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Establishing a Successful Alfalfa Crop

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This guide discusses how to establish a successful alfalfa crop, including soil requirements, seedbed preparation, seeding, the pros and cons of pure stands and mixtures, seed inoculation, weed and insect control, and harvesting guidelines.

Long-term profitable alfalfa production depends on initially obtaining a strong stand. Take advantage of the productive capabilities of alfalfa by establishing a thick vigorous stand of seedlings. Failure to successfully establish a new stand is costly in terms of out-of-pocket expenses, loss of anticipated production and potential soil losses due to erosion.

Soil requirements

Alfalfa grows best on deep soils with adequate internal drainage. Deep soils encourage development of alfalfa's extensive tap-root system, which is capable of utilizing water and nutrients from a large volume of soil. Physical limitations to rooting depth caused by hard pans or bedrock restrict alfalfa's productivity. In some areas, deep ripping is necessary for successful production of alfalfa and other high value crops.

Fungi which cause such diseases as Phytophthora root rot thrive in wet soils. In addition, alfalfa roots are sensitive to low soil oxygen levels and will die if the soil is saturated for an extended period. Use a soil map of the farm or field for helpful descriptions of the soils present.

In Montana, alfalfa is grown on both dryland and irrigated sites, and most fields have variable soil textures and depths. Select irrigation systems to optimize alfalfa production, depending on soil and field characteristics. For example, sprinkler systems are well suited for shallow or light-texture soils where irrigation frequency may be limiting. Under dryland conditions, a healthy stand will tolerate and recover from extended drought periods.

Soil fertility and pH

A soil pH range of 6.5 to 7.0 is ideal for new seedlings to establish and develop rapidly, although alfalfa will establish and thrive at a higher pH (more alkaline). Take soil samples to determine pH and nutrient status several months before seeding or reseeding a field. Apply fertilizer as needed, using soil test results as a guide. Refer to "Fertilizer Guidelines for Montana Crops" (EB 161), available at your local Extension office or on the web at http://www.montana.edu/wwwpb/pubs/eb161.pdf.

Phosphorus and potassium levels, according to soil test, need to be in the upper medium to high range at the time of seeding. Phosphorus promotes rapid root growth, strong seedling development and high yields. Potassium is necessary for healthy, vigorous plants, winter hardiness and persistent stands.

Each harvested ton of alfalfa removes approximately 11 pounds of P_2O_5 and 53 pounds of K_2O. In most cases, application of nitrogen is not necessary since properly inoculated alfalfa can fix its own atmospheric nitrogen with the help of bacteria (*Rhizobium meliloti*). Refer to "Seed inoculation" section for inoculation procedure.

Seedbed preparation

Seedbed conditions are critical to ensure proper germination and plant development. Two essential requirements for good stand establishment are a firm, clean seedbed (relatively free of residue) and a smooth, uniform surface. Packing during seeding and afterwards will yield good soil contact with the seed. This is extremely important for good germination and early vigorous seedling growth. Firm seedbeds also reduce the possibility of planting too deep and hold the moisture closer to the soil surface. **Pack the seedbed firm enough so that a boot print does not make an indentation of more than ¼ inch.**

Seedings following another crop, such as corn or small grain, can be successful in seedbeds prepared by disking and harrowing. This requires less time than plowing, but may not rid the seedbed of undesirable materials such as weed seeds, diseased plant parts or herbicide residues from the previous crop. Carefully plan and execute the herbicide program on the crop preceding the new alfalfa stand to minimize carry-over of residues harmful to the seedings.

No-till seeding can be done under a wider range of soil conditions than seeding with tillage methods. Rocks stay below the surface and the field is less susceptible to soil erosion. Time, fuel and power requirements are less for no-till seeding. Seeding into chemically killed plant cover

requires a minimum of seedbed preparation and provides an excellent micro-seedbed for seed germination and seedling development. No-till seeding requires herbicide application to control existing sod and weeds (including the seed bank). It is important to keep in mind that while glyphosate has no soil residual activity, residue in dying grass roots can kill alfalfa seedlings. Delay seeding 21 days from application. No-till or minimum till planting into a clean fallow or grain stubble is practical on dryland.

Seeding dates

The best seeding date depends on several factors, including soil moisture and previous crop or cropping practice. In general, spring planting of legumes can start when established stands begin to grow well in open fields. On irrigated ground, you can plant legumes as late as mid July to early August, provided conditions favor immediate germination.

Legumes require five to seven days for germination, but require six to eight weeks or more before the first frost to develop a plant that can survive the winter. In the Billings area of the Yellowstone Valley, the average first frost is September 19, so don't seed in this area any later than August 8.

Seeding depth and equipment

Alfalfa seed has a very limited supply of stored energy to support the developing seedling. Seeds placed too deep are not likely to emerge. However, seeds placed at a very shallow depth or in a loose or cloddy seedbed often do not have adequate soil contact. As a result, seeds dry out and seedlings die. A final seed placement of ¼ - ½ inch is the goal on most soils, with proper seed-soil contact fostered by adequate seedbed firmness. Packing and shallow seed placement help to insure good soil moisture retention.

Alfalfa seeding equipment generally consists of grain drills with legume seed attachments, alfalfa or roller type drills and broadcast cyclone-type seeders. Grain drills with legume seed attachments can be used with or without seed-tube press-wheel attachments. If using a grain drill without press wheels, then pack the seed with a corrugated or ring roller. Also, be sure to pack seedings made with cyclone-type broadcast seeders. When broadcasting seed, double the suggested seeding rate.

Companion crop vs. clear seeding

Contrary to popular belief and long-established customs, you will generally obtain a better stand and yield when you seed alfalfa WITHOUT a companion or nurse crop. The most significant reason for using a companion crop is to help establish the stand, i.e., reduce erosion, minimize weeds, maintain high humidity and reduce wind at seedling height. However, cereal grain grown with alfalfa competes with alfalfa seedlings for light, water and nutrients. Research has shown that this type of competition reduces yields by 20-35 percent (Table 1). The following can minimize the competitive effects if cash flow needs require a grain crop during alfalfa establishment.

1. Seed cereal grain at a depth of 2 inches in 18-24 inch rows.
2. Repack the seedbed.
3. Overseed alfalfa ¼ inch deep after seeding and packing grain crop.
4. If under irrigation, keep the alfalfa root zone moist during the growing season and irrigate immediately after harvesting the grain.
5. Harvest the companion crop early for silage, hay or high-moisture grain, to allow the alfalfa seedlings more time to grow and build up carbohydrate reserves in the root system.

If you must plant a cover crop, seed oats or barley at 30-40 lbs per acre ahead of seeding alfalfa. Harvest the grain crop for hay or forage rather than for grain, and cut when it reaches the soft dough stage. Always check nitrate levels of small grain forage before feeding to livestock. For more information about nitrate toxicity, refer to MontGuide 200205, "Nitrate Toxicity of Montana Forages," available at http://www.montana.edu/wwwpb/pubs/mt200205.html or from your local county Extension office.

Pure stands vs. mixtures

Pure stands of alfalfa usually produce the highest protein yield and often the highest tonnage on soils well-suited for alfalfa. Pure stands produce an excellent cash crop, but for most cow-calf operations, a grass/alfalfa mix is more resilient and produces adequate tonnage and quality.

Sowing grasses with alfalfa has a number of benefits. Grass fills in gaps in alfalfa stands caused by poor alfalfa establishment or winter-killing. Grasses reduce weed invasion and soil erosion. If alfalfa is grazed, bloat is less likely to occur when two-thirds or more of the stand is grass. Alfalfa/grass mixtures cure more rapidly and ensile more easily than pure alfalfa. However, most grass yield is at first cutting, so there is little advantage of grass at later harvests. Many herbicides used for weed control in alfalfa injure or kill grasses, therefore a forage grass in the stand restricts herbicide use.

Current research indicates that alternate-row seedings of alfalfa with a grass are beneficial during establishment vs. planting a seed mix in the same row. Keep in mind, applications of nitrogen to an alfalfa/grass stand will favor grass production over alfalfa.

Interseeding thin stands

Most research and producers agree that interseeding alfalfa into thin stands is rarely successful. Thickening an existing alfalfa stand is often unsuccessful because of soil conditions, age of stand, moisture and temperature conditions, disease, competition from weeds or older established plants and autotoxicity. When you add this all up, the deck is obviously stacked against a successful interseeding.

To increase production, consider harrowing the thin stand and drilling an annual crop of hay barley or oats, with the intention of replacing the alfalfa stand the following year.

Variety selection

Select a variety proven adapted to your area. Each Montana Agricultural Research Center participates in the Montana Intrastate Alfalfa Variety Trial, which measures the performance of the various alfalfa varieties under local conditions. This is an excellent way to ensure that a variety is well-adapted to your area. For the latest results from this trial as well as winter survival, fall dormancy, and pest resistance ratings, go to http://animalrangeextension.montana.edu/Forage/forage.htm. Pick a variety that maintains high production in the 3rd and 4th year for the location nearest your operation.

Seed inoculation

If not already inoculated when purchased, inoculate alfalfa seed with

the nitrogen-fixing bacteria, *Rhizobium meliloti*, specific for alfalfa. Even when planting on land that has already grown alfalfa, there is no practical means of knowing if effective nitrogen-fixing rhizobia remain in the soil. Proper inoculation ensures the availability of an adequate number of effective bacteria to infect the root hairs and develop active nodules.

Follow inoculate manufacturer's instructions for proper inoculating procedure. In general, if seed is not sold pre-inoculated, coat seed with a sticker solution of 1:10 sticker to water. Stickers include corn syrup, sugar or powdered milk. Commercial stickers are also available. Slightly moisten seed with sticker solution and mix with inoculate. A cement mixer is ideal for thorough mixing. Pouring seed between two clean five gallon buckets will also work. After mixing, all seeds should be evenly covered will small specks of inoculate.

Seeding rate

The suggested seeding rate for alfalfa depends on the type of seeding equipment used. The suggested minimum seeding rate on irrigated ground is 8 lbs pure live seed (PLS) per acre. On dryland, seed 5 lbs PLS per acre. Use the minimum 8 lb seeding rate on irrigated ground only when seedbed conditions are ideal, uniform seeding depth can be achieved and moisture conditions after seeding remain favorable. Basing seeding rates on PLS assumes every seed is viable and capable of producing an established plant. A seed lot with 100% germination and 100% purity has a PLS index of 1.0. Adjust the rate of seeding or the actual pounds of bagged seed planted upward, for seed lots with a PLS index of less than 1.0. Seeding rates of legumes frequently are not adjusted if PLS is greater than 90%. To determine the adjusted seeding rate for each species or seedlot of a given germination and purity percentage (given on seed tag), follow the steps below:

Step 1:

$$\frac{(\%\ \text{germination} \times \%\ \text{purity})}{10{,}000} = \text{PLS Index}$$

Step 2:

$$\frac{\text{PLS seeding rate}}{\text{PLS index}} = \text{lbs bagged seed per acre}$$

If hard seed content of legumes is greater than 20%, consider scarification, nicking the seed coat to allow moisture to penetrate. Hard seed is seed that is viable but has an impervious seed coat. Most alfalfa seed grown in the Pacific Northwest has less than 15% hard seed, but locally grown seed may have up to 50% hard seed depending on environmental conditions. Remember to at least double the seeding rate if seed is broadcasted instead of drilled.

Weed and insect control

Alfalfa weed control is a three-phase program: 1) pre-crop, 2) seedling year and 3) established stand. Make every effort to control weeds prior to establishing alfalfa. Many perennial weed species are very difficult to control in established alfalfa stands. Utilize the various herbicide chemistries available for weed control in pre-alfalfa crops such as small grains. The non-selective herbicide glyphosate can be very effective against both perennial and annual weeds when applied in the early fall after harvest of any annual crop. Monitor time intervals required between the application of some herbicides and planting of alfalfa.

During the seedling year, alfalfa seedlings are very susceptible to competition from weeds. Competition during the first few weeks of growth can greatly reduce the lifetime yield of the alfalfa stand. Both preemergence and postemergence herbicides exist which effectively reduce or eliminate weed competition without harming young alfalfa seedlings. Examples include Buctril, Butyrac, Eptam, Kerb, Poast, Pursuit, Select and Raptor.

Clipping young stands of alfalfa can also reduce competition and shading from certain weeds. Weed control measures utilized after the alfalfa stand has been established should be intended to preserve or improve the level of control achieved in phases 1 and 2. You can apply several selective soil-residual herbicides in the late fall or very early spring to dormant established alfalfa for control of annual grasses and/or broadleaf weeds. Examples include Karmex, Kerb, Lexone, Prowl, Sencor, Treflan, Velpar and Zorial. Herbicide application accuracy and proper timing are critical. Read and follow all label instructions. For current alfalfa weed control recommendations, refer to the "Montana, Utah, Wyoming Weed Management Handbook," available at your local Extension office.

Insect control during establishment is also critical. Alfalfa seedlings are prone to excessive damage by army and pale western cutworms as well as by alfalfa weevil. The economic threshold for control of both army and pale western cutworms is when larval cutworm counts exceed 3-4 per ft^2 in mature alfalfa stands, and 2 per ft^2 in new alfalfa stands. For alfalfa weevil, consider control measures when weevil populations increase to the point that you expect your economic loss due to stand or yield reduction will exceed management costs. While alfalfa weevil will rarely permanently damage established alfalfa, seedlings can die when weevil feeding defoliates young plants. Monitor alfalfa stands closely for insect populations. Insecticides labeled for control of these alfalfa pests, and others, can be found on the High Plains Integrated Pest Management website at http://scarab.msu.montana.edu/HPIPM/ or by contacting your local Extension agent.

Cutting management of new stands

Many commercial hay producers are now harvesting 2-3 tons of irrigated alfalfa hay in the year of seeding. This is very beneficial to help offset input costs, but it requires careful management. Plant as early as possible, eliminate weed competition and irrigate frequently. The first cutting should occur about the same time as the second cutting of established stands. Allow new seedlings to start to bloom before the first harvest. Avoid cutting between about mid-August until mid-October (until after a killing frost) to allow for root storage. Do **not** harvest alfalfa seeded in late summer until the following spring.

When to renovate?

Montana is widely known for its geriatric alfalfa stands. The highest hay yields in the state are primarily from irrigated fields in the Yellowstone Valley. Alfalfa is typically managed in this region in short crop rotations for maximum production, and little consideration is given to long-term persistence. In contrast, stand longevity is a major goal for ranchers with dryland and even some irrigated stands of alfalfa. Fall harvest management is the single greatest determinant for alfalfa longevity. To optimize alfalfa winter survival, avoid harvesting (or grazing) from early August until mid-October. The actual dates vary in the state, but

correspond to a rest period of 30 to 45 days before the first frost UNTIL after several consecutive days of killing frosts. If you must cut or graze fields in this period, do it on older fields closer to retirement.

The timing for alfalfa stand replacement depends on many factors. For irrigated alfalfa, a stand of 4+ plants per square foot (or better, 60+ stems per square foot) is generally considered a viable economic stand. On dryland, no good estimates are possible due to the growth habit of Ladak 65 and numerous other varieties. Each alfalfa producer should develop a threshold yield level for when to replace stands. The threshold will vary from operation to operation based on overall operation goals and requirements. Each operation should design a rotation plan for alternative annual forages to offset low production of new alfalfa seedings.

Alfalfa is often referred to as the "Queen of Forages" and is the backbone forage for the livestock industry in Montana. For maximum returns, alfalfa producers should strive to: 1) establish good stands, 2) maintain high yields, 3) maintain quality forage, 4) maintain stand life and 5) use efficient marketing and feeding strategies. Recognizing these goals is the first step to profitable alfalfa production.

Table 1

The Effect of a Companion Crop on Alfalfa Yields

Companion Crop	Hay yield by years (% of check)			
	1	2	3	4
None	140*	82	86	87
None + Eptam (check)	100	100	100	100
Barley—6 inch rows**	0	61	69	77
Barley—18 inch rows**	0	86	79	84
Wheat—6 inch rows**	0	74	78	78
Wheat—18 inch rows**	0	96	84	86

*50-60 percent weeds
**Cereal grains were allowed to mature as grain
Baldridge, Huntley, MT, 1976

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