Project No: 3937 (Termination Report)

Title: Cropping Efficiency of Young Fuji Apple Trees

Personnel: Preston K. Andrews, Assistant Horticulturist, WSU-Pullman
Margaret L. Collier, Ag Research Tech III, WSU-Pullman

Reporting Period: 1992-94

Accomplishments:

1. Chemical thinning of young Fuji apple trees was tested during three seasons in a commercial orchard near Orondo. New thinners and earlier applications of carbaryl (Sevin) were tested. Single sprays were insufficient to adequately thin Fuji; an aggressive thinning program with multiple products and timings was necessary. The results of this research will aid growers in establishing chemical thinning protocols for young Fuji orchards.
2. To test the limits of early cropping on subsequent productivity of young Fuji apple trees, an experiment was established in a young commercial Fuji/M.9 orchard. Second-leaf trees were hand blossom or fruit thinned to either heavy or light crop loads, or to no fruit. In the third leaf, trees that were uncropped and lightly cropped in the second leaf were either cropped lightly or heavily. Trees that were cropped heavily in the second leaf were cropped heavily again in the third leaf. Fruit and vegetative growth, types of fruiting wood, yield factors, fruit quality and defects, and return bloom were measured. The results of this experiment will assist Fuji growers in setting crop loads to maximize early returns without sacrificing productivity when the orchard reaches maturity.

Results:

Chemical thinning experiments. Chemical thinning trials were conducted in third- and fifth-leaf Fuji/M.26 plots in 1992. Numerous compounds, combinations and concentrations (all concentrations are per 100 gal except where indicated) were tested. In the third-leaf plot, Ethrel (1.33 pt) applied at full bloom (FB) was the most effective thinner resulting in fruit set near that of the hand-thinned controls. This treatment produced larger fruit than any other chemical thinning treatment. Sevin 4F (0.67 pt) applied 16 days after FB (DAFB), benzyladenine (BA) (12 oz) at 3 weeks after FB, and Ethrel (0.67 or 1.0 pt) at FB + Provide (GA_{4+7}) (13 oz) at 7 and 17 DAFB + NAA 200 (1.2 oz) at 16 DAFB were also moderately effective. Poor thinning was achieved with 0.5 pt Ethrel at FB, Amid-Thin W (NAD) (2.7 oz) at 10 DAFB + Sevin (0.5 pt) at 16 DAFB, and Sevin (0.5 pt) + NAA (0.7 oz) at 16 DAFB. In the fifth-leaf plot, the best thinning and fruit size were achieved with Sevin (0.67 pt) at 16 DAFB or NAD (2.7 oz) at 13 DAFB + Sevin (0.5 pt) at 16 DAFB. The effectiveness of Wil-Thin (D-88) (3 pt) applied at FB in both the third- and fifth-leaf plots was average to poor.

Thinning trials in 1993 were conducted in a fourth-leaf Fuji/M.26 orchard. This plot had a more uniform bloom density (50-75 clusters/100 total buds) than those plots used in 1992. Treatments using Sevin XLR (0.67 pt at 10 DAFB, 0.5 pt + NAD [3 oz] at 10 DAFB, 1.5 pt at petal fall [PF], and 1.5 pt + NAA [2.2 oz] at PF) reduced fruit set more than other treatments (i.e. 0.67 or 1.33 pt Ethrel at FB, 18 oz BA at 21 DAFB [20 mm fruit diameter], and 1.6 gal ammonium thiosulfate [ATS] at FB). Regulaid was used as a surfactant at concentrations of 2 pt with Ethrel, 1.5 pt with NAD, 1 pt with BA, and 0.5 pt with NAA. No chemical thinner reduced fruit set as much as either the hand blossom (FB) or fruit (21 DAFB) thinned trees. Crop densities (number of fruit/trunk cross-section area [TCSA]) at harvest were lowest for the post-bloom Sevin + NAD and Sevin (1.5 pt) + NAA (2.2 oz) at PF treatments. These crop densities were about 30% lower than the unthinned controls, but still 50% higher than the hand thinned treatments. Other treatments had higher crop densities. Yield efficiencies ranged from 1.3-1.8 kg fruit/cm^2 TCSA. These crop loads resulted in yields equivalent to 15-19 tons/A at the tree density of this orchard. Chemical thinning treatments with high concentrations of Sevin applied at PF or Sevin + NAD applied post-bloom resulted in the largest fruit. Return bloom was measured in Spring 1994, but these data have not been analyzed yet.

The 1994 chemical thinning trials consisted of multiple compounds and application timings in fourth-leaf Fuji/M.26 and tenth-leaf Royal Gala/M.7a orchards. Unlike the 1992 and 1993 trials where applications were made with low-pressure hand-wand sprayers, 1994 applications were made with an air-blast backpack sprayer (Solo) at approximately 100 gal/A to the Fuji trees and 200 gal/A to the Gala trees. The bloom density of both plots was uniform at 75-80 clusters/100 total buds. Regulaid was used at the same rates as in 1993. The most effective Fuji blossom (FB or PF) thinning treatment was Sevin XLR (1 pt) + NAD (4 oz) + Ethrel (1 pt), with 40% lower fruit set than the unthinned control. It still had 70% higher fruit set than hand blossom thinned trees, however. Accel applied at either 20 or 30 g active ingredient/A when fruits were 12 mm diameter were more effective post-bloom treatments than Sevin XLR (1 pt) + NAA (1 oz). There were only small differences in the thinning effectiveness of most of the combined blossom/post-bloom spray treatments, including ATS (1.6 gal) at FB + Sevin (1 pt) + NAA (1 oz) at 12 mm fruit diameter, Sevin (1.5 pt) or Sevin (1 pt) + NAD (5 oz) at PF with Sevin + NAA applied post-bloom, Sevin (1.5 pt) at PF + Accel (20 or 30 g a.i./A) post-bloom, and Accel (20 or 30 g. a.i./A) at PF + Sevin + NAA postbloom. Only Wil-Thin (2 pt) at FB + Sevin + NAA post-bloom was an ineffective thinning program. There were no differences in fruit size at harvest; however, all chemical thinning treatments were further hand thinned in late June by a commercial crew. Sevin (1.5 pt) applied at PF to Gala was more effective than PF Accel treatments (20 or 30 g a.i./A). These same concentrations of Accel applied when fruits were 12 mm diameter were more effective post-bloom treatments than Sevin (1 pt) + NAA (1 oz) applied post-bloom. There were no differences in fruit size at harvest. Post-bloom Accel sprays increased

seed mortality to 40-50% dead seeds/fruit. Return bloom will be measured in Spring 1995.

Cropping efficiency experiment. In Spring 1993, second-leaf Fuji/M.9 trees in a high-density commercial orchard (1000 trees/A) were hand thinned to light (11-12 fruit/tree or 2 fruit/cm^2 TCSA) or heavy (22-23 fruit/tree or 4 fruit/cm^2 TCSA) crop loads, either at FB or when the fruits were 20 mm diameter. Control trees were deblossomed and bore no fruit. The heavily cropped trees had higher yields (5.4-5.7 kg/tree) than the lightly cropped trees (2.8-3.3 kg/tree). This resulted in yields/A equivalent to 6 tons for heavily cropped trees and 3-3.5 tons for lightly cropped trees. Time of thinning had no effect on yields. Fruit size of the lightly cropped, blossom thinned trees exceeded that of both lightly and heavily cropped, fruit thinned trees from mid-June through harvest. Heavily cropped, blossom thinned trees had fruit of intermediate size. Vegetative growth, measured by trunk and branch cross-sectional areas (TCSA and BCSA) and shoot growth, was greatest in uncropped, intermediate in lightly cropped, and least in heavily cropped trees. Fruits on lightly cropped trees appeared to have a higher incidence of sunburn (23-25%) than those on heavily cropped trees (14-19%). There were no differences in fruit quality at harvest between lightly and heavily cropped trees.

In the third leaf (1994), crop load was adjusted based on the previous year's cropping level, so that trees lightly cropped in the second leaf were either lightly cropped again or heavily cropped. Trees with no fruit in the second leaf were either lightly or heavily cropped in the third leaf, and heavily cropped second-leaf trees were heavily cropped again. Trees were either blossom or fruit thinned as in the previous year. Uncropped second-leaf trees had better return bloom than previously heavily-cropped trees. Lightly cropped second-leaf trees had intermediate return bloom. Blossom thinning in the second-leaf also resulted in better return bloom than fruit thinning. Lightly cropped, third-leaf trees had 27 fruit/tree or 3 fruit/cm^2 TCSA, while heavily cropped trees had 51 fruit/tree or 6 fruit/cm^2 TCSA. The heavily cropped trees had higher yields (15 kg/tree) than the lightly cropped trees (10 kg/tree). This resulted in yields/A equivalent to 16.5 tons for heavily cropped trees and 11 tons for lightly cropped trees. Time of thinning had no effect on yields. Fruit size was largest when borne on "darts" of lightly cropped trees and smallest when borne on young wood of heavily cropped, fruit thinned trees. Generally, fruit size was larger from "darts", intermediate from spurs, and smaller from young wood. Fruit on spurs had higher incidence of sunburn (17%) than fruit on young wood (13%) or "darts" (8%). Second-leaf cropping levels affected third-leaf vegetative growth independent of third-leaf crop levels. Also, fruit size of heavily cropped, third-leaf trees was larger when these trees were lightly cropped in the second leaf, rather than heavily cropped. There were no differences in fruit quality at the two crop loads.

Publications:

1) Andrews, P. K. and Collier, M. L. 1993. Cropping and thinning of young Fuji apple trees, p. 171-173. Proceedings 89th Annual Meeting Washington State Horticultural Association. (Poster presentation)
2) Andrews, P. K. and Collier, M. L. 1994. Chemical thinning of Fuji and Gala apple trees. Poster presentation at 90th Annual Meeting Washington State Horticultural Association.