How to Grow Large Gala's

Terence Robinson
Department of Horticultural Sciences,
New York State Agricultural Experiment Station, Cornell University,
Geneva, NY 14456
Email: tlr1@cornell.edu

The fresh apple market of the USA provides a significant premium for large 'Gala' fruit (80-88 fruits/box). However, it is often difficult to achieve large fruit size in NY State. The reasons why NY growers struggle to produce the highest priced 'Gala' sizes are that Gala is genetically small fruited and it sets very heavy crops which leads to small fruit size. Furthermore, it is not biennial, thus producing repeated heavy crops with small fruit size, which leads to a decrease in tree vigor over time. Trees that are low in vigor are difficult to thin which further compounds the problem. 'Gala' also produces copious flowers of one year old wood which adds to the over cropping problem. Management approaches to achieve the desired fruit size of 'Gala' include pruning, crop load management (thinning), fertilization and irrigation.

We conducted a 3 year study at Geneva NY using 6-9 year-old 'Gala''/M.9' trees where we compared the individual and combined effects of management factors known to influence fruit size of 'Gala' apple: pruning, thinning, N fertilization and irrigation.

Pruning

The pruning treatments were: 1) limb renewal pruning which consisted of the removal of 2-3 whole limbs to open up the canopy of the tree but no detail pruning, 2) spur pruning or spur extinction which consisted of similar pruning as treatment 1, but with the additional removal of 1/3 of the spurs on the remaining branches (Figure 1A), and 3) stubbing back pruning which consisted of similar pruning as treatment 1, but with the additional stubbing back of all of the remaining fruiting branches by removing about 1/4-1/3 of their length (Figure 1B).

Of the four management factors considered in our study pruning had the greatest effect on yield and fruit size. The stubbing back pruning strategy reduced final crop load and yield the most each year. In 2003, this resulted in a 13 g increase in fruit size, in 2004 a 16 g increase and in 2005 a 7 g increase. The spur pruning treatment had less effect on yield and resulted in a 6 g increase in fruit size in 2003, a 14 g increase in 2004 and a 14 g increase in 2005. Averaged over the 3 years of the study both stubbing back pruning and spur pruning gave a similar improvement in fruit size over the limb renewal pruning treatment. When fruit size was adjusted for crop load the stubbing back pruning and the spur pruning had greater adjusted fruit size than did the limb renewal pruning.

Both stubbing back pruning and spur pruning gave similar improvements in fruit size and crop value. This indicates that despite the difference between the treatments they were accomplishing the same end result: a reduction in bud load and crop load. The stubbing back pruning was a fast and efficient method of reducing bud load while spur pruning was slower would be more costly. The spur pruning in our experiment was similar to the spur extinction used in the SolAxe training system (Lauri and Lespinasse, 2000). This system has been adopted by many growers in France and Chile. In the long term, we expect that spur pruning would result in longer branches while stubbing back would result in a narrow compact tree with branches which would need to be renewed more frequently. If stubbing back

pruning were used, it would allow closer planting spacings since the trees become very narrow and columnar.

Thinning

We compared thinning with NAA plus Carbaryl (7.5ppm Fruitone-N plus 1pt SevinXLR) at 10 mm to thinning with BA plus Carbaryl (75 ppm Maxcel plus 1pt SevinXLR). Thinning treatments had an intermediate effect on fruit size. BA+Carbaryl gave the greater reduction in crop load and yield and also the greater improvement in fruit size. In 2003 BA+Carbaryl improved size by 11g, in 2004 by 6g and in 2005 by 7g. Even when fruit size was adjusted for crop load, BA had a significant positive effect on adjusted fruit size. In most cases, thinning with BA+Carbaryl reduced yield and improved fruit size more than thinning with NAA+Carbaryl.

Fertilization

Nitrogen fertilizer was applied to the soil in the spring at budbreak at either 50 lbs N per acre or 150 lbs N per acre. Fertilization had a significant influence on yield but no impact on fruit size. The high nitrogen treatment resulted in slightly increased yield in 2003 and 2004 but no effect in 2005. The increased yield was from increased fruit number per tree, not an improvement in fruit size.

Irrigation

We compared trickle irrigation to no irrigation. Irrigation had no effect on yield or fruit size in either 2003 or 2004. However, in 2005 irrigation significantly improved fruit size by 12 g. The lack of effect in 2003 or 2004 was due to above normal rainfall in those 2 years. Rainfall in 2005 was less than average resulting in a significant improvement in fruit size with trickle irrigation. However, despite the positive effect of trickle irrigation in 2005, fruit size was smaller than in the other years. Also the relationship of fruit size and crop load for 2005 had a lower intercept than in other years with indicates that other environmental factors other than soil moisture limited fruit size in 2005.

Combined Effects

There were few significant interactions between pruning, thinning, fertilization and irrigation, indicating that each of the main factors could affect yield and fruit size of Gala in an independent and additive manner. The best treatment which combined stubbing back pruning, high nitrogen fertilization and the thinning program with BA resulted in a fruit size of 194g in 2003, 184g in 2004 and 157g in 2005 or a 31%, 23% or 16% increase in fruit size, respectively, compared to the limb renewal pruning, low nitrogen fertilization and the NAA thinning treatment.

Crop value

Both pruning, and thinning reduced yield to increase fruit size. Thus, to determine if the reduction in yield is profitable, crop value must be calculated. Although the fresh apple market rewards fruit growers for large sized Gala apples, the negative relationship between yield and fruit size means that producing very large Gala's is accompanied with significantly lower yield. How much a grower gets paid for his fruit, depends on both yield and fruit size. We calculated crop value for each of our treatments by applying published packed fruit prices for different sizes, to our yield and fruit size data.

In 2003 neither the stubbing back pruning nor the spur pruning improved crop value despite a significant improvement in fruit size. The increase in fruit size was offset by the loss in yield. In addition, the fruit size on the minimally pruned trees was quite large (165 g) giving a high crop value for the

minimally pruned treatment. In 2004, both the stubbing back pruning and the spur pruning treatments resulted in a significant improvement in crop value. In 2004, the fruit size of the minimally pruned treatment was also quite large (158g), but the aggressive pruning treatments resulted in a larger increase in fruit size and thus a significant improvement in crop value. There were very large differences in crop value between the plots, which were due to large differences in yield per acre. In 2005, the spur pruning treatment resulted in the greatest crop value followed by the stubbing back pruning and then the limb renewal pruning. In 2005, the fruit size of the minimally pruned treatment was quite small (122g), but the aggressive pruning treatments resulted in a larger increase in fruit size and thus a significant improvement in crop value.

Thinning with BA+Carbaryl resulted in significantly greater crop value than thinning with NAA+Carbaryl in 2003 and 2004 but not in 2005. In 2005, thinning with BA+Carbaryl reduced cropload too much and crop value was reduced. This indicates that thinning too aggressively to achieve the largest fruit size often does not improve crop value. Increased nitrogen fertilization improved crop value in 2003 but not in 2004 or 2005. Irrigation had no effect on crop value in 2003 and 2004 but improved crop value in 2005.

There were no significant interactions between pruning, thinning, fertilization and irrigation on crop value. The best treatment in each year was the combination of spur or stubbing back pruning, high nitrogen fertilization, irrigation and thinning with BA+Carbaryl. This treatment had a 3-year cumulative crop value of $18,850 per acre or 2.7X the crop value the minimal pruning, low nitrogen fertilization and the thinning treatment.

Optimum yield and fruit size

We calculated theoretical curves to predict the optimum yield and fruit size for Gala that would maximize crop value. This was done by relating crop load and fruit size for each year to construct theoretical yield, packout and crop value curves for the range of fruit sizes. The relationship between crop load and fruit size was significant and negative each year (Figure 2A). In 2003 and 2004 there was no difference in the slopes or intercepts of the lines. However, in 2005 although the slope of the relationship was similar to earlier years but the intercept was significantly lower than in the other years indicating that in 2005 fruit size was smaller than other years regardless of the cropload. These theoretical curves were used to predict optimum yield and fruit size for each year.

The theoretical crop value curves predicted that when yield was reduced crop value increased to an optimum crop value but further reductions in yield beyond the optimum resulted in reduced crop value (Figure 3A). The optimum yield varied widely between years with the optimum yield estimated at 62, 87 and 26 $t \cdot ha^{-1}$ in 2003, 2004 and 2005, respectively. In 2003 our plot had yields from 750-900 bushels/acre, but in 2004, the plot had a very heavy crop with large fruit size resulting in yields from 1600-2000 bushels/acre. These differences illustrate that although fruit size is an important component of grower returns, yield is much more important. This points to the importance of growing trees large enough to fill the allotted space.

The optimum fruit size also varied between years but was similar in 2003 and 2004 (161 and 169g, respectively: ~113 count size) (Fig. 2B). In 2005 the optimum fruit size was much smaller (140g).Our calculations of optimum fruit size indicated that although larger fruit sizes (80 and 88 count) are sold for higher prices in the market, the optimum fruit size from a grower's perspective may not be the larger sizes since they are produced by sacrificing substantial yield. Often the loss in yield to produce the large

sizes with Gala is too high to optimize crop value for the grower. Our data suggest that more moderate sizes of 100-113 count size will provide greater grower returns. To produce the larger average fruit size requires too great a loss of yield with the New York State climate.

Conclusions

The fresh apple market is giving growers a compelling need to grow larger sized Gala apples. However, the negative relationship between yield and fruit size means that producing very large Gala's may not be the most profitable course for growers. Our experiments have shown that by using a combination of aggressive pruning, BA+Carbaryl thinning, high fertilization and irrigation growers can achieve an average fruit size of 190g (80 count Galas). However, crop value appears to be optimized when average fruit size is slightly smaller (161-169g or 113-100 count size). This was true despite significantly lower fruit price for these sizes than 80 count size. Achieving 80 count fruit required too large of a reduction in yield, which negated the higher price for the remaining fruits. To achieve the optimum fruit size will likely require aggressive pruning and thinning. Either the stubbing back pruning or the spur pruning, effectively reduced cropload by 1/3 by dropping on the ground about 1/3 of the buds in the dormant season. Chemical thinning with BA resulted in the best thinning and fruit size increases with Gala. The best results were obtained with multiple thinning sprays. A very interesting approach is the 3 spray program of ATS at full bloom, Carbaryl at petal fall and BA/Carbaryl at 10mm fruit size.

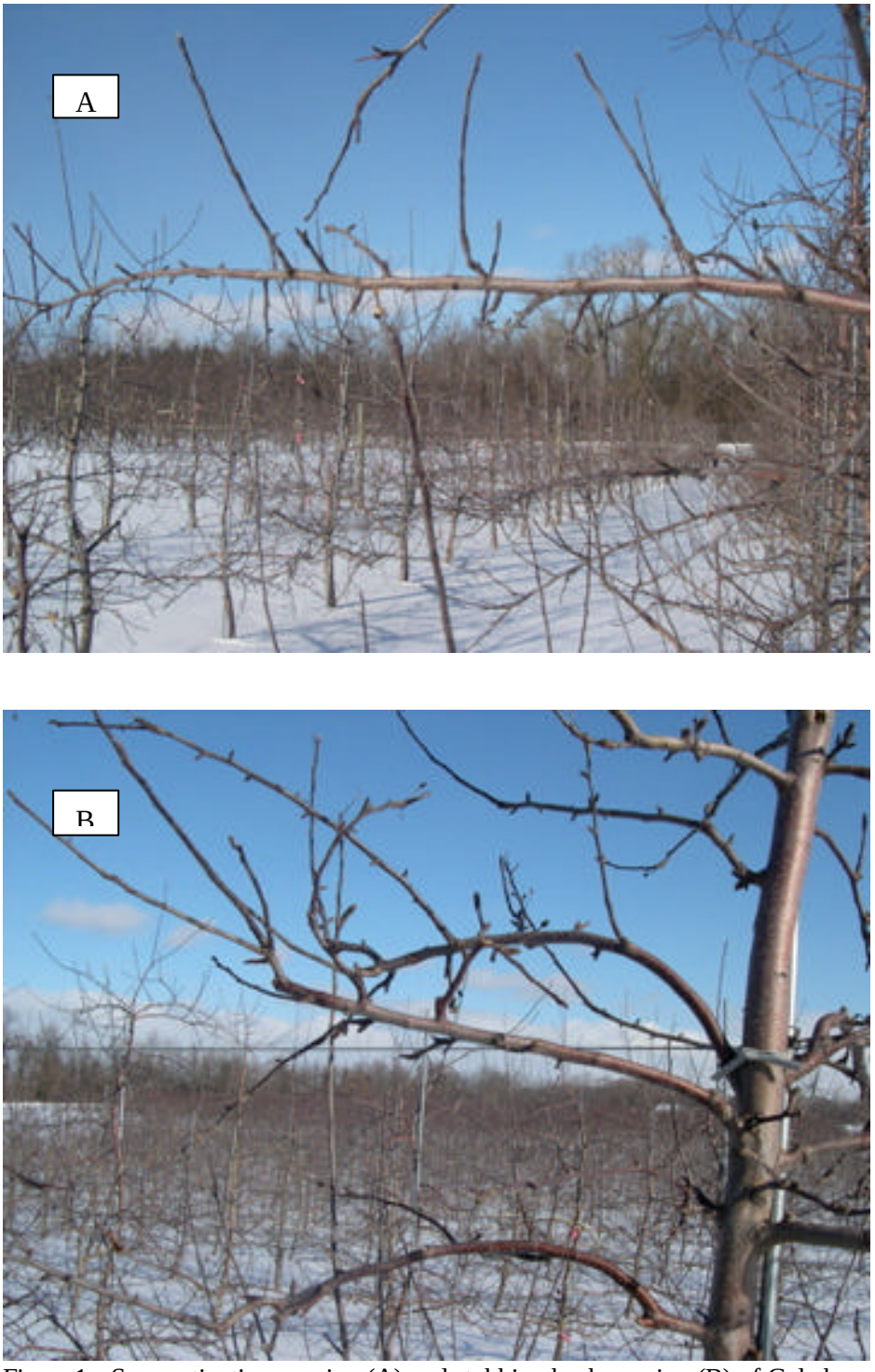

Figure 1. Spur extinction pruning (A) and stubbing back pruning (B) of Gala branches. (Note re-growth response of bourse shoots and at the point of the stubbing back cut.)

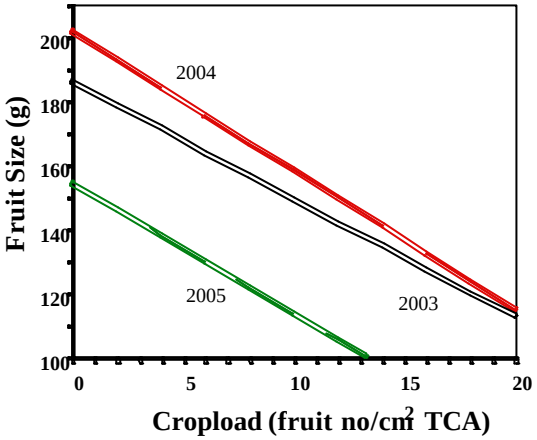

Figure 2. Relationship of crop load and fruit size of Gala apple trees at Geneva NY.

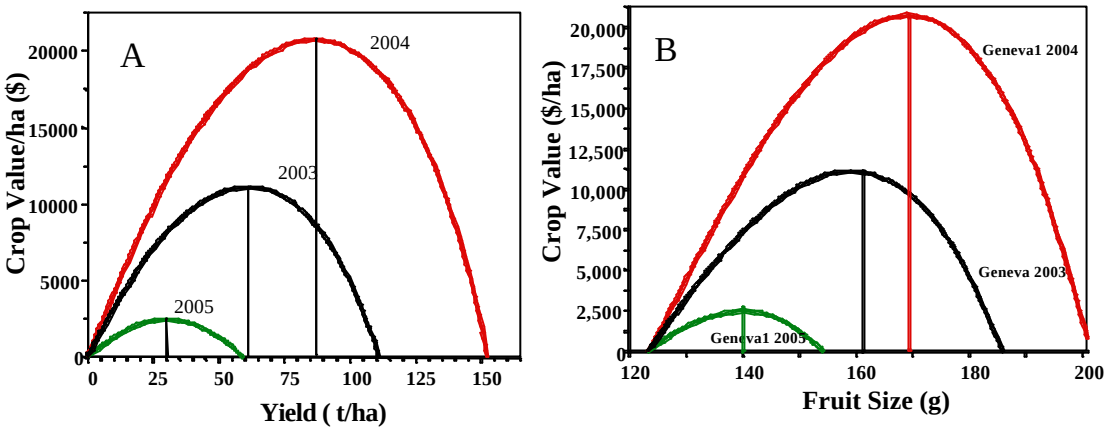

Figure 3. Predicted crop value as a function of yield (A) or fruit size (B) of Gala apple trees at Geneva NY

Terence L. Robinson

Associate Professor
Department of Horticultural Sciences

B.S. 1978 Brigham Young University
M.S. 1982 Washington State University
Ph.D. 1984 Washington State University

Areas of Expertise:

Tree Fruit Crop Management and Applied Physiology of apple, pear, cherry, peach, plum, and apricot.

I am an applied fruit crop physiologist. My goal is to do practical research and extension on tree fruit production problems that will increase the profitability and strength of the NY fruit industry and fruit growers around the world. My research and extension efforts are in 5 areas:

1. Orchard Systems: My goal is to understand the fundamental principles of orchard system performance in both biological and economic terms. I do in-depth studies at Geneva and applied trials on grower's farms around the state in cooperation with extension field staff (Steve Hoying, Mike Fargione and Kevin Iungerman). Our field trials are evaluated from an economic perspective in cooperation with Gerald White, and Alison DeMarree.

2. Rootstcoks: My goal is to evaluate apple rootstocks for adaptability and performance under New York conditions. We are testing rootstocks from around the world including new Cornell-Geneva series of rootstock. This work is done in cooperation with Genarro Fazio of the USDA, Herb Aldwinckle of Plant Pathology and the national rootstock testing project- NC-140.

3. Crop Load and Canopy Management: My goal is to develop improved thinning and canopy management practices that improve fruit size and fruit quality while managing orchard tree canopies at a variety of tree densities. This work is in cooperation with and Alan Lakso, Lailiang Cheng, Duane Greene of U. of Mass and Greg Lang of Michigan State University.

4. Irrigation/Fertigation: My goal is to develop fertilization and irrigation strategies and scheduling programs that will enhance fruit size, quality and yield of both young and older orchards. This work is in cooperation with Lailiang Cheng.

5. Extension Leadership: I serve as chair of the fruit program research and extension team at Cornell and on the advisory committees of the tree fruit extension specialists. We provide high quality in-service training meetings for extension educators through the regional Great Lakes Fruit Workers Conference with Michigan and Ontario Canada. I serve as editor,(along with Steve Hoying) of the NY Fruit Quarterly which is the primary research reporting magazine that provides the fruit industry with regular communication on the progress of research programs at Cornell.