

20 Questions on Establishing a Cider Apple Orchard

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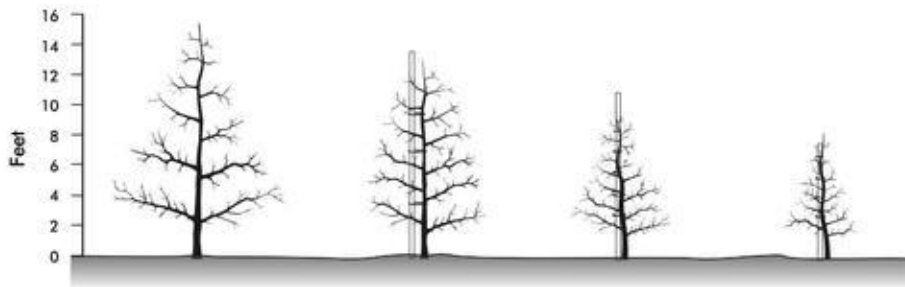
Overall objectives of a grower with the following questions:

- To develop a cider orchard, planting cider apples (heirlooms and crabs), quince, and/or pears using organic farming practices as feasible
- Low(er) labor inputs and high(est) quality apples is desired for premium craft cider production
- Leaning towards standard rootstocks (or possibly semi-dwarf) with wider spacing (100-200 trees/acre)
- Minimal irrigation (or none) – water table is ~6 ft below ground level
- Orchard grass/birdsfoot trefoil for orchard floor established prior to plant-out
- Financial model is built around lower yields (~ 10,000 lb/acre) and precocity (5-7 years before first commercial harvest)

Questions:

1. Planting system? Is shake/catch or shake/sweep viable for harvesting? (important for deciding tree size)

There are various planting systems to choose from and if you ask three different growers what specific system they would recommend, you will likely get three different answers. However, if you ask the same growers about their overall approach to orchard management, the responses would most likely all be encapsulated by what Dr. Don Heinicke (former USDA researcher now apple grower in Wenatchee) coined as Alert Grower Response. A successful grower is aware of how his or her trees are growing and responds to growth (or the lack thereof) such that light interception, airflow, and spray efficiency are maximized while disease pressures, workplace risk, and labor inputs are minimized. See the table below for contrasting a low-density freestanding central leader system with various higher density supported central leader systems. You will note that the higher density systems generally have smaller footprints, are founded on more dwarfing rootstocks, require some degree of external support (as tree independence is essentially sacrificed for greater yields,) and are more precocious (i.e., sooner to bear) than lower density systems. Not shown in the table is that higher density systems require higher upfront capital costs (e.g., trellising) and more intense tree management (e.g., pruning and training) in the early years of establishment. There are various harvesting systems available, and suitability for an orchard is driven by financial and spatial capacity. The large shake and catch harvesters currently applied in England would not be suitable for many of the higher density apple orchards of WA state because the rootstocks are too weak (good chance of uprooting), row spacing too narrow, the trellising would counter the shaking force (resulting if anything in tree-wire abrasions), and there are potential food safety issues with utilizing groundfalls in the U.S. (more regulatory than practical).



Characteristic	Freestanding Central Leader	Vertical Axis	HYTEC (Hybrid Tree Cone)	Slender Spindle
Tree height (feet)	12-14	10-14	9-11	7-8
Tree spread at the base (feet)	9-11	5-7	5-7	3-5
In-row spacing (feet)	10-15	5-6	5-6	4-5
Between-row spacing (feet)	15-22	13-15	11-14	10-12
Density (trees/acre)	132-290	500-700	500-900	700-1,000
Rootstocks	M.7, MM.106, MM.111	M.9, M.26, M.7	M.9, M.26	M.9
Support system required	no	yes	yes	yes
Yield expectations, years 2-4	low	medium to high	high	high
Yield expectations, years 5-10	medium	high	high	high
Central leader pruning	headed annually	no pruning	remove to a weaker lateral; may head or snake depending on tree vigor	remove to a weaker lateral

* Note: Table adapted from *Intensive Orchard Management*, by Bruce H. Barritt, Good Fruit Grower, Yakima, Wash., 1992.

2. Does tree size (standard vs. dwarf) impact fruit quality to the degree that some cider orchardists contend?

This correlation should not be approached in terms of absolutes but rather balances. A standard and a dwarfing tree could theoretically provide fruit of equal quality if the supply: demand nutrient ratios were relatively equal. In one season, a tree will have X carbohydrates to provide to growing tissue (e.g., leaves, shoots, roots) and Y fruit will have to compete for a share of X. The notion of 'fat/excess' does not apply to trees. Generally, it is observed that dwarfing trees produce fruit of higher quality than standard trees because the supply: demand nutrient ratio is greater in the former than the latter. One reason for why the supply: demand nutrient ratio is usually lower for standard trees than dwarfing is because they usually have larger canopies with shaded regions (i.e., inefficiently located solar panels). A standard tree's canopy could be pruned to be planar, maximizing sunlight, but in the process the grower would be sacrificing the tree's yield efficiency (number of fruit per tree footprint).

3. Does tree age impact fruit quality? (true for vineyard – true for orchard?)

There is not a lot of research on the correlation between apple tree age and fruit quality. If you look at the research on wine grapes, there is controversy behind the notion that an older vine produces a better wine grape. Common discussion includes that older vines can produce higher quality fruit because they have more reserves and 'experience' in fighting diseases and

are more focused (in an anthropomorphic sense) on reproduction rather than vegetative growth.

4. What does “fruit quality” look like for cider apples? Low(er) nutrient input, low(er) yields on old(er) and large(r) trees? Higher sugar? Smaller fruit (skin surface area to juice volume ratio.)

While cider makers have made good progress on defining the attributes of their desired final product (i.e., styles of cider), U.S. cider apple growers have yet to solidly define the desired attributes of their final product. Thus far, U.S. cider apple growers have looked to the English classification system of categorizing cider apple cultivars, a system that focuses on titratable acidity (i.e., malic acid) and tannin (i.e., polyphenols, which are not adequately defined by the term tannin). Increasingly, researchers are discovering that classifications of some cultivars in the U.S., are not matching up with results recorded in Europe. Factors such as nutrient management, irrigation, and climate could explain the differences. Once again, cider apple growers with the assistance of cider makers need to decide on the attributes that define their optimal fruit. Dessert apple growers have defined their optimal fruit as having a high sugar content, crisp texture, and beautiful appearance. Based on personal observation, cider apple growers might define their optimal fruit as having high levels of sugar, acidity, and polyphenols.

5. As an alternative to Standard rootstock, is M111 best recommended choice for semi-dwarf (can handle mechanical shake/catch or sweep system and given climate, intermittent flooding, disease/pest risks.)?

EMLA 111 produces a vigorous semi-dwarf tree that is well anchored, resistant to collar rot and woolly aphids., and adapted to heavy, poorly drained soils.

6. Best orchard floor? Leaning orchard grass/birdsfoot trefoil (for hay) and then transitioning into apples (planting out over a few years)

Based on personal observation of cider apple orchards across western Washington, the common flooring strategy is to cultivate grass between rows and maintain bare ground within rows. Vegetative ground cover is favorable for an orchard floor as it provides traction for machinery, protects soil from erosion, prevents runoff and facilitates percolation, and controls dust.

7. Which diseases and pests should I be most concerned about and which can I design around with planting system and/or root/scionstock? (Codling moths, fireblight, scab, etc.)?

In western WA, anthracnose canker is the most concerning disease and codling moth and apple maggot the most concerning insect pests. In terms of anthracnose canker, currently prevention is the best management strategy because there does not exist a reliable treatment post-infection. Prevention entails sterilization of equipment during pruning, immediate removal of diseased or damaged wood, and use of clean planting material. Low populations of codling moth can be suppressed with pheromone disruptors, but high populations should be treated with insecticides for maximum control. Bagging fruit is a non-chemical approach, but would require a lot of hand labor. Apple maggot has traditionally been controlled with insecticides, but growers have seen increasing efficacy in applying Kaolin clay.

8. How critical are apple maggots for apple cider production?

Given that fruit appearance is not important for cider apples and fruit are shredded and pressed, the significance of insect damage is really dependent on cider maker response. If a cider maker is OK with insect contamination in their fruit, then apple maggot may not be critical. There is the potential for the development of off-flavors resulting from insect damage (a possible research project).

9. What 'guild' plants might be considered for inter-planting to help reduce pests? Any to avoid?

The following plants have been demonstrated to provide for pest reduction: marigold (*Calendula officinalis*), buckwheat (*Fagopyrum esculentum*), cosmos (*Cosmos sulphureus*), mustard (*Brassica juncea*), zinnia (*Zinnia hybrid*), and sweet alyssum (*Lobularia maritime*). Some problems associated with cover crops are that they can compete with young trees for nutrients and water, and they can be a habitat for vertebrate pests such as voles as well as insect pests.

10. Any significant research on ectomycorrhizal fungi benefit for apples? Is pre-planting or field-inoculation recommended?

Numerous researchers have examined the mutualistic relationship between soil fungi and apple tree roots. The absorptive area of an apple tree's root system has been demonstrated to increase tenfold when mycorrhizal fungi threads extend out into a greater volume of soil than the roots would access alone.

11. pH is c. 5.5 – how much (if any) liming is critical? Any research on soil pH impact on fruit quality (as defined above)

As recommended in:

http://www.spectrumanalytic.com/support/library/pdf/fertilizing_apple_trees.pdf

soil pH should be around 6.0, liming is a great method of adjusting your pH, and pre-plant adjustment is more effective than post-plant. Soil pH has an impact on mineral exchange (e.g., K, B, and Ca, which are all important in fruit development) and microbial activity. I would contact your lime supplier to determine the exact amount to apply.

12. With water table c. 6 ft. below ground, how critical is irrigation in our climate? (dependent on rootstock obviously)

The cider apple orchard blocks at WSU NWREC are drip irrigated on average 5 hours twice a week from June-September. The water table at this site is ~ 5 ft below ground during the heat of summer and < 1 ft below ground during the heavy rains of winter. The following is a good reference:

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_033068.pdf

13. What grafting methods are most successful? Summer bud-grafting, or winter bench grafting? (considering planting out rootstock and top-working in the field – with lower planting densities, more feasible than 4x10 cordon rows)

There is not a best grafting method, rather selection of method is usually driven by when you want to graft and how well you can execute each method. The following is a good reference:

<https://extension.psu.edu/fruit-tree-propagation-grafting-and-budding>

14. Are there any cider varieties (taste aside) that should be avoided based on your trials? Any that seem to do particularly well?

This is a common question that the WSU Cider Research Program is in the process of answering based on years of varietal evaluations. Note that there are numerous variables to consider in selecting a cultivar and any recommendation should be made with contingencies (e.g., growing region, climate, desired fruit attributes, desired tree size, etc...). See the new handout that provides information on the tree flowering and fruiting habit as well as juice quality characteristics of 74 cider varieties:

<https://s3.wp.wsu.edu/uploads/sites/2167/2018/07/VarietyDataSummary7-9-2018.pdf>

15. Any notable relationship between lower apple planting density and lower disease incidence? (organic – less inputs are desired)

Large between-tree spacing does not necessarily guarantee lower disease incidence. If a high-density apple planting is managed such that the trees have adequate air flow, maximized light penetration, and are routinely monitored and treated for disease, then it would not be unreasonable to expect a low pest pressure.

16. Advantage to planting trees on raised furrows or mounds to improve drainage after flooding and heavy rains? Amend 'above-grade' with pumice/sand for quick draining after flood or heavy rain?

We are unaware of any issue with utilizing raised beds to improve drainage, and utilizing sand/avoiding clay at the base of the bed is a good idea.

17. Recommendations for soil amendments at time of planting?

I would refer to the following:

http://www.spectrumanalytic.com/support/library/pdf/fertilizing_apple_trees.pdf

<http://figs4fun.com/Links/FigLink777.pdf>

18. Any advice on how to measure/balance nitrogen input to reduce nitrogen content in fruit, while maintaining tree health?

There is an increasing amount of research on nitrogen inputs in cider apple orchards and the effect of such inputs on yeast metabolism; apples generally have a lower nitrogen content than wine grapes and supplementation is required to a greater degree in cider than wine. The following scientist are involved in this research: Dr. Greg Peck at Cornell, Dr. Amanda Stewart at Virginia Tech, and Bri Ewing at WSU (just received seed funding to study nitrogen and yeast). In terms of measuring nitrogen content in your soil and/or fruit and responding to possible deficiencies, we recommend talking with the lab that would analyze your samples and a local fertilizing supplier.

19. Would you recommend that I send soil samples to lab for nematode testing prior to planting? Is this critical for more aggressive rootstocks?

Testing would not hurt if the expense is manageable. We are unaware of an apple rootstock that has exhibited reliable nematode resistance. The WSDA Tree Fruit Certification Program recently expressed interest in testing the WSU NWREC orchard soil for nematode presence, so

they could be contacted them for more information,
<https://agr.wa.gov/plantsinsects/plantservicesprogram/default.aspx>

20. What question did I not ask that I should have?

The following sites are reliable sources of cider information if future questions arise:

<https://cider.wsu.edu/>

<https://hardcider.cals.cornell.edu/>

<http://www.nwcider.com/>

<https://ciderassociation.org/>

<https://www.ciderinstitute.com/>