CHAPTER 5

Pasture Renovation and Establishment

CHAPTER 5
Pasture Renovation and Establishment

Productive pastures do not just happen, they are created by careful management. Grazing management can go a long way to maximizing the returns from the forage that is there, but there are times when more intervention is needed. Introducing more productive grasses or legumes, or adjusting soil fertility or pH, can revive "run out" pastures and increase the profitability of the grazing operation. This may be done by adding to the existing sward (renovation) or terminating the existing pasture and starting fresh (re-establishment). Additionally, producers may need additional pasture, whether they are just starting production or need to expand, which may require establishing fields on land not previously in pasture.

PASTURE RENOVATION

Taylor and Barczewski (1998) define pasture renovation as a series of actions that lead to a permanent or long-term change in the botanical composition of a pasture. The changes are designed to improve the species composition or to increase the population of a selected species in the pasture, which leads to an overall improvement in pasture quality and yield (Lawson, 2004). The key to a successful renovation is to plan all aspects well before the planting date.

The following questions should be asked when planning a renovation (adapted from Undersander et al., 2002):

1. What is the current condition and species composition of the existing pasture?
2. What are the current soil pH and fertility levels, especially P and K?
3. Does the pasture have weed issues that need to be controlled?
4. When will weed control happen?
5. Are tillage and/or herbicides acceptable options?
6. How long can the pasture be out of service?
7. How much money and effort should be spent?
8. What type of equipment is accessible?
9. What renovation technique will give me the best results?
10. When should renovation occur?
11. What is the maximum acceptable waiting period for a good establishment?
12. Which legume or grass species and which cultivars are best for the growing conditions and production goals?

ASSESSING CURRENT CONDITIONS

Is renovation the answer to improved pasture productivity? Depleted pastures are often the result of improper grazing management, poor soil fertility or poor drainage. If forage species are introduced without addressing the other underlying issues, then the success of renovation will be short-lived and limited. Renovation should be part of a long-term solution that includes improving grazing management and soil fertility.

Good soil fertility is the foundation of successful pasture renovation. Soil testing early in the planning process is important as the results will show the current status of the pastures sampled. This will include information like the pH of the soil, nutrient levels of a range of important macro- and micro-nutrients, recommended rates to apply for some nutrients to meet production goals and liming requirements to correct soil acidity. Each of these factors is important as they can affect any attempt at improving the pasture.

To improve forage establishment, growth and the maintenance of a desirable pasture stand, a pH range of 5.8 to 6.5 is considered most beneficial. Careful consideration should be given to the choice of legume used in soils with a pH of less than 6.0, as acidic soils can impact N fixation in some species. Lower N fixation can limit the growth of the sward and may require supplemental N applications to improve forage growth and yields. Pastures with pH less than 6.0 may be more suitable to grasses and acid-tolerant legumes like red and alsike clover or birdsfoot trefoil. Some species typically not tolerant of acidic soils may have cultivars with improved tolerance.

If an application of lime is needed and re-establishment of the pasture is necessary, then lime should be incorporated before seeding during seedbed preparation. However, when looking to rejuvenate established pastures or in no-till systems, surface applications of lime need to be applied. Surface applications are slower acting and will need to be applied one year to

six months in advance, or if large amounts of lime are required, annual applications may need to be made for several years. A surface application of lime is unlikely to be effective in strongly acidic soils as the pH adjustment will be confined to a shallow layer at the surface.

Adequate soil P is required for good seedling establishment and root development. This is especially important when overseeding or in no-till seeding. Additionally, adequate K levels are important in maintaining strong root systems and healthy, winter-hardy plants.

The grass/legume balance can be significantly affected by P and K fertilization. Low N rates and high P and K rates can increase the proportion of legumes (either volunteer or seeded legume species) in the existing sward. With this in mind, it is very important that mixed grass/legume pastures receive sufficient lime, P and K fertilizer to establish and maintain the sward's legume component.

See Chapter 4, *Nutrient Management and Pasture Fertility*, for specific information on pasture fertility requirements.

TYPES OF RENOVATION

Pasture renovation can be classified into two groups:

1. Rejuvenation by adding new seed to a pasture through overseeding practices while maintaining the existing sward
2. Stand termination and re-establishment

Overseeding methods use little or no tillage and include frost seeding, seeding with a no-till drill and livestock seeding. Stand termination and re-establishment can rely on tillage as well as no-till methods.

Producers should weigh the pros and cons of each method discussed below. The method chosen will depend on financial means, equipment availability, production and environmental goals, acceptable time frames and acceptable risk.

Rejuvenation methods can be completed in a short time frame but may require multiple attempts over multiple years as success may be incremental. Each seeding attempt may be less costly whether in labour, equipment costs or fuel burned and will be more environmentally friendly as minimum tillage or no-till methods will keep the currently sequestered carbon in the ground and not release it into the atmosphere, can minimize the impact on earthworms and reduce erosion by maintaining the permanent sod. Termination and re-establishment are generally more successful than rejuvenation methods but are expensive, equipment intensive, environmentally damaging, and there is a loss of pasture productivity in the short term.

Rejuvenation

The first method of pasture renovation is improvement through rejuvenation: seeding new species into the existing stand. Most commonly, legumes are introduced this way into declining pasture swards, but the techniques can also be used for grasses. This is known as overseeding or sod-seeding. Successful pasture renovation by overseeding depends on reducing the competition from the existing vegetation while the new seedlings are established. Few pastures are so "run out" that there won't be a flush of spring growth. This clashes with the optimum time for seedling germination, leading to competition for light and space. Managing the competition from existing plants can be accomplished by suppressing the existing pasture stand through herbicide applications, mowing, or grazing. Some methods of overseeding include frost seeding, no-till seeding and livestock seeding and will be discussed further below.

Herbicides can either be non-selective or selective. Non-selective herbicides target a broad range of weeds from both the grasses (monocot) and broadleaf weeds (dicot) families. Some selective herbicides target either grasses or broadleaf weeds while having minimal impact on the other family.

Non-selective herbicides can be useful when all plants within an area must be terminated while selective herbicides can be useful to clean up broadleaf weeds before rejuvenation. Both types of herbicides can be used for spot spraying depending on the type of weed, the weed's growth stage or size, the number of weeds, area covered by weeds and density of weeds.

Planning is needed since the first step is to manage existing growth either by mowing, grazing or applying an herbicide spray to the paddocks to be renovated. This can occur in the fall or spring of seeding. A wider window to manage the existing biomass may be available in the fall compared to the spring but will depend on weather and soil saturation. In preparation for rejuvenation efforts in the spring, producers should target an average sward height of 5-10 cm going into winter or should target this height in spring prior to seeding. This will improve the chances of seed to soil contact and

reduce competition from the established sward. Research in Eastern Canada shows that suppressing the sod at the time of seeding can be successful (Seguin et al., 2001; Kunelius & Campbell, 1984). In a study completed in Quebec it was found that at one of the sites selected, mowing or grazing to 5 cm not 10 cm prior to seeding was sufficient to improve clover populations comparable to that seen with herbicide suppression while the second site in the study only saw improvements in clover population when fall management was also used along with mowing or overgrazing of the established sward to 5 cm prior to seeding (Seguin et al., 2001). More recent research has used mowing or grazing of an established paddock in the fall to an average height of approximately 5-7 cm before frost seeding in the upcoming spring (K. Glover, 2024). Two to three weeks after seeding it may be necessary to mow or graze the paddock to reduce competition from the established plants and allow light to reach the seedling forages. After this, the recommended rest, entrance and exit heights should be followed for the species present.

Supressing the established sward through the use of contact herbicides is an option. Contact herbicides with no residual effects can be used two weeks prior to seeding (Seguin et al., 2001) until the time of seeding (Kunelius, H.T., and A. J. Campbell, 1984). Herbicide sod suppression has been shown to be an effective method when sod-seeding legumes into an existing stand, often providing the greatest number of legumes established compared to other methods. However, chemical sod suppression does have trade offs including providing opportunities for weeds to establish and lower yield in the year of seeding (Seguin et al., 2001). Chemically suppressed paddocks should not be mowed for at least 30 days. Follow the label regarding post application wait periods on when the paddock can be grazed or the mowed forage can be used as feed.

Success with rejuvenating an existing pasture comes in many forms and can depend on a number of factors including time of seeding, weather, soil moisture availability, competition from the already established sward or weeds, and species chosen for the renovation. Many Some desirable species, like birdsfoot trefoil, can be difficult to establish, and others, like red clover, establish well but are short-lived. weeds may be managed through regular grazing practices however others, like biennial weeds (i.e., burdock or thistles) that become an issue during the early stages of establishment of the new forages can be clipped to remove the stalk at the onset of flowering which will be highly beneficial to reduce weed competition and future weed problems. Some of the desirable species chosen for rejuvenating pastures, like birdsfoot trefoil, can be difficult to establish and may have fewer newly established plants but are expected to be long-lived while others, like red clover, may establish more easily, have higher initial new plant counts but are short-lived.

Figure 5.1 Forage Seeds. From wrist to fingers: Red Clover, Timothy and Orchardgrass seed.

In order to maintain a good pasture composition it is necessary to regularly overseed the pasture every few years. Another strategy that some producers use is to intentionally let their pastures go to seed to establish a seed bank of desirable plants (Duynisveld, 2023). This technique can be used in the years following a renovation to encourage the continued presence of newly seeded species. There will be a trade off in pasture quality, but it is an example of a different pasture management goal that may make sense in certain situations. Producers working with multiple pastures and paddocks should rotate which pieces will be allowed to naturally re-seed to balance production needs with rejuvenation efforts. For continuously grazed pastures, animals can be kept out of sections using temporary fencing.

REJUVENATION METHODS

Frost seeding

Frost seeding is generally most successful with aggressive species such as red clover, white clover and tall fescue, or with species with an extended germination period like birdsfoot trefoil and consists of broadcasting the seed onto the existing sward. This should be done in late winter/early spring in the early morning when frost is still in the ground. The daily thawing and nightly freezing action will open small cracks in the soil into which the seed will fall. Moist springs and several frosty nights will be most favourable for success. Broadcasting of seed can be done with a variety of tools, whether by hand, a broadcast spreader mounted to an ATV or other vehicle or tractor, or there has been recent interest in the use of drones.

No-till seeding

No-till drills are best used when little disturbance of the soil and existing sward is desired. The drill inserts the seed into a small slice that the drill has made, increasing the seed-to-soil contact and improving the chance of seedling grass and legume establishment. The establishment of new seedlings into live swards can be improved by managing the pasture for the new seedlings. This can be achieved by mowing or grazing after seeding to reduce competition and shading by taller plants. Tests have shown good success using a no-till drill for red and white clover, as well as grasses like annual ryegrass, orchardgrass, meadow fescue and Kentucky bluegrass.

Figure 5.2 No-till seeding into an established pasture.

Livestock seeding

In livestock seeding, untreated seed is fed to livestock by mixing it into free-choice mineral or a grain ration. Only the hard seed will pass through the animal's digestive tract and will come through in 24-72 hours, so some planning is required in order to renovate the correct pasture. Using livestock to seed legumes into a pasture is a slow process, often taking several years to see a benefit. However, this method may be the only choice for land not accessible by equipment. Untreated seed is fed to livestock by mixing it into free-choice mineral or a grain ration. Only the hard seed will pass through the animal's digestive tract and will come through in 24-72 hours, so some planning is required in order to renovate the correct pasture. A study in Ontario found that of the hard seed that is passed through the digestive system, about 10% will germinate (Winch, 1960). Also, the distribution of the seed will not be consistent, especially in more extensively grazed systems. The seeds that do germinate, however, will benefit from being in an area of enhanced soil fertility and where competition from the native vegetation is suppressed.

Rejuvenation timing

The ideal time to seed is early spring (late March to mid-May) as there is more likely to be adequate soil moisture, and the seedlings have the full summer to establish before the next winter. Late summer (mid-August to early September) seeding can also be done, but results are less predictable since moisture levels can vary and winter survival of fall established seedlings can be poor. Grasses (timothy and bromegrass in particular) are more likely than legumes to establish successfully with late summer seeding. The upside of seeding in late summer is soil temperatures are higher, so seed will germinate more quickly if there is adequate moisture.

STAND TERMINATION AND RE-ESTABLISHMENT

This second method of renovation involves the termination of the existing sward with the intention of seeding a new stand and usually involves primary tillage. Stand termination and re-establishment is a costly method for renovating a pasture and should only be done if other methods cannot meet the required levels of fertility and/or productivity. It is recommended in situations where substantial amounts of amendments (i.e. manure, fertilizer or lime) need to be incorporated to correct fertility or pH issues that limit pasture productivity. For example, if P, K, soil organic matter or pH are in the "Low" to "Low to L minus" range, according to a soil test, then it is recommended to have corrective soil amendments incorporated into the soil,

making tillage the preferred method. Stand termination and re-establishment may be the only viable option if the pasture has been overrun by perennial weeds and there is a need to grow a completely different crop that provides flexibility in weed control options before reseeding the pasture.

When choosing to do a complete renovation of a pasture, it may be advantageous to seed in a **break crop**. A break crop is an annual crop such as annual ryegrass, a brassica (turnip or kale) or an annual grazing mixture that "breaks" disease cycles while also adding organic matter, reducing weed populations, and allowing for the incorporation of nutrients or lime, if large quantities are needed which should be applied to the field over multiple seasons.

When considering a renovation there is no silver bullet, and multiple methods can be applied. A more economical method may be to do a partial renovation which includes renovating only areas of the pasture where there is poor yield or significant damage from winter injury, drought, or where flooding has occurred.

In cases where weeds are a primary concern, but soil fertility levels and pH are optimal and the pastureland would not benefit from or is not suitable for primary tillage, the area can be burned (e.g., sprayed) down with a chemical herbicide in the fall. The following spring, the pasture can be reseeded using a no-till drill. This method will reduce the cost associated with primary tillage, and, provided the sod is completely killed by the burndown, successful stand re-establishment is often achievable.

Pasture establishment

The establishment of vigorous and resilient forages that provide complete ground coverage is essential for any producer relying on pastures in their production system. Producers need to consider their field conditions, soil characteristics, growing environment, goals, equipment, and costs to have success in pasture establishment. These are not items that should be left to the last minute, as failure to consider these issues may lead to lost time, lost productivity, or financial losses. For the successful establishment of new pastures, producers should start planning up to 18 months in advance and should be able to answer the questions listed at the beginning of this chapter before beginning. An additional question to answer when a new pasture will be established is, "How will the seedbed be prepared, and what are the seeding depths?" Some of the information in the final sections of this chapter are not specific to stand termination and new pasture establishment and can also apply to rejuvenating pastures.

Soil Fertility and pH

Soil fertility and pH issues are two pasture characteristics that are difficult to address once a pasture has been established and should be corrected before establishment.

As in the case of pasture rejuvenation, testing the soil will identify fertility or pH issues within the field. The Nova Scotia provincial lab offers soil testing services and provides a report that identifies current nutrient levels, pH and other important soil factors. They can also provide a recommendation for fertilizer requirements for forages as well as the lime requirement of $CaCO_3$ in tonnes/ha needed to bring the soil pH up to 6.5. A pH range of 5.8 to 6.5 is recommended for a good growing environment for forages and to improve nutrient availability during establishment and production periods. Legumes are more sensitive to low pH than grasses, and soil pH will decline over time, so the target soil pH should be higher than the minimum required for the most sensitive species in the mix. Lime reacts slowly with acidity in the soil, so liming materials should be incorporated at least 6 months prior to seeding.

Weed control

Weed control is important in both rejuvenating and newly established pastures. It's important to manage weeds to reduce competition from annual grass and broadleaf weeds after planting and reduce or eliminate perennial weeds that can infest the pasture once it is established. This is particularly important if there is a history of weeds that are toxic (e.g., lupin, tall buttercup) or unpalatable (e.g., knapweed, thistles) to livestock.

When considering weed control, remember that the goal is to create a plan that is efficient, cost-effective and one that reduces the weed population to a level that is not economically damaging. Plans focussing on complete weed removal may be too expensive to pursue. Weed control should be done through more than one method to improve the chances of success. Methods can include chemical, mechanical/physical or through cultural practices (ACCPCFC, 1991). In Atlantic Canada, pastures are often planted with both grasses and legumes (mixed stands) in combination. Controlling weeds through herbicides in established mixed stands is difficult as attempts to apply herbicide for either grass or broadleaf weeds may lead to the loss of the desired species. Controlling perennial weeds in advance of planting is the most effective method.

To reduce the weed population, non-selective herbicides can be applied in late summer or fall of the year prior in preparation for the upcoming year's

seeding. Non-selective herbicides can be applied shortly before planting, whether in spring or late summer of the establishment year and help create a stale seedbed to no-till the new stand into. Timing is crucial for this method but can conserve soil moisture compared to a tilled seedbed. For established perennial weeds, there may not be enough top growth for the herbicides to be fully effective. The time between pre-planting herbicide application and sowing of the field should follow label recommendations. Herbicide selection is important regardless of the timing of the application as some products may have residual effects that can cause poor establishment of a newly seeded pasture.

Mechanical methods of weed control can include mowing/clipping, cultivation, or tillage. These methods are appropriate in certain situations and for those who want to avoid herbicides, such as organic producers. Timing of these activities is important and should happen before the weeds set seed. Mechanical control can spread and/or bury the problem in the form of seeds until a later time. In the year prior to establishing a new pasture, mowing or clipping of weeds is recommended. Clipping can weaken the established weeds and, if done before seeds develop, can limit the amount of new weeds that may establish in the future.

Tillage can be used to kill emerged weeds; however, it may also bring new weed seeds to the surface, allowing them to emerge and compete with the newly seeded forages. The depth and intensity of tillage must be appropriate for the weed species being targeted. Light, shallow tillage will be most effective against small annual weeds, while established perennial weeds with deep roots or extensive rhizomes will need deeper, more aggressive tillage to have any effect. However, be aware of the risk of tillage spreading problem weeds to different parts of the field rather than eliminating them.

If weed emergence is significant prior to seeding but after seedbed preparation, the prepared field can be lightly cultivated to disturb any small or young weeds; however the seedbed will need to be firmed up using a cultipacker or roller before seeding. This additional cultivation may impact moisture availability and affect forage establishment.

If weed pressure is an issue post-forage emergence, clipping the tops of weeds can be effective if cutting height is kept high enough to minimize cutting of the forage while removing the tops of weeds. Clipping can remove the flowering portion of some weeds, may weaken them and may provide more sunlight to establishing forages.

Planting a companion or nurse crop can help to reduce the competition from annual weeds, particularly annual grasses. However, the companion crop will also compete with the establishing forages for nutrients, water, and light. Timing of companion crop removal is critical to reduce the chance of thinned stands in the new pasture. See the below section on underseeding for more information.

Weed control in established forages switches from annual weeds to perennials that grow within the forage stand. Annual weeds growing in a pasture are an indication that grazing management needs careful review since an established forage stand will usually suppress annual weed germination completely. Producers should monitor the movement of biennial or perennial weeds into pastures, as a combination of methods may be needed to maintain a strong forage stand.

Forage species selection

Information on forage species can be found in Chapter 6 along with recommended mixtures for establishing a new pasture. The information in Chapter 6 (*Pasture Species Identification and Recommended Pasture Mixes*) can also be used to choose species for rejuvenating an existing pasture.

Planting timing

Spring planting has a much greater probability of successful seed establishment than any other time of year and should be the first choice for pasture establishment or rejuvenation (except frost seeding). Seeding should occur as early in the spring as possible when fields are dry enough to handle equipment, and there is a low risk of frost at the time of seedling emergence. Unfortunately, for those using tillage practices, this provides a short window with which to complete the many tasks related to field preparation. Luckily, some of the steps for field preparation may be completed in the fall of the year prior to the seeding year. Those following no-till practices should ensure the no-till drill is in good condition and set correctly to cut through residues left on top of the field or cut into living or weakened stands. If a crop is to be terminated or weakened prior to seeding using herbicides, planting dates should account for any pre-plant intervals required by the label.

> If a non-selective herbicide product such as glyphosate is used, there should be no residual herbicide activity, and planting can be performed that day as the sward dies down.

If mowing or grazing is to weaken a crop, mowing and planting dates should

account for the time for forage seedling emergence to reduce competition from the established crop. Ensure the crop is spread evenly behind the mower to limit impacts on seedling emergence. Benefits of spring seeding include allowing seeds to germinate at a time when soil moisture is unlikely to limit germination; lower temperatures, which are ideal for seedlings to emerge and establish before hot temperatures cause heat and water stress; and the full growing season to allow plant establishment before winter.

If choosing a late summer planting timing, be aware that moisture availability and higher temperatures may impact the germination of the seedlings; however, competition from annual weeds may be lower, and there may be more flexibility with fewer competing on-farm activities. Sown-by dates vary across Atlantic Canada, but enough time should be given for plant and root development and to build up energy reserves for successful overwintering (a minimum of eight weeks before the date of normal fall frost is recommended). If not given enough time to establish themselves, late summer plantings can be at risk of winterkill. Grasses are more likely to establish from a late summer seeding than legumes, and clovers are more likely to establish than trefoil.

Seedbed preparation and seeding

When starting with bare soil, an ideal seedbed is one that is fine, smooth and firm. It will improve seed placement and seed-to-soil contact as well as help ensure proper seeding depth. Cultipackers and rollers can be used to firm up a seedbed if soils have been overworked or if larger cultivation equipment is used in preparing the field (ACCPCFC, 1991). If using no-till methods, the no-till drill should have the weight, sturdiness and capabilities to handle residues on top of the field as well as cut into compacted soils or existing sod and, therefore, preparation can focus on termination or weakening of existing crop stands.

Forage seeds tend to be small and round or thin. Seeding depth is species specific however, in general, a seeding depth of 0.64 cm to 1.28 cm (1/4 in to 1/2 in) is recommended and allows for quick and even emergence. If fields are dry, a depth of 1.92 cm (3/4 in) may be used to find moist soil; however, deeper seed placement may lead to slow, poor and/or uneven emergence of the forages. If broadcasting seed onto bare soil, the seeds should be packed after seeding and, ideally, have light soil cover. One of the leading reasons for poor pasture establishment and longevity is a failure to properly prepare the seedbed along with improper seeding depth or poor soil cover, which leads to thin stands with lower productivity and increased risk of weed encroachment.

On cultivated fields, seeding can be completed using a seed drill, cultipacker seeder or by broadcasting seed. Seed drills are more versatile as they can be used to seed other crops; they allow for deeper sowing, which is useful if moisture availability is a concern, but are of limited use in stony fields.

Figure 5.3 A cultivated field recently sown to forage.

Cultipacker seeders can provide a uniform seed distribution at a consistent and shallow depth, along with packing the seed after it is placed into the soil. Unfortunately, if soil moisture is a concern, seeds may not be placed deep enough and may lead to a poor stand. Cultipacker seeders may have difficulty maintaining consistent depth and soil cover on fields with larger stones.

Another option is to broadcast seed, which can be done with a tractor or ATV. When broadcasting seed, choose a day and time with low wind to improve the uniformity of seed distribution. This method is quick and reduces wheel traffic on the field, but different-sized seeds may be thrown at different distances by the spreader, resulting in uneven stands. Seed to soil contact and moisture availability is a concern, and after seeding the field should be packed using a cultipacker or roller.

Figure 5.4 Broadcast seeder mounted to an ATV.

For uncultivated fields, a no-till drill is the best option to ensure seed-to-soil contact and uniform distribution. Ensure the drill is correctly set before seeding begins, and periodically check and assess whether adjustments need to be made. Broadcasting seed can be used but is a less effective method in this situation as seed-to-soil contact is less assured due to existing residues or the existing stand and sod will limit the seed from reaching the soil even with some attachment or implement to roll over or knock down the seed.

The use of the correct seeding rate is important when establishing new pastures to ensure a strong, healthy and long-lived sward. See Chapter 6 for recommended seeding rates for forage species and recommended mixes.

To identify the actual seeding rates, the percent of Pure Live Seed (% PLS) needs to be found.
To calculate % PLS, first, identify the percentage of seed purity of the bag and percent germination of the seed found on the seed tag.

Percent of Pure Live Seed (% PLS) = % seed purity * % germination

Followed by,
Actual seeding rate in kg/ha (lb/ac) = Recommended seeding rate in kg/ha (lb/ac) ÷ % PLS

Legume inoculation

When seeding legumes, whether new stands or for rejuvenation, always apply the correct inoculant for the legume seed being sown and follow the provided instructions. Follow storage instructions provided by the seed supplier for inoculum; however, if none are provided, packets of inoculum should be stored in a cool, dark place. Seed that has been inoculated and stored should be re-inoculated to ensure viable bacteria are on each seed at planting (ACCPCFC, 1991).

Underseeding

Underseeding also known as companion cropping or nurse cropping, is when a small annual grain crop is sown just prior to or with the perennial grass and legumes which will become pasture. The companion crop typically grows faster than the establishing perennial grass and legumes and can provide benefits such as soil erosion control and can also help suppress annual weeds. An additional benefit is that it can provide an earlier crop to harvest as haylage or it can be grazed, which can help lessen the loss of feed when re-establishing a new stand. Underseeding is only recommended for use in the spring and may not be recommended at all depending on the forage species chosen for the pasture. Experience has shown that red clover, timothy and ryegrasses better tolerate the competition from the companion crop compared to alfalfa and many other grasses (ACCPCFC, 1991).

Companion crops can help reduce competition with weeds however they must be carefully managed to ensure that they do not compete with the establishing pasture. To help reduce competition with the seedling perennial forages, N should be carefully managed while other nutrients should be provided to supply both the annual and perennial crops. The establishing pasture should take priority; therefore, all management considerations should favour the perennial forages. The chosen companion crop will compete with the forages for sunlight, nutrients and water and, if not managed carefully, can lead to thin and weak stands whose productivity will be impacted in future years.

To minimize competition, use a reduced seeding rate for the annual crop. Based on recommendations from Quebec, cereal companion crop seeding rates should be reduced by 30% from the recommended seeding rate of the pure grain crop (Bélanger et al., 2022). Spring cereals like oats, barley, rye or triticale or a mixture such as a spring cereal with field peas can be used as companion crops. Choose varieties that are early maturing, short and stiff strawed (Bates, D, 1970). Harvest timing of the companion crop when using

a cereal is at the boot to heading stage, and the crop can be made into silage or haylage or be grazed. If grazing, do not let animals graze the field short enough that they eat the establishing grasses and legumes. Leaving the companion crop to mature for grain harvest will adversely affect the establishment of the forage stand.

Figure 5.5 Forage field established with companion crop. Early season growth (left) beside later season growth (right).

While there are many factors to consider with underseeding, it has been used successfully by farmers. Grain producers in PEI successfully use this method to incorporate pasture into their rotation. They underseed oats, the final cash crop in their rotation, with their pasture mix that includes red clover and alfalfa. Not only do they harvest the oats as a grain crop, they also harvest the straw and have had very successful pasture stands. This is an organic operation, so the soluble N is likely quite low at this point in the rotation, underlining the point that applying too much N might make this practice unworkable. They have used this method for 17 years, and only once did one crop fail: in 2023, a very high moisture year, the pasture species outcompeted the oats (Bernard, 2023). Furthermore, in a study conducted at the Nappan Experimental Farm, when barley was sown as a companion crop to alfalfa, there was no significant impact on the establishment of the alfalfa. While the amount of alfalfa in the barley/alfalfa stand was somewhat lower in the seeding year this was not statistically significant and subsequent production years were similar to alfalfa sown without the companion. Total forage yield was significantly higher in the seeding year in comparison to alfalfa grown without barley, however forage quality was reduced in the first cut. (Dr. Glover, 2024).