Trellis Support Systems for High-Density Apples

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Reasons orchards are built with trellises

• Direct plant energy to fruit, not to growing a strong trunk
• Simplifies training, promoting uniform trees, reduces labour
• Improve light interception, optimize quality, consistent ripening
• Produce earlier yields; many report cropping in Years 2 or 3
• Required to support the high yields modern orchards produce

Virtually no new plantings of apples in Ontario are going in without trellises
Reasons most trellises currently fail

• Posts lean since too shallow; put $\frac{1}{4}$ of post in ground and $\geq 2.75$ ft
• Posts break just above ground due to wind, or poor quality wood
• Anchors pull out of ground as not deep enough or in disturbed soil
• Tree leaders snap above top wire from lack of support above wire
• Staples pull out as too short, not barbed, or installed wrongly

Trellises are very expensive and must last a generation, so they must be built right the first time
**Farm Conditions and Effect on Trellis Strength**

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<th>Worse (Need More Strength)</th>
<th>Better (Need Less Strength)</th>
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<td>Heavier, clay soil</td>
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*Just because a trellis design worked at your neighbour’s farm, doesn’t mean it will work at yours.*
Optimum layout and design

• For 11 ft rows…10 ft trees are best for sunlight penetration
• For 10 ft rows…9 ft trees are best
• 500 ft rows reduces end post loads and simplifies field work travel
• Don’t use any 10 ft posts; only 12, 14 or 16 ft, otherwise posts just can’t be placed deep enough; even 12 ft is often too short
• Increasing post depth 33% increases overturning resistance 100%
• 5 in. diameter posts are 50% stronger than 4 in. diameter ones

Ontario growers say that if you plan to build a trellis in spring 2017, you better have ordered posts in spring 2016
End-of-row anchor systems (Angled-Brace)

- End posts should be pounded, or vibrated into at least 3-4 feet of undisturbed soil.
- Ideally, equilateral triangle with $60^\circ$ angles (post-wire-ground) as it equalizes forces in the post & wire.
- But…there is wiggle room on this angle.

If end posts are placed at $60^\circ$, pounded 3.5 feet deep and the top wire is 9 feet above ground, it requires a 14 foot post.
What wiggle room is there on post angle?

- Research by Tug of War International Federation showed we automatically stand at about $60^\circ$ without thinking
  - $58^\circ$ average for winning teams; highest angle $71^\circ$ for anchor
  - So, no steeper than $70^\circ$ for braces

It is the attention to simple details with materials, design and installation that will keep your trellis strong its entire life.
Post and screw-type anchors

- Post-type anchors should be pounded, or vibrated at least 4 ft into ground, but leaned 10° off vertical against the pull of the wire.

- Screw-type (auger) anchors should be at least 4 feet long with ¾ inch diameter shaft, heavy eye ring and leaned 10° off vertical against the pull of the wire.

Some growers plant 2 or 3 trees between end-post and anchor to provide a visual flag to protect anchor from field equipment damage.
End-of-row anchor systems (H-Brace)

- Both posts should be **pounded, or vibrated into at least 3-4 feet of undisturbed soil**
- Horizontal brace installed $\approx \frac{3}{4}$ height of top wire; toe screw to post...wire holds it tightly
- Tie-back wire is placed from near ground on 1\textsuperscript{st} post, to horizontal brace at 2\textsuperscript{nd} post

Some growers like the H-Brace system for stonier soils, some say it is easier to construct, and some say it is stronger
Wire and staples

- Use highest Class 3 galvanized, 12.5 ga, high tensile wire
- Use 2 in., double-barbed, slash-ended, Class 3 galvanized
- Support wires go on windward side of in-line posts
- Trees should be supported at least every 2-2.5 ft by wires
- Position staples at 1 o’clock if slashes are like in picture

Trees must be supported immediately after planting, since any delay will delay tree growth
Climate change and how trellises can help

- **Drought**: Ideal for attaching drip irrigation to lowest wire
- **Wind**: Expected to be more unpredictable and higher
- **Frost**: Higher yields in trellised orchards helps justify mitigation
- **Hail**: Many Ontario growers use their trellises to support hail nets
- **Sunburn/heat stress**: Hail nets can help mitigate both
- **Pest mgmt**: Trellises could provide skeleton for new applications
- **Monitoring**: Sensor placement for climate/crop/yield monitors

*Trellises help us conceive orchards as simpler 2-D planes, which lends itself well to future coming robotics*
For more information

- 40 copies here of a 10 page factsheet on building trellises I wrote for the Ontario Apple Growers (OAG)
- Or, email OAG at info@onapples.com and they will email you a copy

Thanks for your attention!