

Picking the Right Rootstock for Fresh and Processing Apple Orchards

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Apple growers are adopting improved, production systems to remain competitive in the international fruit market (Robinson, 2008). They are doing this in NY State by establishing high-density plantings with smaller trees using new cultivars. These high-density plantings may cost 10 times more to establish than low-density plantings, however, the potential returns of high-density plantings, far exceed those of low-density plantings, particularly during the first 10 years after planting, often returning the grower's initial investment much sooner than less-costly, low-density plantings. We have recently completed 4 long-term orchard systems field studies which have confirmed that planting highly feathered trees in the Tall Spindle system at 3X11 ft spacing gives the optimum economic result over 20 years (Lordan et al., 2018a,b, c; 2019a, b; Reig et al., 2018; 2019a, b). If the price of fruit is high with a premium variety then the profitability is much higher and the investment can be paid off much quicker but the optimum planting density is the same. If growers grow their own trees and plant lower quality trees then the total lifetime profitability is less and the investment takes longer to pay back. However, if the trees they grow are large and highly feathered then there is no profitability penalty for growing your own trees.

The central component of a high-density production system is the rootstock which provides tree size control to allow for high-density plantings. Our research over the last 20 years has shown that the rootstock influences not only tree size but many other aspects of tree performance including productivity, fruit quality, nutrient uptake efficiency, pest resistance, stress tolerance, and ultimately profitability (Fazio et al., 2019). The evolution from low- to high-density plantings has raised the bar for rootstock performance. A grower's decision to establish a new orchard with a specific cultivar/rootstock combination has financial implications spanning 20 years. Such a financial risk creates economic issues associated with the adoption of new rootstocks which must be considered when choosing a rootstock.

Designer Rootstocks

In the past the primary criteria in choice of rootstock has been will it survive in my climate, is it the right vigor and is it available. Cold damage and fire blight have been the two primary and economically important causes of tree death in North America. In addition *phytophthora* root rot and waterlogging have also caused tree death. Thus, the rootstock decision in the past was usually quite simple with only 1 or 2 choices available to growers. However with the proliferation in apple rootstocks available around the world there is now a dizzying array of choices for apple growers. The Geneva breeding program alone has released 14 apple rootstocks and is poised to release 4 more in the next

few years. With so many rootstock choices, we have suggested the term "designer rootstocks" to indicate the possibility of choosing a rootstock suited for the specific climate, soil, cultivar and planting system a grower chooses. There are 4 variables that need to be combined specifically for each orchard before choosing a rootstock. They are:

1. vigor of the variety,
2. vigor imparted by the climate,
3. vigor imparted by the soil and
4. the space allocated to each tree.

Each of these should be considered as pieces of a puzzle specific to each orchard or areas in an orchard in selecting a rootstock. We have further suggested that a rootstock in a modern orchard should be able to grow well enough to fill the space allocated to the tree by the end of the 2nd or 3rd years and begin production in the second year. This requires planting a large tree. If rootstock vigor combined with scion vigor, climate vigor and soil vigor do not result in sufficient growth to fill the space in two or three years then substantial economic penalties in lost yield accrue to the grower. In the past, with limited rootstock choices, growers often planted a given rootstock which was not well matched with scion vigor, climate vigor, soil vigor or tree spacing resulting in trees that took 5-8 years to fill the allotted space or that grew too vigorously for the allotted space and then were difficult to manage in later years. In one of our recent papers (Lordan et al., 2019a) has estimated that with high priced varieties, the lost yield when trees fail to fill their space by the end of the 2nd or 3rd year can cost \$100,000/acre in lost returns over the first 8 years of an orchard life. This economic reality is often not appreciated by growers who never see the un-realized income from lower than potential yields due to the wrong rootstock choice which is not matched perfectly to scion vigor, soil vigor and spacing.

Most growers are hesitant to plant a novel rootstock that is new to them because of the risk that the rootstock will not do well for them. However it is also true that there are large economic penalties for not adopting truly better rootstocks when planting a new orchard. The introduction of the variety Honeycrisp in the USA in the mid 1990's has brought new challenges to rootstock

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An array of new rootstocks give apple growers unprecedented choices and allow growers to design their new orchard by matching the rootstock vigor, the scion vigor, the soil vigor and the climate vigor. If properly matched the trees should fill the allotted space by the end of the second or third year and produce high yields in the first 5 years. This allows for the full investment of the new orchard to be paid by the end of the fifth year.

selection. It is a weak growing cultivar that often fails to fill the space allocated to the tree in 2-3 years. However, due to its high market price this variety has been very profitable for growers even though it has often not achieved the goal of filling the space in 2-3 years with dwarfing rootstocks. In addition, its susceptibility to the Ca related disorder, bitter pit, has resulted in the quest for rootstocks which will have the perfect vigor level to fill the space in 2-3 years and will have a specific mineral nutrient profile of higher Ca uptake and a better K/Ca ratio in the fruit to reduce bitter pit. We are working to speed the discovery of such rootstocks which will be ideal for each variety in each location where apples are produced. We will develop in the next 2 years an online decision aid tool to help growers choose the right rootstock for their specific soil, climate, variety and spacing.

No rootstock is perfect and thus growers must consider both the virtues and faults of each rootstock in selecting a rootstock for their new orchard. Through this article we present the rootstock options for NY apple growers from the Geneva® series of stocks and our recommendations.

Geneva® rootstocks

Fourteen Geneva® rootstocks have been released of which 11 are being supported for further commercialization. The 3 that are no longer supported are G.65 which is too dwarfing in most situations, G.16 which shows severe sensitivity to virus infected bud wood and G.30 which has many spines in the nursery. The remaining stocks are listed below in order of dwarfing.

Geneva® 11 is similar in size to B.9 in some trials and similar to M.9T337 in others. It is very precocious, has very high yield efficiency, produces large fruit size and reduces biennial bearing with Honeycrisp however, its vigor is too low for Honeycrisp on poor soils. It is fire blight resistant and has good resistance to *Phytophthora* root rot, but it is not resistant to woolly apple aphids. It has mild tolerance to apple replant disease. G.11 produces high quality nursery trees. It is proving to be an excellent replacement for M.9 in North America and Europe. It out-yields M.9 by 10-30%. Its stool bed production in the USA in 2018 was ~1,500,000 liners. For Honeycrisp or other weak cultivars like NY1 we recommend this stock be planted at 2-2.5 ft X 10-11 ft (2178-1584 trees/acre). For vigorous scion cultivars such as McIntosh, Fuji, Mutsu, and Jonagold we recommend this stock be planted at 2.5-3.5 ft X 11-12ft (1584-1037 trees/acre).

Geneva® 41 is similar in size to vigorous clones on M.9 such as Nic29 or Pajam 2. It is usually the most efficient dwarf rootstock and productive rootstock in all our trials plus it reduces biennial bearing with Honeycrisp giving it much greater cumulative yield than M.9 or B.9. It has excellent fruit size and induces wide branch angles. It is highly resistant to fire blight and is also resistant to *Phytophthora* and woolly apple aphids. It has high tolerance of apple replant disease and has good winter hardiness. In the stoolbed, G.41 is a shy rooter and requires specialized rooting techniques including tissue cultured stoolbed mother plants to improve its rooting. It has brittle roots and a brittle graft union especially with Honeycrisp and must be handled with care in both the nursery and in the orchard. In the nursery it requires an individual tree stake and a trellis. In the orchard it requires immediate trellising after planting with a 5 wire trellis. This is a serious weakness with some cultivars but its stellar orchard performance in both eastern and western North America indicate that it is a good alternative to M.9 in high fire blight prone areas, in

replant disease areas and in woolly aphid prone areas. Its stoolbed production in the USA in 2018 was ~4,000,000 liners and is the most planted of all the Geneva stocks. We recommend this stock for replant soil. For weak growing cultivars we recommend this stock be planted at 2.5-3.5 ft X 11-12 ft (1584-1,037 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3-3.5 ft X 11-12ft (1320-1037 trees/acre).

Geneva® 213 depending on location this rootstock produces a tree that is similar in size to M.9Pajam2 and slightly more vigorous than G.11, thus more similar to G.41. It is the newest Geneva rootstock and therefore has less widespread testing than the other stocks. Nevertheless, it is probably a future star. It out-yields M.9 by 10-30% on virgin soil but by 25-50% on replant soil. Its winter hardiness has not been tested but is likely hardier than M.9. Its stoolbed production in the USA is just beginning (<10,000 liners). It should be planted at 2.5-3.0 ft X 11-12 ft (1584-1,210 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3-3.5 ft X 11-12ft (1320-1037 trees/acre).

Geneva® 222 is slightly larger than M.9 and G.41. It has performed well in South Africa and was released in the USA in 2013. It is fire blight resistant and has done well in commercial trials in the USA but it has not generated much interest by the rootstock producers thus its availability on the USA is very limited. If growers want to try this rootstock we recommend it for poor soils or replant soil. For weak growing cultivars we recommend this stock be planted at 2.5-3.0 ft X 11-12 ft (1584-1,037 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3-3.5 ft X 12-13ft (1210-957 trees/acre).

Geneva® 214 is slightly more vigorous than G.41. Field trials in New York State indicate that G.214 is similar in size to M.26 with Golden Delicious and Fuji; however, with Honeycrisp it was similar in size to M.9. It has high yield efficiency, (similar to M.9) but slightly less yield than G.41. However, its graft union is strong compared to G.41. It is resistant to fire blight, *Phytophthora* root rot, and woolly apple aphid. Nursery trials at Geneva, NY and in Washington State have shown that it is easy to propagate in stoolbeds (much easier than G.41). Field trials in Washington State have shown that G.214 like G.41 has tolerance to apple replant disease. Its stoolbed production in the USA is still low (100,000 liners) but is rapidly increasing. G.214 like G.41 is a good replacement for M.9 on replant sites. For weak growing cultivars we recommend this stock be planted at 3-3.5 ft X 11-12 ft (1320-1037 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3.5-4.0 ft X 12-13ft (1037-839 trees/acre).

Geneva® 935 is similar in size to M.26. It is highly precocious has very high yield efficiency. It induces wide branch angles, is highly resistant to fire blight and *Phytophthora*, and is tolerant of apple replant disease. It is more winter hardy than M.9 but not quite as hardy as G.41. It is not resistant to woolly apple aphid. Fruit size is similar to M.9. It is an excellent new rootstock for weak growing cultivars like spur-type 'Delicious', 'Honeycrisp', 'Sweet Tango' or 'Snapdragon'. Its stoolbed production in the USA in 2018 was ~2,000,000 liners. We recommend using certified VF (virus free) wood because of some sensitivity to a new, yet to be determined virus combination. We recommend this stock for high density plantings of weak scion cultivars. For weak growing cultivars we recommend this stock be planted at 3-3.5 ft X 11-12 ft (1320-1037 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3.5-4.0 ft X 12-13ft (1037-839 trees/acre).

Geneva® 969 Geneva® 969 is derived from a cross made in 1976 between Ottawa 3 and Robusta 5 and is one of our newest stocks. Field trials indicate that G.969 is a semi-dwarfing rootstock between the size of M.26 and M.7. It is similar in size to two other Geneva rootstocks, G.935 and G.814. G.969 has very high productivity similar to G.935 but is resistant to woolly apple aphid while G.935 is not. It is resistant to fire blight and *Phytophthora* root rot and has good anchorage in the orchard. It is easy to propagate in stoolbeds. G.969 as well as G.935 and G.814 appear to induce less biennial bearing with Honeycrisp than other stocks and are considered some of the best stocks for Honeycrisp and other weak growing fresh fruit varieties. Its stoolbed production in the USA in 2018 was ~ 900,000 liners thus it is now readily available. We recommend this stock for high density plantings of weak scion cultivars. For weak growing cultivars we recommend this stock be planted at 3-3.5 ft X 11-12 ft (1320-1037 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3.5-4.0 ft X 12-13ft (1037-839 trees/acre). G.969 may also be an excellent rootstock for new high density processing orchards. If processing growers are willing to plant at 4-5 ft in row spacings and 14 ft between row spacings then we suggest they use G.969. It is free standing but will require a trellis to support the high early crops it produces.

Geneva® 814 is also one of our newer stocks and is similar in size to G.935, G.969 and M.26. It is highly precocious has very high yield efficiency. It is highly resistant to fire blight and *Phytophthora* and is tolerant of apple replant disease. It is not resistant to woolly apple aphid. It has been shown to produce large fruit size with Gala. It is an excellent new rootstock for weak growing cultivars like Honeycrisp. In one recent trial it had the highest yield of any stock with 'Honeycrisp'. Its major weakness is that it is susceptible to common latent viruses and therefore requires virus free scion budwood when budded in the nursery. Its stoolbed production in the USA in 2018 was ~50,000 liners thus its availability is still very limited. We recommend this stock for high density plantings of weak scion cultivars. For weak growing cultivars we recommend this stock be planted at 3-3.5 ft X 11-12 ft (1320-1037 trees/acre). For vigorous scion cultivars we recommend this stock be planted at 3.5-4.0 ft X 12-13ft (1037-839 trees/acre).

Geneva® 202 produces a tree larger than M.26 but less than M.7. It has high yield efficiency and is precocious but not as high yielder as all of the other Geneva® rootstocks. However it is much superior to M.7 and M.26. It is resistant to fire blight, *Phytophthora*, apple replant disease and to woolly apple aphid. It is useful with weak growing cultivars and as an alternative to M.26 in climates that have problems with woolly apple aphid. It has proven to be quite sturdy and has done well in many climates and many soils. It has become a popular dwarfing rootstock in New Zealand where almost 1 million trees are planted each year. Its stoolbed production in the USA is much less than in NZ and in 2018 was ~300,000 liners. We recommend this stock for high density processing orchards or for Red Delicious plantings. It is also useful in stressful climates like California, Utah, Colorado or Chihuahua. In more traditional climates like NY and with good soils, we recommend this stock be planted at 3.5-4 ft X 12-13 ft (1037-838 trees/acre) for fresh fruit cultivars and at 4.0-4.5 ft X 13-14ft (838-745 trees/acre) for processing scion cultivars.

Geneva® 210 Geneva® 210 is derived from a cross made in 1975 between Ottawa 3 and Robusta 5. There have been more

than 20 field trials conducted with G.210, which have shown that it is a highly productive semi-dwarfing rootstock similar in vigor to M.7 (Robinson et al., 2003). Often its yield efficiency is similar to M.9. It is resistant to fire blight (Russo, et al., 2007), *Phytophthora* root rot, and woolly apple aphid. It also has very good resistance to apple replant disease in field trials in New York and Washington. However it is not completely free standing due to a largely shallow root system and requires a trellis for supporting the trees, which can lean under wet soil conditions. It has high tolerance of apple replant disease suggests that it is a good replacement rootstock when weak scions are planted in replant soils or for organic production. We recommend this stock for organic production or high density processing orchards or for Red Delicious plantings. We recommend this stock be planted at 3.5-4 ft X 12-13 ft (1037-838 trees/acre) for organic production and at 4.0-4.5 ft X 13-14ft (838-745 trees/acre) for processing scion cultivars.

Geneva® 890 Geneva® 890 is derived from a cross between Ottawa 3 and Robusta 5. It is also one of our newest rootstocks. Field trials in New York State indicate that G.890 is a semi-vigorous rootstock either slightly larger than M.7 or slightly smaller than M.7. It is much more productive than M.7 and is resistant to fire blight, *Phytophthora* root rot, and woolly apple aphid. It is easy to propagate in stoolbeds and is free standing in the orchard. It will grow in many types of soils and climates and it much needed replacement for M.7, MM.106 and MM.111. It is vastly superior to other semi-dwarfing rootstocks. Some have used it in high density plantings for weak cultivars like Honeycrisp and it has done very well. However, it was released specifically for use in new processing orchards in NY, MI and PA. We believe this rootstock will be a great step forward for processing orchards and can be planted at medium-high densities. However, up until now it has not been widely available but its stoolbed production is increasing rapidly and in 2018 was ~800,000. It should now be readily available for new processing orchards. We recommend this stock be planted at 5-6 ft X 14-16 ft (622-454 trees/acre) for processing scion cultivars. It is free standing but will require a trellis or a conduit pole/1-wire trellis to support the large early crops this rootstock gives.

Recommendations for fresh market apple plantings

For fresh market apple orchards we continue to recommend the tall spindle system with a spacing of 3x11ft at a density of 1320 trees/acre. For optimum economic results, this system requires the use of tall (>6 ft) highly feathered (>10) trees at planting. If this type of tree is used and the proper rootstock vigor is matched to the soil, climate and cultivar vigor, the tree should reach 10 ft tall at the end of the 2nd year. We suggest a final tree height of 12 ft and a narrow canopy profile of 3 ft wide at the base and 1.5 ft wide at the top of the tree. This can be achieved with a combination of dormant limb removal (remove limbs larger than ¾ inch diameter) and summer sidewall hedging. Given these essential parameters of a tall spindle orchard, the choice of rootstock must ensure that the trees achieve the desired height within 2-3 years and begin production in the second year. The rootstock must also be highly productive and not impart excessive tree vigor after the trees fill their allotted space.

To achieve this goal, we primarily recommend Geneva® rootstocks for planting in NY State due to risks of fire blight infection and the risk of winter injury with of M.9 and M.26. In addition

the partial tolerance of apple replant disease of the Geneva® stocks helps ensure that the trees will fill the allotted space by the end of the 2nd or 3rd year. The other popular rootstock in NY is B.9 which is also fire blight tolerant. However, it often does not fill the space allocated to the tree quickly and thus does not achieve high yields in the first 5 years. Another newer Budagovsky stock, B.10 has performed well in our trials and is a viable alternative in some situations.

Among the Geneva® stocks the range of vigor's allows choosing a unique rootstock for each scion and soil and region within the state. We are working on a smart decision aid system which will allow growers to input their variety, soil type and region of the state and receive recommended rootstocks for that combination. A preliminary and simplified version is presented in Table 2 which has 1st, 2nd, 3rd, and 4th recommended rootstocks for virgin soil, replant soil and various scion vigor categories for different regions of the state. Until the online version of the decision support system is available this table should help growers plan their future fresh fruit orchard.

Recommendations for processing market apple plantings

Our systems trials at Lagoner and Morgan farms from 1994-2004 indicated that even with processing fruit prices higher planting densities were more profitable than low planting densities (Robinson et al., 2001). From those studies we recommend a vertical axis system with an intermediate spacing of 5x14 ft at a density of 622 trees/acre for new processing fruit orchards. For optimum economic results, this system also requires the use good quality trees at planting. If rootstock vigor is properly matched to the soil, climate and cultivar vigor, the tree should reach 10 ft tall at the end of the 3rd year. We suggest a final tree height of 14 ft and a canopy profile of 6 ft wide at the base and 3 ft at the top of the tree. The tree should have a permanent bottom tier of scaffolds (4-5) and the upper part of the tree should be managed with limb-renewal pruning when limb diameter exceeds 2 inches. Given these essential parameters, the choice of rootstock must ensure that the trees achieve the desired height within 3 years and begins production in the third year. The rootstock must be highly productive and not impart excessive tree vigor after the trees fill their allotted space.

To support this goal we released 2 highly productive semi-dwarfing rootstocks (G.969 and G.890) in 2013. These new rootstocks allow medium high density orchards with moderate initial investment cost that have high early yields and achieve high sustained yields by the 8th year. In table 2 we present our 1st, 2nd, 3rd, and 4th recommended rootstocks for virgin soil, replant soil and various scion vigor categories for different regions of the state. If NY processing growers can adopt these new stocks and the recommended spacing of 5X14 ft, they will achieve much higher early yields with new orchards and higher lifetime cumulative yields.

Conclusions

The greater availability of Geneva® rootstocks now allows all NY apple growers (whether fresh fruit or processing) numerous choices of rootstock with varying vigor levels. If growers can analyze the vigor of the variety to be planted and the vigor of the soil and the vigor imparted by the climate (primarily heat units) and then select a rootstock that will give sufficient vigor to fill the allotted space by the end of the second year or the third year, they

will achieve the optimum profitability with the new orchard. The range of vigor offered by the Geneva® rootstocks allow unique scion/rootstock combinations for each situation. This is true for both fresh fruit and processing orchards even though they are planted at different densities. With greater experience each grower can fine-tune his rootstock selection for the soil type on each block planted.

Even after selecting the best rootstock for your situation, that rootstock may not be available at the last minute. Being able to plant the most desirable combination of rootstock and scion requires advance planning and coordination with your nurseryman. There are now 18 licensed rootstock propagators in the USA (Table 3). If you can't find the rootstock you have selected for your new orchard from your favorite nursery, reach out to the other licensed nurseries and you will most likely find the rootstock you need.

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Table 1. Rootstocks which impart beneficial characteristics to 3 common apple varieties.

	FUJI	GALA	HONEYCRISP
Characteristics that could use improvement	Too much vigor Biennial Color	Fruit Size Productivity Color/Maturity Fire blight	Weak vigor Biennial Fruit disorders
Rootstocks that have shown to improve Biennial Bearing	G.935, G.214, CG.5257, G.41, CG.4004, CG.4011		G.935, B.10, G.814, G.41TC, G.202, CG.4003
Rootstocks that have shown to lower (better) Potassium/Calcium ratio in fruit	CG.5257, G.222, G.935, G.814, G.214		CG.4003, G.214, G.16, G.814, G.969, CG.6001, CG.6976
Rootstocks that have shown to increase Fruit Size	G.11, G.41, CG.5257, G.222, G.935, CG.4004, CG.3001	G.11, G.41, G.814	
Rootstocks with improved Productivity	G.11, G.41, G.214, G.935, G.4011, G.814	G.41, G.214, G.814, G.935, G.11, G.4004	G.890, G.41, G.935, G.814, G.969

Table 2. Rootstocks recommendations for different regions in NY State based on performance and availability in 2019.

Western NY and Hudson Valley	Fresh Fruit Orchard (3X11 ft) Rootstocks ranked by 1st, 2nd, 3rd and 4th choice	Processing Orchard (5X14 ft)
Strong variety on virgin soil	G.11, G.213, G.41, G.214	G.41, G.214, G.935, G.814
Weak variety on virgin soil	G.41, G.214, G.935, G.222	G.969, G.814, G.210, G.202
Strong variety on replant soil	G.41, G.214, G.935, G.814	G.969, G.814, G.210, G.202
Weak variety on replant soil	G.969, G.814, G.935, G.890	G.969, G.890, G.210, G.202
Very weak varieties (spur types) on replant soil	G.969, G.890, G.814, G.202	G.969, G.890, G.210, G.202
Strong variety on virgin soil	G.11, G.213, G.41, G.214	G.41, G.214, G.935, G.814
Northern NY		
Strong variety on virgin soil	G.41, G.214, G.11, G.213	G.41, G.214, G.935, G.814
Weak variety on virgin soil	G.935, G.969, G.814, G.202	G.969, G.814, G.210, G.202
Strong variety on replant soil	G.969, G.935, G.214, G.202	G.969, G.814, G.210, G.202
Weak variety on replant soil	G.969, G.210, G.890, G.202	G.969, G.890, G.210, G.202
Very weak varieties (spur types) on replant soil	G.969, G.890, G.814, G.202	G.969, G.890, G.814, G.202
Organic Production	G.969, G.890, G.210, G.202	G.969, G.890, G.210, G.202

Table 3. List of licensed Geneva® rootstock producers in the USA.

Organization	Contact Person	Email	Address	Phone Number	Website	Licensed Geneva® rootstocks (ranked in order of dwarfing)
Cameron Nursery, LLC	Stacey Gilmore	cnsales@fastmail.com	1261 Ringold Road, PO Box 300, Eltopia, Washington, 99330	509-266-4669	www.cameron-nursery.com/	G.65, G.11, G.41, G.16, G.222, G.214, G.935, G.969, G.202, G.30, G.210, G.890
Carlton Plants LLC	Jason Bizon	jbizon@carltonplants.com	14301 SE Wallace Road, P. O. Box 398, Dayton, Oregon, 97114	800-398-8733	carltonplants.com/index.html	G.41, G.222, G.214, G.935, G.969, G.202, G.210, G.890
Copenhagen Farms		info@copenhagenfarms.com	12990 S.W. Copenhagen Road, Gaston, Oregon, 97119	503-985-7161	www.copenhagen-farms.com/	G.11, G.41, G.214, G.935, G.969, G.202, G.30, G.210, G.890
Cummins Nursery	Steve Cummins	cummins-nursery@gmail.com	1408 Trumansburg Road, Ithaca, New York, 14850	607-227-6147	www.cummins-nursery.com/	G.65, G.11, G.16, G.41, G.935, G.202, G.30
Duarte Nursery, Inc.		sales@duartenursery.com	1555 Baldwin Road, Hughson, California, 95326	209-531-0351	www.duartenursery.com/contact-duarte/	G.213, G.41, G.222, G.214, G.935, G.969, G.814, G.210, G.890
Helios Nursery	Tye Fleming	tye@helios-nursery.com	57 Silvest Road, Orondo, Washington, 98843	509-787-7777	N/A	G.11, G.41, G.222, G.214, G.935, G.969, G.202, G.814, G.30, G.210, G.890,

KCK Farms, LLC		info@kck-farms.com	11483 SE Amity Dayton Hwy., Dayton, Oregon, 97114	503-864-9422	www.kckfarms.com/kcSalesTeam.asp	G.41, G.222, G.214, G.935, G.969, G.202, G.210, G.890
Kit Johnston Farms	Kit Johnston	kitjohnston@msn.com	11320 SE Lafayette Hwy, Dayton, Oregon, 97114	503-864-8210	kit-johnson-farms.hub.biz/	G.11, G.16, G.41, G.222, G.214, G.935, G.969, G.202 G.30, G.210, G.890
North American Plants, Inc.		orders@naplants.com	P.O. Box 743, Lafayette, Oregon, 97127	877-NAP-INFO (627-4636)	www.naplants.com/contact.asp	G.213, G.41, G.222, G.214, G.969, G.210, G.935, G.202, G.890
Plant Quest, LLC	Debbie	debbie.plantquest@gmail.com	10395 SW Old Hwy. 47, P.O. Box 837, Gaston, Oregon, 97119	503-434-9400	N/A	G.41, G.214, G.935, G.969, G.210, G.890
ProTree Nursery, LLC	Sara DeGaff	sara@pro-treenursery.com	Brentwood, California, 94513	800-634-1671	N/A	G.41, G.222, G.214, G.935, G.969, G.202, G.814 G.210, G.890
Sierra Gold Nurseries, Inc.			5320 Garden Hwy, Yuba City, California, 95991	800-243-GOLD (4653)	www.sierra-goldtrees.com/contact-us	G.41, G.222, G.214, G.935, G.969, G.202, G.814, G.210, G.890
Skagit Horticulture, LLC		info@skagithort.com	14113 River Bend Road, Mount Vernon, Washington, 98273	800-753-8372	www.skagithort.com/contact/	G.213, G.41, G.214, G.935, G.969, G.210, G.890
Treco, Inc.	Bret Adams		PO Box 98, Woodburn, Oregon, 97071	800-871-5141	www.treco.nu/products/request/	G.11, G.41, G.16, G.935, G.214, G.969, G.202, G.30, G.210, G.890
Van Well Nursery	Pete VanWell	vanwell@vanwell.net	P. O. Box 1339, Wenatchee, Washington, 98807	800-572-1553	www.vanwell.net/contact/just-ask-us	G.41, G.214, G.935 G202
Wafler Nursery	Paul Wafler	info@waf-lernursery.com	10748 Slaght Road, Wolcott, New York, 14590	877-397-0874	www.waflernursery.com/	G.65, G.11, G.16, G.41, G.935, G.202, G.30
Willamette Nurseries, Inc.	Devon Cooper	willametteinfo@canby.com	25571 South Barlow Road, Canby, Oregon, 97013	800-852-2018	www.willamettenurseries.com/contact-us	G.65, G.11, G.41, G.16, G.222, G.214, G.935, G.969, G.202, G.210, G.30, G.890
Willow Drive Nursery, Inc.	Richard Adams		3539 Road 5 NW, Ephrata, Washington, 98823	509-787-1555	www.willowdrive.com	G.65, G.11, G.41, G.16, G.757, G.214, G.935, G.969, G.202, G.814, G.30, G.210, G.890,

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