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REACTING TO WINTER-INJURY TO ALFALFA

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Severe stand loss and plant injury in alfalfa occurred in much of Nebraska this past winter (1990-1991). Such major widespread losses are not common, although most stands thin slowly as they age. Financial losses can be minimized by rapidly identifying the problem, evaluating the extent of the injury, and selecting stand management or land use options accordingly.

What caused alfalfa death and injury?

Winter-injury to alfalfa rarely occurs due to one factor alone. Many environmental, plant, disease, and management factors cause stress to alfalfa. Some factors can be controlled while others, like weather, are uncontrollable. When several stress factors are combined, alfalfa injury or death can occur. Although cold winter temperatures appear to be the primary cause of alfalfa injury this year, several factors combined to make the injury more severe.

Rapid decline in soil temperatures. Air temperatures during fall and early December were mild and soil temperatures remained at or above freezing. A few days before Christmas, air temperatures became bitterly cold. Soil temperatures dropped from about 32 degrees to less than 15 degrees in only 3 days in the areas of Nebraska that suffered most of the alfalfa injury, and soils stayed very cold for over a week. Such a rapid temperature drop can cause ice crystals to form inside alfalfa roots. These ice crystals destroy cells in the root, causing injury or death. Most of the injury to alfalfa probably occurred during this time.

Dry soils. Fall of 1990 was very dry throughout Nebraska. During winter, dry soils can freeze faster and deeper than soils with more moisture. Rapid soil temperature changes in December were due partly to this lack of soil moisture.

Dry soils also can restrict the hardening process during fall by limiting plant metabolic processes. This affect is likely to be more serious following harvests during the primary period of winter hardening, such as late September.

Dry soils also impede the rate of spring recovery. Soils may warm and plants may break dormancy, but without sufficient moisture to support growth, weakened tillers often wither and die.

Lack of snow cover or shelter. Snow cover, and to a lesser extent shelter, reduces the rate and extent of soil temperature changes as well as desiccation. Most fields winterkilled or injured had no cover during cold weather.

High September temperatures. Record high temperatures in September stimulated alfalfa growth and a late flush of new shoots at a time when alfalfa normally begins to go dormant and develop winter hardiness. As a result, plants may have entered winter with less ability to withstand cold temperatures than normally is developed.

Late harvests. Extra growth that resulted from high September temperatures prompted many growers to harvest alfalfa in late September or early October. By itself, this did not harm plants. But, this late harvest may have reduced further the ability of plants to harden, especially when there was minimal regrowth after harvest due to dry soils.

High February temperatures. Daytime temperatures exceeded 50 degrees through most of February and soils thawed. Some alfalfa plants broke dormancy and began to green-up and grow. When plants break winter dormancy they lose some plant hardiness and rapidly consume energy reserves from roots. Hard freezes in mid-February and early March further weakened plants beginning to grow.

Root and crown diseases. Crown rots and anthracnose have been responsible in the past for severely weakening alfalfa plants prior to winter, thus reducing the plant's ability to harden and withstand cold temperatures. This year, though, disease was not the primary cause of stand loss. Crown rots, anthracnose, and fusarium wilt are present in most alfalfa roots and crowns, but this year they were only a contributing stress factor that probably weakened plants somewhat and made them more susceptible to cold temperatures.

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The Cooperative Extension Service provides information and educational programs to all people without regard to race, color, national origin, sex or handicap.
Class 1: No injury. Plants have a uniform, symmetrical appearance with all shoots about equal in length.

Class 2: Some injury. Plants are symmetrical but shoots are uneven in length. No yield loss is expected.

Class 3: Substantial injury. Regrowth quite variable in length and most shoots are shorter than uninjured plants. Many plants are savable with proper management. Inspect root system to determine amount of damage.

Class 4: Severe injury. Sparse shoots and many fail to lengthen beyond the crown. Most plants are likely to die before or shortly after first cutting. Inspect root system to determine if any hope for survival. Plants that do survive rarely return to normal production.

Class 5: Dead.

Top growth of classes 1, 2, and 5 are easy to interpret. Class 3 and class 4 plants often need root examination to better predict survival and/or production capability of the plant. Dig roots to a depth of 6 to 8 inches and cut open the tap root lengthwise. To evaluate roots use Figure 2.
1. **No injury:**

Healthy roots are solid and white. Texture is firm. Stage 3 plants will recover rapidly. Stage 4 plants are unlikely to have such healthy roots, but if they do they are likely to survive but growth and production will be lower.

2. **Moderate injury:**

Roots are mostly solid and white but darker brown damaged areas occur down 1 to 2 inches in older parts of the crown due to crown rot. Other parts of the root may be tannish or slightly reddish-brown. A spongy texture suggests injury due to cold temperatures. A mushy texture indicates the presence of diseases. If top growth is stage 3 or better, plants are likely to survive and grow well if over 50 percent of the root is solid and white; if less than 50 percent of the root is healthy, plants may survive with proper management but growth, production, and stand life will be reduced. If top growth is stage 4, at least 50 percent of the root must be healthy for plants to survive. Even then, production will be very low.

3. **Severe injury:**

Roots white outside but dark brown discoloration extends deep into root. Other parts also may be discolored, and texture is spongy or mushy. Class 4 plants rarely survive. Class 3 plants usually die if over 50 percent of tissue is damaged; with less than 50 percent damage plants may survive with good soil moisture and management but production will be very low.

4. **Dead roots:**

Roots are completely discolored, often mushy, and partly rotted. Any living top growth can be readily pulled from the crown. All plants will die.
How badly are specific fields injured?

Early stand evaluation to determine whether or not an injured alfalfa stand can be salvaged is the first step to identifying the best management options for the field. Unfortunately, this is not an easy task.

First, identify which plants might live and which might die. This begins by examining top growth in early spring about the time healthy plants are 5 to 6 inches tall. Just because alfalfa initially has green growth does not mean it is healthy. Injured alfalfa stands often have uneven spring growth. Some plants reach a six-inch height rapidly while other plants lag behind. Use Figure 1 to help rate early spring growth.

Estimate stand density after predicting which plants will survive and produce satisfactory yields. Dryland fields only one or two years old need at least 3 to 4 plants per square foot for acceptable yields. Stands may need 6 plants per square foot on highly productive sites. Older dryland sites often remain productive with only 2 or 3 plants per square foot. All irrigated fields need at least 4 to 6 plants to be economically productive, regardless of age. Fields with thinner stands will be very low yielding; usually they should be replanted or rotated to another crop.

How should injured stands be managed?

Injured alfalfa stands often recover if managed properly to allow plant roots to heal and reduce further stresses. Use the following guidelines to regain plant health.

—Topdress 15 to 25 pounds of nitrogen per acre. Damaged roots are unable to absorb nitrogen from the soil effectively. In addition, damaged roots lose most nodules over winter. Nodules will not redevelop to produce nitrogen for the alfalfa plant until plant recovery has been underway for several weeks and new roots develop.

—Topdress phosphorus and/or other minerals suggested by soil tests along with the nitrogen to avoid nutrient deficiency.

—Control weeds. Heavy weed competition will slow recovery. Use Poast to control annual grassy weeds and 2,4-DB for annual broadleaf weeds. Unfortunately, no herbicides or mechanical methods can be used to reduce weed competition from winter annuals like pennycress, mustards, downy brome, and cheatgrass.

—Avoid overirrigation. Weak alfalfa plants often are susceptible to infection by diseases like phytophthora root rot and are quickly injured or killed by waterlogged soils.

—Irrigate dry soils. Weak roots have reduced moisture uptake potential. Allow top 2 or 3 inches of soil to dry between waterings to avoid overirrigation.

—Most importantly, delay first harvest until 25 to 100 percent of plants are blooming. Permit alfalfa roots time to heal, replenish carbohydrate energy reserves, and develop buds for regrowth after harvest. Use longer delays for stands with more severe injury.

—Leave a taller stubble after a delayed first harvest. New shoots may be growing when first harvest is well into bloom. Removal of new shoots forces plants to initiate an entire new set of shoots. New shoots that are slightly topped off and have most of their leaves remaining often regrow themselves, reducing the need for plants to draw on carbohydrate energy reserves to initiate new buds and shoots.

—Allow subsequent harvests to begin to bloom before harvest.

—Avoid harvesting injured fields after September 5 to permit extra time for plants to fully harden prior to winter.

Can injured stands be thickened?

Alfalfa stands that are no more than 12 months old usually can be thickened by direct drilling into the existing stand. Be sure to use a drill that will actually cut a groove into the soil and will place alfalfa seed into that groove. Many small grain drills that contain a legume seedbox can do the job if they have good quality disk openers and good, controllable downward pressure. Do not broadcast seed or use a cultipacker type of seeder. Alfalfa seed must be placed into the mineral soil. Drill 1/4 to 1/2 inch deep in heavy soils and 1/2 to 3/4 inch deep in sandy sites. Adjust seeding rate according to the amount of stand remaining.

Weeds must be controlled. If winter annual weeds are dense, do not direct drill unless these weeds first are killed. They can be killed by tillage or by spraying with Gramoxone Extra (1.5 to 3 pints per acre). However, both these treatments also can kill weakened alfalfa plants. Control annual grassy weeds using Poast and annual broadleaf weeds using 2,4-DB as post-emergence treatments.

Established stands usually should be rotated to another crop rather than thickened. Autotoxic-
ity, low subsoil moisture, and high concentrations of disease organisms all can reduce the success-
fulness of seeding alfalfa into alfalfa. However, 
irrigated alfalfa on sandy sites frequently can be 
reseeded to alfalfa effectively. To reseed on these 
sites, first spray with Gramoxone Extra or Roundup 
before seeding to suppress or kill existing vegeta-
tion. Then sod-seed using a no-till drill that will 
place seed 1/2 to 3/4 inch deep into the soil.

What are options for stands that won't be 
salvaged?

Options are abundant for fields where the de-
cision to abandon is made early. Reasons for 
selecting various options can include a need for 
forage to replace feed lost due to the winterkill, 
cropping flexibility, and a desire to return to alfalfa 
in the same field quickly.

**SELECTED OPTIONS**

A. **Seed to oats immediately.** Seed 2 to 3 bush-
els of oats per acre directly into injured stand. 
Plant as soon as possible. Two tons of hay 
may be harvested from plantings made in April 
if moisture is adequate. Destroy remaining 
alalfa and weeds in early July before seeding 
back to alfalfa in August or to winter wheat in 
September. Or, permit oat stubble and other 
growth to remain as cover until planting to any 
desired crop next spring. (See NebGuide G84-
696, "Small Grains for Silage or Hay").

B. **Seed to millet in June.** Allow alfalfa growth to 
reach 4 to 6 inches in height. Then spray with 
1 quart 2,4-D plus 0.5 pint Banvel or spray with 
2 quarts 2,4-D. Banvel may injure emerging 
millet seedlings unless seeding occurs 4 weeks 
after spraying. Seed foxtail millet at 15 to 25 
pounds per acre if alfalfa is to be replanted in 
August. Cut foxtail millet hay about 10 to 14 
days before planned alfalfa planting date. Yields 
of 1 1/2 to 2 tons per acre are expected. After 
soil is moistened to about a 2-foot depth by rain 
or irrigation, sod-seed alfalfa by August 10 in 
northern Nebraska and by August 25 in the 
south. Use pearl millet at 15 to 25 pounds per 
acre whenever alfalfa will not be replanted in 
August. Cut for hay each time growth reaches 
30 to 40 inches in height. Yields of 2 to 4 tons 
per acre are expected. Destroy and plant to 
winter wheat in September, or leave stubble 
and plant to any desired crop next spring. (See 
NebGuide G74-171, "Summer Annual Forage 
Grasses").

C. **Seed to oats immediately and again to mil-
let in July.** Follow procedure "A" above. If 
irrigated or soil moisture is high after oat hay 
harvest, seed foxtail millet into oat stubble. A 
burndown herbicide treatment, like Gramox-
one Extra, may be needed before seeding 
millet if weedy growth is abundant. Harvest 
millet hay at heading or at frost, whichever 
occurs first.

D. **No-till corn or milo.** Kill alfalfa with 2,4-D and 
Banvel as described in "B" above. Plant corn or 
milo no-till at recommended populations. De-
lay milo planting for 30 days after spraying to 
avoid herbicide injury. Use appropriate weed 
control methods for annual grasses and broadleaves. (See NebGuide G74-131, "No-
Till Corn in Alfalfa Sod").

E. **Thicken alfalfa stand using red clover.** Im-
mediately sod-seed 8 to 10 pounds per acre of 
red clover. Only feasible where weeds are not 
a problem. Can be expected to provide about 
2 or 3 years of hay, but yield will be about 75 
percent the yield expected from alfalfa.

F. **Till and plant to any desired crop.** This 
option is available at nearly all sites but is 
limited due to the amount of field tillage needed 
to develop an acceptable seedbed and by 
delays in planting date.

G. **Replant alfalfa.** Two methods are generally 
used. The preferred method would be to har-
vest what can be economically harvested until 
one month before a planned August planting. 
Till immediately after the final harvest. Prepare 
a conventional seedbed and seed appropri-
ately in August. (See NebGuide G83-652, 
"Seeding and Renovating Alfalfa"). The other 
method would be to immediately prepare a 
seedbed and replant alfalfa. Date of planting, 
autotoxicity, soil moisture, and amount of till-
age needed all discourage this method.
Special Notes

Farm program regulations may restrict seeding options in individual situations. Check with local ASCS officials to determine acceptability of personal choices.

Most crops will need at least a small amount of nitrogen fertilizer at planting. Although alfalfa will release much nitrogen over the season, initially it may actually reduce nitrogen available to other plants because soil microbes will be using the soil nitrogen to decompose dead alfalfa.

Test all grass hays for nitrates before feeding to livestock. High nitrogen availability from alfalfa could result in potentially toxic levels of nitrate in grass hay.

The future?

Widespread winter injury to alfalfa is rare in Nebraska. The amount of injury that appeared during spring of 1991 has not been seen in Nebraska in over 30 years. An unusual combination of factors caused this injury; it is unknown when such an occurrence will happen again.

Cultural practices used successfully, such as good varieties, fertilization, weed control, and harvest management, should not be changed dramatically because of this one unusual incident. Alfalfa is a durable and profitable crop throughout Nebraska, and it will continue to be so using the time and research tested management practices currently recommended.