

Alfalfa Winterkill Winter of 2012-2013

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Alfalfa Winterkill in 2012-2013



- Winterkill generally in portions of fields as at left.
- In severe cases entire fields as above.

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Alfalfa Winter Survival

- Genetic winterhardiness
 - Morphological
 - Physiological
- Development of winter survival potential
- Management to enhance winterhardiness
- What happened in 2012-2013 winter?

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Morphological Basis – deeper crowns



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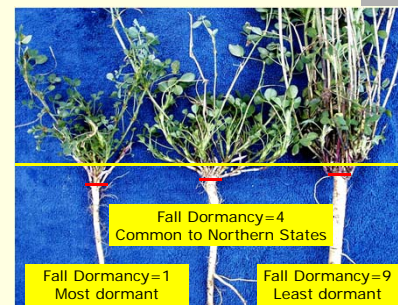
Morphological Basis - Fall Dormancy

- Fall dormancy is determined by height of growth during September.
 - measure plant height 25 to 30 days in late Sept
 - rate dormancy from 1 to 11 based on regrowth height relative to a series of checks.
- Less fall dormancy (higher number)
 - Earlier spring greenup
 - Faster greenup after cutting
 - Increased yield are higher in less dormant varieties
 - Higher crowns

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Morphological Basis – deeper crowns



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Physiological basis - Cold adaptation

- Cold-adapted plants have evolved mechanisms to allow:
 - supercooling of the cell solution (cooling below 32°F without freezing)

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Non winterhardy alfalfa is like diet soda



Regular vs Diet Soda
– which freezes first?



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Physiological basis - Cold adaptation

- Cold-adapted plants have evolved mechanisms to allow:
 - supercooling of the cell solution (cooling below 32°F without freezing)
 - accumulation of soluble sugars
 - root and crown starches breakdown to produce sugars
 - reduce the amount of water lost during extracellular freezing
 - stabilize larger molecules and membranes within the cell.

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Physiological basis - Cold adaptation

- Cold-adapted plants have evolved mechanisms to allow:
 - For supercooling of the cell solution (cooling below 32°F without freezing)
 - To initiate ice formation in outside the cell rather than inside the cell.
 - freezing damage is largely a result of extracellular freezing that dehydrates unfrozen cells and ultimately kills them
 - at -1.5°F, which cold-acclimated alfalfa can tolerate for short period of time, about 90% of cell water has been lost with a corresponding reduction in cell volume

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Physiological basis - Dehydration & cell rupture

Both dehydration and/or cell rupture from crushing can cause membrane breakdown during the thawing that releases toxic compounds from the vacuole which kills the tissue.

This is why plants often look healthy until spring greenup.

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Development of Winter Survival Potential

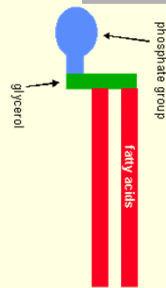
- Dormant cultivars harden up to 3 times faster than non-dormant cultivars
- Hardening begins when crown temperature is 60°F
 - with maximum hardening rate occurs between 40 and 50°F.
 - Hardening is increased by fluctuating temperatures with highs around 50°F and lows near freezing.
- De-hardening occurs:
 - at temperature greater than 60°F and
 - when soil temperature at 2 to 4 inches is above 40°F.

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Hardening

- Cell membrane is composed of phospholipids

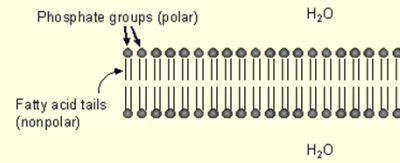


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Hardening

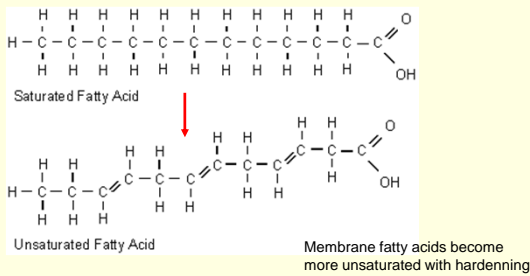
- Membrane is chain of phospholipids



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Alfalfa Hardening



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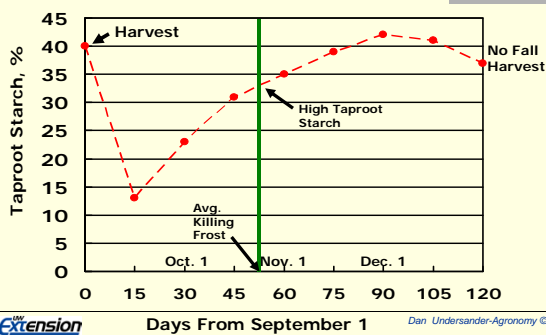
Alfalfa Hardening

- How much the plant hardens depends on
 - plant's genetic potential
 - proper weather conditions
- Hardening will be greater in some years than other years depending on the fall weather with the same variety.

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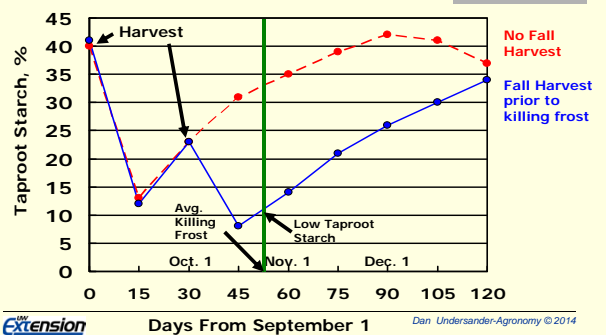
Alfalfa Taproot Reserves Accumulate in Autumn and are Necessary for Winter Survival



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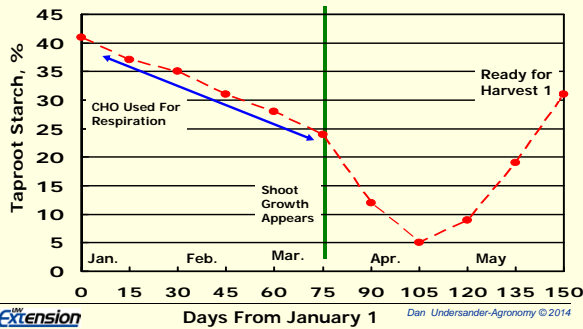
Fall Cutting Management Influences Alfalfa Taproot Reserves and Winter Survival



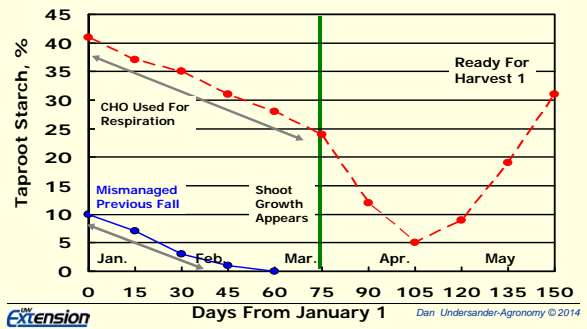
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Plant Survival Over Winter and Shoot Growth in Spring Depends on Taproot Reserves



Plant Survival Over Winter and Shoot Growth in Spring Depends on Taproot Reserves

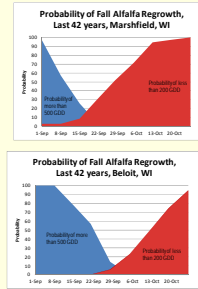


Fall Growth and Last Cutting

Timing of last cutting not related to killing frost

Determined by growing degree days (base 41F)

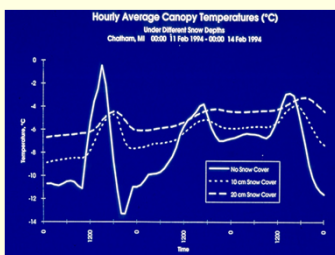
- If more than 500 – good growth and recovery
- If less than 200 – little reserve use



Winterhardness Needed

- Location
- Temperature
- Snow cover

Snow insulates



Data From Richard Leep, MI State Univ

Winter kill

- meristematic tissue killed from exposure to low temperature (< 5° F)
- frost heaving: repeated freezing and thawing pushes crown and root above soil surface and/or breaks roots
- ice sheeting: meristematic tissue suffocates (no soil oxygen for respiration) below ice sheet
- breaking dormancy repeatedly during winter: root reserves become depleted and plant starves

Winterhardiness Needed

- Location
 - Temperature
 - Snow cover
- Management for winter survival
 - Winter survival reduced by:
 - Low soil fertility
 - More frequent cutting
 - Late fall cutting



Low K & P High K & P

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Winter Kill



Alfalfa Winter injury

- Buds from fall killed
- Slow to green up
- Reduced stems/plant
- Lost yield



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What happened in Winter of 2012-2013?

The 'Perfect Storm'

- Low root reserves in fall due to drought of 2012
- Much fall cutting in 2012 due to forage shortage
- Long winter dormancy (late spring) – more respiration
- Some snow melting at periods over winter
- Some soil waterlogging

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Alfalfa has high tolerance to physical stress -
Management often makes a difference



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