Trellis Support Systems for High-Density Apples

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Outside-the-Barn bright thinking for farming in the urban shadow

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 ¼ of post in ground and ≥ 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

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Farm Conditions and Effect on Trellis Strength

Worse (Need More Strength)	Better (Need Less Strength)
Lighter, sandy soil	Heavier, clay soil
Wetter, untiled soils	Drier, tiled soils
Rolling topography	Flat topography
High wind speeds	Low wind speeds
Heavy snow drifting	Light snow drifting

Just because a trellis design worked at your neighbour's farm, doesn't mean it will work at yours

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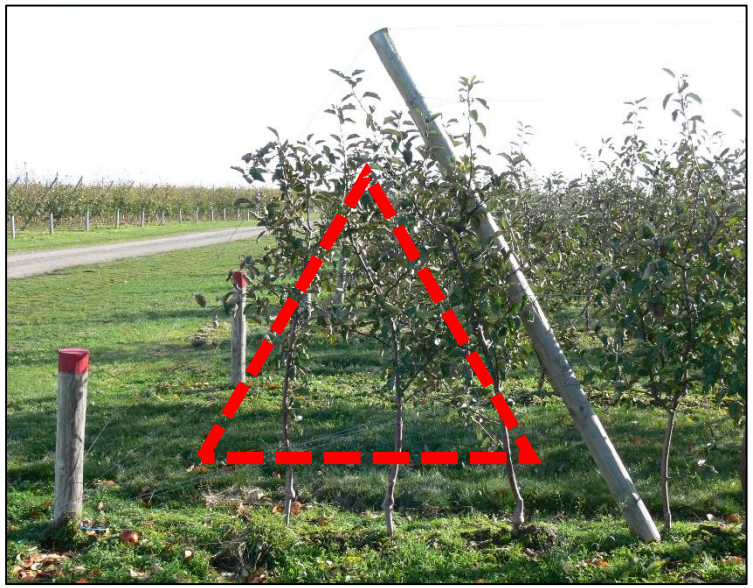
Optimum layout and design

- 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)

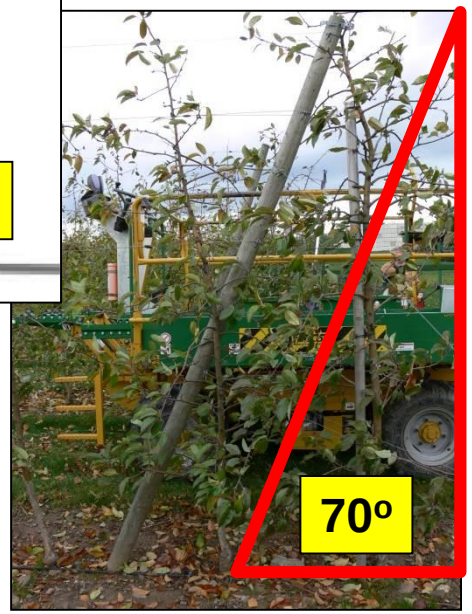
- End posts should be pounded, or vibrated into at least 3-4 feet of undisturbed soil
- Ideally, equilateral triangle with 60º angles (post-wire-ground) as it equalizes forces in the post & wire
- But…there is wiggle room on this angle



If end posts are placed at 60º, 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 60º without thinking**
  - **58º average for winning teams; highest angle 71º for *anchor***
  - **So, no steeper than 70º 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 10º 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 10º 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 ≈ ¾ height of top wire; toe screw to post…wire holds it tightly
- Tie-back wire is placed from near ground on 1st post, to horizontal brace at 2nd 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

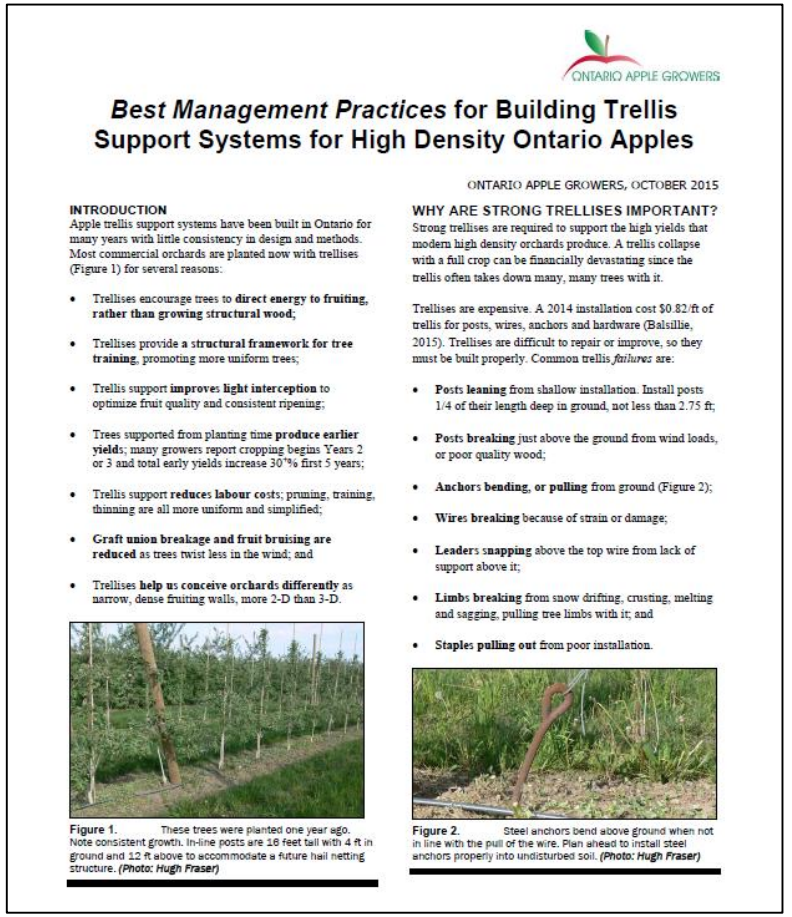
Climate change and how trellises can help

- **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**



ONTARIO APPLE GROWERS

***Best Management Practices* for Building Trellis Support Systems for High Density Ontario Apples**

ONTARIO APPLE GROWERS, OCTOBER 2015

INTRODUCTION

Apple trellis support systems have been built in Ontario for many years with little consistency in design and methods. Most commercial orchards are planted now with trellises (Figure 1) for several reasons:

- Trellises encourage trees to **direct energy to fruiting, rather than growing structural wood;**
- Trellises provide **a structural framework for tree training**, promoting more uniform trees;
- Trellis support **improves light interception** to optimize fruit quality and consistent ripening;
- Trees supported from planting time **produce earlier yields**; many growers report cropping begins Years 2 or 3 and total early yields increase 30'% first 5 years;
- Trellis support **reduces labour costs**; pruning, training, thinning are all more uniform and simplified;
- **Graft union breakage and fruit bruising are reduced** as trees twist less in the wind; and
- Trellises **help us conceive orchards differently** as narrow, dense fruiting walls, more 2-D than 3-D.

WHY ARE STRONG TRELLISES IMPORTANT?

Strong trellises are required to support the high yields that modern high density orchards produce. A trellis collapse with a full crop can be financially devastating since the trellis often takes down many, many trees with it.

Trellises are expensive. A 2014 installation cost $0.82/ft of trellis for posts, wires, anchors and hardware (Balsillie, 2015). Trellises are difficult to repair or improve, so they must be built properly. Common trellis *failures* are:

- **Posts leaning** from shallow installation. Install posts 1/4 of their length deep in ground, not less than 2.75 ft;
- **Posts breaking** just above the ground from wind loads, or poor quality wood;
- **Anchors bending, or pulling** from ground (Figure 2);
- **Wires breaking** because of strain or damage;
- **Leaders snapping** above the top wire from lack of support above it;
- **Limbs breaking** from snow drifting, crusting, melting and sagging, pulling tree limbs with it; and
- **Staples pulling out** from poor installation.

Figure 1. These trees were planted one year ago. Note consistent growth. In-line posts are 18 feet tall with 4 ft in ground and 12 ft above to accommodate a future hail netting structure. ***(Photo: Hugh Fraser)***

Figure 2. Steel anchors bend above ground when not in line with the pull of the wire. Plan ahead to install steel anchors properly into undisturbed soil. ***(Photo: Hugh Fraser)***

Thanks for your attention!

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