

# Alfalfa Establishment: Getting Off to a Good Start!

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Alfalfa is a highly productive forage legume that is well adapted to transition zone states like Kentucky. It can be grazed, hayed, or ensiled. Once established and under good management, expected yields range from 5-7 tons per acre per year. High yields can only be obtained from a dense and vigorous alfalfa stand. The first step in obtaining such stands is establishment. The establishment phase of alfalfa production is critical since realization of returns from all other input costs is dependent upon having a good stand and it is expensive (Table 1). *It is important to remember that alfalfa establishment begins long before the actual seeding.* Successful establishment requires a great deal of planning and attention to detail. The objective of this proceedings article is to outline the necessary steps in logical order that will help you to get off to a good start with alfalfa production.

Table 1. Establishment cost for conventional and no-tillage plantings of alfalfa (VCE, 2016).

Item	Conventional	No-Tillage
	Cost (\$/A)	
<u>Variable Costs</u>		
Seed	\$160	\$160
Fertilizer	\$100	\$100
Lime	\$75	\$75
Herbicides	\$22	\$22
Fuel, Oil, Lube	\$20	\$4
Repairs	\$17	\$7
Labor	\$22	\$15
Interest	\$24	\$12
<u>Fixed Costs</u>		
Equipment	\$27	\$12
Other	\$30	\$30
<b>Total Cost (\$/A)</b>	<b>\$497</b>	<b>\$437</b>

## Pre-Seeding Considerations

**Field selection.** Alfalfa is best adapted to deep and well drained soils with a medium soil texture such as loams, sandy loams, and silt loams (Hall et al., 2004). Alfalfa roots can penetrate soils to depths of greater than 15 ft (Sheaffer et al., 1988). Therefore, soil depth should be no less than 3-4 ft (Hall et al., 2004). Soils that possess a hardpan, fragipan, or perched water table should be avoided. Rocks on the soil surface should be collected and discarded prior to or immediately after establishment. Information on the soils on your farm can be obtained on-line using Web Soil Survey available at <https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm> or by contacting your local extension agent, Natural Resource Conservation Service office or Soil and Water Conservation District.

**Soil test field prior to establishment.** The need for fertilizer and lime can only be assessed by soil testing. It is important to remember that the results of the soil test are only as good as the sample that was submitted. Therefore, it is extremely important to obtain a representative soil sample. For a field that will be conventionally tilled, the sampling depth should be 6 to 8 inches. For seedings that will use no-till establishment,

the sampling depth should 3 to 4 inches. Generally, areas represented by a soil sample should be 20 acres or less and each sample should include at least 20 soil cores. The cores should be thoroughly mixed and subsampled. For more information on collecting soil samples see the University of Kentucky's *Taking Soil Test Samples*, AGR-16 available online at <http://www2.ca.uky.edu/agcomm/pubs/agr/agr16/agr16.pdf>.

**Soil pH.** Soil acidity is a major factor limiting forage production in the southeastern United States. Acid soil conditions reduce nutrient availability, root growth, and nitrogen fixation by legumes. Lime not only corrects soil acidity, but also supplies calcium and magnesium while reducing the availability of toxic nutrients such as aluminum and manganese. Soil pH should be adjusted to 6.5 to 7.0 prior for the establishment of alfalfa or alfalfa-grass mixtures. *This can be accomplished by applying lime 6-12 months prior to seeding to allow for adequate time to react with the soil.* In conventional seedings, where more than 4 tons per acre of lime is required, one-half should be applied and disked in before plowing and the remainder should be applied after plowing and then disked. In no-tillage seedings where more than 3 tons per acre of lime is required, one-half of the lime should be applied the season prior to seeding and one-half just prior to seeding. For more information on soil testing and fertility see the University of Kentucky's 2018-2019 Lime and Nutrient Recommendations, Publication AGR-1 available online at <http://www2.ca.uky.edu/agcomm/pubs/agr/agr1/agr1.pdf>.

**Soil Fertility.** Prior to establishment, phosphorus and potassium should be applied according to soil test results. Table 2 shows fertilizer required for various soil test ranges. Generally, when soil test results are above 60 and 450 lb/A for P and K, no fertilizer is required at seeding. For more information on soil testing and fertility see the University of Kentucky's 2018-2019 Lime and Nutrient Recommendations, Publication AGR-1 available online at <http://www2.ca.uky.edu/agcomm/pubs/agr/agr1/agr1.pdf>.

Table 2. Phosphorus and potassium required at seeding for the establishment of alfalfa and alfalfa-grass mixtures for various soil test ranges (Ritchey and McGrath, 2018).

	P as P <sub>2</sub> O <sub>5</sub>	K as K <sub>2</sub> O
	lb/A	
<b>Very High</b>	0	0
<b>High+</b>	30	60
<b>High</b>	30	90
<b>High-</b>	30	110
<b>Medium+</b>	30	150
<b>Medium</b>	60	200
<b>Medium-</b>	90	250
<b>Low+</b>	120	300
<b>Low</b>	140	320
<b>Low-</b>	150	340
<b>Very Low</b>	160	360



Figure 1. Adjusting soil fertility to the high range is key for successfully establishing high producing alfalfa stands. Maintaining soil fertility in the high range is key for optimizing production and stand persistence following establishment.

**Weed control and herbicide residues.** Weeds should be controlled prior to seeding. In situations where both perennial grass and broadleaf weeds are present, or when a total burn-down is desired, a nonselective (affects both grasses and broadleaf plants), translocatable herbicide such as glyphosate should be applied prior to seeding. This is especially important if a mixture of alfalfa and grass will be established. There are limited herbicides available for controlling grassy and broadleaf weeds in grass-legume mixtures. The use of herbicides and cropping sequences that include winter annual (small grains) and/or summer annual (pearl millet, sorghum-sudangrass) smother crops prior to seeding can prevent the accumulation of weed seed. Herbicides labeled for weed control during alfalfa establishment are listed in Table 3. Reseeding restrictions from the use of herbicides on previous forage and row crops need to be considered prior to the establishment of alfalfa and alfalfa-grass mixtures. For more information on herbicides for alfalfa and alfalfa-grass mixtures see University of Kentucky's Weed Control in Alfalfa and Other Forage Legume Crops, Publication AGR-148, available online at <http://www2.ca.uky.edu/agcomm/pubs/agr/agr148/agr148.pdf> and Virginia Tech's Pest Management Guide Field Crops, Publication 456-016 available at [http://pubs.ext.vt.edu/content/dam/pubs\\_ext\\_vt\\_edu/456/456-016/section5-weeds.pdf](http://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/456/456-016/section5-weeds.pdf).

Table 3. Herbicides labeled for weed control prior to and during alfalfa establishment (*Adapted from Flessner and Cahoon, 2017*).

<b>Herbicide &amp; Use Timing<sup>a</sup></b>	<b>Alfalfa Size</b>	<b>Weeds Controlled/Notes<sup>b</sup></b>
<u>Pre-Plant Burndown</u>		
Glyphosate	n/a	Non-selective
Paraquat	n/a	Non-selective
<u>Pre-Plant Incorporated</u>		
Balan	n/a	Prevents germination of
Eptam	n/a	grasses and legumes
<u>Seedling Stand</u>		
Buctril	4-trifoliates	Broadleaves
Butyrac (2,4-DB)	no size restriction	Broadleaves
Glyphosate	no size restriction	ONLY glyphosate tolerant varieties
Post	no size restriction	Grasses
Prowl H2O	2-trifoliates or 6 in.	Grasses and small seeded broadleaves
Pursuit	2-trifoliates	Grasses and broadleaves
Raptor	2-trifoliates	Grasses and broadleaves
Select	no size restriction	Grasses

<sup>a</sup>Always following application instructions on the herbicide label.

<sup>b</sup>Refer to herbicide label for exact weeds controlled or suppressed and their associated growth stages.

**Autotoxicity.** Established stands of alfalfa produce chemicals that can damage or kill new alfalfa seedlings. This is referred to as autotoxicity. Therefore, it is recommended that established stands be rotated out of alfalfa for at least one-year before reseeding. However, newly established stands that are less than 6 months old can be thickened up by no-tilling alfalfa into the thin stand. Forage production from older stands that are thinning can be maintained for a year or two by interseeding red clover and/or a perennial grass.

**Variety selection.** Alfalfa varieties should be locally adapted with fall dormancy ratings of 3 to 5. The best indication of local adaption is high yields and persistence at multiple locations over multiple years. This data is summarized in the *2017 Long-Term Summary of Kentucky Forage Variety Trials* available online at <http://www2.ca.uky.edu/agcomm/pubs/PR/PR738/PR738.pdf>. This publication ranks the performance of alfalfa varieties as a percentage of yield of all commercial varieties in the test. Choose varieties that have above average performance (<100%) over multiple site-years. In addition to local adaption and fall dormancy, choose varieties that have tolerance to diseases commonly found in Kentucky, including aphanomyces root rot, phytophthora root rot, and anthracnose, and have at least a moderate resistance to bacterial wilt and fusarium wilt. Estimates of disease resistance for commercially available alfalfa varieties can be found at <https://www.alfalfa.org/varietyLeaflet.php>.

**Inoculation.** Legumes form a symbiotic relationship with nitrogen fixing bacteria in which nitrogen from the air is converted into plant available nitrogen. In general, there is no need to add nitrogen fertilizer when legumes make up more than 25% of the stand on a dry matter basis. *Alfalfa seed should always be inoculated with the proper strain of nitrogen fixing bacteria before seeding unless it is preinoculated.* If the seed is not preinoculated or preinoculated seed has been exposed to adverse conditions (high temperatures), the seed should be moistened and prepackaged inoculum should be mixed with the seed just prior to planting.

## Seeding Alfalfa

**Seedbed preparation.** For conventional seedings, a fine and firm seedbed should be prepared by plowing or heavy disking followed by other tillage tools that shape and smooth the soil. Do not overwork the soil. Overworking the soil can result in the formation of a hard layer on the soil surface which inhibits seedling emergence. A firm seedbed serves two purposes. First, it allows capillary action to draw water to the soil surface. This will provide needed moisture for seeds to germinate and help to sustain small seedlings during dry periods. Second, a firm seedbed allows for accurate placement of seed. In many cases, a soft seedbed allows seed to be placed



Figure 2. If you sink past the sole of your shoe when you walk across the seedbed, it should be

too deeply, resulting in poor emergence and weak stands. A general rule is that if you walk across the seedbed and sink past the sole of your shoe, the seedbed is too soft and should be refirmed (Figure 2). No-till seedbeds must also be prepared by killing existing sod and reducing surface residue prior to seeding. This can be accomplished by harvesting any existing forage and then spraying the regrowth a nonselective herbicide. For more information on seeding methods please see No-Tillage Seeding of Forage Grasses and Legumes, Publication 418-007 available online at [https://pubs.ext.vt.edu/content/dam/pubs\\_ext\\_vt\\_edu/418/418-007/418-007\\_pdf.pdf](https://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/418/418-007/418-007_pdf.pdf).

**Ensure good soil to seed contact.** Seeding methods that can be used for alfalfa establishment include drilling, broadcasting and cultipacking, and cultipack-seeding. The type of seeding method that you choose will depend on the equipment you have and whether you are preparing a conventional seedbed or no-till seeding. Regardless of the seeding method, the goal is to achieve good soil-seed contact. Good soil-seed contact ensures that the seed will germinate and emerge in a timely manner.

**Seed on the correct date.** In Kentucky, alfalfa can be seeded in either early spring or late summer. Spring seedings usually have good moisture, but increased weed pressure. A general rule is that early spring plantings should be made no earlier 2 weeks before the last average killing frost in the spring (March 15 to May 1). Late summer seedings are at more risk of failure due to a lack of moisture, but generally have fewer weed problems. If summer annual weeds such as crabgrass or foxtails are a problem, late summer seedings are desirable since summer annual weeds are not actively growing during the fall. It is critical to allow the seedlings time to reach adequate size before winter, therefore late summer plantings should be made at least 4-6 weeks before the first average killing frost in the fall (August 15 to September 15).

**Seed at the proper rate.** It is not uncommon for less than one-third of the sown seed to produce viable seedlings and only half of those to survive the first season. Therefore, recommended seeding rates apply 6-9 times the amount of seed needed to obtain the desired stand density. It is important to remember that raising seeding rates above reasonable levels will not compensate for a rough seedbed or poor seeding methods. Having approximately 25 to 40 plants per square foot at the end of the seeding year will result in a stand density of 15 to 25 plants per square foot the year after establishment. Seeding rates for alfalfa and alfalfa-grass mixtures can be found in Table 4.

Table 4. Seeding Rates for alfalfa and alfalfa-grass mixtures (Brann et al., 2000; Lacefield et al., 1997).

Mixture	Alfalfa	Grass
	lb/A	lb/A
Alfalfa	15-20	-
Alfalfa-Orchardgrass	10-15	4-6
Alfalfa-Tall Fescue	10-15	6-8
Alfalfa-KY Bluegrass	10-15	3-4
Alfalfa-Timothy	10-15	3-4

**Seed at the proper depth.** Small seeded forages have very little energy stored in the seed. Therefore, seed that is placed too deep will germinate, but not have enough energy to make it to the soil surface. On the other hand, seed that is placed too shallow may not have adequate moisture to germinate. In general, best results are

obtained when a seeding depth of ¼ to ½ inch is used. As a general rule, never place small seeded forages deeper than ½ inch. *It is important to remember that proper seed placement cannot be obtained on poorly prepared seedbeds. Seedbeds that are too soft will result in the seed being placed too deeply.*

**Seeding with a companion crop.** Nurse crops are not recommended for late summer seedings due to competition for limited soil moisture. Spring seedings can be planted with companion crop, most commonly a spring oat. Seeding rates for the companion should be reduced by 1/3 to 1/2 to reduce competition for light, moisture, and nutrients with the developing alfalfa seedlings. Ideally, the cover crop should be removed early as possible as hay or silage. In the case of small grains, cut at the boot stage to optimize both yield and quality and to reduce competition for in a timely manner.

**Control weeds during establishment.** Newly emerged alfalfa seedlings are extremely susceptible to weed competition. Weeds compete for water, nutrients, and light. In pure stands of alfalfa and clovers, a number of herbicides are available for the control of both grassy and broadleaf weeds during establishment (Table 3). *No herbicides are currently available for the control of weeds in mixtures of grasses and legumes.* When herbicides are not a viable option for weed control during establishment, new stands can be clipped. This will reduce shading and competition for other nutrients. In pastures, flash grazing can also be an effective weed management tool. Flash grazing is accomplished by restricting a large number of animals to a relatively small area for a short period of time. This results in the quick removal of competing vegetation in a uniform manner. In order for clipping and flash grazing to be successful they must be implemented before weeds become too tall and on a regular schedule until seedlings become established. Allow adequate time for new stands to recover before the first killing frost in the fall. For more information on weed control for alfalfa and alfalfa-grass mixtures see University of Kentucky's Weed Control in Alfalfa and Other Forage Legume Crops, Publication AGR-148, available online at <http://www2.ca.uky.edu/agcomm/pubs/agr/agr148/agr148.pdf> and Virginia Tech's Pest Management Guide Field Crops, Publication 456-016 available at [http://pubs.ext.vt.edu/content/dam/pubs\\_ext\\_vt\\_edu/456/456-016/section5-weeds.pdf](http://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/456/456-016/section5-weeds.pdf).

**Control insects during establishment.** In some years, insects can be a problem during establishment. New stands should be scouted frequently for insect damage. Potato leafhopper infestations can stunt new seedlings and should be controlled with appropriate insecticides when economic thresholds are reached. If insecticides are not an option, stands should be harvested early. More information on managing insects in alfalfa can be found at <http://forages.ca.uky.edu/INSECTS>.

**Harvesting new stands.** Although alfalfa stands can be harvested as early as 40 days after seedling emergence, it is better to wait for new stands to reach the early bloom stage (approximately 60 days after emergence). New stands should be grazed only after plants have reached the early bloom stage and are well anchored. A simple test to determine if the plants are well anchored is to pull several plants with a jerking

motion to simulate defoliation by livestock. If roots are not pulled out of the ground, then in most cases plants will be ok to graze. Do not graze new stands closer than 3-4 inches. Light and infrequent grazing can encourage the development of a healthy sod for alfalfa-grass mixtures, but overgrazing must be avoided. Feed hay in a dry lot to avoid overgrazing during establishment. Do not graze or harvest new alfalfa stands from September 15 until after a killing frost (<24°F) has occurred. This will allow alfalfa plants to store up carbohydrates essential for overwintering and growth in the spring.

**Fertilize newly established stands.** Plants require nutrients to grow and persist. Lime, phosphorus, and potassium should be applied according to annual soil test results. Nitrogen should NOT be applied to legumes or grass-legume mixtures.

## **Alfalfa Establishment Summary**

Alfalfa is a highly productive forage that is well adapted to transition zone states like Kentucky. It can be grazed, hayed, or ensiled. It does require deep, fertile, and well drained soils to be both productive and persistence. While the yield potential of alfalfa and alfalfa-grass mixtures is high, it can only be reached with dense and well managed stands. Getting off to a good start with alfalfa production begins with successful establishment. This requires the development of detailed establishment plan that includes both pre-seeding and seeding considerations and a strict time schedule for completing necessary tasks.

### **Alfalfa Establishment Checklist**

- ✓ Selected a field that has deep and well drained soils.
- ✓ Control problem weeds prior to establishment.
- ✓ Soil test and adjust fertility 6 to 12 months prior to establishment.
- ✓ Selected varieties that are locally adapted and have high disease resistance.
- ✓ Always use pre-inoculated seed or inoculate before planting.
- ✓ Prepare a fine and firm seedbed for conventional seedings.
- ✓ Kill existing sods and reduce surface residue prior to no-till seedings.
- ✓ Seed at the appropriate time of year.
- ✓ Never place seed deeper than ½ inch.
- ✓ Control weeds during establishment.
- ✓ Control insects during establishment.
- ✓ Fertilize new stands according to soil test.
- ✓ Allow new stands to reach the early bloom state before grazing or mowing for hay.
- ✓ Do Not harvest alfalfa stands from Sep 15 until after killing frost (<24°F).



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