by Dr. Brain J. Boman

Fertigation Enhances Grapefruit Yield

When combined with single broadcast fertilization, fertigation of orchards produces results superior to several conventional broadcast applications.

Summary: *During a four-year trial on grapefruit trees, fertigation, combined with a broadcast treatment, outproduced three conventional broadcast applica-tions in three of the four years. The four-year cumulative fresh fruit yield advantage of the combined treatmentaveraged 44 boxes/A per year over the conventional treatment. The production increases by the combined treatment over the conventional treatment represented an 8 percent advantage. The combination treatment also provided a high-er fertilizer-use efficiency (greater production for similar application rates) than the conventional treatments.*

This experiment took place in the Flatwoods of Florida. Flatwoods is the term given to the level, low-lying coastal areas of the Florida peninsula that are underlain by shallow water tables. Nearly all Flatwoods citrus groves are planted on beds raised from 18 to 42 inches above the water furrow. These beds are required to allow for drainage from high-intensity summer rains and provide an improved root zone over non-bedded conditions. Even with such bedding, the rooting depth of citrus on Flatwoods Spodosols is typically lim-ited to about 18 inches.

Irrigation is required on most Flatwoods soils because of low water-holding capacities of the sandy surface layers in combination with the shallow root zones. Fertigation is a common practice on young citrus trees, since they are pushed to rapidly achieve the size required to be economically productive. However, fertigation is less common on mature trees where the emphasis is more on fruit production than growth. For a variety of reasons, microsprinkler sys-tems are the predominant type of irriga-tion system.

The objective of this experiment was to compare conventional broadcast fertilization with a combination of broadcast and fertigation treatments (via the microsprinkler system) on mature “Ruby Red” grapefruit trees.

Responses

Yield. The fertilization treatments produced significant differences in yields per tree in favor of the combination treatments during all except the first year of the study, as shown in Figure 1. The total yield for the four years of the study was 2,071 boxes/A for the combination treatments compared to 1,897 boxes/A for the conventional treatments. The cumulative advantage for the combination treatments was 174 boxes/A or an average annual increase of 44 boxes/A/year, as shown in Figure 2.

TSS. The difference in total soluble solids (TSS) produced between the two fertilization programs was significant only in the 199 1/92 season. However, the four-year total was highly significant. Cumulative TSS produced over four years for the combination treatments averaged 9,744 lbs/A versus 9,048 lbs/A for the conventional treat-ments (Figure 2). The difference in TSS of 696 lbs/A/year resulted in an average of 174 lbs/A/year more TSS for the combination treatments compared

Table 1. Fertilization dates for “Ruby Red” grapefruit trees, Boman, University of Florida, 1988-92.

Treatment	**1988/89**	**1989/90**	**1990/91**	**1991/92**
Conventional				
Broadcast application dates	13 Apr 21 June 26 Oct	21 Feb 13 June 18 Oct	21 Feb 30 May 16 Oct	27 Feb 26 June 6 Nov
Total N & K_2O (lbs/A)	155	160	158	158
Combination				
Broadcast N & K_2O (lbs/A)	52	52	52	52
No. fertigations	18	17	17	17
Fertigated N & K_2O (lbs/A)	113	107	107	107
Total N & K_2O (lbs/A)	165	159	159	159

with the conventional treatments.

Leaf concentrations. Only minor differences were noted with respect to leaf mineral content due to fertilization. The combination treatments had a higher leaf N content in one of four years and lower K in one of four years. No differences were noted in leaf Ca and P concentrations for any of the years. Although it was not noticeable in the trees, leaf N concentrations for one season were below the optimum range. The low concentrations were possibly due to sampling older leaves resulting from an early spring flush, and a September sampling date. Leaf P, K, and Ca levels were at or slightly below optimum ranges throughout the four years of the experiment.

***Fruit** size.* Fruit is sized at the packing house in accordance with how many fit in a four-fifths bushel carton (the larger the number, the smaller the fruit). During the three seasons that fruit size was measured, no statistical differences were noted in the percentage of fruit in any of the size cate-gories. However, the median fruit size in the 1989/90 and 1991/92 seasons was 36 for the conventionally treated plots while the median for the combination-treated plots was a size smaller at 40. When the percentages of each size were averaged for the three years, the conventionally treated plots tended to have a slightly higher percentage of the measured fruit in the bigger sizes (Figure 3). The conven-tionally treated plots averaged 36 percent of fruit size 36 and larger, compared With 32 percent for the plots receiving combination treatments.

Juice quality. The only differences in juice quality between treatments occurred during the first year of the study when the fruit from the combination treatments was larger and had a slightly lower Brix content than the fruit receiving the conventional treatments.

Climatic factors

There were large year-to-year varia-tions in the overall fruit production resulting from climatic factors and tree physiological response.

Temperature. Yields in the 1989/90 season were greatly reduced from the previous season due to a low fruit set caused by sub-freezing temperatures in February. Production rebounded in the 1990/9 1 season with exceptionally

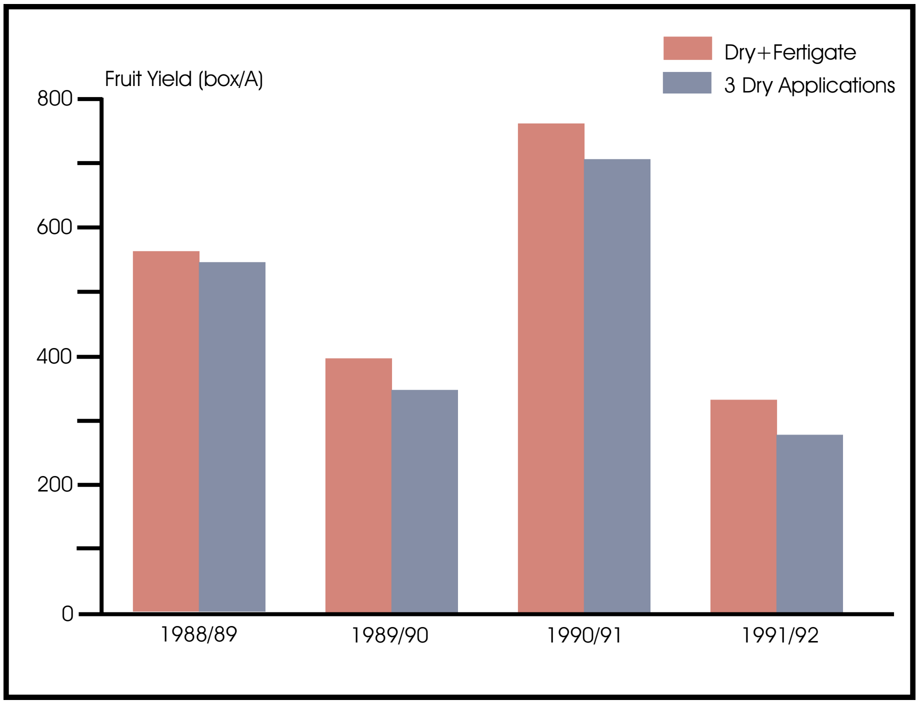

Figure 1. Mean fruit yield by fertilization on “Ruby Red” grapefruit rees, Boman, University of Florida, 1988-92.

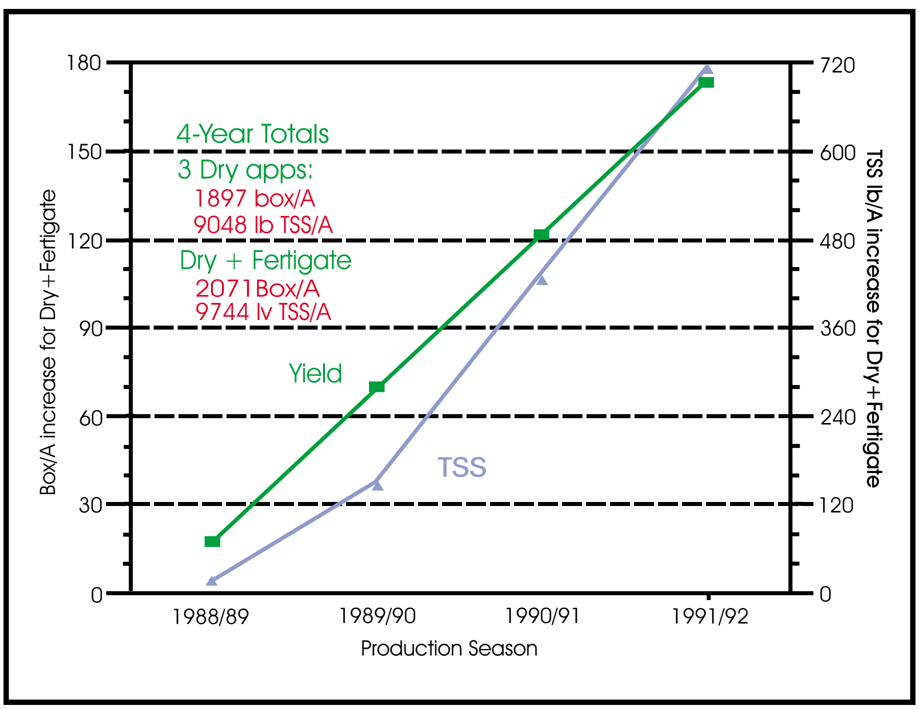

Figure 2. Four-year cumulative TSS and fruit yield advantage of combination treatments over conventional treatments, Boman, University of Florida, 1988-92.

high yields for the block. Yields in the following season (199 1/92) were the lowest in the four-year period, partially as a result of the exceptional yields in the previous season and also due to a sporadic bloom caused by lack of winter dormancy, plus widely fluctuating spring temperatures.

Moisture. One of the driest periods in recent times occurred during the first two-and-a-half years of the study. Normal annual rainfall is about *55* inches in the area of the trials. Only 42 inches of rainfall was recorded in the 1988/89 season (March 1988 through February 1989), followed by 45 inches in the 1989/90 season. The first half of 1990 was also very dry. However, summer rains brought relief to the extended drought. The 1990/91 rainfall was 46 inches. In 199 1/92, 59 inches of rain was recorded. Supplemental irrigation applied during dry periods resulted in total rain-fall plus irrigation averaging *65*, 71, 64, and 65 inches for the 1988/89, 1989/90, 1990/91 and 1991/92 seasons, respectively. Higher water application in the 1989/90 season (23 inches of irrigation) was a result of drought in July through September when summer rains normally supply sufficient moisture.

Methodology

Application. Nitrogen and potassium were applied on the dates shown in Table 1 and at the rate of approximately 160 lbs/A per year.

On the conventional plots, dry appli-cations were broadcast three times per year. About 33 percent of the annual nitrogen and potassium (plus minor ele-ments) was applied in late winter. The same applications were repeated in May/June and October/ November.

On the combination plots a single broadcast application was made in February, applying again 33 percent of the nitrogen and potassium. The remain-ing 67 percent was applied throughout the growing season. A 10-0-10 solution was injected into the irrigation water at the rate of 6 lbs/A of N and $K_2$0 every two weeks from April through early November.

Grass/weed control. A herbicide strip was used in the tree rows to control grass and weeds.

Soil. Experiment was conducted on a Pineda Fine Sand, which has about 6 inches of gray sand overlaying a yellowish-brown sand. A clay layer at a depth of about 3 feet provided a slowly perme-able barrier that perched the water table during high rainfall.

Plots. Most beds contained eight plots with six or eight "Ruby Red" trees per plot. Plots consisted of three or four adjacent trees in a row plus matching trees in the row on the other side of the bed. Tree density was 87 trees/A.

Leaf samples were collected for min-eral analysis during August or September of each year.

Yield measurements were obtained for each randomized complete block design from the total weight of fruit produced on two trees from each plot.

Fertigation beneficial

This experiment suggests that with a properly designed and maintained microsprinkler system, broadcast fertilization

combined with fertigation can provide enhanced returns for Flatwoods citrus growers.

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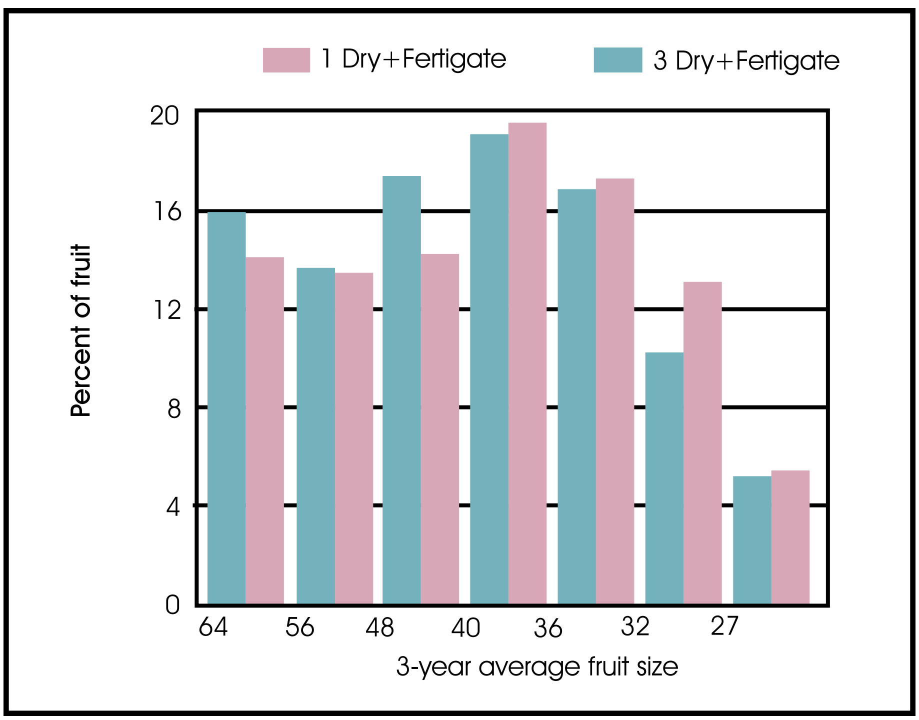

Figure 3. Three-season (1989-92) average percentage of measured fruit within each size category by fertilizer treatment, Boman, University of Florida.