A3681

# Alfalfa

## *germination & growth*

Dan Undersander
Paul Vassalotti
Dennis Cosgrove

Understanding alfalfa germination and growth is important to matching management decisions to alfalfa development. Knowledge of the germination process will help you understand conditions necessary for good stand establishment and reasons for delayed or failed establishment. Knowledge of seedling growth will help you determine when to take remedial action to control diseases, insects, and weeds. Understanding the patterns of spring greenup and regrowth after cutting will aid in determining the presence of disease problems or winter injury and in managing weeds. Knowledge of mature stages of alfalfa will aid in harvest decisions for the desired forage quality.

# Germination and emergence

Supplying the right conditions for alfalfa seeds will help to assure maximum germination. Prepare a firm, weed-free seedbed to minimize competition from weeds and to ensure good seed-soil contact. Avoid overworking the soil surface as rainfall following seeding may crust the surface, preventing seedling emergence. Place seeds ¼- to ½-inch deep in medium and heavy textured soils and ½- to 1-inch deep in sandy soils. These depths cover the seeds with enough soil to provide moist conditions for germination while allowing the small shoot to reach the surface. Soil temperature must be above 37°F for the seed to begin taking up water. Higher soil temperatures increase the rate of germination but do not affect the final germination percentage. High soil salt content will prevent the plant from taking up water and germinating.

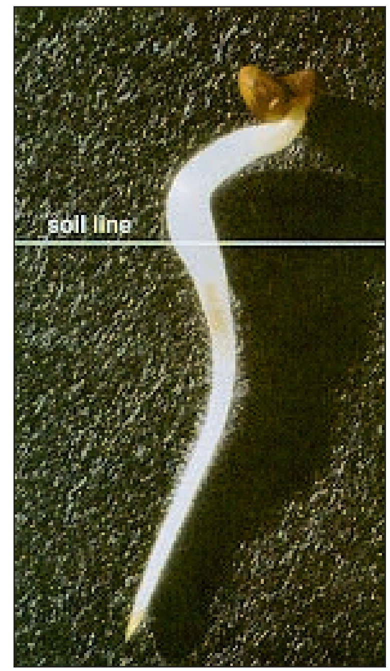
**The seed on the right is swollen with water taken up from the soil. This process marks the first step in seed germination. Under favorable conditions, water uptake begins within 24 to 48 hours after planting.**

**The first part of the seedling to emerge is the root radicle. The radicle anchors the seedling in the soil and always grows downward, regardless of the direction it's pointing in when it first comes out of the seed.**




**As the radicle grows, the portion nearest the seed enlarges and forms a hook. It pushes up through the soil surface, dragging the cotyledons and seed coat with it. ←**

**Once the seedling emerges above ground and is exposed to light, it straightens out. At the same time, small root hairs are developing on the lower radicle. The root hairs absorb water and nutrients from the soil. ↓**



# Seedling development and growth

Young seedlings are particularly vulnerable to diseases and herbicide damage. As the seedlings mature, they become more resistant to seedling diseases and less susceptible to herbicide damage. Many herbicides have application restrictions until a specific growth stage is reached. It is important to be able recognize each growth stage so you can apply treatments at the correct time.

**Cotyledons are usually the first visible portion of an alfalfa seedling above the soil surface.**

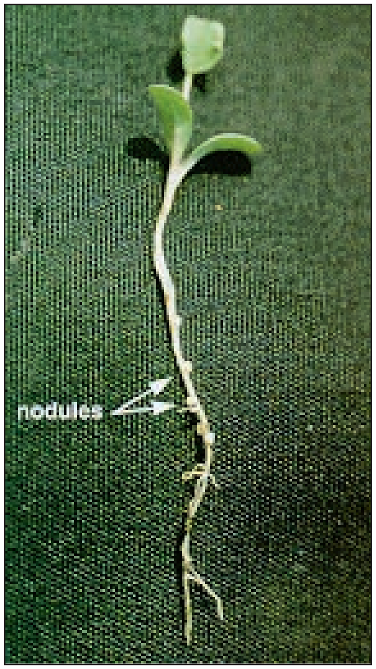
**The first true leaf to develop on an alfalfa seedling has just one leaflet and is called the unifoliate leaf.**

**The second leaf to appear has three leaflets. This is called a trifoliate leaf. Most subsequent leaves are trifoliate, although some varieties produce leaves with four or more leaflets per leaf that are called multifoliate leaves.**

**This plant is at the three-leaf stage. Note the three trifoliate leaves in addition to the unifoliate leaf. At this stage, the seedling can manufacture all of its energy through photosynthesis.**

Counting only the fully expanded trifoliate leaves, this plant is at the five-leaf stage. A leaf is considered fully expanded when the outer edges of all leaflets are no longer touching.

Within four weeks after germination, if *Rhizobium* bacteria is present, round structures called nodules will form on alfalfa roots. The bacteria help the plant use nitrogen from the air in a process known as nitrogen fixation.






# Crown formation and development

Even brief exposures to air temperatures below 27°F will kill young alfalfa seedlings. Alfalfa plants survive cold temperatures by pulling the lowermost buds below ground to form a crown. This process, called contractile growth, begins two to six weeks after germination. To allow enough time for crown development, avoid seeding after the recommended late-summer planting dates. Plants that have not formed a crown will not survive the winter.

**Crown development has not yet begun on this young plant. The cotyledons, though brown, are still present. Note the distance between nodes in this picture compared to those of the plant at right. ↑**

**The lowermost buds have been pulled below ground to form the crown. Crown development on this plant is already sufficient for winter survival. The crown will continue to enlarge throughout the life of the plant. ➔**

# Spring greenup

Spring growth ideally comes from crown buds formed the previous year during late summer and fall. Greenup occurs when buds located on the crown begin to grow in response to warm spring temperatures. In addition to weather, the timing of spring greenup depends on plant health, the genetic fall dormancy of the variety, and the amount of dormancy developed in the plants during the fall (determined by fall weather conditions). If plants are injured or slow to greenup, consider planting more winterhardy varieties.

**This well-developed crown shows healthy crown buds growing to produce the season's first cutting.**

**The plant on the left has suffered winter injury while the plant on the right has not. Injured plants are less vigorous and slow to recover. In addition, if crown buds have been killed, the plant must form new buds to replace them. ↑**

**Uneven (asymmetrical) growth is a symptom of winter injury. The crown buds on the right side of this plant have been killed by cold temperatures. Such damage is often found on older, diseased plants. This plant will be less vigorous and lower yielding than a healthy plant. ➔**

# Growth after cutting

Regrowth after cutting arises from crown buds and from axillary buds. Axillary buds are found in leaf axils, where the leaf joins the stem. The ideal cutting height is at least 2 inches above the soil surface. This height leaves axillary buds for regrowth. Lower cuttings will force regrowth to come from crown buds only, reducing yield of the next cutting. Short cutting intervals (less than 35 days) will also reduce the number of axillary buds. Moisture stress immediately after cutting will reduce the number of crown and axillary buds and, therefore, stem density and yield available for harvest, even if rain occurs later in the growth cycle.


**Regrowth from axillary buds and crown buds.**

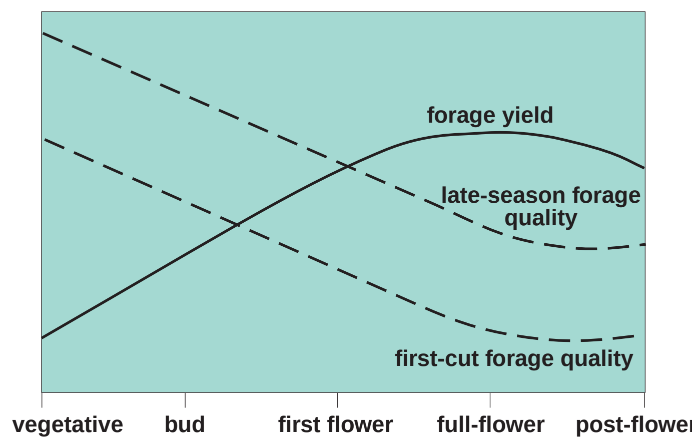


# When to cut

Forage yield, quality, and stand persistence are considerations for deciding when to cut. Forage yield increases until the plant reaches full flower, while forage quality decreases continually during growth or regrowth (see figure). The optimum balance between yield and quality depends on the cutting and forage quality desired. Early in the growing season, plants may not flower normally and quality may decline even though the plant is not flowering. Therefore, take the first cutting of the season based on quality or by date (if quality information is not available). Take later cuttings based on growth stage or by time interval (35 to 45 days).

The optimum yield and forage quality for milking dairy cows ranges from vegetative to early bud on the first cutting to 10% flower on the second and third cuttings to full flower on a late-fall cutting. For animals with lower nutritional requirements, later stages may be harvested. The pictures on the following pages depict growth stages commonly referred to when discussing cutting management.

**Forage yield and quality at various stages of growth**



## Early bud

The flowering process begins when small buds form in the top one or two leaf axils. These buds are detectable as small swellings in the axils of the leaves. Forage cut at this stage will be very high in quality. However, yield will be reduced. Cutting several times per season at this stage will decrease persistence.

## Mid bud

At the mid-bud stage, flower buds are larger and easier to detect. Some buds are beginning to lengthen. Additional buds are forming lower on the stem.

## Late bud

At the late-bud stage, flower buds are large and lengthening rapidly. Buds begin developing at three or more leaf axils lower on the stem.

## Flowers

Alfalfa flowers grow in clusters attached to a stem (raceme). The most common flower color is purple. Purple-flowering plants come from Mediterranean stock and have high yield and quick recovery. Plants with yellow flowers are from more winter-hardy stock. A small percentage of flowers may also be blue, cream, or white.



## 10% flower

At this stage, 10% of the stems have open flowers. Allowing one cutting to grow to this stage during the year will improve stand persistence. Late-season harvests at this stage may still provide dairy-quality hay.

## 50% flower

Half of the stems have open flowers. Roots have the most carbohydrates stored at this stage. This is beyond the recommended harvest stage for quality hay.

## 100% flower

All stems now have open flowers. Shoots from crown buds for next growth cycle may be visible at the base of the plant.

# Estimating preharvest alfalfa quality

Choose five representative 2-square foot areas in the field. (Sample more times for fields larger than 30 acres.) In each area, determine the stage of the most mature stem (see below). Then measure the height of the tallest stem, NOT the highest leaf. Note that the tallest stem may not be the most mature stem. Use the chart to determine relative feed value (RFV) of the standing alfalfa forage. This procedure does not account for changes in quality due to wilting, harvesting, and storage. These factors may lower RFV by 10 to 20 points.

| | |
|---|---|
| **late vegetative** | stem is more than 12 inches tall, no visible buds or flowers |
| **early bud** | 1 to 2 nodes have visible buds; no flowers or seed pods present |
| **late bud** | more than 2 nodes have visible buds; no open flowers or seed pods |
| **early flower** | 1 node with at least one open flower |
| **late flower** | 2 or more nodes have open flowers |

| | stage of most mature stem | | | | |
|---|---|---|---|---|---|
| **height of tallest stem** | **late vegetative** | **early bud** | **late bud** | **early flower** | **late flower** |
| **inches** | **relative feed value** | | | | |
| 16 | 234 | 220 | 208 | 196 | 186 |
| 17 | 229 | 215 | 203 | 192 | 182 |
| 18 | 223 | 211 | 199 | 188 | 178 |
| 19 | 218 | 206 | 195 | 184 | 175 |
| 20 | 213 | 201 | 191 | 181 | 171 |
| 21 | 209 | 197 | 187 | 177 | 168 |
| 22 | 204 | 193 | 183 | 173 | 165 |
| 23 | 200 | 189 | 179 | 170 | 161 |
| 24 | 196 | 185 | 175 | 167 | 158 |
| 25 | 191 | 181 | 172 | 163 | 155 |
| 26 | 187 | 178 | 169 | 160 | 152 |
| 27 | 184 | 174 | 165 | 157 | 150 |
| 28 | 180 | 171 | 162 | 154 | 147 |
| 29 | 176 | 167 | 159 | 151 | 144 |
| 30 | 173 | 164 | 156 | 148 | 141 |
| 31 | 169 | 161 | 153 | 146 | 139 |
| 32 | 166 | 158 | 150 | 143 | 136 |
| 33 | 163 | 155 | 147 | 140 | 134 |
| 34 | 160 | 152 | 145 | 138 | 132 |
| 35 | 156 | 149 | 142 | 135 | 129 |
| 36 | 154 | 146 | 139 | 133 | 127 |
| 37 | 151 | 144 | 137 | 131 | 125 |
| 38 | 148 | 141 | 134 | 128 | 123 |
| 39 | 145 | 138 | 132 | 126 | 121 |
| 40 | 142 | 136 | 130 | 124 | 118 |

*Source: Derived from equations developed by R.W. Hintz, V.N. Owens, and K.A. Albrecht at the University of Wisconsin-Madison, Department of Agronomy.*

## Additional information

For more information on related topics, see the following publications available from your county Extension office.

Alfalfa Analyst (A8CA1018)
Alfalfa Diseases I (A7800601)
Alfalfa Diseases II (A7800602)
Alfalfa Insect Pests (A2156)
Alfalfa Management Guide (NCR547)
Alfalfa Stand Assessment: Is This Stand Good Enough to Keep? (A3620)
Perennial Forage Crop Variety Update for Wisconsin (A1525)



**Authors:** Dan Undersander is professor of agronomy, College of Agricultural and Life Sciences, University of Wisconsin-Madison and University of Wisconsin-Extension, Cooperative Extension. Paul Vassalotti is a master technical service representative, American Cyanamid Co., Cross Plains, Wisconsin. Dennis Cosgrove is associate professor of agronomy, University of Wisconsin-River Falls and University of Wisconsin-Extension.

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