

SOIL REGENERATION UNLIMITED

Alfalfa Factsheet

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North Country AG-Gro Consulting - Originator of CAPPs
Controlled Aeration Plant Production Services

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It's Just Another Legume - Almost

Aeration of alfalfa is nothing more or less than cultivation. It has always proven effective on annual legumes such as beans, pulses and peas. Research is proving that cultivating alfalfa is highly effective too. The difference is that alfalfa is a perennial; aeration of alfalfa requires more management in order to maximize the benefits.

A Few Basics

The primary reason that alfalfa is a most favored forage crop is that it does not know enough to stop growing - even on occasion when it should know better. Hence the reason that dormancy genes have been added to the genome.

The reason it should stop putting on new top growth annually is because it needs to grow replacement feeder roots annually. The annual regrowth of this nutrient gathering network is essential for maximum performance and longevity. Root reserve is actually the growth of new feeder or lateral root mass. New growth of roots permits access to nutrients in different locations in the root zone.

Alfalfa must be told to grow feeder roots unless the cold temperature dormancy gene is the triggering mechanism. Key elements in obtaining maximum lifetime yield performance of alfalfa include timing alfalfa cuttings, observing drought stress, cold temperatures, crown bud condition, fertility levels and nutrient location in the root zone. All of these elements must be assessed correctly in order to achieve annual regrowth of feeder roots or the creation of root reserve.

Starting at the beginning

Preparation of the soil for establishing alfalfa is vital to the success of the stand. Removal of the plow sole is essential if a deep tap root is to develop. This is most effective in the late summer. The benefits of deep-tillage are easily removed by performing secondary tillage when soils are too wet. Late summer seedings can be exceptionally effective largely because soil moisture allows secondary tillage seedbed preparation without resulting compaction.

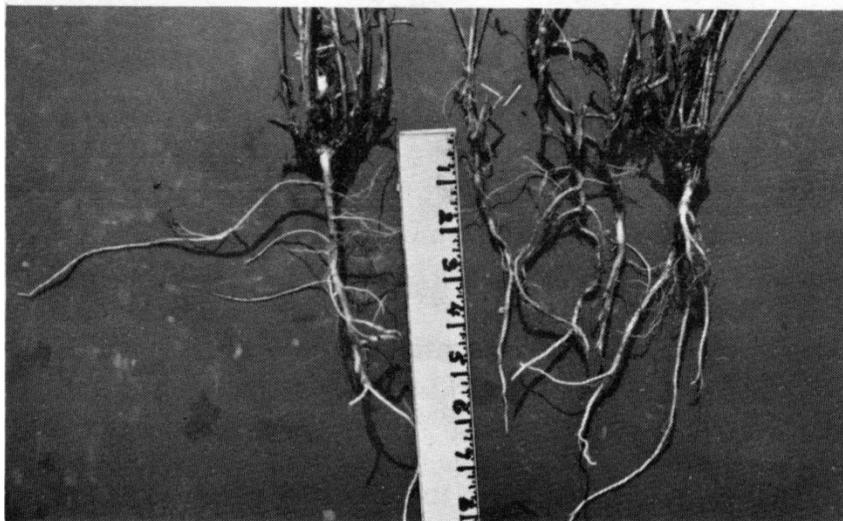
The Curse Buster machine in early spring conditions very effectively normalizes capillary and

free water with no residual compaction. The warm soil on the surface is smoothed and firmed . The extent to which the root zone is left uncompacted will largely determine the first year production and the eventual plant mortality. Frost seedlings in late winter are effective largely because traffic on compaction prone soils is avoided.

The Runt of the Litter- Major Source of Declining Yields

The alfalfa seedling who happens to start it's life in the wheel track is destined to be the equivalent of the runt of the litter. A runt in the animal world never survives without special care. If that care does not occur early in life, then normal growth will likely never occur.

In alfalfa stands, the mortality pattern is obvious from viewing the strips of reduced population and vigor which may begin to appear as early as the third growing season. The increase in bulk density of the soil in the wheel track does not permit normal root development which is equal to that of plants which happened to start their life in a non-traffic areas. Our investigation into alfalfa mortality has shown that more than half of the plants in the planter/tractor wheel track are dead at the end of the third growing season. The wheel traffic area from the last tillage pass may also contribute to the same malady.



The one year old plant on the left was aerated in the fall of its first year before bloom. Note the straightness of the tap and the size and quantity of lateral roots. The plants on the right were from the untreated check in the same field.

More CurseBuster owners are mounting seeders on their machines each year to avoid the runt of the litter issue. Others are pulling seeders directly behind the tillage operation using the optional rear hitch.

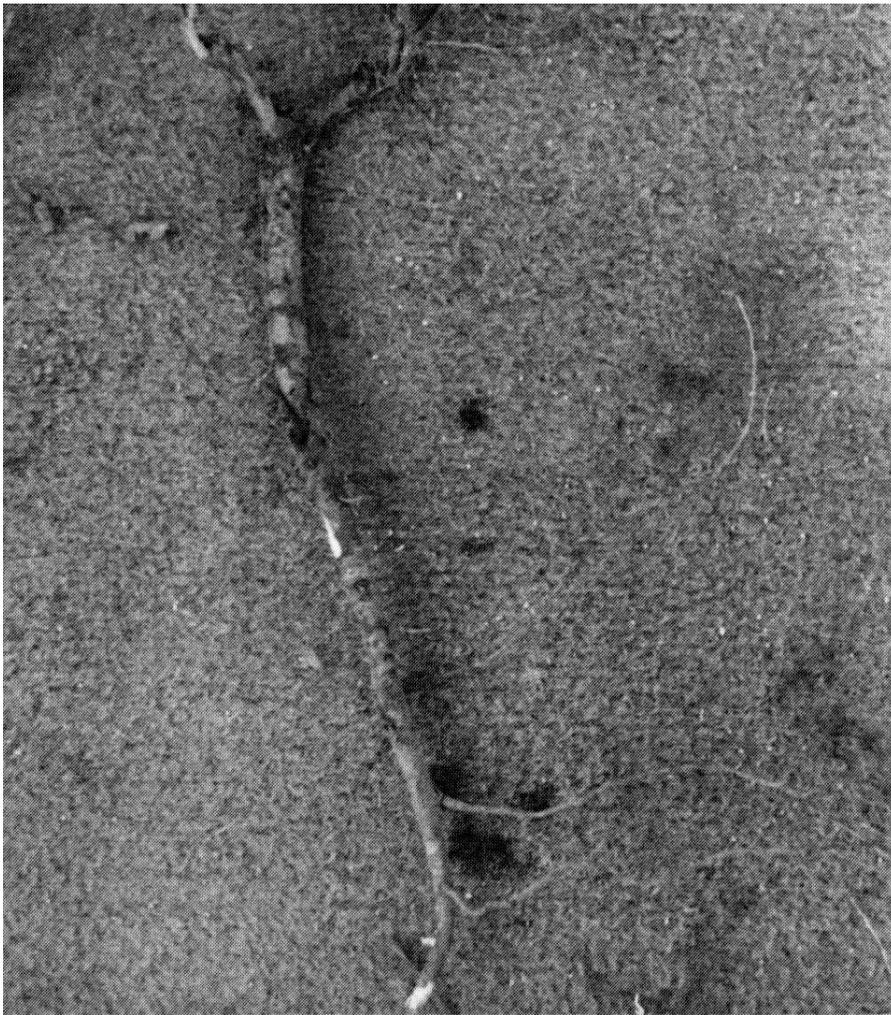
Managing for Feeder Roots

Alfalfa must produce new feeder roots annually in order to maintain vigorous top growth for top

yields. Alfalfa will only attempt to grow feeder roots when at least one of the four following conditions are met:

- 1) Bloom occurs
- 2) Dormancy resulting from drought stress
- 3) Dormancy resulting from cold temperatures
- 4) or if Budding Stage is reached at least four times per growing season (See Univ. of WI study below)

The annual regrowth of feeder roots is the equivalent of growing new mouth parts for the plant. "Managing" to trigger the growth of feeder roots will only result in actual growth of roots if the soil is loose enough (density reduced) to permit root elongation. (Any alfalfa plant which fails to regrow the lateral feeder roots becomes the runt.)



Each time harvest occurs soils are again compacted. Removal of the compaction and management to cause new root development must be coordinated in order to achieve the desired new feeder root development.

This five year old alfalfa plant had very little nutrient gathering ability left as a result of silting, anaerobic soil conditions, insect injury, surface compaction and poor feeder roots.

When and How to Aerate for Feeder Root Growth (and Regrowth)

The most obvious time to aerate alfalfa fields is in advance of the alfalfa plants' attempt to initiate new feeder root

development. That time varies widely from production region to region. In southern areas

cutting regimes are a primary variable. Northern regions are more apt to use the dormancy gene activation.

Soil conditions often can dictate when the use of aeration is practical. Sun-baked adobe and clay soils may require some moisture addition. Reasonably dry soils with up to 8" of snow-cover have been aerated successfully. The dormancy window may have been missed in this scenario but other important goals impacting general soil health development have been achieved in such a situation. Flexibility is the key to success. Always avoid this tillage operation in water-logged early spring field conditions.

Aeration for root development in four (or more) cut systems is very flexible since some root development occurs at the bud stage of each cutting. Remember that if budding is not permitted then little or no lateral replacement root growth will occur. Then it will be necessary to have plants bloom once each year.

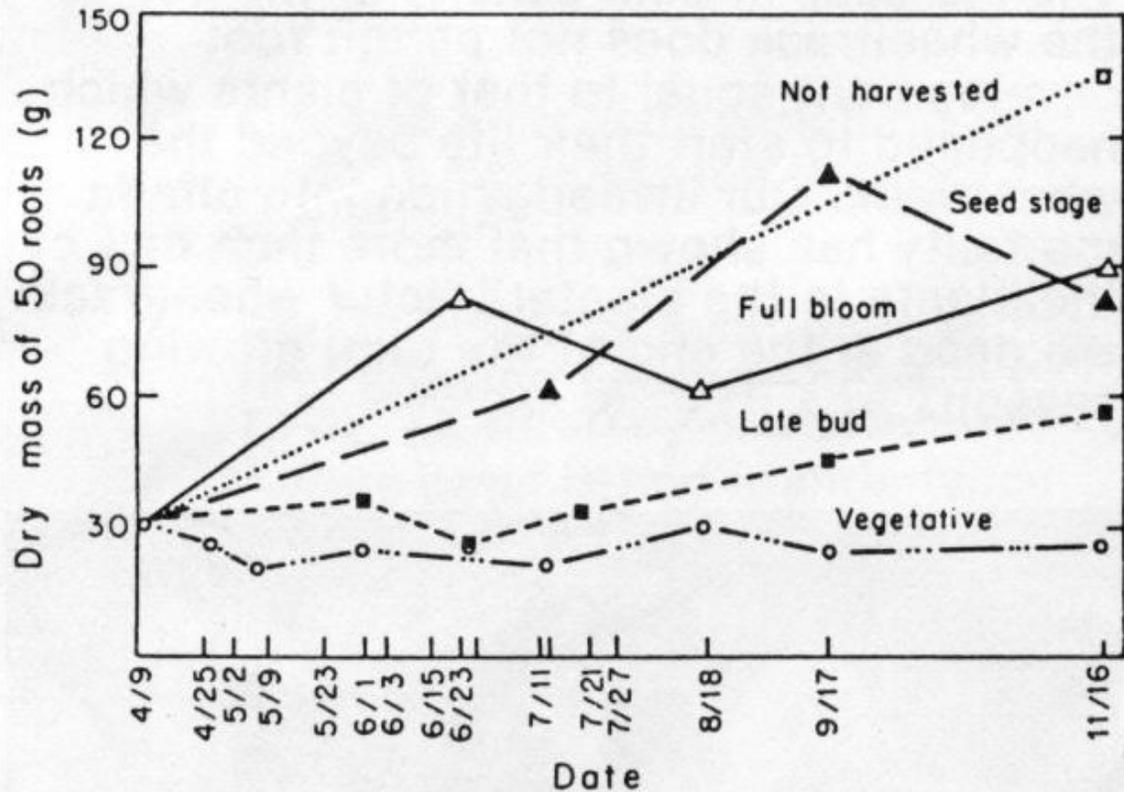
One bloom event is necessary in three cut regimes. The bloom stage that has the least protein depressing impact is in the late summer or fall of the year. Therefore, aeration after the second harvest is the best time in three-cut regimes; after the third cut in four cut systems.

Bear in mind that in established stands of two years or more in age, plants will not bloom uniformly throughout the field. The "runts" who are still surviving are not going to achieve physiological conditions for blooming as quickly as the other plants. The longer the stand is allowed to flower, the larger the percentage of plants that will be able to grow new feeder roots.

These plants which are in decline and supporting only one to three shoots per crown are going to be the big responders to this intervention of tillage combined with cutting regime management. In this same vein, alfalfa stands that are being seriously challenged for dominance by grasses such as Orchard or the Fescues will emerge more competitive in the first growing season following aeration.

Study the chart below carefully. It explains much of the suggested protocols contained here.

ALFALFA ROOT MASS V. CUTTING REGIME



Each circle, square and triangle indicates harvest of foliage.

Alfalfa adds very little dry matter to the root mass while it is adding top growth. The onset of bloom triggers the plant to begin to accumulate root mass.

Aeration of the root zone should be done in advance of bloom so that the soil is loosened for more rapid root elongation.

Taken from: CROP-WATER RELATIONS EDITED BY I.D. Teare & M.M. Peet, John Wiley & Sons, 1983.

Other Objectives of Aeration

It is possible and advisable in most soils to mobilize plant nutrients within the alfalfa plant root zone. In established stands, it is readily observed that most new lateral root development has been occurring in the bottom portion of the plow layer. Fertilizer applications have been made to the top of the plow layer. Shallow soil sample cores reveal that commercial fertilizers and manure nutrients remain highly concentrated in the top of the plowlayer. Most of the impact of applied potash is actually the mobilization downward of calcium. Until the plant realizes the investment that has been made for it, little effect if any will be possible.

Aeration is a two edged sword. Fertilizer moves to existing roots on the one hand, and simultaneously rooting activity is stimulated to occur in the top half of the plow layer where fertilizers have been concentrating. An interesting phenomenon also occurs with respect to the regulation of potassium uptake. Magnesium serves the plant to help regulate uncontrolled uptake of Potash. The soil microbiology will respond to aeration by providing more magnesium to the growing plant and by so doing limiting dangerously high concentrations of potassium.

As soils rest in an untilled condition, they actually change in their ability to transport water and exchange gases. The movement of water through the soil causes silt particles to relocate in the plow layer and form a layer which blocks macropores to reduce the rate at which water moves through the root zone. The tillage process will mechanically disturb the silted layer and restore the soils ability to maintain proper air/water relations.

The restricted movement of water in the soil profile results in periodic anaerobic soil conditions. This environment results in increased fungal and bacterial pathogens that will attack the plant root system. In addition, decomposition of decaying dysfunctional root mass results in negatively impacted with a lack of oxygen in the soil. Thirdly, anaerobic soil will cause bacteria to produce ethylene gas. This water soluble gas will reduce the ability of the plant to produce new root mass that grows normally as well as hinder nutrient uptake.

Restoring normal air/water relationships is beneficial in other ways. Nodule activity and size has been observed to increase by aerating. The addition of atmospheric nitrogen in limited quantities supplies nitrogen to nodule bacteria. Soil phosphorus levels improve where aeration has occurred. The action of aerobic bacteria which is stimulated with aeration converts phosphorus reserves into plant available ortho-phosphate forms.

On the flip side, aeration has clearly reduce weed pressure in alfalfa stands. Some shallow, fibrous rooted weeds are mechanically removed by the action of the aerator tines and especially so when in combination with the Phillips Rotary Harrow attachment. Reducing the concentration of fertility in the surface (which weeds enjoy) and allowing greater access of nutrients to alfalfa improves the competitiveness of the alfalfa too.

Parting Glances - Do's and Dont's

Do :

- 1) Aerate when soils are dry enough for tillage.
- 2) Be sure the aerator can conform to irregularities in the field.
- 3) Aerate perpendicular to normal traffic patterns (You may think about running a track machine.)
- 4) Aerate after plant regrowth (4 inches) to avoid crown injury.
- 5) Add ballast sufficient to obtain full penetration of the tines.
- 6) Operate at speeds which permit uniform performance in rocky conditions.
- 7) Aerate alfalfa at least once in the first growing season - preferably in late fall before dormancy.
- 8) Aerate established stands twice the first year.
- 9) Expect fertility programming to become more cost effective.
- 10) Drag a chain or plank behind the aerator in order to knock down rocks which may be set on edge in stony conditions.
- 11) Aerate seedlings at 1 degree or less of CurseBuster roller offset. Rotary harrows in passive mode and 25 degrees of offset.

Don't :

- 1) Aerate plants when crown buds are easily injured
 - 2) Aerate water-logged soils
 - 3) Expect results in one year.
 - 4) Expect rapid large yield increases in shoot numbers from stunted plants
 - 5) Rely on old fertilizer top dress programs as they may no longer be cost effective.
- 6. DON'T JUMP THE GUN... WAIT TO AERATE UNTIL ALL PLANTS REGROW REACHING A MINIMUM OF 4 INCHES IN HEIGHT**



The "Track"-Record in Alfalfa