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COMPACT NEWS

A Periodic Newsletter of the International Dwarf Fruit Tree Association

No. 1 February 1992

A MESSAGE FROM THE EDUCATIONAL DIRECTOR

The program and plans for the upcoming Annual Conference are being well received. I hope to see you in Niagara Falls. We will welcome any comments you may have concerning future programs. We are anxious to develop topics that will be of help to you as you look to the future. Information and results from applied research programs are important. I would hope you would review the articles that are included later in this publication.

I realize that many of you will not be able to attend the 1992 Annual Conference in Niagara Falls, but all of the papers presented will be published in Volume 25 of Compact Fruit Tree. *Be sure to read them when you receive your copy. I have reviewed several of them already. They are well done and informative.*

H.A. (Jack) Rollins, Jr.

1992 Summer Tour Plans Progressing Rapidly

Pierre Philion reports that things are really moving for a good summer fruit tour in Quebec. There is a good crew of growers helping with the details.

The tour headquarters will be at Macdonald College in Ste-Anne de Bellevue which is located on the West-end Island of Montreal. It is a quiet area where the St. Lawrence and Ottawa rivers meet and it is an easy access by routes 20 and 40. Maps will be available with the registration kits.

Registration and details will be forwarded to you in March. Set the above dates aside, it will be an interesting tour. Some of you may have been on the tour in 1982 but the 1992 tour is a completely renewed program and will provide an opportunity to see the fruit industry developments and advances that have taken place over the past ten years.

The Summer Tour program outline is as follows:

DATES:

Sunday, June 14	Afternoon registration starting at 1:00 P.M. Social evening dinner 6:30-8:30 P.M.
Monday, June 15	Orchard Tours
Tuesday, June 16	Orchard Tours
Wednesday, June 17	Breakfast and check out

This year's Summer Tour is an event you can't afford to miss — watch your mail for more information!

HIGH DENSITY, PEDESTRIAN APPLE ORCHARD PRODUCTION

Dick Unrath, Mike Parker, Eric Young
Horticultural Science, NCSU

A dwarfing, high density apple orchard was established in 1988 to evaluate the potential of developing a pedestrian (totally contained and managed within reach of the ground) apple orchard management system for North Carolina apple growers.

In 1991, its fourth year, this orchard yielded 500 bushels of fruit per acre.

Because labor is becoming more costly and scarce, and pesticide rates are being reduced and many chemical registrations cancelled, the use of shorter, smaller canopied trees which are planted at 500 to 1000 trees per acre, managed totally from the ground and fruited early, could have considerable advantages for North Carolina growers.

Labor efficiency, pesticide effectiveness and earlier return on investment are all attractive features of these orchards. The fourth year of 500 bushels per acre is above the current state average for all bearing apple acreage. In a year of extreme disease pressure from climatic conditions and registration loss of effective chemicals for disease control, these small canopied trees produced large size, top quality fruit. These pedestrian orchards may hold the best hope for a bright future for the North Carolina apple industry.

For additional information contact C.R. Unrath (704-684-3562).

NC-140 APPLE ROOTSTOCK TRIALS UPDATE

Eric Young
Horticultural Science, NCSU

The oldest apple rootstock trial of the NC-140 cooperative rootstock testing project was planted in 1980 and terminated in 1990 and the final reports of this trial are now available.

Reports covering many aspects of this trial make up a complete issue of the *Fruit Varieties Journal* published by the American Pomological Society. This issue, volume 45, number 4, is available from the American Pomological Society, 102 Tyson Building, University Park, PA 16802 for $7.00.

This trial involved nine rootstocks with "Starkspur Supreme Delicious" as the cultivar and was managed as a medium density, central leader orchard in 27 sites around the US. Rootstocks tested in this trial were: Ottawa 3, M.7 EMLA, M.9 EMLA, M.26 EMLA, M.27 EMLA, M.9, MAC.9 (Mark), MAC.24, and OAR.1.

Continued on next page.

Annual Conference Transportation

Arrangements are being developed to assist with your transportation from the Buffalo, New York airport to the Radisson Hotel in Niagara Falls.

Those needing assistance should call Darrel Oakes (IDFTA Board Member, Lyndonville, New York) at 716-765-2046. Leave your name, telephone number, date and time of arrival, airline, and flight number.

NC-140 APPLE ROOTSTOCK TRIALS UPDATE . . .

Continued from page 2

The reports included in this issue of *Fruit Varieties Journal* cover rootstock effects on such characteristics as overall growth and productivity, cold injury, pruning requirements, fruit maturity, size, and storability, foliar nutrient content, and root growth.

The overall performance summary indicates that the greatest tree losses were with 0.3, M.27 EMLA, and MAC.24. Largest trees by far were on MAC.24 (100%) and smallest were on M.27 EMLA (6%). 0.3, M.9, M.9 EMLA, and Mark (20-25%) did not differ in size while M.26 EMLA (40%) and M.7 EMLA (50%) were intermediate. Trees on MAC.24, OAR.1, and M.7 EMLA produced much *less* fruit per tree size than the smaller trees.

Estimated production potential per acre based on 10-year tree size showed that trees on Mark had the greatest potential yield, followed by M.26 EMLA, 0.3, M.7 EMLA, and M.9 EMLA. Performance in North Carolina has generally agreed with the overall results of this trial.

The second oldest NC-140 apple rootstock trial, planted in 1984, has completed its eighth leaf and is still in the ground at the Mountain Horticultural Crops Research Station (MHCRS) at Fletcher. This trial also has "Starkspur Supreme Delicious" trained as in the previous trial but on 16 rootstocks and in 31 North American sites. Among the most productive trees in this trial are those on the Polish rootstocks, P.1, P.2, and P.16, also the Russian rootstock B.9, as well as M.26 EMLA. In North Carolina, B.9, P.1, and M.26 EMLA have performed the best, while P.2 and P.16 have not done as well as in other states, possibly due to our high summer temperatures. This trial will continue for two more years before final reports are prepared.

The newest NC-140 apple trials in North Carolina are the systems trial and a cultivar/rootstock trial, both located at MHCRS. The systems trial includes four training systems: slender spindle, vertical axis, HI-Tec, and central leader, using "Empire," "Earli-Red-One," and "Royal Gala" with various rootstocks. The cultivar/rootstock trial's purpose is to evaluate the interaction between four cultivars with different growth habits and five rootstocks that are suitable for higher density, slender spindle type plantings.

Future NC-140 apple rootstock trials will be planted in 1993 and 1994. These trials will evaluate rootstocks from M.9 size up to MM.106 size with cultivars like "Gala" and "Liberty."

Many new rootstocks from the breeding program at Cornell-Geneva, NY will be included in the 1993 trial and other rootstocks from around the world will be in the 1994 trial. Each trial will need to last at least 10 years, but this is necessary to obtain reliable information for our industry.

IMPORTANT NOTE:

Registration for the Annual Conference on Sunday, February 23, 1992 will be held in the lobby of the Radisson Hotel rather than the Niagara Falls Convention Center as previously announced.

This change applies to Sunday only – registration for Monday and Wednesday (February 24 and 26) will be at the Convention Center.

IS RESEARCH LOSING ITS RELEVANCE?

Earl L. Butz

Today there is a pervasive attitude in our land grant universities that applied research work is not important.

This is especially true among the younger generation of agricultural scientists and assistant and associate professors on the way up.

They recognize, probably too often, that the main criterion for promotion is publishing in scholarly journals. They do research to advance knowledge for knowledge's sake, write for their peers and present to their dean (and promotion committee) a list of publications that, in many cases, even the dean cannot understand.

They feel little responsibility to contribute to the once basic institutional mission of solving society's applied problems. From purely a personal point of view, they are probably right; this is not where the payoff comes.

To make matters worse, the published papers by these bright young staffers are so mathematical and analytical as to discourage the policymaker from spending much time trying to understand them. One need only open at random any recent issue of a technical journal, take a look at the complicated formulas and deeply technical language, to understand why the policymaker, in USDA, Congress, the media, or in farm organizations, seldom finds any helpful practical material.

Perhaps the need is two-fold. First, a larger share of our research effort should be directed toward the analysis of practical problems, either currently existing or anticipated. Second, we need to encourage (and reward) a third group of agricultural scientists — those who can bridge the gulf between the theoretical researcher and the ultimate user, whether that person be on the farm, in agribusiness, or in politics.

We need Extension specialists and researchers who can communicate with the man in the street and with the representative in Congress. Unfortunately, this is not the college position that comes up first for promotion in academic rank.

THE PRACTICAL SCIENTIST IS MORE ESSENTIAL NOW THAN EVER BEFORE

Never before in our history was the opportunity greater for competent and objective agricultural scientists with a practical bent for lay communication. The level of agricultural literacy of the public must be raised if sound agricultural philosophy on a continuing basis is to find expression in our legislative halls. Sound governmental decisions in the agricultural area can never go very far ahead of the level of agricultural literacy of the people. Agricultural literacy influences present legislation as well as the thinking of our leaders a generation hence. So it is that all of us need to be convinced that sound public policy formulation thrives only in the soil of rising agricultural literacy among all our people.

One of the greatest challenges facing the agricultural scientist involved with public policy in America is to cast his influence on the side of keeping government the servant of agriculture, not its master. To accomplish this, we must bring more of our research down to a more practical plane of public policy formulation and administration.

For the individual scientist, this may be less exciting in the short run, but in the long run it will yield large dividends in the form of a progressive agriculture and strong America.

(From: Better Crops with Plant Food 74(4):9)

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COMPACT NEWS

A Periodic Newsletter of the International Dwarf Fruit Tree Association

No. 4 July 1992

A MESSAGE FROM THE EDUCATIONAL DIRECTOR

"Compact News" is designed to keep members up-to-date on IDFTA activities, particularly details about the upcoming annual conference each February and the summer orchard tour. In addition, it serves as a vehicle for the IDFTA president and board members to express their views and summarize their discussions about the activities and future direction of IDFTA. "Compact News" also serves as IDFTA's educational newsletter with information about intensive orcharding. The intent is not to publish long, detailed reports. The Compact Fruit Tree is our publication for such articles. "Compact News" will include focused, relatively short articles and excerpts from longer articles by pomologists from throughout the world. These articles will serve several purposes: 1) provide practical information on fruit growing with dwarf trees; 2) provide summaries of IDFTA-supported research, and 3) provide new and perhaps controversial ideas, many from districts with very different growing conditions and markets than your own. Hopefully these articles will stimulate you to think about and perhaps question your current orchard establishment and management practices. Many of the articles will have appeared in regional or international publications but will be included in "Compact News" because they have a message for the IDFTA membership.

Bruce Barritt

QUEBEC SUMMER TOUR

In the middle of June, five busloads of IDFTA members and supporters met at Macdonald College near Montreal to tour Quebec orchards for two days. The weather was sunny, cool and tailor-made for comfortable touring. Quebec orchards are situated in elevated areas to the north, southeast, and southwest of Montreal in rural communities that date back into the eighteenth century. Apples are the principal fruit grown.

The French Axe

The Quebec industry experienced a severe freeze in 1981 that resulted in heavy tree mortality in some areas. Thus many growers were faced simultaneously with the need to replant and get back into production quickly. It was at this time that J. M. Lespinasse was developing his "French axe" or vertical axis system of tree training. This system was a logical one for Quebec conditions. . . the teacher was French-speaking, Quebec soils are variable and deeper-rooted rootstocks will do better in some sites, and, deep winter snows were considered a threat to shorter fully-dwarfed trees. With a visit by Lespinasse himself and some progressive work by extension specialist Pierre Philion this system was widely adopted. What we saw on tour were some of the original vertical axis plantings as well as some of the later refinements. One thing evident was that this system could become very productive relatively quickly. . .one of its original aims.

Points of Interest

At the farm of Jean Claude Spenard, trees were being planted in the center of a four foot plastic mulch strip. The mulch was laid first. Trees were planted through the mulch by first removing most roots and then inserting them into the ground using a water nozzle at 500 p.s.i. ►

with starter solution in the sprayer tank. Trees seemed to respond well to this treatment.

The Josee & Jacques Viau orchard was a regular research station. Different trellising methods were being tried using bench-grafted vs. purchased nursery trees. An interesting bench grafting demonstration was given and the economics of bench grafts were discussed in detail.

Guy Jalbert takes the prize for building the sturdiest trellis for tatura and vertical axis you'll find anywhere (telephone poles for posts, cable for wire). Mr. Jalbert speaks no English but is a regular on IDFTA summer tours. The ideas he has picked up on these tours are evident everywhere in his own orchard and are a tribute to his powers of observation and abilities as a fruit grower. I must also add that the glass of cider handed out as we left his place was enough to "blow your hat in the creek."

A visit to the Rochon brothers farm showed the "solen" training system . . . an interesting concept that produces a truly pedestrian orchard. In a mature vertical axis planting adjacent to this, it was sad to see extensive tree mortality due to light snow cover last winter.

Ottawa 3 was outperforming M.9 on the farm of Paul Gadbois by a good margin. This grower was successfully growing his own Ottawa 3 rootstock which he says is due to the apple pomice mulch used in the stoolbed.

Our tour was running a little late and the visit to Allan Thompson's orchard was cut short. Mr. Thompson had sizeable plantings of M.9 that looked good except for some areas of weaker soil. This was a picturesque, well-kept orchard. Would have liked to have seen the rest across the road.

Finally, the hospitality shown to us by our Quebec hosts was exceptional. The "sugar bush dinner" and musicians playing Quebec folklore music (27 in all) was an unforgettable experience. Our thanks to all our Quebec hosts.

IDFTA members who have not attended our summer tours are well-advised to do so. This is your chance to see theory and convention slide shows put into practice by fellow growers. The hospitality you encounter, the new acquaintances you make, and the scenic countrysides you enter are all a bonus. Join us in Ontario in June, 1993! □

MANAGING TREE VIGOR WITH INTENSIVE SYSTEMS IN NEW ZEALAND

Dr. Stuart Tustin • DSIR Fruit and Trees • Havelock North, New Zealand

The emphasis of this article is managing fruit tree canopies in a high vigor environment. In such an environment apple yields of 2,000 boxes/acres or more are common. These yields are also achieved without the use of very high tree densities. We are talking about densities between 260-360 trees per acre. You may ask whether this is really management of an intensive system. I suggest that any system which is yielding above 2,000 boxes per acre is definitely intensive.

Use of Increased Tree Density to Control Vigor

Increasing tree density is not a practical way of controlling tree vigor. Despite optimistic ideals, trees with roots in relatively unconfined soil do not exhibit vigor control through root competition. (However, there is good evidence that root restriction practices do have a positive effect on reducing vigor of fruit trees.) The effect of planting trees at densities closer than appropriate for rootstock vigor results in the need for excessive containment pruning, the problem of inadequate light environment in the lower and mid-canopy zones, asymmetric distribution of crop and fruit quality and an increase increase in production of low quality fruit because of canopy crowding.

Strong containment pruning can overcome the worst of inadequate light environment. However, this results in significant reduction in yield potential due to severe pruning and the invigoration of the tree canopy.

My observation of many European systems for managing very high density plantings is that severe containment pruning is employed. In addition, dramatic branch training techniques are used. The net effect of this type of pruning is to reduce the production efficiency of the canopy by the need to remove high quality buds and wood to maintain the tree to a predetermined size which is much less than the space needed for the rootstock-scion combination. In other words, the very purpose for using high density planting (increased yield efficiency and quality) is negated by the need to prune in a way which reduces fruiting and stimulates vegetative growth.

No matter what vigor of rootstock is used for intensive plantings, there will be limits on the spacing and arrangement of trees which if exceeded by planting closer can only result in the development of less efficient tree canopy and the subsequent loss in performance. ►

Training and Cropping

These two techniques form the basis for our strategy for regulating vigor in trees. Branch training to flatter orientations will reduce vigor, encourage lateral branch development and usually enhance precocity. Cropping at suitable levels from soon after planting will also have a marked influence on reducing vigor.

By using sparing and careful minimal pruning when the tree is young, coupled with early branch positioning, tree development can be controlled effectively to give very good yields early in the life of the orchard. Pruning is limited to the selection of scaffold laterals in the first year during early summer. This gives a typical pruning response—longer individual branches but less total growth. Growth can resume in the second year without the need to do any dormant pruning. The additional length of scaffold limbs provides greater bud numbers for development of secondary laterals and spurs. The limbs are also strong enough to be easily trained into flatter positions, thus beginning the devigoration process and encouraging fruit bud initiation. If fruit are present at this stage a portion of the crop can be retained but without interfering with limb development or orientation. Fruit in the outer positions will almost certainly need to be removed to prevent excessive bending. Further pruning to assist the limb development is likely to be restricted to directing the growth of a single terminal shoot extension of the limb, again by early summer pinching.

In effect the strategy is to use many of the techniques which are used in intensive system management but applied to larger tree units. The process relies foremost on rootstocks which induce a high degree of precocity. In the New Zealand high vigor environment, MM.106 performs not unlike M.9 in European conditions in respect to precocity induction.

In the event that cropping does not occur early in the tree life, or is irregular because of environmental constraints, controlling tree vigor can be difficult. My experience has been to do the opposite of what most fruit growers would be inclined to do. When trees show excessive vigor the impulse is to prune them into shape. However, unless a heavy crop can be guaranteed to follow, the correct strategy is to not prune at all. The most devigorating treatment in the absence of reliable cropping is to not prune and, if required, train branches to flatter angles. The result is not pretty to look at for a short time but the results can be effective. Once fruiting increases with a shift in the fruiting-vigor balance, pruning can be reintroduced to remove wood of low vigor. Progressively the tree can be returned to a normal cycle of pruning and fruiting.

Pruning Methods in a High Vigor Environment

We endeavor to use pruning techniques which minimize the tendency to invigorate the tree. These include 1) renewal pruning which focuses on removal of poor quality fruiting wood which is devigorated by fruiting, 2) avoidance of heading cuts as a method of pruning and 3) avoidance early in tree development of invigorating management which delays fruiting. There is an idea that using dwarfing rootstocks will overcome the invigorating effects of severe pruning. This is wrong. Invigorating pruning methods will give equally disadvantageous responses on dwarfing rootstocks. This is most graphically seen with heading cuts.

Techniques to Increase Vigor

These may become important in the future with the extensive use of dwarfing rootstocks. If the opposite strategies to those used for devigorating trees are used then the expected result would be invigoration of the tree. These strategies include 1) heavier pruning to induce growth, 2) training branches to more acute angles and 3) reducing crop by heavy thinning and pruning. □

CALCULATING TREE DENSITY

Bruce H. Barritt, Horticulturist
WSU Tree Fruit Research and Extension Center • 1100 N. Western Avenue • Wenatchee, WA 98801

The calculation of tree density is straightforward with single-row plantings but can be more difficult for multi-row designs. With single rows tree density per acre is simply the number of square feet per acre (43,560) divided by the number of square feet per tree which is between-row distance multiplied by within-row distance (both in feet). It is usually not necessary to calculate tree density for single-row designs, as tables are available in nursery catalogs.

For multi-row designs the calculation of tree density becomes more complicated. The following formula can be used for both multi-row and single-row systems:

$$\text{Tree density (trees per acre)} = \frac{N\ (43{,}560)}{(A + B)\ D}$$

►

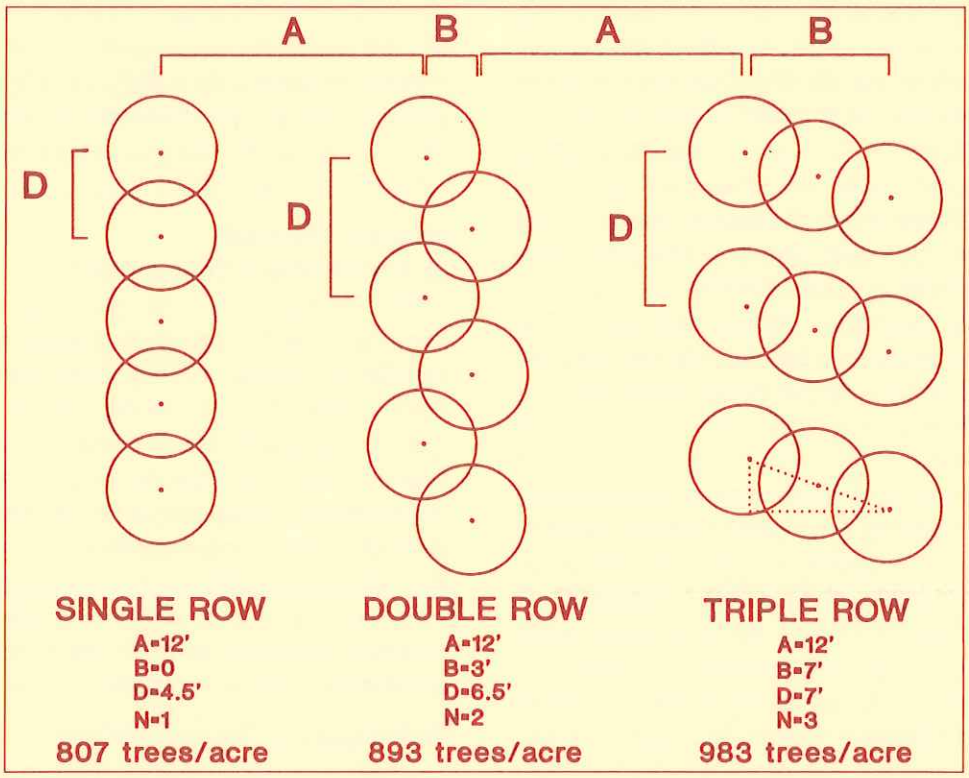
The variables in this formula are shown in the adjoining figure and are defined as follows:

A – Alley or between-row width; the driveway for tractors and other equipment.

B – Bed width in a multi-row design; the distance from one side of the bed to the other. It is the distance between the two rows of a double-row system or between the two outside rows of a three-row or wider bed. For single rows B = 0.

D – Distance between trees within each row.

N – Number of rows within the bed. For single rows N = 1.



When distances are in metric units (meters) the number of square meters per hectare (10,000) is substituted for 43,560 in the formula and tree density is calculated in trees per hectare. For conversion purposes, one hectare equals 2.47 acres and one meter equals 3.28 feet.

It can be confusing when trying to describe a particular tree spacing, particularly with multi-row bed designs. When asked to describe the spacing in the single-row planting (left in figure), we respond by saying 12′ by 4.5′. The term 12′ x 4.5′ becomes 54, the number of square feet per tree. How do we describe the double-row planting (center of figure)? We might say the alleyway is 12′ wide, the two rows are 3′ apart and the trees are 6.5′ apart down each row. This can be written (12 + 3) x 6.5. This term when divided by the number of rows (in this case, 2) is 48.75, the number of square feet per tree. With the three-row design (right in figure) we can say the alleyway is 12′, the three rows in the bed are 3.5′ apart and the trees are 7′ apart down each row. This can be written (12 + 3.5 + 3.5) x 7. This term when divided by the number of rows (in this case, three) is 44.3, the number of square feet per tree. With these descriptions of tree spacing we do not consider the arrangement of trees in multi-row designs. Tree arrangement and the pros and cons of multi-row designs will be topics of a subsequent article.

What has the biggest impact on tree density, changing by one foot the distance between rows (alleyway) or changing by one foot the distance between trees in the row? A single-row 14′ x 6′ planting has 519 trees per acre. What will be the effect of reducing alley width from 14′ to 13′? At 13′ x 6′ tree density is 558 trees per acre, an additional 39 to 5′? At 14′ x 5′ tree density is 622 trees per acre, an additional 103 trees per acre (a 20% increase). Therefore, in-row tree spacing has a greater impact on tree density than between-row spacing.

You may wish to practice calculating the tree density and tree spacing for the following examples (answers at end of article):

1. You will be planting a new orchard of Empire/M.26 and will use metal conduit individual tree supports attached to a single 8′ high wire. You plan to use a double-row design with the two rows 4′ ►

apart and an alleyway of 14′. The trees will be spaced 7′ apart in each row. What is the density in trees per acre?

2. You are planning a very high density super spindle trial planting of Jonagold/M.27 and wish to plant 2900 trees/acre trained vertically in single rows. With your present tractor and spray equipment you can plant rows 12′ apart but no closer. What will be the spacing within the rows if rows are 12′ apart?
3. You wish to plant a new Gala/M.9 high density slender spindle planting using a three-row bed design. Each tree will have an individual support post. In the bed the rows will be 3.5′ apart and the trees will be 7′ apart in each row. The alleyway for equipment will be 11′ wide. What is the tree density?
4. You are planning to plant a high density Fuji/M.9 orchard with trees trained in a 'V' design at 1675 trees per acre. In a single row every second tree is trained to one side at an angle of 70%. You would like the trees to be 2′ apart in the row. What will the between-row spacing be? □

Answers to questions:

1. **691 trees per acre**
2. **1.25′ or 15″**
3. 1037 trees per acre
4. 13′.

THOUGHTS ABOUT SUPER SPINDLE

Mike Sanders, Tree Fruit Specialist
British Columbia Ministry of Agriculture, Fisheries and Food • 1873 Spall Road • Kelowna, B.C. V1Y 4R2

An exciting development has been underway for the last five or six years in some European and English apple plantings. It is called super spindle – a move to super high planting densities ranging from 2,500 to 8,000 trees per acre.

The driving force of this development is profit. European growers have long recognized the economic advantages of high early production and understand the relationship between early production levels and planting density.

Since super spindle is such a new development, little information has been available about the economic potential and cultural management of such planting densities. Recent Dutch information on the earliest super spindle plantings indicates that some vigor control problems are developing and that the overall profitability has not been as good as predicted. This is not unusual for new technology which always has a few kinks to smooth out. Based on these results, it is likely that future super spindle plantings will be at lower tree densities.

So far only a small number of British Columbia growers seem interested in putting in trial plantings of super spindle. Do not be a spectator! Ignoring this concept because it seems so "far out" could cost B.C. producers. This happened in the 1970s when the Dutch started to plant outlandish densities of 700 and 800 trees per acre and we missed out on some tremendous opportunities.

Even if super spindle at densities of 2,500 to 8,000 trees per acre turns out to be impractical, considerable knowledge will be gained and skills will be learned. The outcome will be establishment of new planting density standards at a level somewhere between slender spindle and super spindle that may prove profitable for B.C.

The Profitable Orchard

Supere spindle may be more suitable for the English and European producers as they have several advantages over us, such as higher skill levels, use of growth regulators (e.g., Cultar) and cheaper nursery stock. This latter item becomes extremely important at super spindle densities. In addition, they usually receive higher fruit prices – a factor that has the most impact on the comparative profitability of various planting densities.

It is possible to contain trees to the space allocated but only by using a number of properly timed horticultural techniques. These include summer pruning, root pruning, bending, nutrition management, water management and girdling. The big question is whether or not the time and costs required to manage vigor will allow a profit and whether the yields and returns justify the high establishment costs.

If high early yields can be achieved, super spindle may prove quite profitable, particularly for the most marketable new varieties that often pay well. It is doubtful if super spindle will be profitable with lower paying varieties.

Regardless, growers who have a good understanding of tree physiology and vigor control, and are successfully managing orchards of 700 and more trees per acre, should try some super spindle.

Some pretty high production figures for super spindle plantings have been thrown about – such as 80,000 ►

kg/ha (approximately 70,000 lbs/a) in the second leaf from a planting of 20,000 trees/ha (8,000 trees/a). It appears that such high yields are not very common. Table 1 gives the apple production figures from a Dutch study.

When trying to design the most profitable orchard, information on planting density and yield is important. However, the most profitable orchard is not always the one with the highest production. Items such as establishment cost, labor, interest and fruit prices must also be considered. An individual economic analysis is essential to plan the most profitable orchard for particular varieties and site.

The Dutch study also compared the net present value of planting densities indicating the greatest return from 4,800 trees per acre, followed by densities of 3,200 and 1,600 trees per acre.

There is little local data available for trees trained to, or similar to, super spindle except for some yield data for McIntosh on Malling 9 from plots planted in 1989 at the Test Orchard near Oliver, B.C. These trees did not crop in the planting year, but the results in Table 2 might help your analysis preparation.

These trees might have been overcropped in the second leaf, which contributed to the yield loss in the third leaf. The 1992 results should be interesting.

Super Spindle Trees

Super spindle trees consist of a main leader and many short branches. Trees should not be any taller than 6 feet (1.8m) and cannot be wider than the in-row spacing which should range between 10 to 27 inches (.25m to .7m). Ideally trees should be treated in the nursery with hormones to encourage fruit production in the planting year. To date this has not been very successful and cropping usually has started in the second leaf.

The most common support system for super spindle plantings is a trellis. Four-inch-diameter posts were driven in to allow six feet (1.8m) or slightly more showing above the ground. Sometimes the posts at the ends of the rows were slightly larger in diameter. Post spacing is from 30 to 40 feet (9 to 12m) but 30 feet (9m) between posts in the row is probably the best.

Wire is strung along the tops of the posts and bamboo stakes are attached to the wire with steel clasps or other tying material. Each tree is then tied to the bamboo stake.

The most popular rootstock for super spindle plantings appears to be Malling 27, especially for triploid varieties like Jonagold. This demand has created a shortage of Malling 27, so Malling 9 is being used to a greater than desirable extent. British Columbia producers should try both Malling 27 and Malling 9. Other possible choices are Mark and Budagovsky 9.

Multi-Row, Split Row or Single Rows

Orchards can be designed as multi-row beds, split rows or single rows.

It appears multi-rows are the least desirable choice even though they offer the greatest early production potential due to the higher planting density. However, shading of lower tree portions will move the crop to the top of the tree, and yields and fruit quality will decline. This is now becoming evident in some of the earliest European super spindle plantings.

Both split rows and single rows make sense from yield, quality and management aspects.

Trees in split rows are trained on an angle of about 70 degrees away from the center of the trellis. Every second tree is trained in the same direction, so when seen from the end of the row, the planting has a V-shape. Tree spacing in the row ranges between 9.75 and 19.5 inches (.25m and .5m) so spacing between trees trained in the same direction is between 19.5 and 39 inches (.5m to 1m).

Trees planted in single rows are trained in an upright position and spaced between 15 to 27 inches (.4m to .7m) apart. Spacing between rows should be determined by equipment and slope. Keep in mind, though, that spacing does not have to be as wide as with slender spindle because super spindle trees are much narrower. Eight to ten feet (2.5m to 3m) between rows is preferable. Split rows will require slightly wider spacing than single rows because of the angled planting.

Tables 3 and 4 summarize suggested tree spacings and the resulting tree density. Because of vigor control problems that are occurring in some European super spindle plantings, the widest of these spacings should be tried and perhaps even slightly wider than those in the tables.

The ideal nursery tree for super spindle would have numerous short feathers with the terminal buds being fruit buds. This would give the potential for cropping in the planting year. It is unlikely that this type of nursery stock will be produced – at least for some time.

There are some suggestions that feathered trees are the most suitable for super spindle. If these are used, the feathers should be headed back at planting to keep the tree narrow. If the feathers are weak, an alternate treatment might be to shorten them back to a fruit bud in the second spring.

A whip is probably the best. In the planting year several shoots might develop from vegetative buds but the rest of the buds would develop into fruit buds. Cropping in the second year will mostly be on the leader.

The key to pruning in the first year is minimal pruning to encourage fruit bud formation. Any strong growing shoots should be pinched to control vigor and ►

encourage fruit bud formation. Several pinchings may be necessary.

In subsequent years summer pinching will be the main cultural technique but some pruning will also be required. Any pruning will be done between blossom and early September. It will consist of removing strong shoots by bench cutting and removing strong growth at the top of the tree to limit tree height.

The most efficient way of feeding is fertigation but not all growers are able to do this. The key is to develop a nutrition program that directs energy into fruit and fruit buds rather than excessive vegetative growth. This is not easy to do, but is a realistic and necessary goal for super spindle plantings.

In summary, super spindle is a concept that offers potential for increased profitability. Growers with good tree management skills should try some, but not to the extent that failure would result in hardship. Remember, this technology is new and there is a lot to learn.

Table 1

ANNUAL PROJECTED PRODUCTION (lbs/a) FROM APPLE TREES

Planted at Different Densities*

Trees/ Acre	Year 2	Year 3	Year 4	Year 5	Year 6
800	6,172	17,636	28,218	33,509	35,273
1,600	13,403	31,746	37,037	40,564	40,564
3,200	24,691	48,677	50,793	52,204	52,204
4,800	34,920	59,259	60,317	60,317	60,317
6,400	43,738	66,313	66,313	66,313	66,313
8,000	52,910	70,546	70,546	70,546	70,546

*Research Station for Fruit Growing: 1990 Annual Report, Wilhelminadorp, The Netherlands.

Table 2

SUPER SPINDLE YIELDS (lbs/Tree)*

	1990	1991	Cumulative
Average	7.9	6.9	14.7
Range	5.5 – 10.9	0 – 21.82	5.5 – 28.7

*Sanders, BCMAFF 1992.

Table 3

SINGLE-ROW TREE SPACINGS AND RESULTING TREE DENSITIES

In-Row	Between Rows	Trees/ha	Trees/a
15.6 in. (.4m)	8.2 ft. (2.5m)	10,000	4,000
19.5 in. (.5m)	8.2 ft. (2.5m)	8,000	3,200
23.4 in. (.6m)	8.2 ft. (2.5m)	6,666	2,666
27.3 in. (.7m)	8.2 ft. (2.5m)	5,714	2,285
15.6 in. (.4m)	9.0 ft. (2.75m)	9,090	3,636
19.5 in. (.5m)	9.0 ft. (2.75m)	7,272	2,909
23.4 in. (.6m)	9.0 ft. (2.75m)	6,060	2,424
27.3 in. (.7m)	9.0 ft. (2.75m)	5,194	2,077
15.6 in. (.4m)	9.8 ft. (3.0m)	8,333	3,333
19.5 in. (.5m)	9.8 ft. (3.0m)	6,666	2,666
23.4 in. (.6m)	9.8 ft. (3.0m)	5,555	2,222
27.3 in. (.7m)	9.8 ft. (3.0m)	4,761	1,904

Table 4

SPLIT-ROW TREE SPACINGS AND RESULTING TREE DENSITIES

In-Row	Between Rows	Trees/ha	Trees/a
9.75 in. (.25m)	8.2 ft. (2.5m)	16,000	6,400
15.6 in. (.4m)	8.2 ft. (2.5m)	10,000	4,000
19.5 in. (.5m)	8.2 ft. (2.5m)	8,000	3,200
9.75 in. (.25m)	9.0 ft. (2.75m)	14,545	5,818
15.6 in. (.4m)	9.0 ft. (2.75m)	9,090	3,636
19.5 in. (.5m)	9.0 ft. (2.75m)	7,272	2,909
9.75 in. (.25m)	9.8 ft. (3.0m)	13,333	5,333
15.6 in. (.4m)	9.8 ft. (3.0m)	8,333	3,333
19.5 in. (.5m)	9.8 ft. (3.0m)	6,666	2,666

□

International Dwarf
Fruit Tree Association
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No. 4 COMPACT NEWS July 1992

In this issue. . .

The summer tour in Quebec was a great success and a summary of events is included. Tree vigor control, whether there is too much or too little growth, can be a difficult task in high density orchards. **''Managing Tree Vigor with Intensive Systems in New Zealand''** presents a candid view on managing vigor in high vigor and high productivity environments such as New Zealand. Orchardists often struggle with tree density calculations when planning a new orchard. **''Calculating Tree Density''** provides a simple method for calculating tree density (English or metric units) that works with single- and multi-row designs. **''Thoughts About Super Spindle''** is presented to stimulate thinking about extremely high density orchards.

Bruce Barritt
Education Director

QUEBEC SUMMER TOUR

1992 IDFTA Summer Orchard Tour • June 14-16, 1992 • Quebec, Canada

IDFTA IDFTA IDFTA IDFTA IDFTA

The fruit growers and extension people of the province of Quebec are happy to invite you to the 1992 Summer Orchard Tour. Even though some of you were here in 1982, you will enjoy a completely renewed program. It will again be a very relaxing session — so TAKE TIME OFF for QUEBEC!

BIENVENUE AU QUEBEC

We are extremely pleased to receive visitors and we hope to show you many different aspects of our apple production. The province has five major areas of production. While one area is further east including Quebec city, the other four areas are closely related to Montreal district, where the majority of the fruit are marketed.

The total production is in the range of 5.5-6.0 million bushels. The McIntosh variety is still leading in all areas and may account for 65% of the total crop. Other varieties are Cortland 10%, Logo, Spartan, and Empire, 4% each. The remaining 13% consists of a wide mix of summer apples including VistaBella, Jerseymac, Paulared, and also some declining Melba acreage.

The areas surrounding Montreal will bloom within a week difference from as early as May 15th to as late as June 3rd. The Quebec area blooms on a fairly regular schedule from June 5th to June 10th. It is a wide area of production with different climates.

Small fruit production such as strawberry, raspberry, and blueberry, may account for some cash crop in limited acreage. Maple syrup is a great production combination with apple. In Quebec, we produce about 90% of the Canadian crop. The bulk of this production is done by specialized growers in the eastern township, but you may see some production sites on the tour.

The 1992 tour will consist of a one-day visit to the North of Montreal which was heavily affected by a 1981 freeze, and the Southeast area that some of you may have seen in 1982.

We sincerely hope that your stay in the Province of Quebec will be rewarding, relaxing, and enjoyable.

The headquarters for the tour will be at Macdonald College in Ste. Anne de Bellevue. Located on the western end of the Island of Montreal, it is a quiet area where the St. Lawrence and Ottawa rivers meet, and it has easy access by routes 20 and 40. A map will be available with the registration kit. *"Vous êtes toujours bienvenus chez-nous."*

One way transport service will be available from Dorval Airport or Dorval Train Station to Macdonald College from 2:00pm til 11:00pm on June 14th. Fare will be $10.00 per person. Be sure to fill out the transportation portion of the accompanying registration form.

Registration will begin at 1:00pm on Sunday, June 14. A social evening dinner will follow starting at 6:30pm. Each day will begin with breakfast and follow with tours. There will be a Ladies' Tour of Montreal on Monday. Checkout is Wednesday.

ADVANCED REGISTRATION IS NECESSARY

To make sure all details of the tour go smoothly, we are requiring advanced registration. A special advanced registration fee of $230.00 per person (based on double accommodations) will include three nights of lodging, eight meals, bus transportation for orchard tours, and entertainment. Add $10.00 per night for single occupancy, but hurry as these rooms are limited.

If you do not lodge and do not have breakfast at the college you may deduct $90.00 per person. **Deadline for advanced registration is May 23rd.**

Please sign up as early as possible. Registrations postmarked after the May 23rd deadline will require ►

a fee of $250.00 per person.

Further information will be sent upon receipt of advance payment. Don't miss out on this terrific summer tour — register today!

LADIES' TOUR

A full seven-hour tour of the Montreal area is scheduled for Monday, June 15th. A professional tour guide will provide an exciting day of sights, history, and world-famous dining.

HOTELS AND CAMPING FACILITIES

The following accommodations are conveniently located within ten to fifteen minutes from Macdonald College. IDFTA has not reserved rooms for this summer tour, so availability is first-come, first-served.

• **Hotel Journey's End** – 700 Boulevard St. Jean, POINTE-CLAIRE, H9R 3K2. 514-697-6210 or 1-800-668-4200. *$64.07 per room, all tax included. Double room for one to four persons no extra charge. Restaurant across the street, no swimming pool.*

• **Journey's End Suite** – 6300 Trans-Canadienne Road, POINTE-CLAIRE, H9R 1B9. 514-426-5060 or 1-800-668-4200. *$94.16 per room, for one to four persons no extra charge. Restaurant available, no swimming pool.*

• **Holiday Inn** – 6700 Trans-Canadienne Road, POINTE-CLAIRE, H9R 1C2. 514-697-7110 or 1-800-465-4329. *$80.25 all tax included, for one to four persons no extra charge. Complete restaurant, swimming pool, sauna.*

• **Sheraton Chateau Vaudreuil** – Exit 35, Trans-Canadienne Road, VAUDREUIL, J7V 5V5. 514-363-7896 or 1-800-268-8930. *$105.00 plus tax of 7% and 8%. Restaurant and interior pool available.*

• **Camping** – Rigaud Camping Choisy 514-458-4900. Ile Perrot Camping Sugar Bay 514-453-2725. Vaudreuil Camping Riverview 514-455-4932.

The prices listed are available with BEL-AIR Travel Agents. In all cases, a 7% tax refund may be obtained for U.S. residents if the proper forms are requested from the hotel.

For additional information about accommodations in and around Quebec, contact Pierre Philion, agr., B.R.A. Huntingdon, 2-C, rue Henderson, HUNTINGDON (Quebec) J0S 1H0. Phone 514-264-6141 or FAX 514-264-9772. □

TOUR ORGANIZING COMMITTEE

Guy Jalbert, J.C. Spénard, Gilles Lussier
Gérald Lussier, Peter Ednie, Bob Petch
Bill Stevenson, Lise & Pierre Philion

We would like to express our appreciation to the following companies for providing juice and wine:

A. Lassonde et Fils, Rougemont Qc
Vins Dumont Ltée, Rougemont, Qc

Special thanks to visited growers:

Gilles Desrochers Orchard
Josée & Jacques Viau Orchard
Pierre & Francois Rochon
Spénard Orchard
Guy Jalbert Orchard
Alan Thomson Orchard
Paul Gadbois Orchard
Station de Recherches

This tour is hosted by the following:

Pomologists of Québec Department of Agriculture
Association des Arboriculteurs Fruitiers du Québec
Fruit Specialists of Agriculture Canada

Ladies' Tour Schedule

A seven-hour tour of Montreal and surrounding areas will be conducted on Monday, June 15. The tour will be led by a professional guide and highlights are as follows:

Departure from Macdonald College at 8:30am

Visits to St. Joseph Oratory, Notre-Dame Church, Montreal Botanical Garden, Stadium Funicular at Olympic Park

Lunch at "Brochetterie du Vieux Port" in old Montreal

Afternoon in "Old Montreal" – business section and new architecture of Montreal. Site of Expo 67. Stop on Mount Royal for a panoramic view of Montreal.

Return at 5:00pm for dinner in St. Benoit

See accompanying registration form for cost and additional information on this tour.

IDFTA 1992 SUMMER ORCHARD TOUR
Quebec, Canada – June 14-16, 1992

TOUR STOPS AND DESCRIPTIONS

Desrochers Orchards, St. Joseph

The farm was purchased in 1980. The old standard trees were damaged in 1980 and all have since been removed. Today the orchard consists of five hectares with trees planted over the two-year period, 1984-1986.

Soil preparation was done with roundup herbicide and incorporated fertilizers according to soil test. Drip irrigation is automatically controlled by a tensiometer-related device.

Rootstocks used are 30% M7. The rest are M26 and M9 (Lancep and cepelant). The dwarf trees are trained to the vertical axe system and M7 trees to central leader. Varieties are Empire 40%, McIntosh (Macspur and Summerland) 40%, other 20% are VistaBella, Melba, Paulared, Earlygold, Lobo, Spartan, and Smothee.

Rochon et Eères Enr. Dairy and Orchard Farm, St. Benoit

This is a family farm purchased from their father in 1974. Pierre Rochon deals mainly with the dairy operation and Fran-s is in charge of the orchard.

They now have 24 acres of standard trees and younger plantings as follows: 1980-81, eight acres on M7 of McIntosh, Spartan, Lobo, and Jerseymac planted at 12x20 and trained to central leader. In 1984 and 1985 the vertical axe was tried on ten acres of M26 spaced 6x15 with Paulared, VistaBella, Spartan, Empire and McIntosh plus an additional planting in 1989.

In 1990-1992 and projected for 1992 bench grafting trees are being used for vertical axe and solen training systems. No real acreage yet established with this new system. More vigorous cultivars will eventually be on M9 to continue on vertical axis in 1992.

Josée and Jacques Viau Orchard, St. Joseph

They are newcomers in apple production. The farm is divided into maple bush, raspberry and ten hectares of old standard apple trees of regular varieties and of semi-dwarf trees on MM106, M26 and M9 top-grafted to Empire, Cortland, Liberty and Jerseymac. Those trees are trained to vertical axes and three axes Palmette.

The technical aspect of the stop at this farm will be a com-te demonstration of how to make your own bench grafted trees and result in orchard of cost operating when compared to bud grafted trees in August. Growth in both cases was about three feet and retake ranged from 80-90%. Training and summer pinching will be part of the demonstration.

Spénard Orchards in St. Eustache

The ancestral farm has been in the family since 1800 and is operated by Jean-Claude, his wife Raymonde and their sons Pierre and André. Another farm was purchased in 1960 about 1/2 mile down the road. The freeze in 1981 was disastrous and killed about 60% of the orchard which consisted of 65 acres of standard trees and five acres on M7 rootstocks.

In 1982 a tour in France to observe the axe system convinced them to train all new plantings to the axe on M26 rootstock.

McIntosh Summerland and Empire were planted in 1983-84 and 85 at five meters by 1.75 for a total of 1,335 trees/ha or 460 per acre (16.5 feet x 5.5). Yield in 1990 of those plantings averaged 1,090 bushels/acre for McIntosh Summerland and 700 for Empire. In 1991 the Empire came back to 1,200 bushels/acre and the McIntosh Summerland damage by cold weather, mostly in top of trees, was not evaluated individually but included with different strains of McIntosh – giving an average production of 475 bushels/acre. There is no irrigation system but a plastic strip was used at planting. The marketing of the fruit is done through Nature Pac Inc.

Guy Jalbert Orchard, Rougemont

This farm was purchased in 1972 and the old site replanted since 1975. The orchard is 50 acres of flat land with heavy soil drained and irrigated.

Rootstocks M7, M26 and M9 were used at different spacings of 10x20. 8x14, 5x14, 4x14 are staked and a modified Tatoura system at 2½x16 feet.

Varieties are by importance. Late: McIntosh, Empire, Spartan, Cortland. Early: Quinty, VistaBella, Jerseymac and Paulared. The next planting to be set in 1992 will be golden Delicious on M9.

The trees are either supported by a post or wire. He packs his crop and delivers to store.

Paul Gadbois Orchard, Rougemont

The farm is elevated with variations from 225 to 425 feet above sea level and 108 feet lower than the lake on the mountain next to it. It is gravely land with running springs that had to be drained. It is a site of 80 years' history in orcharding.

The dwarf tree orchard plantings started in 1976 with M9 and different varieties. Half of them are replanted due to replant problem disease and inappropriate varieties. ►

In 1981 fumigation done in one plot prepared to plant 4,000 rootstocks of M9 and 5,000 of O3 (Ottawa 3).

Another planting in 83 of one year whip M9 grafted and ungrafted rootstock O3. Yield on those first plantings in 88-89 and 90 were double on O3 versus M9 plantings. In 1991, McIntosh variety averaged 585 and 404 bushels/acre on two plots of M9 versus 1,008 bushels/acre on Ottawa 3 (O3).

Alan Thomson Orchards, St. Paul Abbotsford

The farm is a 35-acre apple orchard on which 12 varieties are grown. The orchard consists of 24 acres planted at 6x12 feet spacing, five acres at 8x15 feet and six acres of old standards at 30x30 feet. The rootstock used in the dwarf plantings are the EMLA series including 7, 26, 111, 106 and 9.

Trees are staked with cedar pickets and trained to the slender spindle system. Dwarf plantings range from three to 23 years old. There is no permanent irrigation system installed but a portable overhead system is used to irrigate three acres at a time.

Research Station of Frelighsburg, Québec

Three stops have been chosen on the farm: **Plot 1** – Rootstocks study started in 1988. MM111, Bud 9, Ottawa 3 and M7 rootstock topworked with Empire, Cortland, Lobo, and McIntosh. The training system I use is "spindle bush." **Plot 2** – Two rootstocks and two training systems set out in 1989. A. Ottawa 3 top worked with Spencer, Empire, MacSpur and Lobo. B. Mark Rootstock topworked with MacSpur, Lobo and VistaBella. Both rootstocks also have ten scab-free cultivars. Training systems are Palmette three axis and Spindle Bush. **Plot 3** – NC 140 started in 1990.

Wash.: Oriented towards Washington State training system comparison. Varieties are Jonagold, Empire, Gala. Systems: Central leader, Vertical axe, Slender Spindle and Hytec. Rootstocks: M39, Poland I, Ottawa 3, Bud 9, Mark, EMLA 27, EMLA 9, EMLA 26. Mass.: Unique training system is vertical axe. Rootstocks EMLA 9, Bud 9, Mark, M26 and Ott 3. Cultivars: Golden Delicious, Jonagold, Empire, Law Rome, and Marshall.

IDFTA CONFERENCE TOUR SCHEDULE

Sunday, June 14

1:00 - 11:00pm
Registration at Macdonald College, Ste. Anne de Bellevue

5:00 - 6:30pm
Get-together with cash bar at Macdonald Lounge

7:00pm
Wine and chicken brochette dinner and evening program.
Welcome . . . . . Bob Petch, IDFTA director
"Quebec Apple Growers"
Introduction:
"Montreal and its 350th Anniversary" . . . John Dickenson
Université de Montréal historian
"Glance at Quebec Horticultural
Production and Tour Highlights" . . . . . Pierre Philion, agr.
Quebec Department of Agriculture
Comments . . . . . Harold Schooley, IDFTA President
Ontario, Canada
Informal Crop Report . . . . . Sharing session from IDFTA members. Please share your slides or comments.

Monday, June 15

6:30-7:30am Breakfast at cafeteria (coupon needed)

7:45am Bus loading behind Centennial Centre

8:00am sharp Departure for Deux-Montagnes area

8:30am - Ladies' Tour Departure

9:00am Arrive in Deux-Montagnes county

12:00noon Lunch at Guy Cataphard Packing House facilities.

Orchard Tours throughout afternoon

5:00pm
Meet at "Chalet du Ruisseau" St. Benoit for roast beef dinner and wine.

8:00 - 8:30pm Arrive at Macdonald College

Tuesday, June 16

6:30 - 7:30am Breakfast at cafeteria (coupon needed)

7:45am Load buses behind Centennial Centre

8:00am sharp Departure for Rouville county

9:00am Arrive in Rouville county

12:00noon
Lunch on the mountain if weather permits, or at a new packing house in the area

Orchard Tours throughout afternoon

5:00pm
Meet at Erablière "La Goudrelle" at St. Grégoire for a very typical sugar bush dinner. Entertainment by 15-18 violin musicians. It will be Quebec folklore music.

7:30 - 8:00pm Arrive at Macdonald College

Wednesday, June 17

6:30 - 7:30am Breakfast and check out

Have a sound and careful return trip
and remember that we are glad
to have you around!

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COMPACT NEWS

A Periodic Newsletter of the International Dwarf Fruit Tree Association

No. 3 June 1992

A MESSAGE FROM THE EDUCATIONAL DIRECTOR

As my term as Education Director draws to a conclusion, I look back over the past four years as being exciting and personally rewarding. It has been particularly challenging to organize and develop the annual conference educational programs and see them stimulate the thinking of fruit grower audiences. It is always satisfying to observe research findings and grower experiences coupled together and put into successful application.

As Bruce Barritt takes over the Education Director role, I am sure he will find it as stimulating and satisfying as I have.

The proceedings of the 35th annual conference is at the printers and will be soon sent out to all IDFTA members. I would encourage everyone to read Volume 25 of Compact Fruit Tree. You may also find it helpful to scan over earlier volumes. Many of the papers included are now taking on new meanings.

I also want to take the opportunity to express my appreciation to the IDFTA board of directors, the speakers at the annual conferences, those involved in the orchard tours and the total membership of IDFTA for the support and assistance provided me over the past four years. THANK YOU.

H.A. (Jack) Rollins, Jr.

"APPLE TREE, U.S.A."

Dr. Loren D. Tukey, Professor Emeritus of Pomology • The Pennsylvania State University

An apple tree consists of two or more cultivars growing together as a single unit. Rootstock provides the root system while scion, the vegetative part. In doubleworked trees, a third cultivar may be used as an interstock. An extensive vascular/physical support system connects these cultivars. This multi-genetic tree functions in two entirely different environments: its root system in the soil, and its vegetative and fruiting part in the atmosphere (air). The above ground part (top) provides energy while the below ground part (roots), nutrients and water. Both produce hormones. In the spring, the roots supply gibberellins and cytokinins for "startup" growth in the top. In the fall, maturation of the tree starts in the leaves and moves downward to the roots. During the winter or dormant period of the top, the roots remain functional, depending upon soil temperatures, continuing to supply water to the tree. Roots do not become dormant.

An apple tree may be compared to a community with water wells, reservoirs, pumping stations, mineral mines, power plants, heat exchangers, sugar factories, chemical plants, warehouses and assembly plants. Located in various parts of the community, they are interconnected by roadways, transportation, water pipes, power lines and a communication system. The chief product manufactured by the community is apples.

Apple fruits do not "blow up" like a balloon. They are formed, and enlarge and mature in an orderly manner, following a regular sequence of events. A fruit is somewhat like a building, consisting of different sections and rooms (tissues and cells). These vary in size, shape and function. The makeup of a fruit, as in a building, depends on how it was constructed and under what conditions. Environment, cultural and climatological, plays a very important part in the outcome of the apple at harvest. An apple fruit develops and grows during parts of two growing seasons, from its origin as part of a flower to mature fruit at harvest, an embryonic fruit the first year and a maturing fruit the second.

The beginning of what will become a mature apple originates in the fruit bud. This bud contains a vegetative structure (a compact meristematic stem) which bears an inflorescence (flower stock) terminally on which five primordial flowers are formed. The receptacle of the flower (stem tissue encasing the carpels and supporting the flower parts) later develops into an apple as succulent woody tissue.

Fruit bud formation is associated with the cessation of a shoot's growth and the setting of the terminal bud. A period of time is required for the compact vegetative tissue to develop as a short stem and reach a stage, known as "ripeness to flower," for the formation of the inforescence and flowers. The initiation of a flower is associated with bract formation. Without a bract, there would be no flower induction.

A bud always forms flowers unless prevented from doing so. Conditions which enhance or prolong vegetative growth in shoots and within the bud delay the time of fruit bud formation. If a delay is sufficiently long, there is not enough time during the growing season for bud development to reach either the stage of ripeness to flower or for bract formation. The bud remains vegetative. Thus, the problem in fruiting may be one of "failure to flower" rather ►

than one to promote flowering.

The size and form of an apple at harvest is related to the number and size of individual cells in the fruit. Those with a large number of cells by 30 to 45 days after full bloom (end of cell division period) have a greater potential to become larger than those with fewer cells. Increased fruit length (typiness) is related to increased cell division in the calyx end of the fruit during a 30 day period following bloom. Fruit lengthening can be stimulated by cool spring growing conditions and Promalin™ applied during bloom, especially in those cultivars and sorts with a genetic potential for typiness. During the remainder of the growing season, fruit enlargement is primarily related to expansion of existing cells.

A certain amount of daily moisture stress seems to be necessary for fruit growth and development. Larger fruit are those which are subjected to a daily, diurnal cycle or morning fruit contraction (shrinkage), afternoon recovery, and late afternoon and evening enlargement. Stress also affects shoot and tree growth. Spreading, bending and arching reduce shoot elongation, which enhances lateral branching, spurring and fruiting. Mechanically induced stress (MIS), caused by the movement of shoots in the wind, can affect growth. Tying the central leader to a vertical pole prevents stress, enhancing shoot lengthening, but growth is restricted if the leader is allowed to move freely in the wind (MIS). Close planting (intensification) creates stresses for soil moisture and nutrients, supressing growth and enhancing bearing.

Warm bright days and cool nights late in the season cause the development of temperature gradients within the fruit, resulting in a mass transfer of moisture in the flesh. With the fruit surface warmed by morning sunlight, moisture in the intercellular spaces moves toward the cool core area because of a vapor pressure differential. This is observed as a contraction of the fruit. The reverse occurs as a warm fruit cools at night. This pulsing under warm bright days and cool nights appears to be important in the fruit maturation process. Shaded fruits and fruits maturing under cloudy weather conditions pulse less or not at all, and fruit maturation process is poorer or delayed. Thus, the crop from small trees with exposed fruits is usually of higher quality than that from large trees with less exposed fruit.

The cropping potential of an apple tree and an orchard is associated with the volume of its bearing wood. A planting with high tree density is usually more productive than one with fewer trees, because of a larger total volume of bearing wood. How a tree is developed and trained, including the choice of rootstock, also can influence the volume of bearing wood developed in a tree and planting. With increased interest in the intensification of apple production, factors influencing fruit growth and development and the manipulation of tree development and growth become important. A better understanding of the plant and how it "works" enables intelligent approaches to obtaining productive trees with early and improved regular production of premium-value fruit. □

FRUIT TREE ROOTSTOCKS:

A Summary of Recent Observations in Research Plots and Commercial Orchards in Maryland

Christopher S. Walsh • Dept. of Horticulture • University of Maryland*

During the 1980s a series of rootstocks trials were established in Maryland. Many of these are formal research plots that we have set at the Western Maryland R&E Center in Keedysville. In addition, through my Extension travels I have observed a number of different rootstocks at grower orchards. The following is a summary of recent observations of rootstock performance in Maryland. The discussion of apple rootstocks is based on observations in commercial orchards, while those of pear and cherry stem from MC-140 plantings set at Keedysville in the mid-1980s.

Apple Rootstock Trends

M9 remains the primary stock used in intensive, supported orchards. M9 is fireblight susceptible, and would be a poor choice for varieties such as Gala and Braeburn. Small tree size, early production and large fruit size are benefits of M9. Despite these characteristics, there has never been a significant use of this rootstock in Maryland, due to the requirements for permanent support and detailed summer pruning.

MARK was widely planted in the late 1980s. It is similar in size to M26, but more precocious. Unions with Stayman, Jonagold, Granny Smith and Braeburn are brittle when grafted to MARK; trees require temporary support such as conduit. Delicious trees on MARK have been precocious and productive. MARK may be the best choice for growers who wish a non-spur type Delicious planting for direct-market sales. MARK is expected to be fireblight-susceptible, and should not be used as an understock for fireblight susceptible varieties such as Rome, Gala and Fuji.

M26 was planted heavily in the 1970s and 1980s. Since trees are precocious with bulbous unions, they require temporary support such as conduit. M26 is fireblight-susceptible, and should not be used as an understock for fireblight-susceptible varieties such as Rome, Gala and Fuji.

M7/M7a was in favor in the 1960s and 1970s. Growers discarded it as Delicious/M7 trees leaned, and were poorly anchored in the non-bearing years. In addition, fruit size on this stock is not as great as on M9 and other dwarfing stocks. However, with a blend of intermediate size and disease resistance it may be the best long-term choice for the new, precocious, fireblight-susceptible varieties like Gala and Braeburn.

Apple Rootstocks — The Next Generation

M27 is a stock that produces trees smaller than M9. This stock offers the greatest potential size reduction. Relatively little information is available about this stock, especially in hot summer conditions. Its extreme dwarfing characteristics would be useful for highly-vigorous varieties grown on deep, production soils. Little is known of its long-term performance. I have observed winter-induced bark splitting on trunks, at cold orchard sites.

In addition to M 27, there is a new series of rootstocks on the horizon. This new series, "Elite" Cornell-Geneva selections has been bred to offer disease-resistance and size control. These offer precocity, size control, tolerance to collar rot and fireblight. Unfortunately, they remain untested, and are not yet available from commercial nurseries. ►

Sweet Cherry Rootstocks

Colt: This rootstock is more precocious than Mazzard, but has shown little size control in commercial plantings. Colt was developed in England, and does not have the needed winter-hardiness for our U.S. conditions.

Mazzard by Mahaleb hybrids (M X M): Trees were selected in Oregon, and appear adapted to North American conditions. But they show little size reduction and only slight improvement in precocity. These are readily available from commercial nurseries.

Grand Marie Series (GM Series): Trees of this series, bred in Belgium are very size controlling. GM9 is the most dwarfing stock available. GM61/1 (also known as "Damil") is a "semi-dwarf" tree. Despite their size control, trees are not very precocious and have been slow to come into bearing. This has been seen in the NC-140 trials, and in grower orchards. Limited numbers of trees budded onto GM 61/1 have been propagated by commercial nurseries, and have been set in grower trials during the past few years.

One GM selection, GM 79, is *Phytophora* susceptible. Due to its poor performance, it is not being widely propagated.

Giessen Series (Gi Series, or "Gisela" series): Bred as interspecific hybrids in Germany. Many selections from the German program have been in the U.S. for a decade, but few budded trees have been sold by commercial nurseries. This is due to difficulties in nursery propagation of stocks, and licensing problems.

Most observations have been made in NC-140 replicated plantings. Some stocks under test combine size control and precocity. More than 10 stocks of this series are now under test in the NC-140 trial. Difficulties in propagation have limited the establishment of rootstocks at commercial nurseries. Promising clones should be available from nurseries in spring, 1993.

GI 148/1 has looked good at Keedysville. In that clone, a slight swelling above the union has been visible in some clones. This syndrome is associated with increased bloom density in spring and delayed leaf drop in the fall. In addition bloom date may be delayed, possibly avoiding spring frost damage.

A concern with these Giessen clones is that flowering may lead to excessive crop and small fruit size. This concerns cherry growers in California and Washington, who specialize in shipping fruit to eastern markets, and require large sized fruit. In the east, this probably will not be troublesome, as late freezes thin our crop, and fruit can be sold pick-your-own. In that case, the benefits of a "pedestrian" sweet cherry orchard will outweigh any slight loss in fruit size in a heavy crop year.

Pear Rootstocks

Quince A: This rootstock is incompatible with most pear varieties. However, in our trials at Keedysville, it has proved compatible with Magness. Magness/Quince A trees began bearing in their fourth leaf. Since then, we have harvested six straight crops. Since quince is fireblight-susceptible it should only be used in limited cases like Magness, where the scion is compatible, and fireblight-tolerant.

Old Home by Farmingdale Hybrids: A number of OH X F hybrid stocks are available for pear. They are fireblight tolerant, which makes them a better rootstock choice than Bartlett seedling. Some OH X F stocks reduce tree size slightly. Unfortunately, these appear similar in precocity to seedling and do not lead to early bearing. □

**Maryland Orchards, April 1992*

FLOWERING, EFFECTIVE POLLINATION, AND FRUIT SET

Dr. Loren D. Tukey, Professor Emeritus of Pomology
The Pennsylvania State University

Flower bud formation in the apple follows shoot growth cessation and setting of the terminal bud. Cessation of growth appears to be due to a localized depletion of cytokinins in the apical meristem of a shoot, causing young meristematic lamina (leaves) to abort and become bud scales. The lack of developing leaves leads to a decline in terminal growth. With the formation of bud scale, shoot elongation stops, and a terminal bud is formed. The time of growth cessation varies among shoots: first in spurs, then short shoot, and later in more vigorous shoots. The terminal bud may be either a fruit bud or a vegetative bud. However, it appears that terminal buds are actually fruit buds, becoming a vegetative bud when flowering is prevented. Thus, the problem in flowering may be "failure to flower" rather than the induction of flowering.

Fruit bud formation is divided into two phases: vegetative and reproductive. The vegetative stage is the development of a meristematic shoot, primordial leaves and axillary buds, and a terminal meristem. "Ripeness to flower" terminates the vegetative phase and enables the reproductive phase. Flower induction occurs with the formation of a bract, a leaf-like structure. Formation of bracts continues laterally up the inforescence with the last flower terminal. Later, this flower is known as the "king flower," the strongest and the first flower to bloom.

Flowering does not appear to be related to a specific flowering hormone, but rather to a gibberellin-cytokinin balance. A relationship favoring cytokinins allows the bud to continue developing and produce flowers. If the relationship favors gibberellins, however, the "ripeness to flower" stage is prevented. The strength of a flower and floral resistance to cold spring temperatures also appear to be enhanced by cytokinins.

Flower induction may occur throughout the summer, and is not necessarily limited to the early part of the growing season. Early flower induction is exhibited the following spring by showy blossom clusters with small leaves, strong flowers, and good fruit setting. Late induction produces showy foliage clusters with large leaves, weak flowers with long pedicels (stems), and poor fruit setting. Shoots ceasing growth first have earliest fruit bud formation, such as spurs and short shoots. Buds setting late may not reach the "ripeness to flower" stage, and thus, remain vegetative.

Bending, tying down, arching, and brutting shoots and branches suppress growth, increasing the potential for a fruit bud. Mechanically induced stress (MIS) also can increase flowering by suppressing shoot growth. If MIS is prevented, shoot elongation remains active. Very dwarfing rootstocks enhance early tree flowering by suppressing tree growth. Chemical fruit thinning sprays with NAA can stimulate return bloom, over and above that caused by the removal of young fruits, through growth suppression. Conversely, a heavy fruit set with inadequate thinning can reduce flowering, especially if fruit thinning is late or not at all. Further, weak trees usually have more flowering than vigorous trees, and low nitrogen trees than high nitrogen trees.

Pollination and Fertilization

Pollination is the transfer of pollen to the stigmatic surface of ►

the pistil. In self-pollination, the pollen source is from the same or a genetically identical cultivar. In cross-pollination, the pollen source is from a genetically different cultivar than the cultivar to be pollinated. Some apple cultivars will pollinate themselves adequately (selfing), others benefit from cross-pollination, while still others need cross-pollination to develop a commercial crop. Poor pollen sources are triploids (3n), such as Baldwin, Boskoop, Gravenstein, Jonagold, Mutsu, R.I. Greening, Spigold, Stayman and Thompsons King. Pollen has a short life at moderate temperatures, high humidity, and high light intensities. Pollen, however, will remain viable for several days to a week or more at low temperatures, humidity and light intensity.

The pollinizer needs to be matched with the cultivar to be pollinated: period of bloom, compatible pollen, and adequate pollen. The bloom period of the pollinizer should slightly precede, or coincide with, that of the cultivar to be pollinated. Even though a good match between the pollinizer and the pollinated cultivar exists, pollination must occur for fertilization. Bees are good transfer agents, but must be in sufficient number to adequately pollinate an orchard. One strong colony normally is adequate for an acre. To assure adequate pollination from crabapples, several cultivars differing in time of bloom should be used. These should be distributed evenly over a planting. Generally, the bloom period among apple cultivars is more consistent than that for crabapple pollinizers and apple cultivars. Thus, crabapples and apples often are not a good match.

The steps from pollination to fertilization and fruit set can be outlined as follows: (a) transfer of pollen to the stigmatic surface of the pistil, (b) germination of the pollen on the stigmatic surface, (c) growth of the pollen tube down the style into the ovule and embryo sac, (d) fusion of a generative nuclei (microgametes, 1n) with the egg (megagamete, 1n) forming the zygote (2n) which later becomes the embryo or seed, and (e) fusion of the second generative nucleus (microgamete, 1n) with the fused polar nuclei (2n) forming the endosperm (3n), a nourishment source for the young developing embryo. Initial fruit set has been completed. Final fruit set is established after young fruits are shed.

The sepals of the flower at full-bloom are usually in a horizontal position. At petal fall, they curve downward. Later, they return to a horizontal poisition, and then become vertical by the swelling (enlargement and lengthening) of the fruit. At calyx closing, the sepals are brought together by further fruit growth. In typey fruits, sepals become extended, forming a deep calyx cavity. This change in sepal position from horizontal to vertical indicates effective fertilization has occurred. Fruitlets lacking this movement abscise or shed later. However, some set fruits may be shed in the June drop.

Effective Pollination

The period of effective pollination (EPP) is the time interval between the longevity of the ovule (receptively) and the growth of the pollen tube. For example, if the pollen tube requires five days to reach the ovule, the ovule longevity is eight days in duration, there is a three day period (window) in which pollination can be effective. This is irrespective of the number of days the stigma is receptive to pollen. Factors influencing the length of the EPP are: temperature effect on rate of pollen tube growth, diploid (2n) vs. triploid (3n) cultivars, nitrogen, and "on" vs. "off" blooming years.

Temperature: A linear relationship exists between temperature and the rate of pollen tube growth for ambient temperatur from 45 to 60°F. For each 1.5 to 2°F above 45°F, one da less is required to achieve effective fertilization. Since the EPP is shortened by cool temperatures, the duration of ovule longevity becomes especially important for effective fertilization in a cool spring.

Diploid vs. Triploid Cultivars: The heavier set with a triploid vs. a diploid appears to be related to (a) a longer duration of ovule longevity, and (b) potential for more embryo sacs (e.g., 2 vs. 1). Based on research data, stigma receptivity was two days longer in a triploid than a diploid (9 vs. 7 days), pollen tube growth the same (five days), and ovule longevity four days longer (12 vs. 8 days). The net effect was a four day longer EPP in the triploid than the diploid (7 vs. 3 days), increasing the probability of effective fertilization.

Nitrogen Effect: A late foliar application of nitrogen can increase the duration of ovule longevity. This could increase the EPP. Research data from England has indicated a nitrogen treatment to increase both the duration of the stigma receptive period and ovule longevity four days each, but has no effect on pollen tube growth (4 days). The net effect was a four day longer EPP than the control (6 vs. 2 days). A treatment extending the EPP a few days could make a big difference in obtaining fertilization. It is not known if the data was for trees with a normal or a low level of nitrogen. However it appears that a late season foliar application of nitrog may significantly influence fruit set the following year.

"On" vs. "Off" Years: There appears to be a longer EPP in an "on" year than in an "off" year. The EPP was found to be eight to 12 days in an "on" year, but four to seven days in an "off" year.

Fruit Set

After petal fall, there are several times when noticeable shedding of flowers and fruitlets are observed. The "first drop" usually is heavy, and consists of unpollinated flowers and undeveloped fruitlets. After initial fruit set, there may be two to three more drops which contain poorly developed fruits and fruits with a low seed number. The "June drop" is generally considered due to competition among fruits for water and nutrients. Final fruit set usually is established after this shedding. Normally, three to five seeds in a fruit are necessary for final fruit set, and for fruit development to maturity.

The number of flowers setting fruits is based largely on the amount of bloom. If bloom is light, fruit set is more important in obtaining a sufficient crop than if bloom is heavy. Thus, more flowers need to be set in light blooming years than in heavy blooming years to obtain the same number of apples. If fruit thinning is required, there have been more flowers effectively pollinated and fertilized than necessary.

Ideally, there should be no more fruit buds, flowers initiate and fruits set than are necessary for a crop. Consequent pollination, flowers and fruit set should be approached from the standpoint of adequacy rather than maximizing. Adequacy not only is number but distribution over a tree in order to have an optimum leaf/fruit ration for each apple. □

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COMPACT NEWS

A Periodic Newsletter of the International Dwarf Fruit Tree Association

No. 2 May 1992

A MESSAGE FROM THE EDUCATIONAL DIRECTOR

The 35th Annual Conference of IDFTA was held at the Radisson Hotel in Niagara Falls, New York. Twenty-five speaker presentations were made and copies of their papers have been received and will be soon sent to the printer for inclusion in Volume 25 of Compact Fruit Tree.

I hope that you will plan to take part in the Quebec Summer Tour that is scheduled for June 14-16, 1992. Seven orchards will be visited. The Quebec fruit growers have done an outstanding job in preparing for our visit. Details are included.

The IDFTA sponsors tree fruit research. Included is a list of projects that were approved for partial support at the meeting of the Rootstock Research Committee held February 23, 1992 in conjunction with the annual conference in Niagara Falls. A list of the proposals funded in 1992 is included along with a copy of the Guidelines for project proposals. The need for industry support of relevant research is becoming increasingly critical. University budgets have been reduced and we will see a continuing reduction in the numbers of state and federal supported tree fruit related researchers and extension specialists.

H.A. (Jack) Rollins, Jr.

THE APPLE INDUSTRY IN QUEBEC

Pierre Philion

The Quebec province offers a lot of scenic pictures for those interested in fishing, skiing or hiking. A great territory for wildlife. A fantastic area for dreamers or optimistic apple growers. What else!

I have to agree with Dr. C. Forshey when he says that apple growers are "short term pessimists and long term optimists."

The apple industry in Quebec is mainly set 35 to 40 miles around the city of Montreal and another area surrounding the city of Quebec. They are really two different areas with at least two weeks difference in bloom period.

The production is oriented toward fresh fruit and very few orchards are oriented toward processing. It has been, and will be for long term, yet a fresh market oriented industry even though one of the major Canadian juice companies is located in Rougemont – about 25 miles southeast of Montreal. They used 90% of Quebec juice apples – either drops or grade outs.

Fruit growers in Quebec are still producing a high percentage of McIntosh, a well known variety to drop before it really takes the color needed for good marketing. Young plantings are improving the situation. Better quality will be produced and the ratio of McIntosh is being changed. Other varieties like Empire and Spartan are popular as late varieties, Jerseymac and Paulared are replacing the old Melba. But the McIntosh, Cortland and Lobo are still the leading varieties produced in Quebec. Trees are planted in different types of soil, from heavy loam to very light gravel. Drip irrigation is necessary and used in the light soil. It is not a general recommendation, but with dwarfing rootstock such as EM 26 and EM 9, growers are really going all the way.

Old trees are a thing of the past, some are still present but not efficient and will be removed. Progressive growers are all in the process of rejuvenating their orchards. The rootstocks in use are mainly EM 26, M9, MM106 and M7.

The staked or supported trees are on M 9, M 26 either

central leader type or French vertical axe and a few other sophisticated Tatura or "Y" systems.

The orchards are not huge and may vary from 10 acres to 125 acres. The average is in the range of 25 to 80 acres.

The apple is almost the only fruit tree grown in Quebec. Pears and plum are strictly grown for roadside markets. Varieties are Clapps Favorite, Flemish Beauty, Phileson for pears and Mont-Royal for plum.

Weather can be tough. The day I wrote this article it was −32C on January the 15th, 1992. Winter kill is always a problem and seems to be worse on EM 7 for dwarfing rootstock.

Varietywise it is quite hard to specify, but recent plantings of Empire show sensitivity to cold winter at a point that fruit bud leaves are narrow compared to oval leaves of the extension growth that are not exposed to winter cold temperatures.

Other trees killed by cold weather on winter-related damage are Jerseymac on bare soil, which could be a consequence of herbicide strip on some sites and poor air drainage could be the reason on some other sites.

Paulared and Vista Bella are doing well but are at times affected by fireblight. They are good for early market.

Disease

Scab is a major problem in Quebec. McIntosh is well known to be susceptible to the disease, but Jerseymac and Vista are a lot worse. While Paulared seems to be semi-resistant to scab, Empire and Spartan are intermediate. All other varieties like Golden Russet, Red Delicious, Golden Delicious are on limited acreage.

The total acreage in Quebec is about 17,000 acres for a total production of 5.5 to 6 million bushels in 1990 and target is 7 million plus in later years.

Old plantings are declining fast and new plantings are improving, but cold weather will always be a limiting factor for high yields that could justify numerous sophisticated planting systems. Structural posts have to be dug 4.5 to 5 feet deep to overcome weaving problems. Single posts per tree in gravel hydraulically driven remains permanent but not in loamy soil.

Growers are aggressive and innovative, and some of that energy should be oriented in their marketing system. This is probably the weak link to a good industry in Quebec. Montreal market is the only volume market and a lot of apple growers are offering apples.

Buyers are wise guys. They wait and see if it is a price market instead of a quality market. Growers will have to review their quality minimums to meet import quality standards and be a lot more disciplined in their marketing. □

High Density, Pedestrian Apple Orchard Production

Dick Unrath, Mike Parker, Eric Young
Horticultural Science – NCSU

A dwarfing, high density apple orchard was established in 1988 to evaluate the potential of developing a pedestrian (totally contained and maintained within reach of the ground) apple orchard management system for North Carolina apple growers.

In 1991, its fourth year, this orchard yielded 500 bushels of fruit per acre.

Because labor is becoming more costly and scarce, and pesticide rates are being reduced and many chemical registrations cancelled, the use of shorter, smaller canopied trees which are planted at 500 to 1000 trees per acre, managed totally from the ground and fruited early, could have considerable advantages for North Carolina growers.

Labor efficiency, pesticide effectiveness and earlier return on investment are all attractive features of these orchards. The fourth year yield of 500 bushels per acre is above the current state average for all bearing apple acreage.

In a year of extreme disease pressure from climatic conditions and registration loss of effective chemicals for disease control, these small canopied trees produced large size, top quality fruit. These pedestrian orchards may hold the best hope for a bright future for the North Carolina apple industry.

For additional information contact C.R. Unrath (704-684-3562). □

Don't miss the
1992 IDFTA Summer Tour
in QUEBEC, CANADA
June 14-16, 1992

Deadline to register is May 23, 1992.

Register today!

Dr. Rollins to Retire as IDFTA Educational Director

Dr. H.A. (Jack) Rollins will retire as Education Director of the International Dwarf Fruit Tree Association in June of this year. He has held the position for the past four years. Dr. Rollins has organized and led the organization to annual meetings in Fresno, California; Penticton, British Columbia; Grand Rapids, Michigan; and Niagara Falls, New York.

Throughout his professional career, Dr. Rollins has been involved with research and extension programs involving tree fruits. He has held the position of Professor of Horticulture and chaired the Horticulture departments at both Virginia Polytechnical Institute and Ohio State University. He has served on Cooperative State Research Service in-depth review panels of horticultural departments at a dozen different universities. He has been a member of the American Society for Horticultural Science, the National Peach Council, the Council on Pesticide Application, the American Pomological Society, the Council for Agricultural Science and Technology and the International Dwarf Fruit Tree Association.

Dr. Rollins is a Fellow, American Society for Horticultural Science, and has received the Virginia Peach Industry Superior Service Award, the National Junior Horticultural Association Distinguished Service Award, the IDFTA Distinguished Service Award, and the Ohio Vegetable and Potato Association Distinguished Service Award. He and his wife Lucille are enjoying their retirement home in Gilford, New Hampshire.

Jack, thank you for your contribution to our organization over the many years you have supported us and especially over the past four years as our Education Director.

Best wishes to you in your retirement years! ☐

Dr. Bruce H. Barritt to succeed Dr. Rollins as IDFTA Educational Director

International Dwarf Fruit Tree Association president Harold Schooley is pleased to announce that Dr. Bruce H. Barritt of Wenatchee, Washington will become our new Education Director, commencing in June.

He will succeed retiring Director Dr. H.A. (Jack) Rollins of Gilford, New Hampshire.

The duties of this position are to act as resident technical advisor, steering the direction of IDFTA, organizing educational programs for annual conventions, editing the resulting proceedings for publication, and preparing articles for newsletters. This position has a four-year term of office, with an optional second term. In this way the leadership of IDFTA moves around the scientific community adding new ideas and direction.

Dr. Barritt received his Bachelor's and Master's degrees in horticulture from the University of British Columbia and his Ph.D. in pomology and plant breeding from Cornell University.

For 12 years he was the strawberry and raspberry breeder at the Washington State University Research and Extension Center at Puyallup where he contributed to the release of new varieties.

Since 1981 he has been a research pomologist at the WSU Tree Fruit and Extension Center in Wenatchee. His research on orchard management systems and rootstocks has been supported through grants from the Washington Tree Fruit Research Commission.

Dr. Bruce H. Barritt

He has published over 150 research and magazine articles. He has studied tree fruit production in New Zealand, Australia, western Europe, China and the former Soviet Union, and has led study tours to these fruit producing regions.

He received the Researcher of the Year Award in 1989 from IDFTA.

Recently there has been renewed interest among fruit growers in moving from semi-dwarf plantings to higher density staked or trellised plantings.

The systems to accomplish this are varied and numerous. Judging by the study tours that Dr. Barritt has recently led and by his speaking engagements and recent magazine articles it is evident that he enjoys researching and teaching in the field of dwarf tree culture.

Members of IDFTA can look forward to his input of knowledge and leadership.

Bruce, welcome aboard! ☐

1992 Proposals Funded by IDFTA Rootstock Research Committee

February 23, 1992

Investigator	Location	Project Title
1. Rom, C.R.	AR	The International Orchard Development Trial: the effect of climate and spacing on apple tree growth and productivity
2. Tukey, L.D.	PA	Performance of Very Dwarf Rootstocks with Apple Cultivars (previously funded 8 years)
3. Autio, W.R.	MA	Screening Rootstocks for their Effects on Apple Ripening and Quality (previously funded in 1989 @ 1000)
4. Baugher, T.	WV	Influence of Rootstock and Training System on Constituent Carbohydrate Content of Apple
5. Rom, C.R.	AR	The Use of Vigorous, Fireblight Resistant Interstocks on Blight Susceptible Rootstocks to Avoid Infection in High Density Orchards
6. Ferree, D.	OH	Influence on New York Dwarfing Fireblight Resistant Interstems on Growth of "Gala"
7. Tehrani, G.	ONT	Performance of Anjou, Bartlett and Bosc on Standard and Old Home X Farming Clonal Rootstock (previously funded 1986-89)

Guidelines for Rootstock Research Committee and Project Proposals

The following guidelines should help those who are writing project proposals in the development of their proposals. To qualify for funding, the project should meet one or more of the guidelines listed.

- Cooperative broad base testing of rootstocks.
- Developing new dwarfing materials.
- Methods of identification for rootstocks.
- Problems of graft unions.
- Factors enhancing adaptability and survival of rootstocks.
- Pest problems that pertain directly to interstem and rootstock survival.
- Cultural technique for tree size control involving dwarfing rootstocks.
- The influence of a range of rootstocks on tree or fruit physiology or performance.
- Systems of culture that utilize rootstocks.
- The following generally would not be funded unless a special unique characteristic is involved in making a more efficient compact tree: general physiology, mechanization, or orchard management.
- New concepts and innovative ideas for rootstock research will be given favorable consideration.
- Funding for all projects will be based on funds available, and with the idea of supplying seed money rather than complete funding with no funding promised in succeeding years.
- Consideration for funding requires that a written report on a previously funded project be submitted to the Rootstock Research Committee by February 1 of the following year.
- These guidelines are to be reviewed each year by the Rootstock Research Committee at the yearly meeting. □

Apple Rootstocks of the Future?

Loren D. Tukey
Department of Horticulture • The Pennsylvania State University

INTRODUCTION

Modern apple production dates back to the Middle Ages and the gardens of Europe. Some apple trees were large while others intermediate or small in size. By grafting varieties onto dwarf apples, trained trees of various forms and designs could be developed.

Commercial apple production was an extension of garden plantings. Trellising was the transformation of espalier trained trees against a wall to training trees like a wall (hedge). Forms for tree training included the Marchand, Belgium fence, oblique palmette, and Delbard Tri-Crossarm.

The French became known for their trellised plantings of low height apples and pears. Others worked with vertical trees, using the art of tree training and pruning on small individual trees. The Lorette System of pruning had a great influence on methodology. Foremost in European thinking was the desire for low height, compact individual trees, or a group of trees forming a hedge.

In the U.S., apples were mainly seedling trees, and cultivars, chance seedlings. Tree size was of less concern than in Europe. The idea of dwarf apple trees was relegated to amateur fruit growing.

However, the change from a seedling root system to clonal rootstocks was a major advancement in the industry. For the first time, trees could be made genetically identical, enhancing uniformity. The East Malling rootstocks led this advance. However, dwarfing rootstocks were used mainly to reduce the vigor of over-vigorous apple trees rather than to produce small-size trees as in Europe.

The East Malling rootstock cultivars were originally selections of various dwarf apple sorts, but later included some controlled crosses. Rootstocks were grouped according to the degree of tree size control, or dwarfing, provided in a tree: standard, semi-standard, semi-dwarf, dwarfing, and very dwarfing, as M.16, M.2, M.7 and M.26, M.9, and M.27, respectively.

The Malling-Merton cultivars were crosses, with Northern Spy as one of the parents, having resistance to wooly apple aphis. Rootstocks used commercially are M.111 and M.106 alone, or double worked with M.9 to reduce their vigor.

Other rootstock cultivars, through breeding and selection, have been introduced for tree size control, increased winter hardiness, and resistance to disease: Budagovsky series (Bud or B), Polish series (P), Michigan Apple Clones (MAC), Cornell-Geneva group (CG), Ottawa series (Ott), and Oregon Apple Rootstocks (OAR).

Other rootstocks of interest include: M.4, C6, Pajam 1 (French, Lancep), Pajam 2 (French, Cepiland), Jork or J9 (German), Alnarp-2 (Swedish), Robusta 5 (Canadian), and YP (Finnish). Thus, there is available a fairly large selection of rootstocks differing in the degree of tree size control, and a few with increased winter hardiness. This list is increasing by new introductions, through breeding and selection of superior sorts, e.g., M.9 sorts.

THE FUTURE

The European industry, with low central-axis trees, is centered around the use of M.9 and its sorts as the main rootstock.

However, M.27 has received commercial interest because less pruning and training is required than with M.9. The spindle and its various forms dominate European apple production.

The apple industry in the U.S. is in transition. Although orchards with freestanding, doubleworked trees mainly are being planted, a switch to lower height trees with central-axis support and a dwarfing rootstock is taking place. Medium height central-axis systems are evolving for local conditions by combining the training of the spindle with those of the French AXE, or vice versa.

However, low central-axis trees as spindles for intensive apple production are being tried. Other support systems being used are the Tatura trellis, Lincoln canopy, "A" frame trellis, and low trellis hedgerow. The objective with every system is a lower height tree than previously used, greater efficiency in production, and increased land

productivity. The problem, however, in making a change to an intensive system is which dwarfing rootstock to use.

Frequently, the cultivar and rootstock combination produces a tree too vigorous for the intended production system under local growing conditions. Unlike Europe, there does not appear to be a universal satisfactory rootstock for all soils and under all growing conditions.

SYSTEMS AND ROOTSTOCKS

Each intensive orchard system requires a specific tree size and form as building blocks. Each tree or stion (cultivar/rootstock combination) has a natural or trainable size determined by the balance of vigor between the cultivar and rootstock. Not only must there be an appropriate balance between cultivar and rootstock vigor (stion vigor), but also an appropriate balance between stion vigor and environmental vigor. That is, very vigorous cultivars would require a more dwarfing rootstock to obtain a certain tree size than cultivars of medium and low vigor.

In turn, a vigorous stion is better suited (balanced) with a low vigorous soil and poor growing conditions, while a less vigorous stion, with fertile soils and good growing conditions.

Consequently, the selection of a rootstock (degree of dwarfing) depends upon the orchard system (required trained tree height and form), cultivar vigor (tree size), and environmental vigor (soil vigor and growing conditions). There is no singular rootstock suitable for all cultivars, orchard system, soils, and growing conditions.

Conversely, a specific rootstock may be best suited to local soils and growing conditions, but stions are too vigorous for handling as a low central-axis tree (spindle).

This is especially so with the M.9 regular and EMLA, a high quality dwarfing rootstock. This has been the case with M.9 in the plantings at Rock Springs; stions resemble those with M.26 in other areas.

In such situations, the rootstock influences the system rather than the reverse. Instead of "battling" the training of low central-axis trees, a system should be used which fits the stionic vigor. A planting with medium height central-axis trees might be chosen, where trees would be trained by combining techniques used in the spindle and French AXE.

The Quebec system, and other local systems under development, are examples. Thus, the rootstock can influence the system rather than the opposite.

ROOTSTOCK EVALUATIONS

In the U.S. and Canada there is much research activity in the evaluation of tree size controlling rootstocks, matching cultivar/rootstock vigor with systems, productivity of various rootstock-cultivar combinations, and selection and breeding of new rootstocks.

This research is in several coordinated plantings of the NC-140 Cooperative Regional Project on Rootstock and interstem Effects on Pome and Stone Fruit Tree Growth and Fruiting. Additional apple rootstock research at Penn State has concentrated on dwarfing and very dwarfing rootstocks for intensive orchard production systems.

Plantings are mainly at Rock Springs, but three young plantings are in grower orchards. Annual reports of this research are published in *Pennsylvania Fruit News*, usually in the February issue.

Freestanding Trees:

In the 1980/81 planting, tree efficiency (yield per unit trunk cross-sectional area) was greatest with Starkspur Supreme Delicious on Ott 3 and EMLA 26. Ott 3 produced a slightly more dwarfed central-axis tree than M.26, bore a crop earlier, and was easier to train.

EMLA 9 also had efficiency equal to M.26 and Ott 3, but needed trunk support. EMLA 7 and OAR 1 still had low efficiency in the 10th leaf, large trees with low production.

In the 1984 planting, MAC 39, a relatively low central-axis tree with good production, has had the greatest tree efficiency to date. Both Ott 3 and MAC 39 rootstocks should be tested commercially as a freestanding tree for red Delicious.

Supported Trees:

Trees on dwarfing and very dwarfing rootstocks were being trained as a low central axis tree (spindle).

The degree of cultivar tree size control was in relation to the dwarfness of the rootstock, e.g., M.27 more dwarfing than P22, and P22 more than M.9.

However, the vigor of the cultivar directly affected tree size control, e.g., with M.27, Nittany was a larger tree than Mutsu, and Mutsu larger than Golden Delicious. Thus, a vigorous cultivar needs a more

dwarfing rootstock than a less vigorous cultiver to produce the same size tree, e.g., Nittany on M.27, Mutsu on P22, and Golden Delicious on B491.

Spur cultivars (red Delicious sorts) are dwarfed more by a dwarfing rootstock than non-spur cultivars, e.g., red Delicious sorts being about 50% smaller than Golden Delicious on the same dwarfing-very dwarfing rootstock. Golden Delicious on P22 appeared to be comparable to Starkspur Supreme Delicious on B491, and Golden Delicious on B9 or M.9 Bonn, to Mutsu or Spendour on P22 at Rock Springs.

Thus, red Delicious sorts need a more vigorous very dwarfing rootstock than a non-spur cultivar to produce an equivalent tree size.

Two dwarfing rootstocks appear to be ideally suitable for red Delicious, in two different trials: Lancep (Pajan 1), slightly more dwarfing than M.9; and Cepiland (Pajam 2), slightly less dwarfing than M.9.

Although trained as a supported low central-axis tree, they appear to be more suitable as a supported medium central-axis tree. Tree efficiency was almost the same at Rock Springs.

Red Delicious on B491, about half the tree size with Lancep, has had greater tree efficiency. These rootstocks warrant commercial testing.

Golden Delicious on B491 is a smaller and more efficient tree than on M.9R (regular). Generally, M.9 at Rock Springs has been too vigorous for a low central-axis tree, but appears to be satisfactory for a supported medium height central-axis tree.

Greatest tree efficiency with Golden Delicious has been with P22 under less vigorous, and with M.27 under more vigorous growing conditions.

Similarly, Mutsu and Nittany (vigorous cultivars) have had greater tree efficiencies with P2 and P22 under less vigorous growing conditions, while with P22 and M.27, under more vigorous conditions.

Thus, growing conditions, including the soil, can influence the selection of a very dwarfing rootstock.

Trellised Trees:

The most satisfactory rootstock for the Penn State low trellis hedgerow system is M.9 for all but very vigorous cultivars. M.27 should be used with Firmgold, Jerseymac, Mutsu, N.Spy, Spigold, York Imperial, and Nittany.

P22 might be used with these cultivars, but trials are limited. Trellised red Delicious should be with M.26, or M.9 under vigorous growing conditions. In a young planting, red Delicious has performed well with MAC 9 (Mark).

SUMMARY AND CONCLUSIONS

The selection of a dwarfing rootstock depends upon the orchard system, cultivar vigor and type, and environmental conditions.

There is no one best tree size controlling rootstock for all conditions and systems. A less vigorous dwarfing rootstock should be used in vigorous soils and under vigorous growing conditions, while a more vigorous rootstock under less vigorous conditions.

In tree size control, rootstock vigor and cultivar vigor are balanced.

Conversely, if M.9 is the only dwarfing rootstock can be used, the size of the trained tree with M.9 would determine the orchard system to be adopted, or the design to follow. New central-axis systems can be developed to meet local conditions by molding together techniques used in spindle and French AXE training.

There are suitable dwarfing rootstocks for use in future intensive orchard production systems. Suggested productive rootstocks for medium height, freestanding, central-axis trees are M.26 and Ott 3, and possibly MAC 39 (trial only).

Rootstocks for supported central-axis trees are, for Dwarf: M.9R, M.9 EMLA, M.26 EMLA (under certain conditions), Cepiland (Pajam 2) and Lancep (Pajam 2); and for Very Dwarf: B491, P22 and M.27. Dwarf rootstocks worthy of trial in supported medium-height systems are: J9, P2 and B9. Suggested rootstocks as interstems for freestanding trees are: M.9R and EMLA, B491, P22 and M.27.

Trellised plantings should be with M.9, except for vigorous cultivars when M.27, and possibly P22, should be used. Red Delicious should be on M.26, but can be on M.9 under vigorous conditions. Trial trellis plantings with MAC 9 (Mark) are suggested.

Research is continuing with tree size controlling rootstocks. There are some exciting new introductions coming along, and new approaches for handling various dwarf rootstocks in intensive plantings of low central-axis trees. The future is here for dense, supported apple tree systems. □

NC-140 Apple Rootstock Trials Update

Eric Young
Horticultural Science • NCSU

The oldest apple rootstock trial of the NC-140 cooperative rootstock testing project was planted in 1980 and terminated in 1990 and the final reports of this trial are now available.

Reports covering many aspects of this trial make up a complete issue of the *Fruit Varieties Journal* published by the American Pomological Society. This issue, volume 45, number 4, is available from the American Pomological Society, 102 Tyson Building, University Park, PA 16802 for $7.00.

This trial involved nine rootstocks with "Starkspur Supreme Delicious" as the cultivar and was managed as a medium density, central leader orchard in 27 sites around the US. Rootstocks tested in this trial were:

Ottawa 3, M.7 EMLA, M.9 EMLA, M.26 EMLA, M.27 EMLA, M.9, MAC.9 (Mark), MAC. 24, and OAR.1. The reports included in this issue of *Fruit Varieties Journal* cover rootstock affects on such characteristics as overall growth and productivity, cold injury, pruning requirements, fruit maturity, size, and storability, foliar nutrient content, and root growth.

The overall performance summary indicates that the greatest tree losses were with 0.3, M.27 EMLA, and MAC.24. Largest trees by far were on MAC.24 (100%) and smallest were on M.27 EMLA (6%). 0.3, M.9, M.9 EMLA, and Mark (20-25%) did not differ in size while M.26 EMLA (40%) and M.7 EMLA (50%) were intermediate.

Trees on MAC.24, OAR.1, and M.7 EMLA produced much *less* fruit per tree size than the smaller trees. Estimated production potential per acre based on 10-year tree size showed that trees on Mark had the greatest potential yield, followed by M.26 EMLA, 0.3, M.7 EMLA, and M.9 EMLA. Performance in North Carolina has generally agreed with the overall results of this trial.

The second oldest NC-140 apple rootstock trial, planted in 1984, has completed its eighth leaf and is still in the ground at the Mountain Horticultural Crops Research Station (MHCRS) at Fletcher. This trial also has "Starkspur Supreme Delicious" trained as in the previous trial but on 16 rootstocks and in 31 North American sites. Among the most productive trees in this trial are those on the Polish rootstocks, P.1, P.2, and P.16, also the Russian rootstock B.9, as well as M.26 EMLA.

In North Carolina, B.9, P.1, and M.26 EMLA have performed the best, while P.2 and P.16 have not done as well as in other states, possibly due to our high summer temperatures. This trial will continue for two more years before final reports are prepared.

The newest NC-140 apple trials in North Carolina are the systems trial and a cultivar/rootstock trial, both located at MHCRS. The systems trial includes four training systems:

Slender spindle, vertical axis, HI-Tec, and central leader, using "Empire," "Earli-Red-One," and "Royal Gala" with various rootstocks. The cultivar/rootstock trial's purpose is to evaluate the interaction between four cultivars with different growth habits and five rootstocks that are suitable for higher density, slender spindle type plantings.

Future NC-140 apple rootstock trials will be planted in 1993 and 1994. These trials will evaluate rootstocks from M.9 size up to MM.106 size with cultivars like "Gala" and "Liberty." Many new rootstocks from the breeding program at Cornell-Geneva, New York will be included in the 1993 trial and other rootstocks from around the world will be in the 1992 trial.

Each trial will need to last at least 10 years, but this is necessary to obtain reliable information for our industry. □

One last reminder:

Register today for the

1992 IDFTA Summer Orchard Tour.

Deadline is May 23rd, so hurry!

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COMPACT NEWS

A Periodic Newsletter of the International Dwarf Fruit Tree Association

No. 6 November 1992

European Tree Fruit Study Tour — July 16-31, 1993

Dr. Bruce Barritt, IDFTA Education Director and Washington State University horticulturist, will lead a 16-day European Tree Fruit Study Tour July16-31, 1993. This will be Dr. Barritt's seventh study tour with previous tours in Australia, New Zealand, Europe and the former Soviet Union. The goal of the study tour will be to evaluate the components of high density orchard systems including dwarfing rootstocks, pruning and training techniques, tree density and arrangement, tree quality and tree support systems. Slender spindle, 'V' and super spindle orchards will be visited. There will be opportunities to study Integrated Fruit Production techniques to minimize chemical use and to see the newest orchard equipment for intensive orcharding.

The orchard, nursery and research station visits will begin in the South Tyrol fruit district in northern Italy, continue to the Bodensee districts in southern Germany and Switzerland, travel north to the Netherlands and finish in southeast England in the Kent fruit district. A complete travel itinerary with costs will be available December 1, 1992. For more information please call Curtis-C Travel at 1-800-562-2580 or (509) 884-3539, or Bruce Barritt at (509) 663-8181, ext. 233. □

THE SUNLIGHT FACTOR IN THE MANAGEMENT OF HIGH DENSITY ORCHARDS

Bruce H. Barritt
Tree Fruit Research and Extension Center • Washington State University • Wenatchee

For the fruit grower there is both good news and bad news about sunlight in the orchard. The good news is that sunlight, the indispensable energy source required for tree and fruit growth, is free. Unfortunately, for many orchardists the bad news is threefold: 1) not enough sunlight strikes the tree, too much strikes the orchard floor; 2) not enough sunlight reaches all parts of the canopy, too much of the canopy is severely shaded; and 3) too much sunlight may directly strike the fruit, reducing fruit quality by increasing sunburn.

Why is sunlight so critical for successful orchard management? Sunlight is the energy source that drives the photosynthesis factory. Photosynthesis produces the products, carbohydrates and energy containing molecules, essential for plants to grow and fruit. Like any factory that manufactures a product, there must be supplies to build a product and fuel to run the factory. The supplies that are needed for photosynthesis are carbon dioxide and water, which are abundant. The fuel or energy source for photosynthesis is sunlight. The biggest factor limiting the output of the photosynthesis factory is the amount of fuel or sunlight striking the orchard canopy. Leaves in the shade have reduced photosynthetic efficiency and therefore do not produce the carbohydrates necessary for the development of new leaves, shoots and fruit.

The influence of sunlight or shade (the absence of direct sunlight) on tree and fruit development can be understood by studying three factors: 1) light interception by orchard canopies, 2) light distribution within each tree canopy and 3) transient shade within the canopy. Each of these factors is critically important for achieving high production with high fruit quality and each can and should be manipulated by the orchard manager.

Light interception. The percentage of sunlight striking the total orchard area (both trees and soil) that actually strikes tree canopies is termed percent light interception. Sunlight which strikes the orchard floor is wasted for the most part. Light interception for an orchard is usually high with tall trees, with wide trees and with narrow tractor rows. By selecting narrow orchard equipment and by reducing the width of tractor rows in high density orchards, light interception can be increased. High light interception can be achieved quickly in young orchards if the tree canopy can be developed quickly. ►

Vigorous trees with large, healthy leaves intercept more sunlight than weak trees.

Why is light interception so important? Studies in several fruit districts have shown that as percent light interception by orchard trees increases there is a parallel increase in fruit production per acre. In New York with 12-year-old Empire trees and in Washington with five-year-old Gala and four-year-old Granny Smith trees studies show a strong, positive correlation between percent light interception and total fruit production/acre. Of the total variation in yield/acre approximately 80 percent can be accounted for by differences in percent light interception. In other words, just 20 percent of the variation in yield can be explained by factors other than light interception. This is such a close relationship and it accounts for such a high proportion of variability in yield that it cannot be ignored.

The influence of percent light interception on yield/acre is a universal relationship as long as trees have good light distribution within the canopy. With relatively small trees in high density orchards the relationship is usually very good. It is therefore essential to achieve high light interception as quickly as possible in the life of new orchards and to achieve high light interception in mature orchards.

There is often a poor relationship between yield/acre and percent light interception with large trees. Large umbrella-shaped trees which extend over the tractor alleyway have very high light interception, in some cases almost 100 percent. However, with large trees a high proportion of the tree canopy is shaded. In these trees production is reduced in the shaded zones and production/acre is therefore not correlated with percent light interception.

Achieving high light interception. With careful planning *before* an orchard is planted an orchardist can maximize light interception in young orchards. First, fumigate all replant sites to assure that trees grow to their full potential and fill their space quickly. Second, plant at high tree densities, also to fill the space quickly. Third, plant large, well-branched nursery trees. By making these critical decisions before planting, it is possible to develop a tree canopy quickly and to achieve high light interception early in the life of the orchard.

Light interception can be 100 percent in orchards where the canopy completely covers the orchard floor. However, achieving 100 percent light interception is generally not practical. First, moving equipment under orchard canopies can be complicated and, secondly, sunlight may not penetrate into the interior of large trees, reducing yield and fruit quality in the shaded areas. When light interception is 70 to 80 percent, between-row spacing for orchard equipment is minimal but adequate and good light distribution is usually possible. It is essential that 70 percent light interception be achieved as quickly as possible in the life of the orchard and that internal tree shading is avoided. With high density orchards a realistic goal is to achieve 70 percent light interception by no later than the sixth year.

In trials at Wenatchee with Gala /M.26 trees trained to the freestanding central leader system at 324 trees/acre, light interception in year two was approximately 10 percent and it gradually increased to approximately 30 percent by year six. If extrapolated beyond year six, this block of trees would achieve 70 percent light interception in year 10 or 11. A second group of Gala/M.9 trees in the same orchard was supported, trained to the slender spindle system and planted at 772 trees/acre. These trees had light interception of over 30 percent in year two and it increased to 70 percent by year six. As percent light interception increased in this planting there was an increase in production/acre. The high density slender spindle trees have outproduced the low density central leader trees in years two through six (115 bins/acre for slender spindle and 45 bins/acre for central leader). The key to success with the slender spindle orchard was achieving high light interception quickly by planting at a high tree density.

In summary, the preplant decisions which help to quickly achieve high percent light interception are: 1) fumigating replant soils, 2) planting large, well-branched trees and 3) planting high tree densities.

After an orchard is planted there are several management practices that can be used to increase percent light interception and therefore increase production/acre. First, have high expectations for tree growth and health and strive for vigorous and healthy trees with proper nutrition, water management, pest and disease control, etc. Second, train trees to a height of less than two times the clear alleyway width. As cone-shaped trees increase in height from seven feet to 10 feet their canopy volume increases by 60 percent, they intercept a higher percentage of sunlight and therefore have greater yield potential. Third, it is possible to train trees to a 'Y' or 'V' canopy form with canopies extending over the tractor driveway, allowing less light to reach the orchard floor.

Light distribution. Does sufficient sunlight reach all zones of the tree canopy? Light distribution is the percentage of full sunlight that is received at a specific location within the tree canopy. With the traditional large, round tree canopy there is a zone on the outside of the tree that receives adequate sunlight, usually more than 60 percent full sunlight. There is a second zone closer to the center of the tree that receives less sunlight. A third zone in the center of the tree is shaded for much of each day and usually receives less than 30 percent full sunlight.

Adequate sunlight levels are found in the outer three-foot-thick shell of all tree canopies. As a general guideline, areas of the canopy that are more than three feet from the outer canopy surface have light levels that are too low to achieve adequate flower bud development, fruit set, fruit size and fruit color. From mid-May onward, with mature, pyramid-shaped spur Delicious trees 12 feet tall and nine feet wide at the base, sunlight levels near the central leader and three feet above the soil surface were often less than 30 percent full sunlight and in many cases were as low as 10 percent. These zones of the tree had few if any flower buds and, if fruits did set, they were small and poorly colored. ►

A study of the influence of sunlight levels on fruit production was conducted in England by Jackson and Palmer (1977) with the Cox's Orange Pippin variety. Whole trees were covered with shade cloth so they received just 37 percent, 25 percent and 11 percent of full sunlight. Some trees were not shaded (100 percent full sun). Trees were shaded for either one season or for two consecutive years. The lowest two light levels in these canopies, 25 percent and 11 percent full sunlight, are typical in the center of large trees in commercial orchards. When the light levels were reduced to 25 percent and 11 percent of full sun, yield was reduced by 48 and 66 percent, respectively. The reductions were due to both reduced fruit set and smaller fruit size.

In Washington with spur-type Delicious spur leaf quality was evaluated within tree canopies in different light zones. Percent full sun near the trunk was 53 percent, 24 percent and 12 percent in the top, middle and lower portion of the tree, respectively. Leaf dry weight per spur, an estimate of photosynthetic potential of the spur, was measured at the same locations where light levels were determined. Leaf dry weight/spur was 63 percent lower in the low canopy position than in the top position. Fruit size and fruit color also decreased from the zone of high light distribution in the top of the tree to the shaded lower zone. Fruit soluble solids, acidity, starch levels and firmness were also influenced by the extent of shading.

In the Cox's Orange Pippin study in England, fruit production was evaluated on the same trees the year after the shade treatments were applied. In this second season all shade cloth was removed and all treated trees received full sunlight. In the second year, the number of flower clusters was reduced by more than half on those trees that received 25 percent and 11 percent full sunlight the previous summer. By the end of the second season the trees that had received low light levels the previous year had a reduction in crop of more than 50 percent. Shading in one season had a substantial carryover effect on fruit production in the second season. When trees were shaded for two consecutive seasons yield reductions were even greater.

What are the factors that influence light distribution in tree canopies and how can they be managed by orchardists? To influence light distribution an orchardist must consider: 1) row orientation, 2) tree height in relation to row width, 3) canopy thickness and 4) canopy openness. Rows oriented in a north-south direction have even light distribution on the east and on the west side of the row. With rows that are oriented east-west, the north side of the row generally receives less sunlight and can have fewer flowers, poorer fruit set, less fruit color and smaller fruit size than the south-facing side of the row. It is more important with tall trees than with short trees that trees be in north-south row.

The ratio of tree height to row spacing can influence the amount of sunlight that reaches the lower part of tree canopies. When tree height is less than twice the width of the clear alleyway there is usually adequate light distribution in the lower part of the canopy. For example, if an alley width of five feet is required for orchard equipment, tree height should be no higher than 10 feet. With a two:one ratio of height to clear alley width adjacent rows do not seriously shade each other. Trees taller than 10 feet may have poor light distribution in the lower portion of their canopy regardless of row spacing due to shade the tree casts upon itself.

It is difficult for sunlight to penetrate into the center of wide or dense canopies. Trees in which all of the canopy is within three feet of the outside surface of the canopy (three feet from full sunlight) have excellent light distribution. Therefore, trees that are six feet wide have better light distribution than trees that are nine feet wide. Cone-shaped trees have better light distribution than rectangular trees with the same height and basal width. In mature trees adequate light distribution is guaranteed if canopies remain open. It is necessary to remove large or major limbs to provide canopy openness if sunlight is to reach all portions of the tree.

Transient shade – good shade. As discussed above, if light distribution is poor, shading can become so severe that fruit number and fruit quality are reduced. However, some shading can be beneficial. In hot, sunny climates, heavy shading can be harmful but limited shade can be helpful. In the upper, outside regions of tree canopies fruit may be exposed to full sunlight and become sunburned. In the sunny fruit districts of the Pacific Northwest it is necessary to provide some transient or temporary shade to protect fruit from sunburn.

Pruning techniques can be used to induce transient shade and reduce sunburn. Limbs which are stiff and allow limited fruit movement during the growing season have less fruit sunburn. When a fruit surface, just as human skin, moves from a shaded to a sunny location on hot days, it usually sunburns badly. Limbs can be stiffened by heading pruning of one-year-old or older wood.

Shoot leaf area adjacent to fruits protects them from sunburn. Shortening pruning, a technique of heading fruiting limbs into two-year-old or older wood, can both stimulate lateral and bourse shoot growth and stiffen limbs, and thus reduce the incidence of sunburn.

In summary, orchardists with intensive plantings can influence orchard production and fruit quality by learning how to manage sunlight. First, because light interception is directly related to fruit production, it is necessary to achieve high light interception as quickly as possible in the life of the orchard and achieve high light interception with mature orchards. This means planting large trees at high tree densities and promoting rapid canopy development. Second, adequate light distribution within tree canopies is achieved by limiting tree height to 10 feet or less, by planting trees in single rows, by ensuring that no part of the canopy is more than three feet from full sunlight and by judiciously removing large limbs to ensure canopy openness. Third, in sunny climates it is critical to ensure that there is sufficient lateral and bourse shoot growth and limb stiffness to reduce the incidence of fruit sunburn. ►

An ever present concern is that orchard managers may take sunlight for granted; after all, it is a free energy source. However, we must be proactive and light manage orchards to effectively utilize sunlight. Successful orchardists are LIGHT managers. They appreciate that pruning is LIGHT work and that pruning puts fruit in a better LIGHT.

Additional Reading

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Forshey, C. G., D. C. Elfving, and R. L. Stebbins. 1992. Training and pruning apple and pear trees. American Society for Horticultural Science, Alexandria, VA.

Robinson, T., E. J. Seeley, and B. H. Barritt. 1982. Light intensity, spur age effect on fruit quality. *Goodfruit Grower* 36(6):32,33,36.

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Rootstock Research Grants — CALL FOR PROPOSALS

Deadline is December 31, 1992

Monies that have been contributed to IDFTA and designated for the support of rootstock research are maintained in a separate IDFTA account for use in funding research grants. The IDFTA Board of Directors determines the amount of these monies that will be available each year. The Rootstock Research Committee meets at the time of the annual conference to review submitted proposals and make recommendations to the IDFTA Board.

The IDFTA Board will have modest monies for the support of 1993 research proposals. Researchers are encouraged to review the following proposal guidelines and where practical and appropriate, submit an application for research funding.

PLEASE NOTE:

The deadline for requesting IDFTA grants is **December 31, 1992.** Mail applications to Bruce H. Barritt, Educational Director, IDFTA, 1100 N. Western Avenue, Wenatchee, WA 98801. Please be brief, but specific, and use only space allocated on the **Application For Research Funding** form (including the back side) on the following page of this newsletter. If the project was previously funded by IDFTA, describe in the **"Progress"** section the 1992 research findings. To save time and mailing cost, use the form in this issue of "Compact News" or make a copy of it. Projects not received by December 31 will not be included for 1993 evaluation. Please enclose 22 copies of the proposal.

Rootstock Research Proposal Guidelines

The following outlines the major criteria used by the Rootstock Research Committee for evaluating proposals.

	Percent
Will the research results be useful and/or of value to the tree fruit industry? Does the project support the guidelines established by the IDFTA? What are the implications for advancing industry knowledge?	40
Will the results of the research apply to the whole fruit industry or a limited segment?	10
Is the research justified?	10
Are the project objectives clearly stated and soundly developed with enough detail to determine credibility?	10
Does the present status of the research enhance its possibility of success?	10
Is the use to which the grant will be put practical?	10
To what degree would the grant facilitate the research?	10

APPLICATION FOR RESEARCH FUNDING

Sponsored by International Dwarf Fruit Tree Association

(Please use only the front and back of this form for each application submitted.)

PROJECT TITLE: _____

INSTITUTION: _____

MAILING ADDRESS: _____

_____

LEADER: _____

FUNDS REQUESTED: _____ COMPLETION DATE: _____

☐ NEW PROJECT ☐ RENEWAL

NUMBER OF YEARS PROJECT PREVIOUSLY WAS FUNDED: _____

OTHER SOURCES OF FUNDING:

CURRENT: _____

OTHER GRANTS: _____

YEAR	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
FUNDS ALLOCATED											

JUSTIFICATION: _____

_____

_____

_____

_____

_____

OBJECTIVES: _____

_____

_____

_____

_____

_____

Application for Research Funding (Continued)

Sponsored by International Dwarf Fruit Tree Association

PROGRESS: *(if previously funded)*

PROPOSED RESEARCH: *(experimental outline of treatments, design, etc.)*

FOR OFFICE USE ONLY

Recommended by: Rootstock Research Committee

Signature of Chairman _____

IDFTA Conference

February 21-25, 1993 • Wenatchee, WA

The 36th Annual Conference of the International Dwarf Fruit Tree Association (IDFTA) will be held at the Wenatchee Convention Center with accommodation at hotels and motels in Wenatchee, East Wenatchee and Leavenworth.

Program Highlights The Sunday (February 21) evening program will introduce participants to the multifaceted Washington tree fruit industry. Ten speakers will address topics including 1) Washington's unique climate, soils and fruit districts; 2) tree fruit variety, rootstock and tree density trends; 3) CA storage facilities and fruit maturity program; 4) Washington Apple Commission (promotion); 5) Washington Tree Fruit Research Commission; 6) the critical role of horticultural fieldmen; 7) the joint Wenatchee Valley College-Washington State University tree fruit management four-year degree program.

Monday and Wednesday educational programs at the Wenatchee Convention Center will feature speakers from throughout North America, from Europe and from South Africa. On Tuesday and Thursday bus tours will include orchard, research station and warehouse visits. The awards and recognition banquet will be Wednesday evening.

The Robert F. Carlson Distinguished Lecture will be presented by Dr.Don Elfving from the Horticultural Research Institute of Ontario, Canada. His topic will be "Factors Influencing Productivity of Apple Trees." Dr. Elfving is a productive and enthusiastic researcher with dwarf trees and has recently co-authored a new book entitled *Pruning and Training Apple and Pear Trees.*

The program will also feature two international speakers who share a practical approach to fruit tree management. Dr. Dan Strydom from South Africa and Ko Reinhoudt from The Netherlands will discuss the most recent developments in the fruit industries in their respective countries. Each will also speak on tree quality and the pruning and training of apple trees from planting time until they reach their full size.

The program will include grower panel discussions on 1) successful orchard systems, 2) orchard management techniques for new varieties (Fuji, Gala and Braeburn), and 3) the factors that influence economic success of high density orchards. Tree quality (feathers), fumigation and fertigation will be discussed by a panel on new orchard establishment.

Research and extension pomologists from throughout North America will present new information about successfully growing dwarf fruit trees. Speakers will include Dr. Terence Robinson (New York) on orchard systems and fertigation, Dr. Ron Perry (Michigan) on cherry orchard systems and apple rootstocks, Dr. Curt Rom (Arkansas) on tree training physiology and apple rootstocks, Steve Hoying (New York) on tree girdling and ringing, Mike Sanders (British Columbia) on nursery tree quality and Dr. Bruce Barritt (Washington) on apple rootstocks.

Two full days, Tuesday and Thursday, will be devoted to visiting high density apple orchards (spindles, vertical axis, Heinicke central leader, Tatura, HYTEC, etc.), pear and cherry orchards, research trials and packing and storage facilities. It will be necessary to preregister for the two-day tour package to ensure a place on the buses. Even though 16 buses will be used, it is anticipated that there will not be enough space on the buses for everyone who wishes to participate in the tours.

Travel Arrangements Wenatchee is served by just one commuter airline (Horizon Air) which is affiliated with Alaska Airlines and Northwest Airlines. The small commuter planes, limited number of flights, and the possibility of fog mean flying into Wenatchee may not be possible for everyone. Alternatives include renting cars or vans in Seattle or a bus transfer arranged by IDFTA for the trip from Seattle to Wenatchee and return. It is a three-hour drive from Seattle to Wenatchee.

To obtain low air fares, many participants will wish to fly to Washington State on Saturday, February 20. Whether arriving in Seattle on Saturday or Sunday, arrangements can be made for the IDFTA bus transfer to Wenatchee. Buses will depart from Seattle's Sea-Tac International Airport at regular intervals on Saturday afternoon and Sunday morning and early afternoon. It will be necessary for buses to leave the Seattle airport by 3 pm on Sunday to arrive in Wenatchee in time for the Sunday evening program. This should be a fun trip with lively discussion among fruit growers from every fruit district in North America.

Those who choose to use the IDFTA transfer buses to Wenatchee will return to Seattle's Sea-Tac Airport either Thursday, February 25, after the tours, or Friday morning. Travel time from Wenatchee to Sea-Tac Airport is three hours.

The cost of the IDFTA bus transfers from Sea-Tac Airport to Wenatchee and return is $55. Reservations for the bus transfer to and from Wenatchee should be made with Curtis-C Travel (P.O. Box 7188, East Wenatchee, WA 98802; phone 1-800-562-2580 or 509-884-3539). Curtis-C Travel can also make airline reservations at the best available fares for travel from your home to Seattle and return. Your local travel agent and commercial airlines can also make travel arrangements at the best available fares. It is not too early to start making your travel plans now.

Registration material for the conference and a complete program will be mailed to IDFTA members in late December. Registration materials can also be obtained from the IDFTA business office, 14 S. Main Street, Middleburg, PA 17842 (717-837-1551; FAX 717-837-0090). □

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COMPACT NEWS
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Membership Dues, Research Dollars Play Important Roles in Our Future

IDFTA membership dues for 92-93 will be mailed on the first of December. Your timely payment is very important to the successful operation of the Association. If you haven't already budgeted the cost of your membership, please take the time to do so now.

Exactly where does your membership money go? Most of the funds collected from membership fees are used for the publication and mailing of our annual *Compact Fruit Tree* and periodic newsletter *Compact News.* What better way to spread the word about new research, knowledge and discoveries to so many people, all around the world?! Administrative costs are also covered, and whatever remains goes toward funding research projects. This past fiscal year $15,000 was directed to research and $22,000 has been budgeted for 1993 projects.

The products of research ensure a promising future for all of us. Without ongoing experimentation and new, improved rootstocks and techniques, the dwarf fruit tree industry cannot remain profitable. To stimulate additional research, the Board of IDFTA encourages you to find a place in your budget to match the amount of your dues with an equal or greater amount for research. By doing this, you can directly affect the future of rootstock development and evaluation of high density orchard systems. □