandarin trees seemed to be quite efficient in increasing flower intensity, fruit set percentage and fruit yield.