



The UVM Apple Program:

*Extension and Research for the commercial tree fruit grower in Vermont and beyond...*

Our commitment is to provide relevant and timely horticultural, integrated pest management, marketing and economics information to commercial tree fruit growers in Vermont and beyond. If you have any questions or comments, please [contact us](#).

### ***UVM Apple Team Members***

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### ***Apple Orchard Information for Beginners.....***

*[The following material is from articles that appeared in the "For Beginners..." Horticultural section of the 1999 Vermont Apple Newsletter which was written by Dr. Elena Garcia. Please see <http://orchard.uvm.edu/> for links to other material.]*

#### **Websites of interest:**

UVM Apple Orchard

<http://orchard.uvm.edu/>

UVM Integrated Pest Management (IPM) Calendar

<http://orchard.uvm.edu/uvmapple/pest/2000IPMChecklist.html>

New England Apple Pest Management Guide [*use only for biological information*]

<http://www.umass.edu/fruitadvisor/NEAPMG/index.htm>

Cornell Fruit Pages

<http://www.hort.cornell.edu/extension/commercial/fruit/index.html>

UMASS Fruit Advisor

<http://www.umass.edu/fruitadvisor/>

Penn State Tree Fruit Production Guide  
<http://tfpg.cas.psu.edu/default.htm>

University of Wisconsin Extension Fruit Tree Publications  
<http://learningstore.uwex.edu/Tree-Fruits-C85.aspx>

USDA Appropriate Technology Transfer for Rural Areas (ATTRA) Fruit Pages:  
<http://www.attra.org/horticultural.html>

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### **Considerations before planting:**

One of the questions most often asked is, "What do I need to do to establish a small commercial orchard?" The success of an orchard is only as good as the planning and site preparation that goes into it. One important factor you should think about is whether the location or the tract of land you have selected meets certain economic criteria and environmental criteria.

### **Economics**

- Availability of money: If you have to borrow money to start an orchard, is there a bank or some type of lending institution near you which understands and will be able to meet your needs?
- Availability of resources and supplies: How far will you have to drive to buy your orchard supplies? How long will you have to wait for your orchard supplies?
- Cooperatives: Is there a group in your area with whom you can join forces to buy supplies or market your fruit?
- Professional groups: Are there university personnel or private consultants near you who can make regular visits to your orchard or be easily accessible to answer your questions?
- Marketing: How do you plan to market your fruit? Will the population in the area support your type of marketing strategies? The marketing avenue you select will determine your rootstock and cultivar selection
- Transportation. How far is the orchard from packing houses? Are the roads in good condition to transport your fruit? If you choose to have a pick-your-own operation, is your location easily accessible?

### **Environment**

- The temperature parameters of a location are critical for fruit production.
- The state of Vermont is at the temperature limits for apple production. Trying to grow apples in Hardiness Zone 3 is very risky.
- Other climatic consideration include:

Spring frosts: If the site is prone to spring frost, you may lose your crop before it begins to grow.

Heavy winds: Heavy winds may break the graft union or make your trees lean. This breaks the roots and weakens the anchorage of the roots to the soil.

## Site Selection

Once you have considered the above economic and environmental factors, you will be selecting a site. Site refers to the way the tract of land is in relation to the environment surrounding it. These are some things you should consider in selecting a site:

- **Slopes:** The ideal site should be on rolling or elevated land so that cold air can drain during spring frost. A 4% to 8% slope is ideal. A steeper than 10% slope may make it difficult to operate machinery. Avoid areas at the bottom of the hill where cold air settles and frost pockets form.
- **Slope exposure:** A south facing slope receives more sun, thereby warming faster in the spring. A north facing slope will be colder, warming up late in the spring.
- **Soil considerations:** Soils provide anchorage, nutrients, water, and the biotic environment in which the trees will live. Deep, sandy clay loam soils are best for orchard sites.
- Before selecting a site, consult a county **survey map**. Soil survey maps are available at most Soil Conservation Services in Vermont. These publications are valuable in determining if your site has the requirements for a long-term, viable orchard operation.
- **Soil drainage** is probably the most important factor in the longevity of an orchard. If the soil does not have good drainage, there are some options available, such as tiling, but they cost money to implement.
- If possible, use a backhoe to dig holes 5 to 7 feet deep so that the **soil profile** can be examined. Poorly drained soils often have horizontal layers of light colored material.
- **Soil fertility** is important, but not as important as drainage. Soil fertility can often be corrected by applying fertilizers and by increasing the amount of organic matter.

Of all the decisions you make in establishing your orchard, choosing the correct site and location has the greatest long-term impact. An orchard is a long-term venture; it may be productive for 30 to 75 years, and in some instances, even longer. It is necessary to make educated and well informed decisions in selecting the location and site of your future orchard.

## **Soil Preparation**

Soil preparation should be done in the fall before planting. This is the time to do a soil test to determine the needs of your soil. This way you have time to correct any deficiencies and improve soil fertility.

Correcting the soil pH is one of the most effective nutrient management practices to improve fertility in an apple orchard. Try to maintain the soil pH in the range of 6.0 for the subsoil to 6.5 for the topsoil because the pH influences the availability of the various elements to the plant. For example, as the soil pH becomes acidic (pH <5.5), the phosphorous in the soil becomes unavailable to the plant. It does not matter if there is an adequate amount of phosphorous in the soil; the roots are unable to uptake it, or some elements become toxic at high or low pH. Correcting the soil pH needs to be done before planting because once the trees are in place, it is very difficult to change it. In regions with acidic soils, lime, preferably dolomitic for apple orchards, is usually used to raise the pH. Other ways to improve soil fertility include:

- Addition of organic matter
- Maintenance of good tilth
- Crop rotation
- Erosion control
- Addition of nutrients when needed

## **Cultivar and Rootstock Selection**

Selecting and ordering the cultivars and the rootstocks you will be planting is a decision that should be given much consideration. It should also be done in the fall. For large plantings or custom orders, this is done two years in advance. There are approximately 10,000 apple cultivars and 20 rootstocks commercially available. On what basis do you decide what to plant?

The following is a list of factors to consider when selecting a cultivar:

- Marketability of the cultivar. Is this cultivar well known? Or will you have to develop a market for this cultivar? How will you sell it? Does it fit a niche market?
- Adaptability to the region. Here in Vermont, the issue of winter hardiness needs to be considered very seriously.
- Uses. Determining your marketing avenues will help decide on what cultivars to plant.
- Maturity. Depending on the marketing plans you have for your apples, it might be advantageous to have cultivars ripening at different times.

When selecting a rootstock to use for the cultivar you have chosen, consider

what effect the rootstock is going to have on the aerial portion of the tree. The genetic control of the rootstock on the cultivar include:

- Size. The overall size of an apple tree will be greatly determined by the rootstock, but you must consider the cultivar that will be grafted onto the rootstock. You may not want to have a low vigor cultivar grafted onto a very dwarfing rootstock because the result may be a very 'runted' tree
- Date of bloom and amount of bloom. Some rootstocks may delay or hasten bloom.
- Precocity. Precocity or ability to bear fruit early is one of the advantages associated with some rootstocks, particularly the more dwarfing stocks.
- Winter hardiness. Winter hardiness of the rootstock is important to consider here in Vermont. Some rootstocks are slower at 'hardening' for winter and might be killed if an early frost occurs.
- Resistance. As you are able to choose disease resistant cultivars, so may you choose disease resistant rootstocks to such diseases as fireblight and collar rot.

To get more information on potential cultivar and rootstock for Vermont, check our websites at : <http://orchard.uvm.edu/uvmapple/hort/cultivars/index.htm> and <http://orchard.uvm.edu/uvmapple/hort/Rootstocks/index.html>

The following information on rootstocks is taken from the 2006-2007 Penn State Tree Fruit Production Guide (<http://tfpg.cas.psu.edu/138.htm>). Underlined rootstocks are recommended in Vermont.

Rootstocks to control tree size have been used in apple production for over 2,000 years. The clonal apple rootstocks that we use in the United States have traditionally originated in Europe.

In the mid-1800s horticulturists began referring to rootstocks by name. They were called Paradise (or French Paradise) or Doucin (or English Paradise), the former being more dwarfing than the latter. These plants, however, showed much variation in size control. In addition, many new stocks had been introduced inaccurately under these names; undoubtedly viruses and genetic mutations had occurred in the plant material. In the late 1800s one author described 14 different kinds of Paradise rootstocks. This diversity led researchers at England's East Malling Research Station to gather the selections to determine their trueness to name. The researchers concluded that indeed there were numerous misnamed and mixed collections of plant material.

Dr. R. Hatton decided that because of the confusion he would drop the proper names and assign each stock a number. He assigned a Roman numeral to each of 24 selections but did not number them in any order with respect to tree size. Hence, M.9 with a larger number is a smaller tree than M.2. Most of these, with the exception of M.9, M.7, M.2, M.8, and M.13, were never commercially important in the United States. In succeeding years some rootstocks were developed from controlled crosses, M.26 and M.27 being the most famous.

In 1917 a second research station, the John Innes Institute of Merton, England, joined with the East Malling station to begin a breeding program. Their efforts, oriented mainly toward developing rootstocks resistant to woolly apple aphids, produced the Malling-Merton series of rootstocks, of which MM.106 and MM.111 are still used widely today.

In the late 1960s, researchers began work to remove many of the viruses naturally present in the rootstocks in order to reduce incompatibility problems caused by the viruses. The first rootstock to be partially cleaned

up was M.7; it was designated M.7a. Later still, more viruses were removed from all of the Malling and Malling-Merton series of rootstocks. These were then designated EMLA for the East Malling and Long Ashton research stations in England. While the viruses have been removed, some of the rootstocks' size control has been lost. Therefore, the old "dirty" M.9 will produce a smaller tree than the "clean" M.9EMLA. Currently in the industry nearly all apple rootstocks are virus free.

The next few years will bring several new rootstocks, many developed in Europe. Those likely to be available first are the Budagovsky series. Designated as either Bud or B, they were developed in the central plains of the Soviet Union for their cold-hardiness. The next rootstocks to be released will probably be from Poland and are called the "P-series." Like the Russian series they are expected to have some cold-hardiness. The P-series was developed from crosses between M.9 and common Antonovka. Reportedly, these stocks have good resistance to collar rot.

The newest rootstocks, however, are being developed here in the United States. One group comes from Cornell University's breeding program, which has bred rootstocks for resistance to fire blight. Some of these rootstocks are also resistant to other problems such as apple scab, collar rot, and woolly apple aphids, and exhibit a reduction in burrknot formation.

A large multistate research program known as the NC-140 Research Project is primarily responsible for conducting most evaluations of these new rootstocks. Penn State has been a member of this project since its inception.

Growers should be aware of each rootstock's known capabilities and limitations. Many of the newer rootstocks will probably be available to the commercial industry before they have been thoroughly evaluated with different cultivars.

### ***Specific rootstocks***

Following are brief descriptions of and comments on apple rootstocks. Rootstocks are listed in order from smallest to largest. (Much of the information was gleaned from research reports of the NC-140 committee from around the country.)

**Poland 22 (P.22):** P.22 produces trees that are smaller than those grown on M.9. It is reported to be resistant to collar rot, apple scab, powdery mildew, and crown gall. P.22 is susceptible to fire blight and woolly apple aphids. Its major benefit may be as an interstem piece. In one trial planting with Gala, it has produced a tree slightly smaller than P.16. However, in a younger planting with Ginger Gold, it is slightly larger.

**Malling 27 (M.27):** A very dwarfing rootstock. Unless the central leader is supported, the tree will be very small. Little is known about disease or insect susceptibility. To date, most commercial nurseries are using this rootstock only as an intermediate stem piece on MM.106 or MM.111. If handled and spaced properly, it can be a very productive stock for a vertical axe system.

**Budagovsky 469 (B.469)** induces dwarfing similar to that of M.27 and is very winter hardy. Its only use would be for an interstem. Test plantings of Ginger Gold with this rootstock at University Park have not been viable. In New York State trials B.469 has shown very good compatibility between the scion, without the typical overgrowth.

**Poland 16 (P.16)** is from the same cross as the other Poland rootstocks and is reported to produce a tree about the size of M.27, although this has not proven to be the case in research trials in Pennsylvania. Test plantings of this rootstock at University Park with Gala and Ginger Gold show that trees are about 40 percent of the size of the same cultivar on M.9 rootstock. At this time this rootstock is suggested for trial only. P.16 is reported to be resistant to apple scab, powdery mildew, collar rot, and crown gall. It is susceptible to fire blight.

**Geneva 65 (G.65)** was developed by Dr. Jim Cummins at Cornell University. Due to errors in tissue culture buildup of this rootstock, the U.S. distribution of this rootstock has been hindered. Tree size once thought to be about that of M.9 is now considered to be closer to M.27. The rootstock is difficult to propagate in nursery stool beds. It is susceptible to tomato ring spot virus and apple stem grooving virus. It is resistant to fire

blight and collar rot.

**Budagovsky 9 (B.9 or Bud9)** is a new dwarfing rootstock bred in the Soviet Union from the cross of M.8 x Red Standard (Krasnij Standart). Like the other stocks in this series, the leaves are a distinctive red. Trees on this stock are 25 to 35 percent smaller than M.9EMLA depending upon the cultivar. In a 10-year trial at University Park, York Imperial, Rome Beauty, and Empire on B.9 were approximately 25 percent smaller than the same cultivar on M.9EMLA; while Jonagold, Golden Delicious, and McIntosh were approximately 35 percent smaller. B.9 appears to be resistant to collar rot and is very cold-hardy. In limited trials, it has performed very well across a wide range of conditions. Trees will need to be supported.

**Poland 2 (P.2)** was developed from a cross between M.9 and Common Antonovka. Trees grown on P.2 are 15 to 25 percent smaller than M.9. The rootstock is resistant to collar rot and slightly susceptible to apple scab and powdery mildew. Young test plantings in Pennsylvania with Gala and Ginger Gold show that P.2 is nearly as precocious as M.9. Smoothie Golden Delicious on this rootstock produces a very smooth and straight union. However, Delicious grown on P.2 is reportedly as susceptible to apple union necrosis as the same cultivar grown on MM.106.

**Malling 9 (M.9):** The traditional and best-known dwarfing rootstock. It should be planted on a well-drained site. Trees on this rootstock always require leader support. The rootstock is very susceptible to fire blight and can develop burr knots. Numerous clones of M.9 are now being sold by nurseries, including M.9 NAKB 337, the current dominant strain used. It is a virus-free clone from Holland and appears to be 5 to 10 percent less vigorous than M.9EMLA. M.9EMLA is a virus-free clone from the East Malling/Long Ashton research stations. It is approximately 25 to 30 percent more vigorous than M.9. Pajam 1 (Lancep) and Pajam 2 (Cepiland) are French selections that are relatively new. They are 35 to 40 percent more vigorous than M.9 NAKB 337. One other clone is M.9 RN 29, selected by Rene Nicolai in Belgium. In plantings at University Park with Gala, it is approximately 30 percent larger than M.9 NAKB 337.

**Geneva 41 (G.41)** was released in 2005 as a rootstock that produces trees the size of M.9. The rootstock was developed from a cross between M.27 and Robusta 5 made in 1975. It was selected for resistance to *Phytophthora* and fire blight. Oldest planting with this rootstock is located at FREC in Biglerville and started in 1998 with Jonagold. Three-year-old trees at Rock Springs with Golden Delicious are identical in size to M.9T337 and about 15 percent smaller than M.26. Finished trees should be available in limited quantities in 2007.

**MARK:** Formerly named MAC 9, developed in Michigan. It is an open-pollinated seedling of M.9. Trials in Pennsylvania indicate that this rootstock is not freestanding and is slightly larger than M.9. The central leader tends to lean. In recent years this rootstock has fallen into disfavor due to an abnormal growth proliferation at the soil line. Trees with this growth proliferation cease to grow and become spur bound; therefore, it is not recommended to be planted unless supplemental irrigation is provided. Very drought sensitive.

**Geneva 16 (G.16):** This is a recent rootstock released from Cornell University's breeding program. Like others in the series, it is resistant to fire blight. It is tolerant of collar rot and immune to apple scab. It is susceptible to woolly apple aphid and powdery mildew. Size is reported to be between that of M.9 and M.26. In a trial at Rock Springs at the end of the third growing season it is approximately 33 percent larger than M.9T337 and 12 percent larger than M.26. It does appear, however, to induce wider branch angles in the scion cultivar. Geneva 16 is very sensitive to latent viruses in apple and should only be propagated with virus free scion wood on top. At this time G.16 is recommended for trial only.

**Ottawa 3 (O.3):** This relatively new rootstock was bred in Canada for its cold-hardiness, with one parent being M.9. Trees on O.3 are about the size of M.9EMLA but smaller than M.26. Induces early bearing. Resistant to collar rot, but susceptible to fire blight and woolly apple aphids. Ottawa 3, although being available for many years, has not been popular with the nursery industry. Young stool beds of O.3 produce few saleable liners, although with age the stool beds become more productive. Ottawa 3 is very susceptible to apple mosaic virus, so only material known to be virus free should be planted on this rootstock.

**Vineland 1 (V.1):** This is the newest rootstock to come from the breeding program at the Vineland station in Ontario, Canada. Tree size is comparable or slightly larger than M.26. Yield efficiency and fruit size are equal to or greater than M.26. However, unlike M.26, it appears to be highly resistant to fire blight. It should be in limited supply for the 2003 growing season.

**Malling 26 (M.26):** A more vigorous rootstock than M.9. It can be used to produce either a dwarf or a semidwarf tree, depending on scion variety, production system, and soil type. It is susceptible to collar rot and fire blight and should not be planted in a wet site. Certain varieties, such as Rome, Stayman, Golden Delicious, and many triploids, when grafted onto this rootstock may exhibit signs of graft union incompatibility. When incompatibility occurs, the trees may break off at the union in high winds. Because exposed portions of the rootstock have a strong tendency to produce burr knots, the union between the scion variety and the rootstock should be set no more than 1 to 2 inches above the final soil level.

**Geneva 935 (G.935)** is a 1976 cross of Ottawa 3 and Robusta 5. Size is reported to be slightly larger than M.26, but the rootstock has resistance to fire blight and crown rot. It is not resistant to wooly apple aphid. Production efficiency is rated equal to M.9. In the Golden Delicious trial at Rock Springs in 2005, tree size was about 25 percent larger than M.9 and 4 percent larger than M.26. Production efficiency was not significantly different although slightly higher than M.9 in 2005. Finished trees should be available in late 2006 or early 2007 in limited quantities.

**Geneva 11 (G.11):** The second release of the Cornell breeding program; only limited plantings exist in Pennsylvania. Reported to be similar in size to M.26 but more productive. Has the advantage of being resistant to fire blight and crown rot as well as only rarely producing suckers or burr knots. Availability limited. Tissue-cultured trees are larger than trees propagated by stool beds.

**Geneva 202 (G.202)** is a semidwarfing rootstock that produces a tree slightly larger than M.26. It was developed from a cross of M.27 and Robusta 5. It is fire blight and Phytophthora resistant as well as having resistance to wooly apple aphids. The rootstock has been mainly tested in New York and New Zealand. In New Zealand they are looking at this rootstock as a possible replacement for M.26 since it is more productive than M.26. In a 9-year study with the scion cultivar of Liberty, G.202 was about 50 percent smaller than M.7 but had much greater production efficiency.

**Pillnitzer Supporter 4 (Pi.80)**, a cross between M.9 and M.4, has recently been introduced from Germany. It is reported similar in size and in anchorage to M.26. Yield capacity is reported to be better than that of M.26. A planting with McIntosh as the cultivar was established in 1999 at Rock Springs. To date, Supporter 4 is about 15 percent larger than M.7 EMLA. Yield in 2001 was nearly double that of McIntosh/M.7EMLA and 50 percent greater than McIntosh/M.26EMLA. Interstems are becoming increasingly popular in Pennsylvania orchards. This stock is composed of an understock such as seedling MM.111 or MM.106, onto which an intermediate stem piece of M.9 or M.27 is grafted. The variety is budded or grafted onto M.9 or M.27. Size control is directly related to the length of the intermediate stem piece. Interstem apple trees offer a strong root system while reducing the size of the overall tree.

**Interstem** trees should be planted so that a portion of the interstem is buried. Test plantings in Pennsylvania indicate that interstems on either MM.106 or MM.111 sucker, and very vigorous varieties and Stayman have not performed well on interstems.

**Geneva 30 (G.30)** is currently available from commercial nurseries. The advantages of this M.7-size rootstock are early production, fewer burr knots, and less suckering. Tests at Rock Springs do indicate that trees on this rootstock come into bearing earlier and produce more fruit than M.7. Unfortunately, in the last two years questions have arisen about the graft compatibility of this rootstock with Gala. In tests around the country in the NC-140 trials, there have been occasions where Gala/G.30 have snapped off at the bud union during high winds. Therefore, it is recommended that if Gala is propagated on G.30, the trees be supported by two wires, one at approximately 36 to 40 inches above the ground and a second wire at 8 to 9 feet. Individual stakes or poles have not been sufficient because they allow excessive twisting of the trees in the wind.

**Malling 7 (M.7):** This rootstock produces a semidwarf tree that is freestanding in deep well drained soils. In rocky, steep, or shallow soils, it tends to lean. High budding and deeper planting may help remedy this problem. The rootstock may sucker profusely and is susceptible to collar rot. M.7a is a clone of the original M.7. but which has had some of the inherent viruses removed.

**Poland 1 (P.1):** This rootstock appears to be about the size of M.7. It may, however, require some tree support.

**Budagovsky 490 (B.490):** This rootstock produces a tree the size of MM.106 and has the same favorable characteristic of inducing early bearing. Burr knots rarely occur. The rootstock has some resistance to collar

rot and is reportedly moderately resistant to fire blight. Nurseries find this stock easy to propagate by hardwood cuttings and are grooming it to replace MM.106.

**Malling-Merton 106 (MM.106):** A rootstock, slightly larger than M.7, that produces freestanding, early-bearing trees. Trees on MM.106 are susceptible to collar rot when planted in wet soils and are not recommended for poorly drained sites. Delicious on MM.106 is susceptible to apple union necrosis.

**Malling 2 (M.2):** An older rootstock that is reappearing in nurseries and orchards. It produces a semidwarf to semistandard freestanding tree, depending on scion variety. Trees are strong, crop well, and do not have collar rot problems.

**Poland 18 (P.18):** This stock holds the most promise for those wanting a larger tree about the size of MM.111. Its other advantages are tolerance to fire blight and resistance to collar rot. It will probably perform better in wet or heavier soils.

**Malling-Merton 111 (MM.111):** A well-anchored rootstock, resistant to woolly apple aphids, and tolerant of drier soil conditions. It is the most cold-hardy rootstock readily available. Trees on MM.111 are semistandard to standard in size. Planting depth of this rootstock is critical. The union should be no higher than 1 to 2 inches above the final soil line.

**Budagovsky 118 (B.118)** is a more vigorous clone out of the Minsk breeding program. It is more vigorous than the other rootstocks in the series but still imparts the high degree of winter-hardiness. It propagates easily in stool beds and does not sucker. It has moderate resistance to fire blight but is susceptible to *Phytophthora*. Because of the vigor of the rootstock it is only recommended for spur strains of apple or in weak soil or replant situations.

**Seedling:** A rootstock from apple seeds, with a variable genetic makeup and suckering and disease susceptibility. Varieties on this rootstock produce the largest trees.

### **Selecting a nursery**

The investment you will be making when buying your trees needs to have very careful consideration. The tree quality you buy will have an effect on the life-long productivity of the orchard. Choose a nursery carefully. Ask other growers for suggestions on where to buy your trees.

*Things to keep in mind when buying trees:*

- Bargain or low priced trees are more costly in the long run because they may be of poor quality.
- Ask the nursery if they have enough trees to meet your demands. You are better delaying your planting for a year than ending up with a mixed block where the spacing might not be correct or trees are not compatible (i.e., cross pollination, blooming time, pest management).
- Ask about any guarantees about survivability, quality, and trueness to type.
- Order early. This will give you a better chance of getting what you want.
- The ideal tree size is 1/2 to 5/8 inch diameter. These trees are usually 4 to 6 feet tall. Avoid larger trees unless you are planting a high density orchard where feathered trees (trees with branches) are better.
- If you need the nursery to custom bud or graft to a particular cultivar, you need to contact the nursery in June or July two years before you wish to plant.

- Information about a nursery from other growers can be invaluable. Ask growers about their experiences with the nursery.
- Tell the nursery when you want the trees to be delivered, and ask them to let you know when they are being shipped so you will be prepared. Here in Vermont, planting is done in the spring when ground has thawed and the danger of hard freezes has past.

## Tree Fruit Nurseries

### ***A Partial List of Nursery Sources for Fruit Trees:***

***[Not all nurseries are included in this compilation. No discrimination or endorsement is intended or implied. We encourage you to examine all of the sources of nursery trees.]***

Adams County Nursery <http://www.acnursery.com/>  
26 Nursery Rd PO Box 108 Aspers, PA 17304 (717) 677-8105  
Commercial-grower oriented nursery.

Cummins Nursery <http://www.cumminsnursery.com/>  
738 W. Hunt Rd. Alcoa, TN 37701 (865) 681-8423 (Nov-March)  
4233 Glass Factory Bay, Geneva, NY 14456 (315) 789-7083 (April-November)  
Specializing in hard-to-find varieties as well as large orders.

Lawyer Nursery <http://www.lawyernursery.com/>  
950 Highway 200 West Plains, MT 59859 (406) 826-3881  
[trees@lawyernursery.com](mailto:trees@lawyernursery.com)  
Wholesaler of nursery stock with a selection of fruit trees. Grafted selections include newer, often cold-hardy varieties. Also carry clonal and seedling fruit rootstock.

C&O Nursery <http://www.c-onursery.com/>  
PO Box 116 Wenatchee, WA 98807 (800) 232-2636  
West Coast commercial-grower oriented nursery.

Van Well Nursery <http://www.vanwell.net/>  
2821 Grant Road & PO BOX 1339 Wenatchee, WA 98807 (800) 572-1553  
[vanwell@vanwell.net](mailto:vanwell@vanwell.net)  
West Coast commercial-grower oriented nursery.

Stark Brothers Nursery: <http://www.starkbros.com/>,  
<http://www.starkbros.com/wholesale.jsp>  
PO Box 1800, Louisiana, MO 63353 (800)325-4180  
Homeowner and commercial-oriented nursery. Oldest fruit tree nursery in the US.

Hilltop Nursery  
60395 County Road 681 Hartford, MI 49057 (800) 253 2911  
Commercial-oriented nursery.

Summit Tree Sales <http://www.summittreesales.com/contact.htm>  
55826 60<sup>th</sup> Ave, Lawrence, MI 49064 (800) 424-2765  
Wholesale tree brokers. They work with many nurseries...if you need it they can probably find it.

Willow Drive Nursery: <http://www.willowdrive.com/>  
3539 Road 5 NW, Ephrata, WA 98823 (888) 548-7337  
Commercial nursery.

### **Steps for Planting Fruit Trees:**

How to plant fruit trees is one of the most often requested pieces of information. Although the following steps are designed for the person who is planting a few trees in their backyard, the procedure, other than more detail on pre-planting soil preparation (see April 21, 1999 issue) and orchard design, is basically the same whether you are planting one or one hundred trees.

- 1) After you have decided where you want to plant, you need to clear the sod from that area. A circular area of at least 30 inches is recommended.
- 2) Dig a hole large enough to accommodate the roots.
- 3) You may want to lightly prune the roots; so as to encourage growth. Spread the roots out in the hole. (A mixture of peat moss, limestone and soil can be placed around the roots to ensure water uptake by the roots)
- 4) The graft union (where the scion and rootstock were grown together) should be 2 to 5 inches above the ground.
- 5) Make sure that the graft union is facing 90° against the wind direction (so as to prevent easy breakage)
- 6) Fill the hole in with soil and gently tamp it down to get rid of any air pockets.
- 7) Water immediately.
- 8) Stake the trees (if required by rootstock size) and loosely tie the tree to the stake with a plastic or fabric tie.
- 9) Head back the tree with a diagonal cut so the tree is approximately 36" in height. Cut just above a bud, if possible. If branches are present cut 10"-12" above the highest branch. Also, remove any branches or buds below two feet.
- 10) As new growth begins in the spring, be sure to spread the limbs to get the desired growth form (this can be done with clothes pins).
- 11) You may also want to apply some fertilizers after growth has begun. Do not fertilize at planting because it may burn new roots. It is generally recommended that this soil amendment be done prior to June 15. Be sure not to place fertilizer too close to the tree! A circle 18" away from the tree trunk should be suitable. A 10-10-10 fertilizer or its equivalent is recommended.
- 12) A mouse guard should be placed around the tree trunk and cover the bottom two feet.
- 13) Water regularly throughout the first year.

14) In the dormant season, prune trees according to nursery/training system recommendations.

### **Planting density**

The planning of a new orchard block can be more difficult than its actual planting. When planning an orchard block, one of the most crucial decisions the orchardist must make is the planting density of the new orchard block. Planting density, or the number of trees per acre, greatly effects orchard efficiency, productivity and the intensity of management needed to run the orchard.

Higher density orchards (500+ trees/acre) maximize productivity per acre while minimizing land waste. Lower density orchards (100-300 trees/acre) tend to produce less, but also minimize intensity of management, such as water management, tree training and pruning. Today, the majority of mature orchards have densities between 200-500 trees per acre, but many growers are switching to higher density plantings in order to maximize production and precocity. At whatever planting density is finally decided upon, a basic rule is to plant the trees so that, when they reach maturity the trees touch but do not crowd each other. Also, ensure that space is available for machinery to move freely through the orchard.

In order to achieve the ideal tree size for the planting density used, the rootstock/cultivar combination must be chosen carefully. Rootstocks which offer less size control (M.111, M.7a and G.30) are usually better for orchard blocks planted at lower densities (100 to 300 trees/acre), and do well with a central leader system. The more size-controlling the rootstock (M.26, M.9 and Bud. 9), the better adapted it is to higher density planting systems (500 +trees/acre). The more dwarfing the rootstock, the more likely it will need staking or trellising to support growth. These support systems can greatly increase the initial cost of planting. Many different training systems may be used with higher density plantings, including Vertical Axis and Slender Spindle.

The growth habit, precocity and vigor of the cultivar will also effect the mature size of the tree. The mature size of different cultivars on the same clonal rootstock can vary by as much as 40% (table 1). When cultivars with different degrees of vigor are planted within the same block, adjustments must be made in rootstocks used and/or in planting distance. Additional variations in mature tree size can be caused by geographical location, soil fertility, available water, light intensity, in-row spacing and grower management. Your nursery catalog or Extension Service can provide the appropriate recommendations for determining the growth habit of trees.

*For more information on planting density calculation see the Michigan Tree Spacing Calculator website here:*

<http://web1.msue.msu.edu/fruit/mispacingfinal1.htm>

<b>Table 1. Potential variety vigor for various apple cultivars in Vermont</b>		
<b>LOW</b>	<b>MEDIUM</b>	<b>HIGH</b>
Braeburn	Empire	Cortland
Golden Delicious	Fuji	Fortune
GoldRush	Liberty	Ginger Gold
Law Rome	Gala	Jonagold
Macoun	Golden Supreme	McIntosh
Red Rome Beauty	Jonafree	Pulared
Senshu	Suncrisp	Spartan
Spur Red Delicious		

### **The Soil World of Young Apple Trees**

(Modified from original article written by J. Costante)

The key to a successful orchard, regardless of the size, is the management given to the trees in the first eight years. On top of the list of cultural management practices to follow is the soil preparation before and the two years following planting.

The soil environment of a young apple tree lies within an area approximately 5 feet wide, 6 feet long, and 10 inches deep. This area must be prepared to maintain ideal fertility to allow the young trees unimpeded growth. A two year preparation program for a new site should involve:

- Correcting the soil pH
- Building the organic matter level in the range of 5% to 10%
- Adding the necessary soil nutrients, such as nitrogen, phosphorous, etc.
- If this is a replant site, you need to have the soil tested for harmful pathogens and nematodes
- Correcting water drainage

The best way to maintain fertility in your newly planted trees includes:

- Conduct leaf and soil analysis annually. Leaf analysis is done from mid-July to mid-August, and soil analysis is done in the fall.
- Water, at least 5 gallons/tree/week for 10-12 weeks during the growing season, particularly during the summer
- Fertilizer, at least 1/3# of actual nitrogen/tree if organic matter is less than 6%, and 1/4# per tree if organic matter is over 6% but under 10%.  
Double these rates if you are planning on leaving sod around the trees

- For trees 1 to 2 years, spray 1/4# Solubor/acre at 1st and 2nd cover sprays; for 3 to 5 year old trees spray 3/4# per acre at each of the two cover sprays. Boron is an important element in root development.
- Eliminate as much stress from the plant as possible by the applications of herbicide near the tree to eliminate weed competition, and by the addition of mulches around the tree to increase the organic matter. The following table indicates the impact of herbicide, mulches or both on various aspects of young tree growth versus a sod cover around the tree.

**Table 1. Impact of herbicides mulches (or both) versus sod cover around the tree in various aspects of young tree growth**

	Herbicide or mulch (or both)	Sod cover
Tree growth	+	-
Root growth	+	-
nutrition	+	-
Early yield	+	-
K availability	+	-
Ca and Mg availability	?	+
Soil pH	lower	higher
Filling allotted space	+	-
Nematode build-up	+	-

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### ***Disease and Insect Management -- Using an IPM approach***

IPM stands for integrated pest management which is an approach to managing pests (i.e., insects, mites, disease-causing organisms, mice, etc.) which combines biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks.

It is a significant challenge to produce a high quality apple crop while minimizing spraying. A high level of knowledge of the crop, the various pests, the beneficial organisms, and how they interact and affect each other within the apple ecosystem is required.

There are many insects and diseases which attack the various parts of apple trees. Various degree-day models, monitoring techniques and action thresholds

have been developed to aid in IPM decision-making. Disease risk can be reduced by planting disease-resistant apple cultivars which are commercially available. However, depending on your marketing goals, these may not be appropriate for your orchard. Disease-resistant apple cultivars are highly recommended for those considering organic apple production.

Information about the various insects and diseases which you will have to manage can be found on the **Vermont Apple IPM Focus website**: <http://orchard.uvm.edu/uvmapple/pest/index.html>.

A **synopsis of key arthropod and diseases** affecting apples can be found at: <http://orchard.uvm.edu/uvmapple/pest/BacktoBasics/index.htm>.

An **IPM Checklist** of management items for consideration during the year is at: <http://orchard.uvm.edu/uvmapple/pest/2000IPMChecklist.html#An%20IPM%20hecklist%20for%20Vermont>

It is **highly recommended** that all orchardists obtain education and training in the safe use and storage of pesticides. Information on how to obtain your Vermont Pesticide Application License is at: <http://pss.uvm.edu/pesp/>

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