



No-Till Seeding of Forage Grasses and Legumes

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No-till seeding has become accepted practice for establishing forage grasses and legumes for a number of reasons. Foremost among these is that no-till management helps keep soils in place. Tilling soils to create a seedbed for new forage stands greatly increases the risk of soil erosion during the establishment period. The loss of valuable topsoil costs the farm operation both through lost nutrients and through reduced soil quality. Erosion also has negative impacts on ecosystems when soils and nutrients are lost to surface waters. In addition, the resulting ruts and gullies can damage equipment and are dangerous to equipment operators.

No-till establishment helps maintain environmental quality, improves growing conditions for seedlings, and is more cost-effective than conventional planting. No-till planting conserves moisture already present in the seedbed and dramatically reduces water runoff, benefiting the environment and greatly improving the water supply for new seedlings. No-till seeding methods also require less time and fuel than traditional tillage methods because they require fewer passes over the field with heavy equipment and because rocks remain below the soil surface.

Despite these benefits, no-till seeding is not without its challenges. Residue on the soil surface must be properly managed prior to seeding. Additionally, a well-maintained, no-till drill must be properly calibrated and precisely set to the soil conditions.

No-till seeding can be used to improve forage stands in existing pastures and hayfields or to completely reseed forage stands that have become unproductive. Forage stands can be improved with no-till methods by adding legumes to pure grass stands or by strengthening weak grass stands through the introduction of legumes, grasses, or both. No-till seeding also has great utility when rotating crop fields to pasture or hay production

and when changing the type of forage stand to summer or winter annuals in the crop rotation scheme.

Basic Rules for No-Till Establishment

Several rules must be followed for no-till seeding to be successful. The five most important are:

- 1. Properly test soils and amend accordingly.** It is a waste of time and money to try to establish or improve stands when soil pH, fertility, or both will not adequately support plant production. (Soil sampling recommendations can be found in “Soil Sampling Instructions for the Farm,” available online at https://www.soiltest.vt.edu/content/dam/soiltest_vt_edu/PDF/farm-sampling.pdf.) Fertilize and lime according to soil test recommendations prior to seeding. Ideally, lime should be applied at least six months in advance of seeding so it has time to react with the soil and increase soil pH. Most pasture legumes typically require pH higher than needed for grasses. Red clover requires a minimum pH of 6.2 to 6.5, and alfalfa requires a pH of 6.4 to 6.8.
- 2. Minimize competition.** Competition can occur from the existing sod as well as weeds. Every effort must be made to prevent weeds or existing forage plants from competing with the new seedlings. Heavy thatch and plant growth tall enough to shade the soil surface must be removed. Grazing, hay cutting, and/or application of herbicides are the primary means for reducing this competition prior to seeding. Difficult-to-control weeds may need to be addressed well in advance of seeding since some weeds require multiple herbicide applications to control, and certain herbicides have seeding restrictions after application. After seeding into an existing pasture or hay stand, periodically graze or mow the older forage plants to favor growth of the newly established seedlings.

Routine evaluation of the stand will be needed to determine appropriate vegetation management. Clipping older plants to the height of the new seedlings is a good strategy, but in some cases it can leave heavy residues that cover the new seedlings, reducing growth or causing mortality. Without suitable management, animals may selectively graze new seedlings. Flash grazing — short-duration, high-density stocking — is a good strategy to minimize time and selective grazing on new stands.

3. **Seed in the proper season.** Depending on the situation, no-till seeding can be successful in late winter, spring, or late summer/early fall. It is extremely important to make plans and preparations well in advance so the seeding can be completed in a timely fashion.
4. **Use high-quality seed.** Plant forage species and varieties that are adapted to Virginia. Use certified seed with high germination and low weed-seed percentages. Your local Virginia Cooperative Extension agent (<https://ext.vt.edu/offices.html>) can provide information on forage species and varieties adapted to your area. Cheap, low-quality seed is often the most expensive part of no-till seeding because it results in thin, weak, or low-productivity stands.
5. **Control depth of seeding.** Seeds of most perennial forage plants are small and cannot be counted on to emerge from a seeding depth of greater than 1/2 inch. Adjust seeding equipment to place the seed at a shallow depth of 1/4 to 1/2 inch. Placing the seed too deep is the most common single reason for failure to get a stand. If you see a few seeds on the soil surface after seeding, then your seeding depth is about right.

Broadcast-Seeding or Frost-Seeding Clover

Many Virginia pastures and hayfields have adequate grass stands but lack sufficient clovers or other legumes. The general goal for most pastures is to have clovers present at about 30 to 40 percent of the stand. Absence of a legume results in poor growth and vigor of the grass stand unless regular applications of nitrogen are applied. Forage quality also suffers. It is certainly not desirable to kill the grass simply to add legumes to the mixture, however. The most practical way to get clover back into grass-dominated sods is to broadcast the clover seed over the sod in late winter.

In order for broadcast seeding to be successful, the existing sod must be grazed or mowed short (so you can

see your shoe soles when standing on it). Since almost all herbicides available for use in pastures and hayfields control clover species in addition to broadleaf weeds, it is important to control weeds prior to clover seeding. During the fall, kill any perennial weeds that are present and apply lime and fertilizer based on current soil test recommendations. Apply the seed from late January to early March (depending on your location) when the sod is not actively growing and the soil still has a tendency to freeze. Seeding at this time, called “frost seeding,” takes advantage of the nighttime-freeze/daytime-thaw cycles that open and close the soil and bury the seed at a shallow depth. Seeding rates for frost-seeded legumes can be found in table 1. Seeding must occur early enough in winter that the soil will have several weeks of freezing and thawing to “plant” the seed. Leaving livestock on the area may also help to tread-in the seed. Frost seeding is quick, easy, inexpensive, and can be done on steep, rocky areas where tillage equipment cannot be used. Keeping the dead standing forage below about a 2-inch height at seeding can translate into greater clover yield in mid-summer (see Virginia Cooperative Extension publication 418-022, “Winter Seeding Methods to Establish Clover in Permanent Pasture,” http://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/418/418-022/418-022_pdf.pdf).

As the existing sod begins to break dormancy and grow, it is crucial to graze or mow it routinely to prevent it from crowding out the new clover seedlings. Rotational grazing is recommended, and monitoring of grazing height is essential. When allowing livestock to graze, it is vital to prevent overgrazing and damage to new seedlings.

Table 1. Legume seeding rates and mixtures for broadcasting-seeding/frost-seeding hay and pasture.

Hay	
Legume species	lb/acre
Red clover	6-10
Annual lespedeza	10
Pasture	
Legume in mixtures	lb/acre
Red clover	4-6
Ladino clover	1-2
Annual lespedeza	8

Improve Existing Sods by Drilling Legumes and Grasses

Weak sods that have lost desirable grasses and legumes and have high proportions of “poverty” grasses (e.g., broomsedge) and broadleaf weeds often reflect underlying management issues. These fields may respond dramatically to interseeding legumes and grasses, but if thinning occurs due to current management practices, they must be addressed first. Appropriate grazing and harvest management are foundational to all profitable forage-livestock operations. For example, reducing grazing or haying frequency and raising mowing/grazing heights can support growth of the existing improved forages, and in some cases, these changes will be sufficient to recover the field with time. Readers seeking additional information on grazing management may want to read VCE publication 418-012, “Controlled Grazing of Virginia’s Pastures” (https://pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/418/418-012/418-012_pdf.pdf). If stands have declined due to low pH or poor fertility, liming and fertilizer will be essential, and these inputs can help return the stand to productivity. When overseeding is needed, it is essential to first fertilize, lime, and address existing weed issues. Before seeding, pasture and hayfields should be grazed or clipped if more than 2 to 4 inches of growth is present. It is not recommended that alfalfa be seeded into an existing stand of alfalfa that is more than 6 months old.

While clover can be established by broadcasting in seed on the soil surface in winter, drilling can provide greater assurance of establishment success. However, it is very difficult to establish most grasses and alfalfa by broadcasting or frost-seeding. When thickening existing grass-clover sods, it is best to plant the grass and clover seed with a no-till drill. Conventional grain drills will work as long as they penetrate the soil surface and adequately cover the seed. If alfalfa is to be established in a strong, tall fescue sod, it is helpful to suppress the sod with a low rate of paraquat when the sod is 2 to 4 inches tall.

For fall seedings, sod suppression with herbicides is an acceptable alternative to grazing, mowing, or haying. Fall sod suppression for subsequent spring seeding also works well. However, spring sod suppression with herbicides generally is not recommended for spring seedings. Waiting for the existing stand to grow enough leaf area to “receive” the herbicide can often delay seeding past the optimal window of establishment, and ensuing hot weather and weed competition during early development generally result in a poor forage stand. For

fall plantings, first make sure to graze or hay the existing sod to 2 to 4 inches. If not, dead residue from herbicide application can interfere with drilling and severely limit light to the emerging seedlings. Apply either paraquat at 0.25 lb active ingredient (ai)/a (e.g., 1 pt/a Gramoxone SL 2.0) or glyphosate at 0.77 lb acid equivalent (ae)/a (e.g., 1.13 qt/a Roundup Powermax) one to two weeks prior to seeding. There is a risk of stand reduction, especially when applied in the fall. Paraquat is generally preferred because it leaves grass stems and leaves very brittle and easy to seed into.

Kill the Old Sod and Reseed

In many cases, completely killing the existing sod and reseeding may be more successful than simply trying to improve the existing hayfield or pasture (see figs. 1-6). In such cases, it is usually best to apply a broad-spectrum herbicide such as glyphosate or paraquat to eliminate the existing forage plants and weeds, and then reseed grasses and clovers using a no-till drill. New stands of alfalfa also can be established in this manner. As with the previously described no-till methods, liming and fertilizing to soil test recommendations and controlling weeds in advance of seeding is essential.

Pictures of residue management for no till can be informative (figs. 1-6).



Figure 1. Bare ground is not necessary at planting and can expose the soil to erosion. (Photo by Michael Flessner.)



Figure 2. Killed sod is clearly distinguished from living sod. (Photo by Michael Flessner.)

No till can be helpful for establishment when the dead plants act as a mulch layer, holding moisture and keeping soil in place. However, too much residue can interfere with seed placement.



Figure 3. Thick plant residues interfere with seeding and can shade out and kill the newly emerging seedlings. (Photo by Michael Flessner.)



Figure 4. Large amounts of residue left from mowing can also interfere with seeding and emergence. (Photo by Michael Flessner.)



Figure 5. It is possible to plant into standing dead material without mowing if the material has an upright structure and does not impede planting or growing seedlings. (Photo by Michael Flessner.)



Figure 6. Controlling development of weeds such as this henbit, a winter annual, is critical to stand success. In this case, the henbit emerged after the initial burndown but before planting. Another herbicide application would be needed to remove this competition. (Photo by Michael Flessner.)

The best time to seed depends on factors such as the weeds present, soil moisture, forage needs (whether for grazing or hay production), and species to be sown. For cool-season forages, late-summer/early-fall seedings and late-winter/early-spring seedings are most likely to be successful. In late summer, weed competition is usually not severe, and the seedlings have an opportunity to become well-established before the next season. This is especially true with forage grass establishment. One option is to seed the forage grass either alone or with small grain in the fall, and then overseed with clover in late February/early March. Forage seeding rates to improve pastures can be found in table 2.

Table 2. Seeding rates and mixtures to improve existing hay and pasture stands by drilling.

Hay	
Plant species and mixtures	lb/ac
Orchardgrass	6-10
Red clover	3-4
Tall fescue	5-10
Red clover	6-8
Timothy	4-8
Red clover	6-8
Alfalfa into grass sod	10-15
Red clover into grass sod	6-10

Pasture	
Plant species and mixtures	lb/ac
Orchardgrass	6-10
Red clover	4-6
Ladino clover	1-2
Tall fescue	5-10
Red clover	4-6
Ladino clover	1-2
Alfalfa into grass sod	10-15
Red clover into grass sod	6-10

Fall plantings without small-grain nurse crops should be sown between mid-August and mid-September west of the Blue Ridge, and between late August and late September east of the Blue Ridge. Planting in late summer is usually better than early fall as long as there is sufficient soil moisture because the earlier timing allows for strong seedling development before frost. Evidence suggests, however, that grass seed germination is lower with high temperatures. Thus, seeding rate should be on the high end of planting recommendations in late summer. Seeding mixtures and rates for reseeding killed sods can be found in table 3.

Table 3. Seeding mixtures and rates for reseeding killed sods.

Hay	
Plant species and mixtures	lb/ac
Alfalfa	15-25
Orchardgrass	10-15
Tall fescue	15-25
Orchardgrass	8-12
Red clover	6-10
Tall fescue	10-15
Red clover	6-10
Timothy	6-8
Red clover	6-10
Alfalfa	10-12
Orchardgrass	4-6
Timothy	3-4

Pasture	
Plant species and mixtures	lb/ac
Orchardgrass	8-12
Red clover	6-8
Ladino clover	1-2
Tall fescue	10-15
Red clover	6-8
Ladino clover	1-2
Orchardgrass	4-6
Alfalfa	10-12

Sclerotinia crown and stem rot could be a problem with late-summer legume seedings in some years, especially when seeding alfalfa into a sod that has clover present. Since Sclerotinia damage is most severe on small plants, alfalfa establishment success can be significantly increased by seeding in mid-August. Another option is to seed alfalfa in the spring. Insects can sometimes be a serious problem when seeding into a killed sod in late summer.

The most reliable procedure for killing the existing sod and seeding in late summer is to graze or take a late-spring hay cutting from the field to be reseeded. Then in early June, when the plants have 2 to 4 inches of regrowth, apply glyphosate or paraquat as previously described and seed foxtail (German) millet with a no-till drill at the rate of 20 pounds per acre. The millet serves as a smother crop, provides an excellent hay cutting, and makes no regrowth to interfere with the new seeding. After the millet is harvested in early August, apply herbicide if there are weeds or survivors present from the old sod, and seed the new forage with a no-till drill.

Alternatively, the stand can be sprayed in summer. In this scenario, the stand should be re-sprayed in three or four weeks to kill escaped plants and seeded with the new forage in late summer or early fall. Some producers choose to spray in late summer/fall, plant a winter annual, and then follow with a summer annual before seeding a new forage stand the subsequent fall. This approach is effective but time-consuming, and thus, it is usually more expensive.

Late-winter seedings (i.e., early March) can also work, but they require herbicide application during the preceding late fall while the weeds and other plants are still growing. Seed into the killed sod in early March. This approach is more effective than waiting until spring to kill the sod. Spring applications require waiting until the plants are actively growing, which delays seeding until weed competition is often so severe that it chokes out the new seedlings, or hot, dry conditions slow the growth of the forage seedlings.

New Forage Seedings Following Crops Other Than Sod

Producers often need to establish new alfalfa or grass-clover stands following a crop such as corn, small grain, sorghum, millet, or soybeans. Forage establishment after a row crop can be done very effectively by no-till methods rather than disturbing the soil to prepare a seedbed. In fact, it is not uncommon to use these crops as a means of controlling weeds prior to no-till forage seedings. For example, spring no-till planting of grasses, clover, or alfalfa can be successful in fields planted to corn the previous season. Before seeding the following spring, make sure that the seedbed is free of weeds. If even small weed seedlings are present, a herbicide such as glyphosate or paraquat should be applied. Preferably, the cornfield would be planted to a small-grain cover crop in the fall, but this is not necessary.

There are several ways to successfully seed forages into a small-grain crop in the spring using no-till. One method is to spray the small grain with paraquat when growth is 4 to 6 inches tall and then seed. Small-grain regrowth will probably occur and must be mowed or grazed to prevent smothering the grass or legume seedlings. Another option is to completely kill the small grain with glyphosate before seeding.

Forages may also be seeded without tillage into standing small grain (8 to 10 inches tall) prior to harvesting for silage. Barley and wheat cut at the dough stage will produce very little regrowth. Rye harvested for silage in the boot stage will normally produce regrowth that must be mowed when 4 to 6 inches tall to reduce competition to the seedlings. Rye also can suppress weeds, but this allelopathic effect can also limit initial forage growth, particularly for alfalfa.

Forages may also be seeded into small-grain stubble after silage or grain harvest. If the silage harvest was made prior to dough stage, wait five to 10 days for regrowth to develop, and then apply paraquat or glyphosate to burn back the regrowth and kill weed seedlings. If the harvest was made at dough stage or later, apply paraquat or glyphosate immediately and seed. Since grain harvest is late in the spring, waiting until early August to spray with paraquat or glyphosate and then seeding the forages is usually best. Another option is to apply paraquat or glyphosate and seed foxtail (German) millet using no-till instead of sowing the forage after the small-grain crop is removed. Forage is then seeded in August after harvesting the millet at late-boot to early-head stage, as discussed earlier.

Herbicides for Killing Sod

In general, killing existing grass sods is best accomplished by using glyphosate (e.g., Roundup Powermax) or paraquat (e.g., Gramoxone SL 2.0). For both fall and spring seedings, high rates of glyphosate (2.25-3.375 lbs ae/a or Roundup Powermax at 2-3 qts/a) are generally required to control both the grass sod and perennial weeds. For spring seeding, glyphosate should be applied the previous fall. Ideally, the sod should be grazed or mowed before application to reduce surface residue to a height of 2 to 4 inches. A short regrowth period (one week) is useful to ensure that actively growing leaves are present to absorb the herbicide. In some instances, it may be necessary to apply a second glyphosate application at a lower rate (1.13 lbs ae/a or 1 qt/a Roundup Powermax) or to apply appropriate broadleaf herbicides to control certain perennial broadleaf weeds. Seeding should usually be delayed for

at least seven days after application to allow desiccation of weeds and sod and prevent competition with the germinating seedlings. For fall seeding, it is best to control perennial broadleaf weeds in spring and summer.

Another option, especially with predominantly tall fescue stands, is to apply paraquat in October on sod grazed to 2 to 4 inches. Applying paraquat at 0.5 lb ai/a (e.g., Gramoxone SL 2.0 at 2 pt/a), followed by paraquat at 0.375 lb ai/a (e.g., Gramoxone SL 2.0 at 1.5 pt/a) 10 to 14 days later will also kill existing sod. Seeding is done in early March the following year. If winter annual weeds are present, they can be controlled before seeding with an additional application of paraquat. Many perennial broadleaf weeds will not be controlled with paraquat and must be controlled with glyphosate or appropriate broadleaf herbicides.

Herbicides for Broadleaf Weed Control

It is critical to control broadleaf weeds prior to clover reseeding because these weeds cannot be

removed selectively with herbicides after the clover is established. Control herbaceous perennial weeds with 2,4-D, dicamba, triclopyr, metsulfuron-methyl, and/or clopyralid in the summer prior to late-January/early-March clover reseeding. Match the herbicide, rate, and timing of application to the specific weed infestation. See VCE publication 456-016, "Pest Management Guide: Field Crops" (<http://pubs.ext.vt.edu/456/456-016/456-016.html>), and/or consult your local Extension agent for specific chemicals, rates, and intervals from herbicide application to grass or legume seeding. The use of these chemicals will remove any clover remaining in the stand. Control the biennial thistles (bull, musk, plumeless, etc.) while they are in the rosette stage in the late fall or early spring. Observe label restrictions regarding the interval from application to reseeding. These weeds cannot be effectively controlled with summer herbicide treatments. After the clover is re-established, watch for re-infestation by the perennial broadleaf weeds and spot treat if possible to avoid a general re-infestation.



Figure 7. Fescue (left) and orchardgrass (right) at one-, two-, and three-leaf growth stages. Plant sensitivity to herbicide varies by species, growth stage, and herbicide.

Controlling weeds during establishment is also important, and the timing of application relative to seed germination and seedling development varies by herbicide (fig. 7). For grass-only stand improvements or renovations, application of GrazonNext at 1.5 pt/a two weeks prior to seeding provides residual control of many winter annual weeds. Otherwise, seedling grasses need to develop secondary roots or be in the tillering growth stage before they are tolerant to herbicides such as 2,4-D or dicamba, or aminopyralid. Do not apply metsulfuron-containing herbicides to seedling grasses.

Additional Herbicide Considerations

Be cautious about soil residues from herbicides applied to the preceding crop. Triazine herbicides (e.g., atrazine, simazine) will kill or injure legumes planted in the fall following a spring application, and with certain herbicides, injury can even occur the following spring. If a legume seeding is anticipated, minimize triazine residues by eliminating simazine and restricting the amount of atrazine used. Do not apply metsulfuron-containing herbicides such as Cimarron for at least six months before seeding. Consult VCE publication 456-016, “Pest Management Guide: Field Crops,” consult your local Extension agent for more specific recommendations, or both.

Pesticide Precautions

Select and use all pesticides carefully. Before using any pesticide, read the instructions printed on the label of its container; follow those instructions, heed all cautions and warnings, and note precautions about residues. Store pesticides in their original containers. Store them where children and animals cannot get to them — away from food, feed, seed, and other materials that could become harmful if contaminated. Dispose of empty pesticide containers in the manner specified on their labels. See your doctor if symptoms of illness occur during or after use of any pesticide.

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