

WINDBREAK ESTABLISHMENT



SWEETWATER COUNTY



CONSERVATION DISTRICT

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Topics of Discussion

- **Benefits of Windbreaks**
- **Windbreak Design**
 - **Soil Conditions**
 - **Design of Windbreak**
 - **Layout of Windbreak**
 - **Planting Stock**
 - **Planting**
 - **Care**
- **Windbreak Establishment**



Benefits of Windbreaks

- Windbreaks Conserve Energy.
 - Well designed windbreaks can cut energy costs 10 – 40 %.
 - Reduction in wind chill factor values.
 - Reduces the effect of hot, dry summer winds.
 - Provides for significant evaporative cooling and may lower local air temperature several degrees (including during winter).
- Windbreaks Control Snow Movements and Depositions.
 - Well placed windbreaks can reduce or eliminate snow drifts around buildings, along driveways and roadways.
 - Can be designed to spread snow across a large area.
 - Can be used to deposit snow in certain locations.
 - Can reduce snow removal times.

Benefits of Windbreaks

- Windbreaks can improve overall working and living environments and decrease potential soil erosion.
- Well designed windbreaks can improve outdoor recreational environments.
- Windbreaks can help to improve garden yields, and also increase bee and other pollinator activity.
- Can provide nesting, sheltering, feeding, and breeding habitats for wildlife, as well as, travel corridors.
- Provides shelter for livestock and crops.
 - Improves weight gain and breeding/calving success.
 - Helps to relieve desiccation of crops.
- If designed and maintained properly, windbreaks can provide products such as: firewood, post and poles, possible produce products (i.e. pinyon nuts, chokecherries, honey). Some windbreaks even provide timber.

Benefits of Windbreaks



Windbreak Design

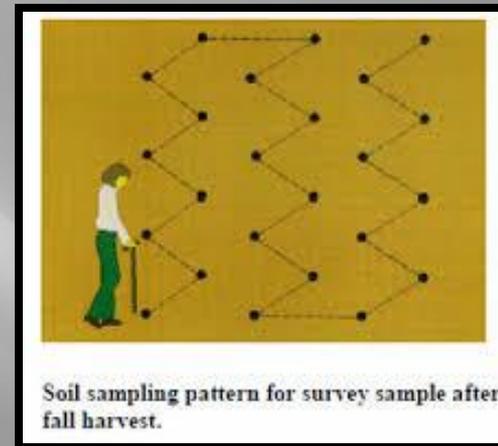
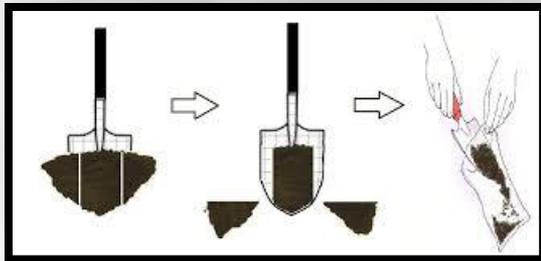
- Complexity of windbreak design depends on objectives of landowner.
 - Primary Objective – Reduce wind speeds for a certain area.
 - Secondary Objective – Landowner desire... snow management, livestock protection, crop protection, wildlife enhancement, timber or other product enhancement (Xmas trees, fruits and nuts, firewood, etc.).
- Primary and Secondary landowner objectives (coupled with site conditions) will help to determine which species are suitable to plant for the windbreak.
- Careful evaluation must occur by landowner. Depending on objectives and project area, planting a windbreak may not be the best solution.

Windbreak Design: Soil Conditions

- A soil test is the best way to check the growing potential of the proposed windbreak site.
- Conducting a soil test will allow for the soil's chemical composition to be investigated.
 - Determines salinity through soluble salt content.
 - Determines ph, organic matter content, nitrate-nitrogen, phosphorus, potassium, zinc, iron, lime, copper, and manganese levels.
- Helps landowner to determine which shrub and tree species would best work on the site.

Windbreak Design: Soil Conditions

- Samples should be taken at least to a depth of 8-12 inches. Multiple Samples over entire project area should be collected.

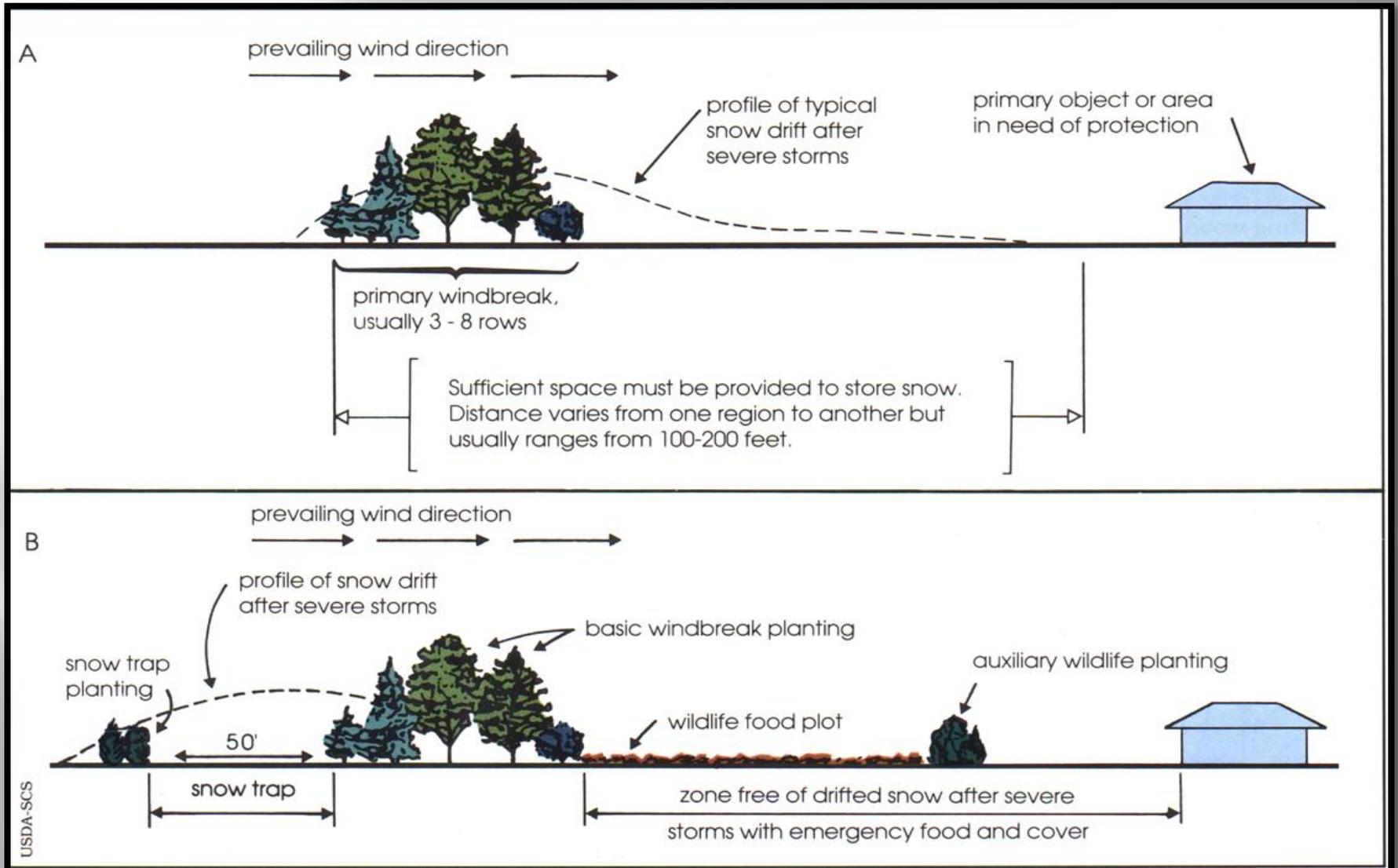


- Important to take sample correctly.
- Ward Laboratories, Inc website – <http://www.wardlab.com>
- CSU Soils Lab website - <http://www.soiltestinglab.colostate.edu/>

Windbreak Design: Design

- As mentioned before, windbreak design will be determined on objectives for the windbreak.
 - Regions needing both wind and snow protection need the most windward row 100 – 200 feet from the areas needing protection to allow room for snow storage.
 - Ideally the row with the tallest tree species should be 2 – 5H (H = mature height of tallest tree) from all primary objects/areas needing protection.
 - Multi-row, homestead windbreaks have the zone of maximum protection approximately 2 – 7H to the leeward side of the windbreak.
 - Additional wind protection can be found 1 – 3H to the windward side.

Windbreak Design: Design



Windbreak Design: Design

- Utilizing evergreens and deciduous trees and shrubs offer the best diversity and the most year around protection. This also lessens the chance of insect and/or disease impacts on the entire windbreak.
- Five to seven rows in a windbreak is considered desirable, but ambitious. Limited space is best protected with 2 – 3 rows of evergreens. One row may be sufficient to achieve landowner objectives.
- Good idea to curve the windbreak if possible.



Windbreak Design: Design

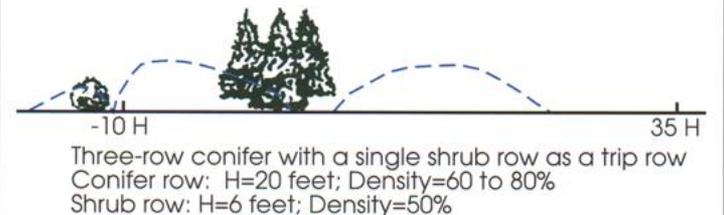
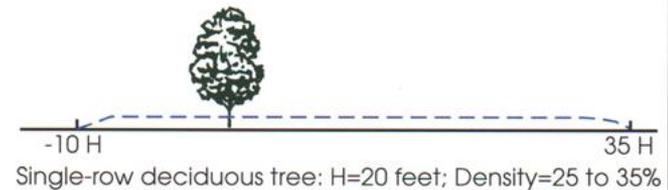
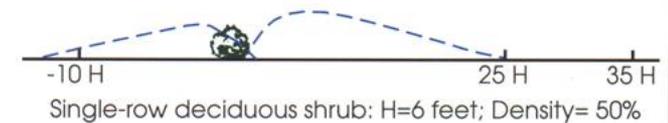
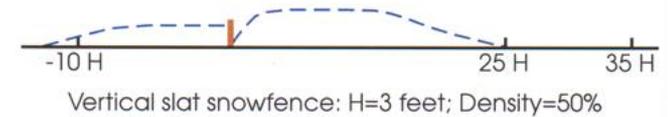
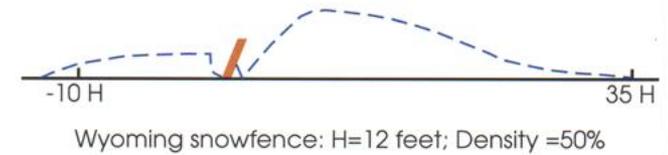
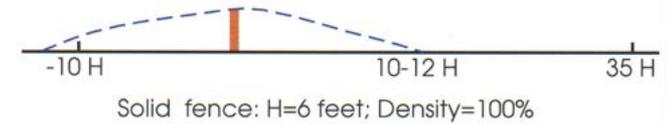
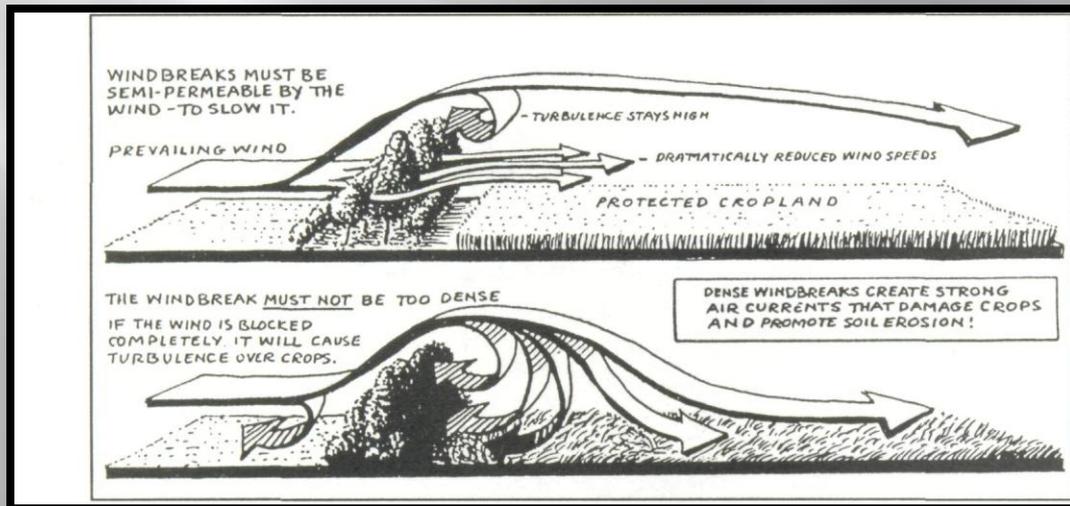
- Spacing between rows depends on the moisture available. Common mistake is to plant rows too close together causing crowding/competition in the future.
 - A spacing of at least 20 feet between rows for dry-land windbreaks.
 - Spacing dependent on property size, and species' mature size.
 - Greater spacing between rows can help distribute stored snow levels throughout the windbreak compared to just on the leeward side. In Great Plains conditions it is recommended to space rows 50-75 ft apart.
 - Must consider future maintenance techniques.
- Spacing between trees or shrubs in a row depends on species planted.
 - Distance btwn. hardwood plants in shrub row is approximately 3 - 6 ft. If juniper is used as the shrub or outside row spacing should be 5 -7 ft.
 - Spacing btwn. tree species varies from 6 - 20 ft for evergreens and 6 - 15 ft for deciduous trees.
 - Greater crown and root spread can be expected from hardwoods than from evergreens. The larger the mature size of species used the greater the space.
- Spacing can be too close causing the windbreak to be too dense and not as efficient in its tasks.

Windbreak Design: Design

- Interaction of height and density of a windbreak determine its effectiveness and the extent of protected area.
 - Windbreak height is the most important factor determining downwind area protection. Doubling the height can quadruple the snow storage potential.
 - Windward side...
 - Wind speed reductions are measurable upwind for a distance of $2-5 \times H$
 - Leeward side...
 - Wind speed reductions occur up to $30H$ downwind of the barrier (depending on barrier density).
- Example: If the tallest tree row in the barrier is 30ft lower wind speeds are measured 60 to 150 ft upwind and 900 ft downwind.

Windbreak Design: Design

- Windbreak density is the ratio of the solid portion of the barrier to the total frontal area of the windbreak.
- Factors controlling density are: number of rows, distance btwn trees, distance btwn rows, and species composition.
- A windbreak density of 40 – 60% provides the greatest downwind protection.
- To get even distribution of snow across a field densities of 25 – 35% are most effective.
- Windbreaks designed to catch and store snow in a confined area usually have several rows, and densities in the range of 60 – 80%.
- If density is above 80%, excessive leeward turbulence may reduce windbreak effectiveness beyond 8H.



Windbreak Design: Design

- Orientation of the windbreak also lends to the effectiveness of the barrier.
- Windbreaks are most effective when oriented at right angles to the prevailing winds.
- Wind may blow from a predominant direction, but rarely blow exclusively from that direction. As a result, protection is not equal for all areas on the leeward side.
- Using multiple legged windbreaks provides a greater protected area than a single legged windbreak.

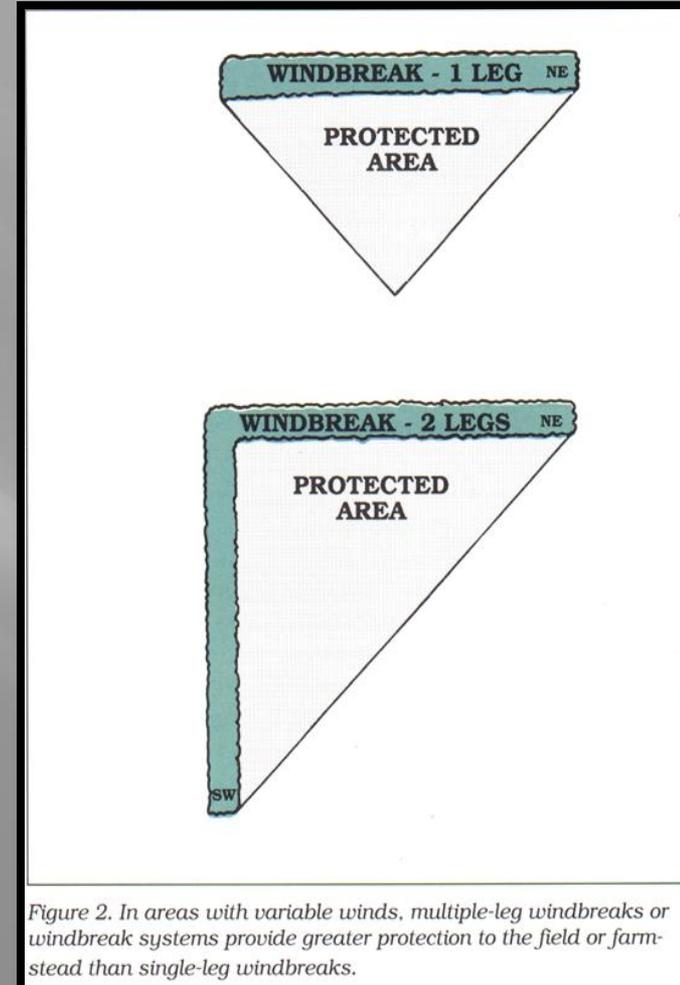


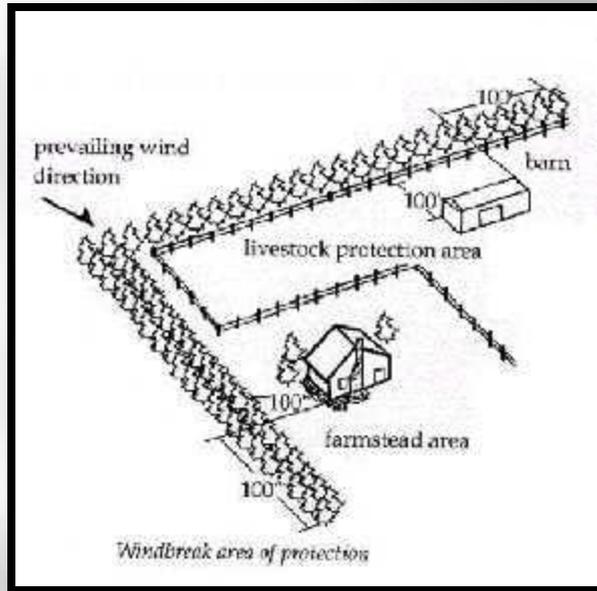
Figure 2. In areas with variable winds, multiple-leg windbreaks or windbreak systems provide greater protection to the field or farmstead than single-leg windbreaks.

Windbreak Design: Design

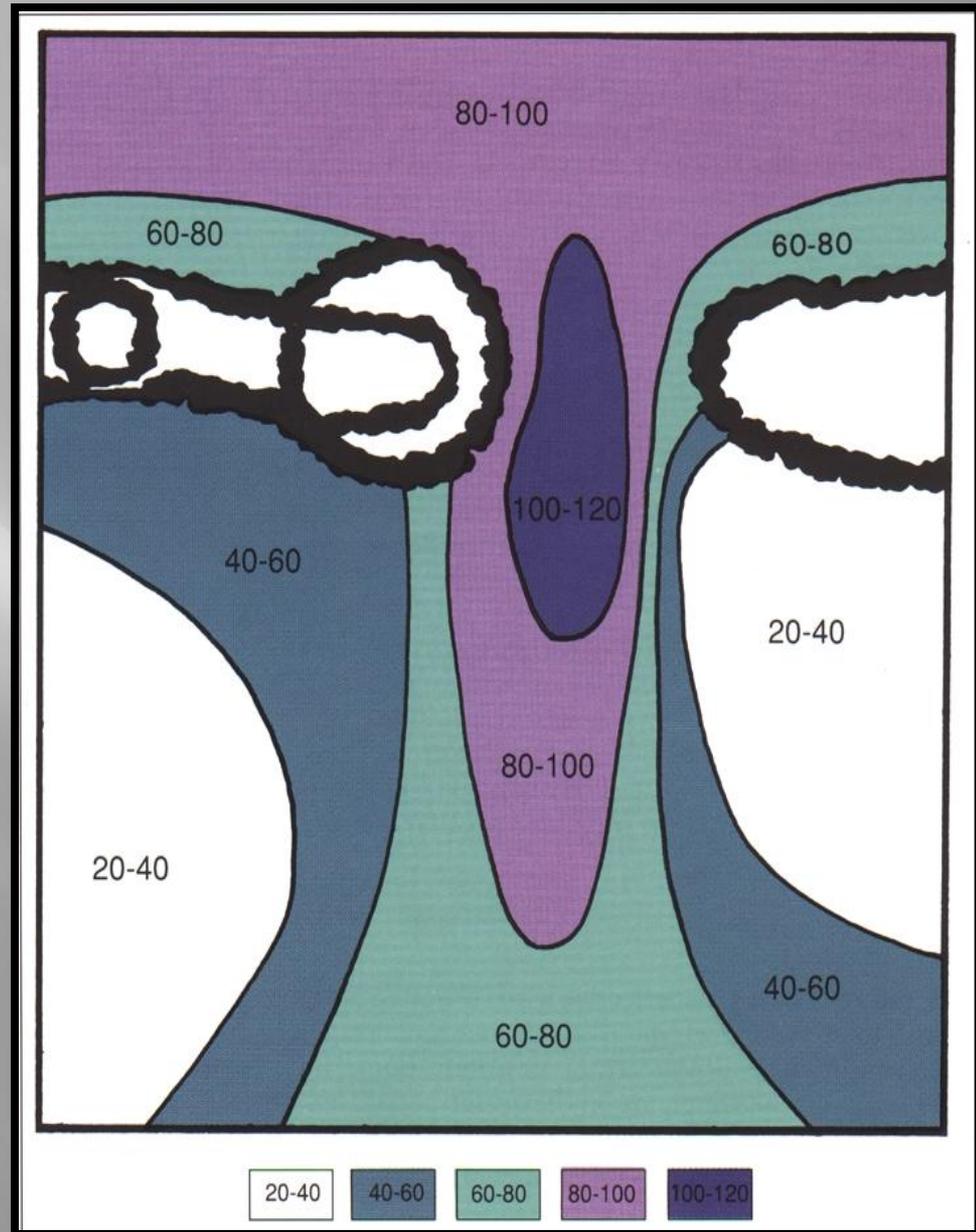
- The length of the windbreak determines the amount of total area receiving protection.
- For maximum efficiency the uninterrupted length of a windbreak should exceed the height by at least 10:1.
- This ratio helps to alleviate the influence of end-turbulence on the total protected area.
- Example: If the tallest tree row is 30 ft the length of the windbreak should be 300ft.

Windbreak Design: Design

- The length of the windbreak should also be extended at least 100 ft beyond the protected area in each direction.



- Gaps in the windbreak should be avoided whenever possible. Gaps funnel concentrated wind flow, creating areas on the downwind side of the gap in which wind speeds often exceed open field velocities.
- If a gap is unavoidable overlapping of rows can provide alleviation to this issue.

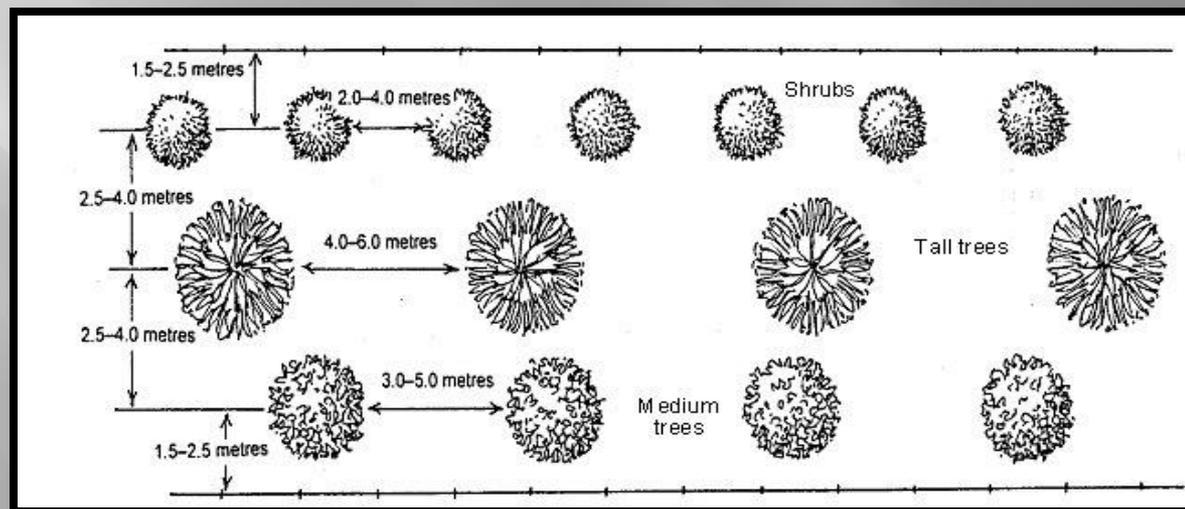


Windbreak Design: Ground Layout of Windbreak

- Before planting, it is best to layout each row of the windbreak on the actual planting site.
- Layout the dimensions of the windbreak, including the spacing between rows and between trees within rows.
- Individual tree locations should also be marked to help the landowner get a general visualization of how the windbreak will look.
- This effort will help insure that the design will provide the protection needed and will fit within the desired planting area.
- Poorly planned windbreaks can create issues worse than before the windbreak was installed.

Windbreak Design: Ground Layout of Windbreak

- Layout before actual planting will also insure that the site will move forward toward being ready to plant when planting stock arrives, eliminating long storage periods for the stock.
- It may be advantageous to install a temporary slatted snow fence for one year to ensure planting location is optimum in relation to landowner objectives.



Windbreak Design: Ground Layout of Windbreak

- After layout has been completed and the design is agreeable, it is also suggested that the site is prepped.
- Proper site preparation is one of the best ways to improve the survival of the planting stock. Plantings have little chance unless the planting site is well prepared.
- Preliminary groundwork reduces competition from weedy species, turf, can conserve soil moisture, and make the planting easier and smoother.
- It is noted that site prep is best accomplished the year prior to the actual planting of the windbreak.
- Heavy grass sod can be treated with a herbicide application in the spring, plowed in the fall, and disked just prior to planting. This will help to conserve soil moisture, control early spring weeds, and reduce soil erosion potentials.
- If rodents are a problem it is best to begin control measures in advance.
- Fencing to exclude livestock should be installed around the planting area after site prep is completed, but before planting occurs.

Windbreak Design: Ground Layout of Windbreak

- Having holes dug before the arrival of the planting stock will also reduce stock storage times.
- Windbreaks are an investment of time and money. Layout and site preparation will save the landowner in both.



Windbreak Design: Planting Stock

- Species selection is primarily dictated by the site and its conditions in relation to soil type and chemical composition, water resources, and the function of the species in relation to the effectiveness of the windbreak.
- The most effective wind breaks have at least 2 rows of evergreens.
- Deciduous trees and shrubs can add wildlife and aesthetic benefits to windbreaks and should be considered.

Windbreak Design: Planting Stock

- Successful establishment depends on planting quality stock, handling the plant stock carefully, and using proper planting techniques.
- Planting material must be chosen for its suitability to the soils and environment of the planting site.
- Seedlings and trees should come from nurseries using locally collected seed or seed from known origins.
- Do not be too quick to buy the cheapest seedlings/trees, may not be the best value in the long run.
- Take time in selecting nursery. Do some investigation and ask questions regarding the seedlings/trees appropriateness to the planting site.

Windbreak Design: Planting Stock

- Planting Stock Types...
 - Ball and Burlap, and Potted Large Caliper Saplings
 - Pros – Larger more established tree. Quicker establishment of windbreak.
 - Cons – More labor to transport and plant. More expensive.
 - Potted Seedlings
 - Pros – Buy in bulk and are less expensive. Less labor to transport and plant. Roots protected in soil matrix.
 - Cons – Not large and will take 3 -5 years of care for establishment. Need greater protection of domestic animals and wildlife, sun and wind, and mechanical damage. Need more frequent watering. Longer grow time to effectively reduce wind speeds.
 - Bare Root Seedlings
 - Pros – Buy in bulk and are less expensive. Less labor to transport and plant.
 - Cons – Not large and will take 3 -5 years of care for establishment. Need greater protection of domestic animals and wildlife, sun and wind, and mechanical damage. Need more frequent watering. Roots not in soil matrix. Longer grow time to effectively reduce wind speeds.

Windbreak Design: Planting Stock

- Types of Planting Stock...



Windbreak Design: Planting Stock

Some Appropriate Wyoming Broadleaf Trees/Shrubs...

- Golden Willow
- Narrowleaf Cottonwood
- Caragana
- Cotoneaster
- Honeysuckle
- Chokecherry
- Lilac
- Native Plum
- Sumac
- Nanking Cherry
- European Sage
- Buffaloberry
- Four-Wing Saltbush
- Golden Current
- Serviceberry
- Mountain Mahogany
- New Mexico Privet
- Snowberry
- Green Ash
- Siberian Elm
- Hackberry
- Lombardy Poplar
- Lacebark Elm
- Black Locust
- Aspen



Some Appropriate Wyoming Evergreens...

- Rocky Mountain Juniper
- Utah Juniper
- Austrian Pine
- Ponderosa Pine
- Lodgepole Pine
- Pinyon Pine
- Colorado Blue Spruce
- Engelmann Spruce
- Scotch Pine
- Eastern Red Cedar



Windbreak Design: Planting

- Windbreak establishment success depends on planting quality material, handling the planting material carefully, and using proper planting techniques.
- Whenever planting stock arrives it is crucial to properly care for the stock.
- Upon arrival immediately inspect the planting material for dry, moldy, or very small trees
- Discard heavily damaged trees.

Windbreak Design: Planting

- Storage of the planting stock may be necessary before the actual planting can occur.
 - For Potted Seedlings – Keep the potting matrix moist, checking daily for adequate moisture, store in a cool (34 – 40°F, 80 – 100% humidity if possible) dark place (i.e. root cellar, basement, cool garage, unheated room).
 - For Bare-Root Seedlings – Keep packing material around the roots, making sure the roots are damp at all times. Store in a cool (34 – 40°F, 80 – 100% humidity if possible) dark place (i.e. root cellar, basement, cool garage, unheated room). This is if the seedlings can be planted within a day or two.

Windbreak Design: Planting

- Storage of the planting stock continued...
 - If bare-root seedling planting must be delayed, remove seedlings from packaging, place in a shallow trench, spread the roots and cover with soil, pack gently, and keep moist. This is called 'heeling' in and should be done in the shade and when frost is out of the ground.



Windbreak Design: Planting

- Storage of the planting stock continued...
 - For Ball and Burlap, and Potted Saplings –
 - Keep root ball moist by checking daily.
 - Mulch can be used to cover B and B trees much like ‘heeling’ in bare root seedlings without the need for a trench.
 - Store in the shade if possible.
 - These planting stock types are much more developed and not as sensitive as potted and bare-root seedlings.

Windbreak Design: Planting

- The best time to plant seedlings is in the spring before the buds begin to swell and as soon as frost is out of the soil.
- Ball and Burlap, and Potted large saplings can be planted anytime of the year (except when soils are frozen).
- We will now discuss planting techniques starting with seedlings....

Windbreak Design: Planting

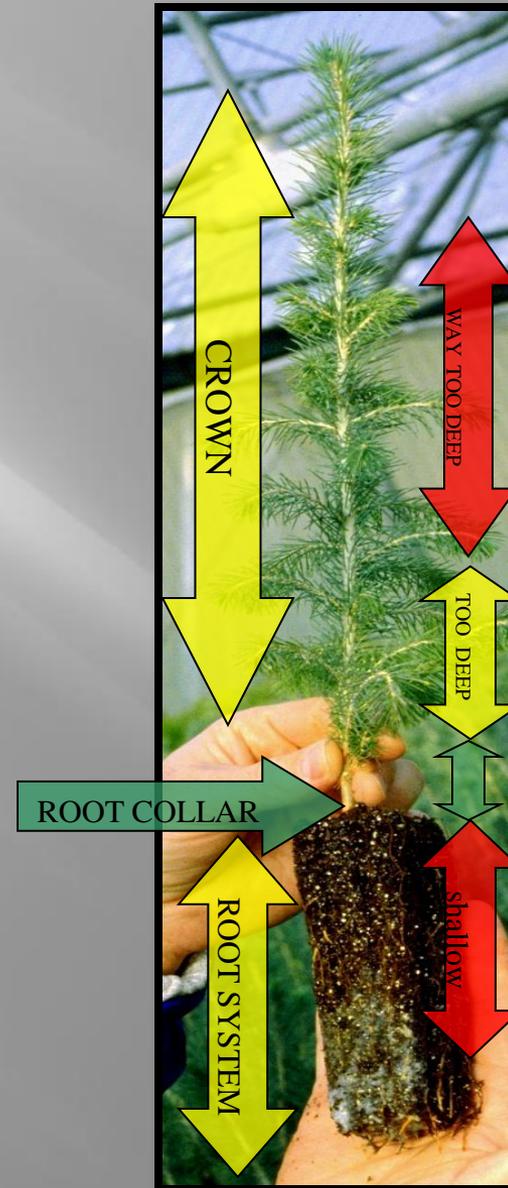
- To minimize stress on seedlings it is best to plant on a calm or cloudy day.
- It is extremely important to avoid exposing seedlings' roots, especially bare-root conifers, to air any longer than absolutely necessary.
- Tree roots should be well soaked before planting.
 - For Potted Seedling – Place seedlings in a tub with enough water to cover the pots for only a few minutes.
 - For Bare-Root Seedlings – If practical place the roots in a bucket containing a slurry of soil and water. Do not store the seedlings in the slurry for more than a few hours.

Windbreak Design: Planting



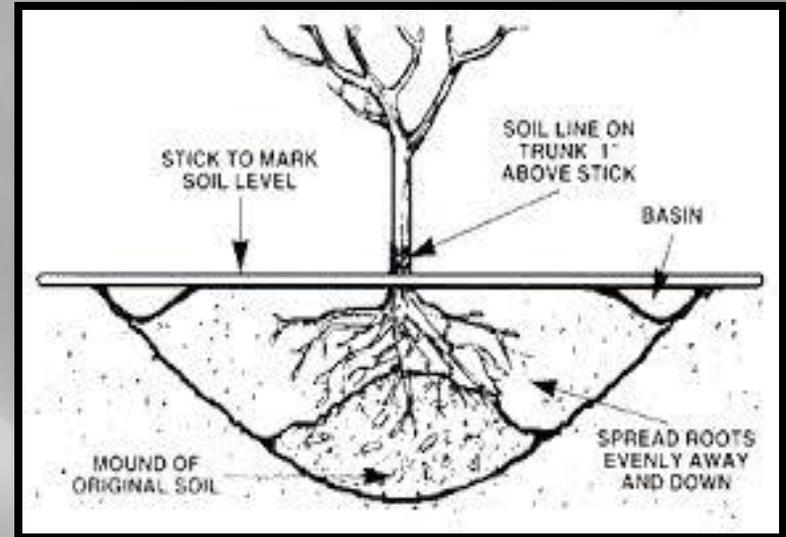
Windbreak Design: Planting

- There are essentially two ways to plant – by hand or machine. We will only discuss hand planting.
- Make sure the tree is planted correctly.
 - Too deep and the tree will starve for oxygen.
 - Too shallow and the tree will dry out.



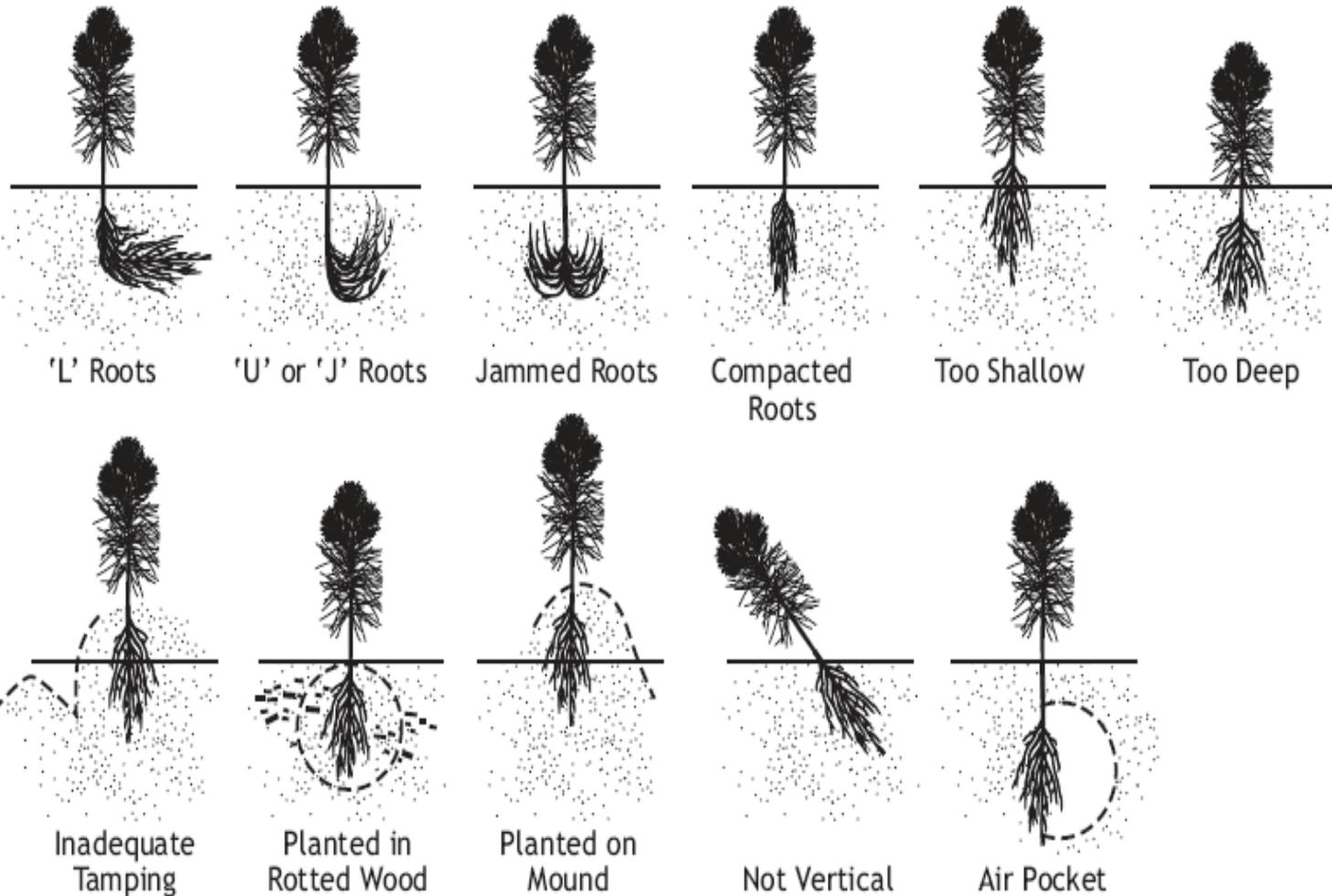
Windbreak Design: Planting

- Planting Bare-Root Seedling...
 - Remove from the shipping/packaging material, or 'heel' in trench.
 - Place in bucket of soil/water slurry.
 - Have hole dug large enough and deep enough so roots go into the ground straight. Root ends should not be curled upward.
 - Helpful to have a mound of dirt in the bottom of the hole to drape the roots over.
 - If roots are extremely long prune CONSERVATIVELY and handle roots as little as possible.
 - Spread roots and soil in.
 - Fill the hole half full of soil and water in.
 - After water has soaked in, finish backfill to root collar, pack firmly, and water again.



Windbreak Design: Planting

Figure 1. How NOT to Plant A Bareroot Seedling



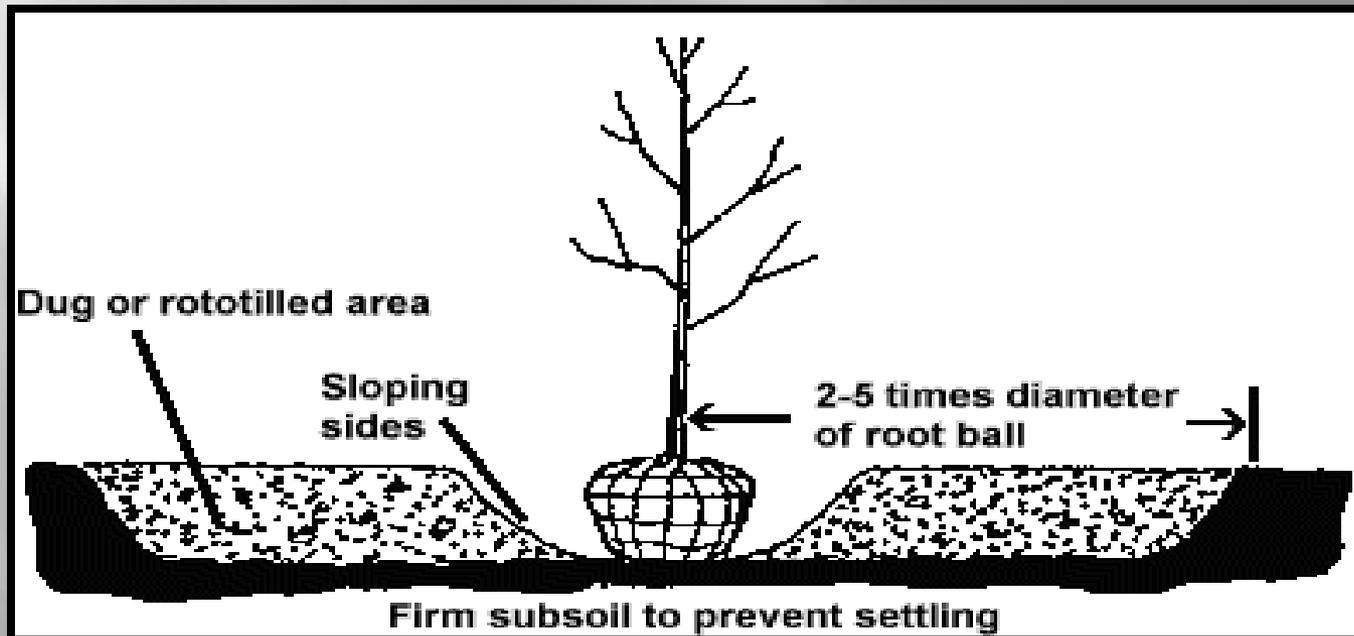
Windbreak Design: Planting

- Planting Potted Seedlings...
 - Have a hole pre-dug that will provide 2-3 years root growth through loose soil matrix and is the proper depth.
 - Ensure that the potting soil is moist.
 - Gently remove seedling from pot by inverting pot and gently pulling seedling at root collar while pushing up through hole in bottom of pot.
 - Place in hole. Fill the hole half full of soil and water in.
 - After water has soaked in, finish backfill to root collar, pack firmly, and water again.



Windbreak Design: Planting

- Planting Larger Stock (Ball and Burlap, and Large Potted Saplings)...
 - Plant tree with top of root ball even with grade or just a bit above grade. Never position below grade (beware of backhoes!).
 - Backfill to root collar with native soil and water in tree. Do not amend the native soil.
 - Tamp backfill gently to fill large air pockets.



Windbreak Design: Planting



Good Hole



Bad Hole



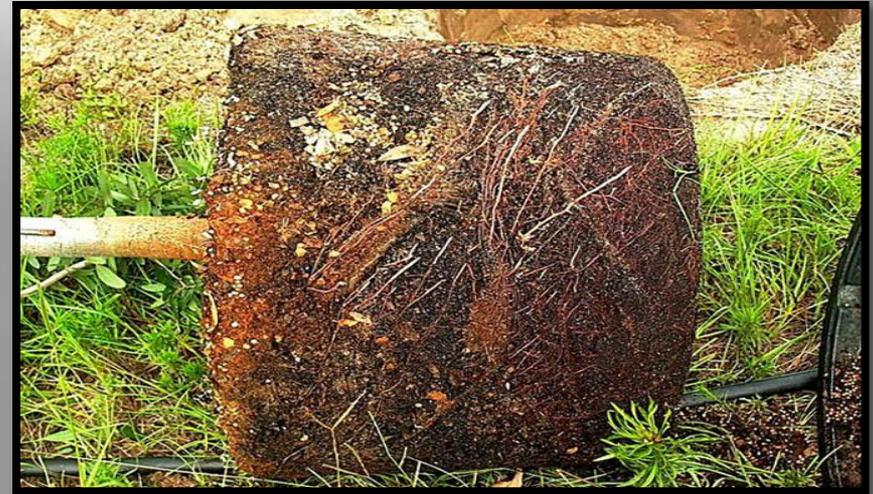
Windbreak Design: Planting

- Planting Larger Stock (Ball and Burlap, and Large Potted Saplings)...
 - Remove all wiring, wrapping, strapping, and containers. This includes burlap material (synthetic or other).



Windbreak Design: Planting

- Circling roots – cut them, or tear up the edge of the root ball to spread roots out.



Windbreak Design: Planting

- **“Boxing” Root Ball -**
Using a pruning saw, one can “box” a root ball by removing no more than $\frac{1}{4}$ inch of root material on each side of the root ball to help eliminate chance of circling/girdling roots forming. This is best used on Large Potted Saplings.



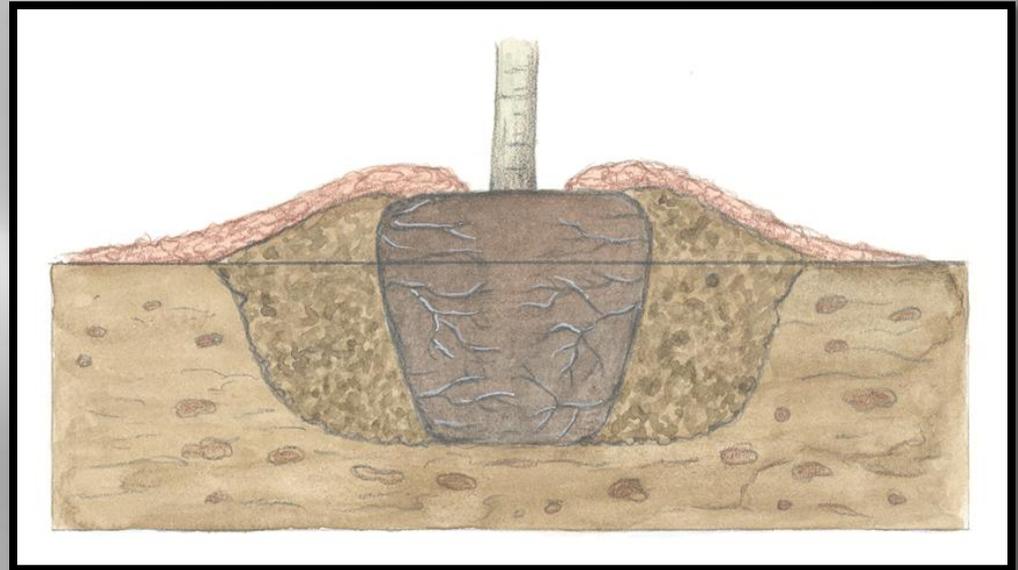
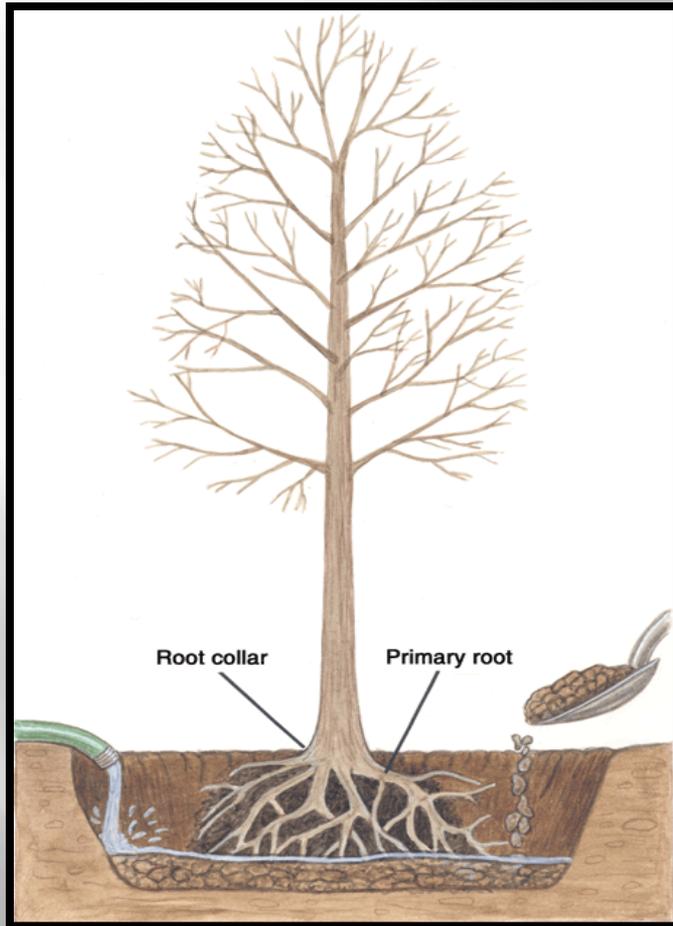
Windbreak Design: Planting

- Lifting tree into the planting hole...
 - To avoid damage when setting the tree in the hole, lift the tree with straps or rope around the root ball, not by the trunk.



Windbreak Design: Planting

- Roots need oxygen, so do not plant to deep!



- Some trees may come with soil covering root collar. Always be sure to remove excess soil from top of planting stock to expose root collar before planting.
- Main-order roots should be within 1-2 inches of the soil surface.

Windbreak Design: Planting

- Slice a shovel into the soil at the edge of the hole to enlarge the hole.
- Breakup and push this soil against the root ball.



Windbreak Design: Planting

Moderately pack the backfill soil.



Windbreak Design: Planting

Water the backfill to settle.



Windbreak Design: Planting

- Look, up, down, and around.
- Consider above and below ground growth when determining planting distances.



Windbreak Design: Planting



Windbreak Design: Care/Maintenance

- Another facet of windbreak establishment success is proper care and maintenance of the barrier.
- Windbreaks are like other financial investments and must be properly managed and cared for...
 - Supplemental watering.
 - Wind, sun, and wildlife/livestock protection.
 - Grass/forb/weed competition management/control.
 - Staking.
 - Pruning.
 - Fertilizing.

Windbreak Design: Care/Maintenance

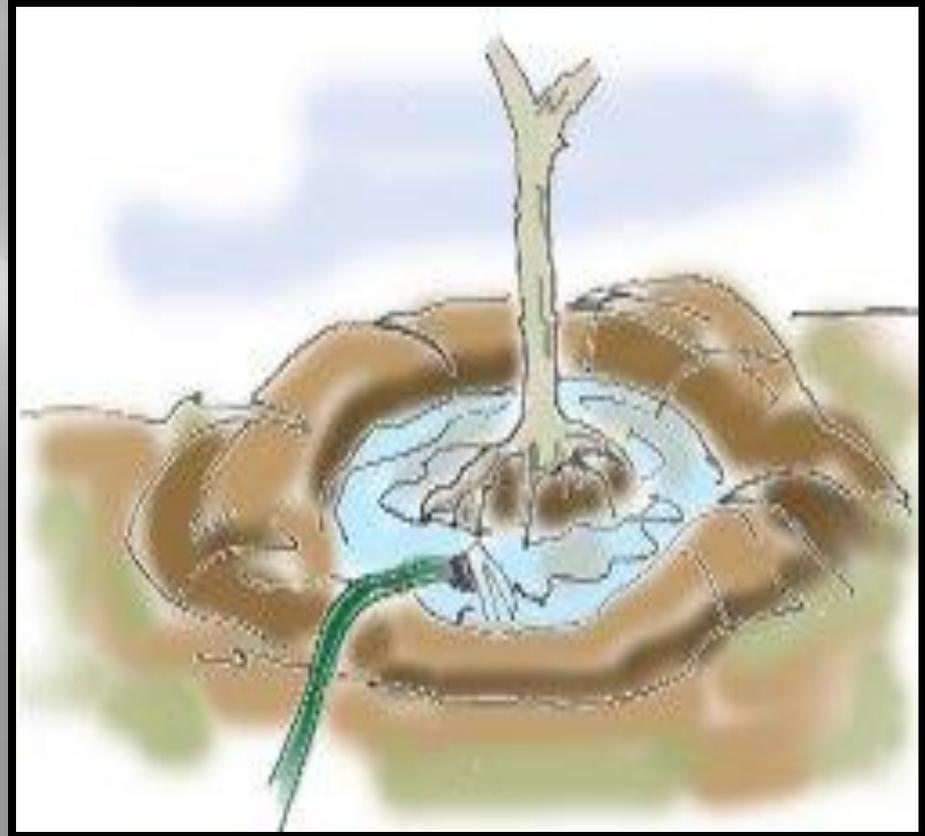
Supplemental Watering...

- Most important care factor in an arid environment.
- Will occur post planting 3-5 years for proper establishment. Indefinitely for vigor (in arid climates).
- Consider a basin around the planting hole.
- Water right on top of the root ball where roots are located.
- Consider drip irrigation system.
 - If used must move emitters as drip line of tree expands.
- Slowly water tree once a week during dry summer months for B&B trees (larger sapling planting stock).
- Water 2-3 times per week for potted (larger sapling planting stock).
- Winter water when soil is not frozen - especially evergreens.

Windbreak Design: Care/Maintenance

Supplemental Watering...

- Water where the roots are, not where they will be.
- Never allow the roots to dry out, or become flooded.
- Frequency depends on the soil, the tree, and the site.



Windbreak Design: Care/Maintenance

Supplemental Watering...

- Is it volume or frequency?
 - **It's frequency!**
 - Experiment done on 4-inch hardened-off B&B trees where 1.5, 3, or 5 gallons of water were applied per inch trunk caliper.
 - Results show that volume did not matter but frequency did.



Windbreak Design: Care/Maintenance

Frequency of irrigation based on tree size

Size of nursery stock	Irrigation schedule for vigor	Irrigation schedule for survival
< 2 inch caliper	Daily: 2 weeks Every other day: 2 months Weekly: until established	Twice weekly for 2-3 months
2 – 4 inch caliper	Daily: 1 month Every other day: 3 months Weekly: until established	Twice weekly for 3 – 4 months
> 4 inch caliper	Daily: 6 weeks Every other day: 5 months Weekly: until established	Twice weekly for 4 – 5 months

Windbreak Design: Care/Maintenance

Seedling Protection...

- Seedlings are very sensitive to desiccation. Protecting your seedling investment against wind and sun damage will help with survivability.
 - Landowners can purchase a variety of materials that will help reduce damage from sun and wind.
 - Shade guards.
 - Shake Cedar Roof Shingles.
 - Bales of Hay.
 - Pallets.
 - Slatted Snow Fence (removed after 3 years to reduce breakage).
- These items should be used on at least two sides of the seedlings (typically the south and west sides), but use around the entire tree is suggested.
- Remember to protect trees from winter sun scald and frost checking.

Windbreak Design: Care/Maintenance

- Types of Seedling Protection...



Windbreak Design: Care/Maintenance

Seedling Protection...

- It is essential that livestock be excluded from windbreaks.
 - Eat seedlings.
 - Trample seedlings.
 - Browsing and breaking older trees.
 - Soil compaction, cutting oxygen off to roots and limiting water infiltration.
- Fencing the windbreak off from livestock will help windbreak establishment.
- Fencing should be completed after site prep and before planting.

Windbreak Design: Care/Maintenance

Seedling Protection...

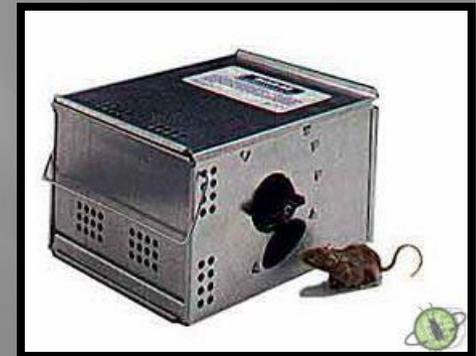
- Wildlife can also damage windbreak seedlings and trees as livestock do.
- Companies have developed wildlife repellent products.



Windbreak Design: Care/Maintenance

Seedling Protection...

- Jackrabbits, cottontails, mice, and voles often damage trees and shrubs by chewing on the bark, girdling branches or the main stem, or by gnawing the plant completely off above the ground line.



Windbreak Design: Care/Maintenance

Grass/Forbs/Weeds Management...

- Grasses, forbs, and weeds compete with trees and shrubs for moisture, light, and soil nutrients.
 - Tree roots and grass/forbs/weeds roots occupy the same first 18 inches of soil.
 - Grass roots generally occupy a much greater soil volume than tree roots and can out-compete them for water.
- Competition should be kept at a minimum.
- Grass/forb/weed control should occur within the rows and between rows of the windbreak.
- First 3-5 years the most important.

Windbreak Design: Care/Maintenance

Grass/Forbs/Weeds Management...

- Mulch...
 - Can help to moderate soil moisture and temperature levels.
 - Do not use hay or straw to avoid attracting rodents.
 - Can be prone to wind removal.
 - Apply to drip line of tree if possible.
 - Do not bury the stem of the tree, apply 2-4 inches in depth around tree.
 - Keep 4 inches away from trunk of tree with mulch.



Windbreak Design: Care/Maintenance

Grass/Forbs/Weeds Management...

- Landscape fabric can be a suitable alternative to mulch for controlling grass/forb/weed competition.
 - Not prone to blowing to Nebraska.
 - Can be more expensive.
 - Less maintenance.
 - Can be harder to install.
 - Reduces soil moisture loss.
 - Last 5-10 years.
 - Must be UV resistant.
 - Must be expanded away from trunk as tree grows.



Windbreak Design: Care/Maintenance

Grass/Forbs/Weeds Management...

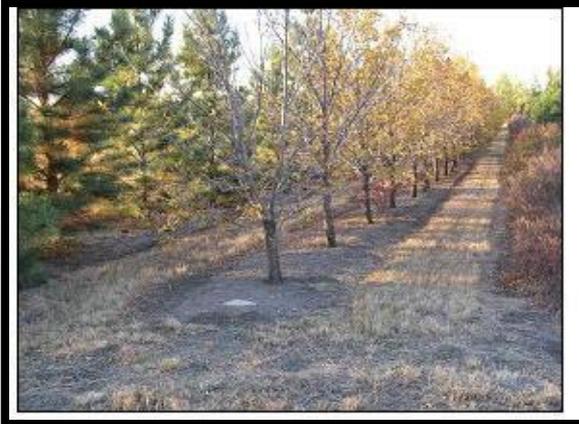
- Chemical control of grasses/forbs/weeds is also an alternative.
 - Read label before applying. Can harm trees and shrubs.
 - Can harm beneficial insect populations.
 - Cost in association to annual application.
 - License to apply?
 - Protective clothing?
 - Overspray affects on neighboring plant communities.



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Grass/Forbs/Weeds Management...

- Annual mechanical removal of turf/weeds competition can also be used as a management technique.
 - Time consuming.
 - Multiple times per year.
 - Manual v. Mechanical.



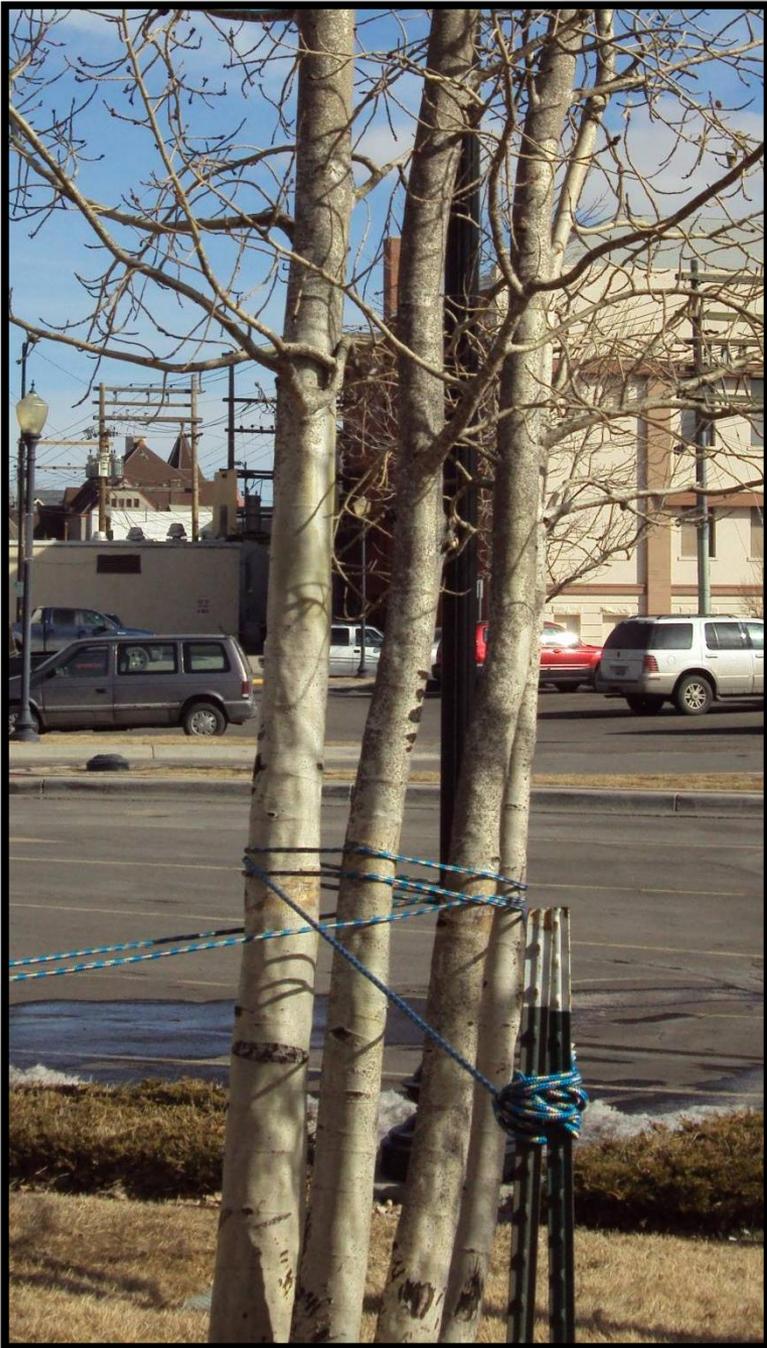
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Staking...

- Stake tree if root ball is unstable.
- Allow slack for the top to sway.
- Use straps that do not damage the stem.
- Be careful not to drive stakes into root ball.
- Remove support system after 1 year.
- More critical for potted and B&B trees.







Windbreak Design: Care/Maintenance

Pruning...

- Under no circumstance should live healthy limbs be pruned from windbreak trees.
- The effectiveness of a windbreak is directly related to the tree and shrub foliage being as close to the ground as possible.
- Pruning should only be used to remove broken or damaged limbs or alter the structure of the windbreak as it relates to density and landowner desire.

Windbreak Design: Care/Maintenance

Pruning...

- Annual inspections to look for and prune damaged or deformed trees will keep task manageable.
- Pruning is best accomplished in late winter.
- When done on a regular basis not as labor intensive.
- Benefits of Structural Pruning...
 - Pruning wounds are small, seal quickly.
 - Growth goes where you want it.
 - Develop strong structure when tree is young.
 - Prevent future structural problems.
 - Less damage from storms.
 - Only minor pruning will be necessary later on.

Windbreak Design: Care/Maintenance

Pruning...

- Wait until the tree is established - putting on good growth.
- Species and planting stock dependant.
- Usually 2-4 years after planting.



Windbreak Design: Care/Maintenance

Pruning...

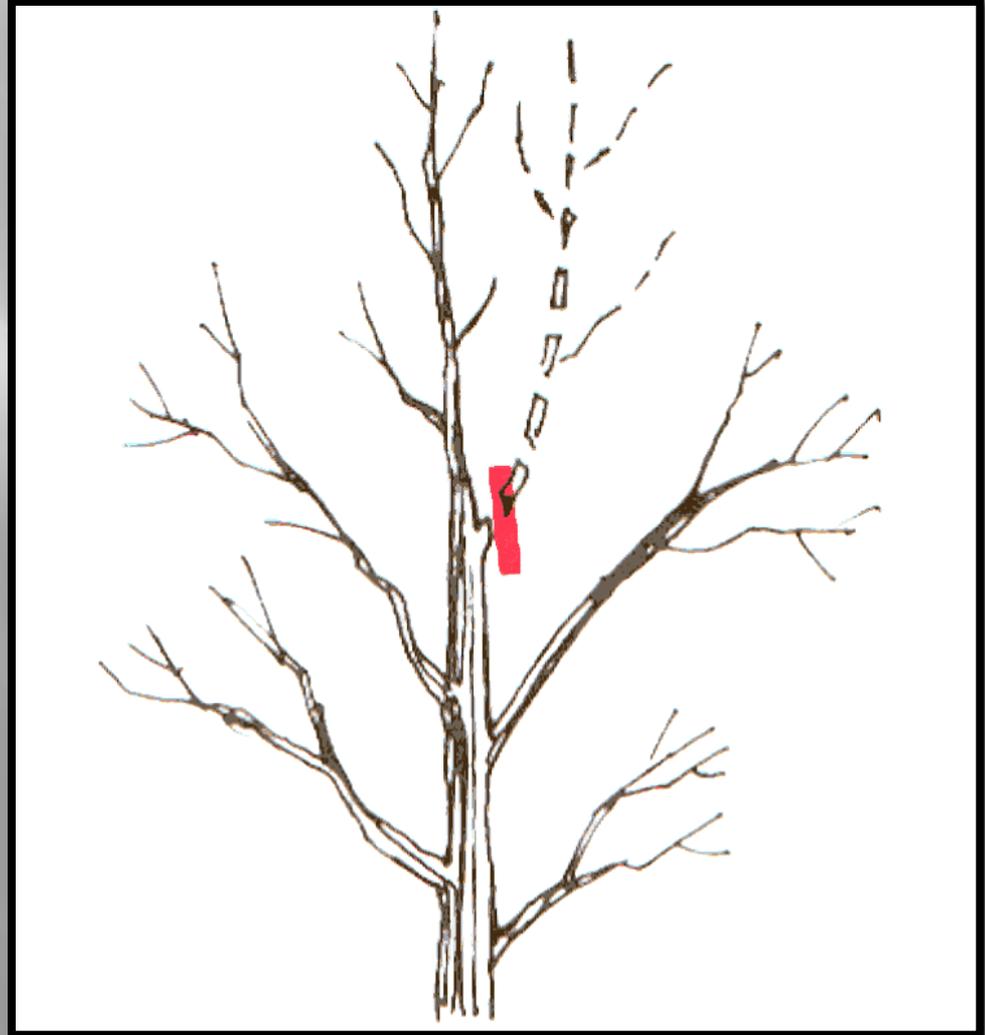
- Most experts say can remove 1/4 - 1/3 of living crown.
- Things that should be consider...
 - Species.
 - Health.
 - Growth rate.
 - Position in the windbreak.
- Remember this is a windbreak, the more pruning that is done, the less dense the barrier, the less frictional drag applied to the wind, less leeward area protection.

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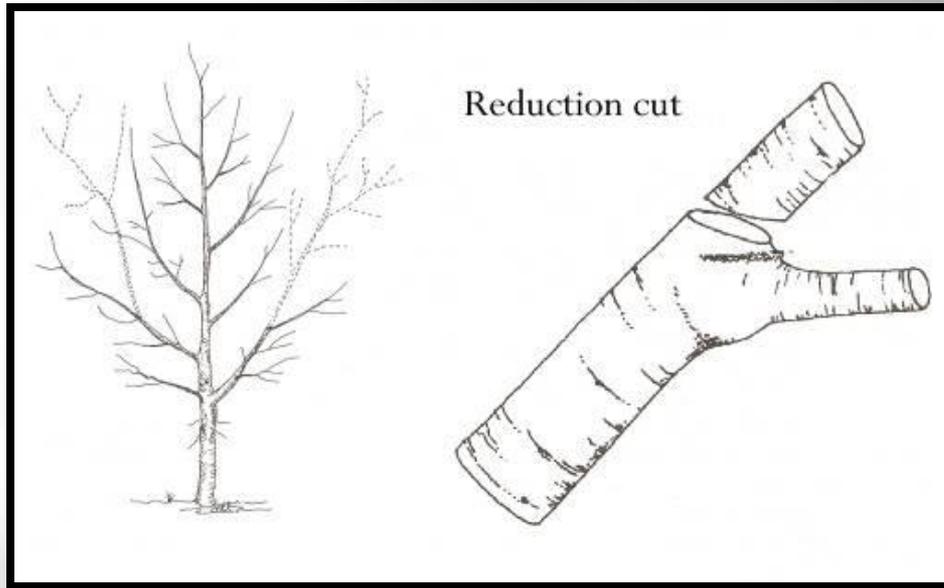
Pruning...

Double Leaders

- Prune out leader with weaker attachment.
- Suppress competing leaders.
- Protect leader from competition.
- Main leader will grow faster.

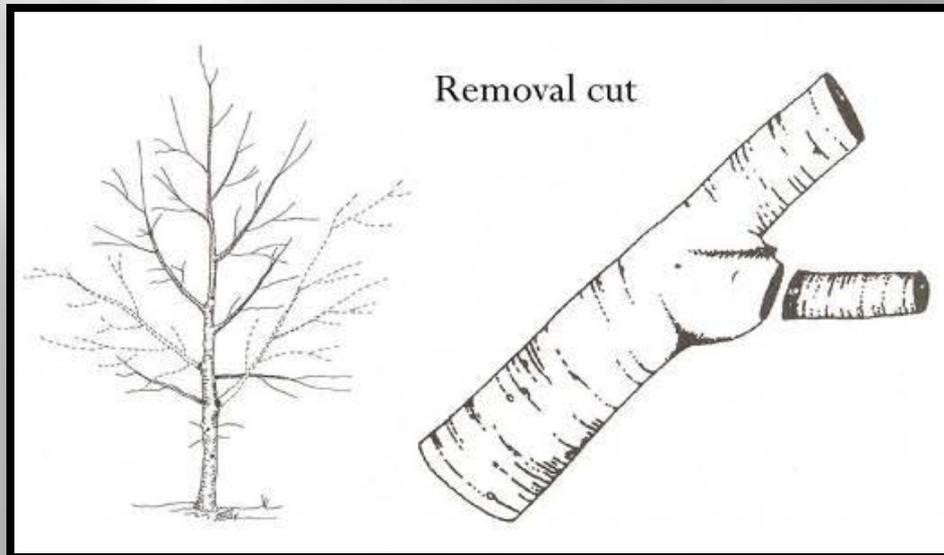


Windbreak Design: Care/Maintenance



Types of pruning cuts:

Reduction cut - shortens the length of a stem by pruning back to a smaller limb.



Removal cut - prunes a branch back to the trunk or parent branch.

Windbreak Design: Care/Maintenance

Fertilizing...

- In most cases trees will not require fertilization.
- Over-fertilization can cause rapid growth, which can lead to large weak leaders, reduced density, and under-developed root mass to canopy growth ratio.
- If it is suspected that soils are low in a critical nutrient, have soils tested before applying any fertilizer.

Windbreak Design: Care/Maintenance

Less is often Better

Fertilizing...

- Don't over fertilize.
- Application rates should not exceed 2 lbs. per 1,000 sq. ft.
- Aerate.
- Add organic matter – mulch.
- Drainage?
- Steady dose is better than dumping.
 - Slow release.



Windbreak Design: Care/Maintenance

Fertilizing...

- Avoid fertilizing newly planted trees until after their first growing season.
- Use caution with “weed and feed”.
- Slow-release over 6-12 months, granular or liquid fertilizes recommended.
- Soil test to determine deficiencies.
- Purchase tree fertilizer vs. turf.



Windbreak Establishment

Establishment period: The time it takes for a tree to regenerate enough roots to stay alive without irrigation. In dry climates (western US), many trees will need supplemental irrigation well past the establishment period and may need supplemental watering for vigor for the entire lifespan of the tree.

Windbreak Establishment

Establishment rate is influenced by a variety of factors

Encourages growth	Limits growth	Little or no effect
Loose soil	Compacted soil	Peat or organic matter added
Proper irrigation	Little or no irrigation	Water absorbing gels
Mulch 8' around planting hole	Grass and weeds close to trunk	Root stimulant products
Root flare above soil surface	Planting too deeply	Adding spores of mycorrhizae *
Leaving shoots intact	Pruning at planting	Fertilizing at planting

Windbreak Establishment

- Irrigate.
 - 2 – 3 times weekly until established.
 - 2 gallons per inch trunk caliper on root ball.
 - Remember to move watering location out with expanding drip line of tree.
- Mulch/Weed Barrier Fabric.
 - Control weeds.
 - Increase mulch diameter over time to keep pace with root growth.
- Protect.
 - Winter desiccation/sun scald, wildlife, livestock.
- Minimize soil compaction.
- Remove stakes, protect lower trunk.

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