climatesmart LAND NETWORK

Managing for Windfirmness: Part 1

Bulletin Synopsis *October 2014*

Background and Concepts

We can build wind resistance at multiple scales – both forest stands and the trees within those stands can be managed to be windfirm. Similar principles also apply to resistance against ice/snow damage. Two key areas of wind damage risk in trees: (1) the tree's grip on the ground and (2) tree stem strength.

No stands or trees can reasonably be expected to withstand winds over 95 MPH that are produced by derechos (line storms), downbursts (micro & macro), tornadoes and category 2+ hurricanes. Although, the relevant metric for forest management is actually critical wind speed, which is defined as the speed at which trees begin to blow over. Shallow rooted trees on wet sites with saturated conditions may begin to topple at 40 MPH and speeds over 50 MPH begin to damage many susceptible trees.

With an increased risk of strong storm events under future climate scenarios, the question is: How do we develop stands and trees with ground grip and stem strength strong enough to withstand 70 MPH gusts?

What Do We Know?

Characteristics known to increase risk of wind damage, by blowdown or severe breakage:

- **Tree height** – Taller trees regardless of age, species or any other factor are more susceptible. This is simple physics, a longer lever (height) exerts more force at the fulcrum (root collar).
- **Stem taper** – Little taper = more susceptible (esp. small diameter trees). Open-grown trees exposed to wind have stronger, tapered trunks, but little commercial value – key is the right combination of strength and value.
- **Height diameter ratio** – This relationship is expressed in like units: A 60 ft tree that is 10 in DBH has a ratio of 72; (60x12=720/10=72). Trees with ratios between 50 and 70 tend to be stable, while trees with ratios over 90 are at high risk of damage.
- **Shallow or restricted roots** – Whether caused by thin soil, wet soil or species characteristics, shallow or restricted roots are a disadvantage because they reduce the tree's grip on the ground. A related characteristic is small root area or lack of spread.
- **Saturated unfrozen soils** are physically weaker so the tree's grip on the ground is diminished.
- **Trees weakened by decay –** Anytime the roots, trunk or branches have internal decay the structure is weakened and less able to withstand the bending force of wind, ice, or snow.
- **Trees with branching patterns that have proven to be susceptible –** These include co-dominant stems and branch joints that include bark in the joint.
- **Old trees**, simply because older trees tend to be taller and have a higher likelihood of decay.
- **Recently thinned stands –** In fully stocked conditions, trees are supported and constrained by adjacent trees, making them susceptible when those trees are removed. It generally takes trees 5yrs to adjust to more open conditions, by expanding roots, crowns and stem configurations.

How Trees Grow and Respond to Physical Stress

Trees strengthen themselves by adding wood at the points of stress, i.e. where bending occurs, such as points within the crown, the base of the crown, and the stump. The well-known phenomena of compression and tension wood in tree stems are exaggerated examples of this growth response. Thus, trees grown in open vs. highly-stocked conditions develop different growth strategies:

- **Open Conditions**: Trees develop a very large crown that can absorb light from all directions, as well as an exaggerated root collar to deal with the bending stress of the large moving crown. Growth is concentrated on crown expansion and stem/root stability, rather than height growth.
- **Fully Stocked Stands**: In this case, there is relatively little stem bending stress, but there is strong vertical competition for light, which results in tall, relatively thin trees.

Click on the sub-headings above to go directly to the corresponding section of the full bulletin, or read the full bulletin online:
http://climatesmartnetwork.org/2014/10/managing-forest-stands-for-wind-and-iceheavy-snow-damage-two-threats-likely-to-increase-with-climate-change/