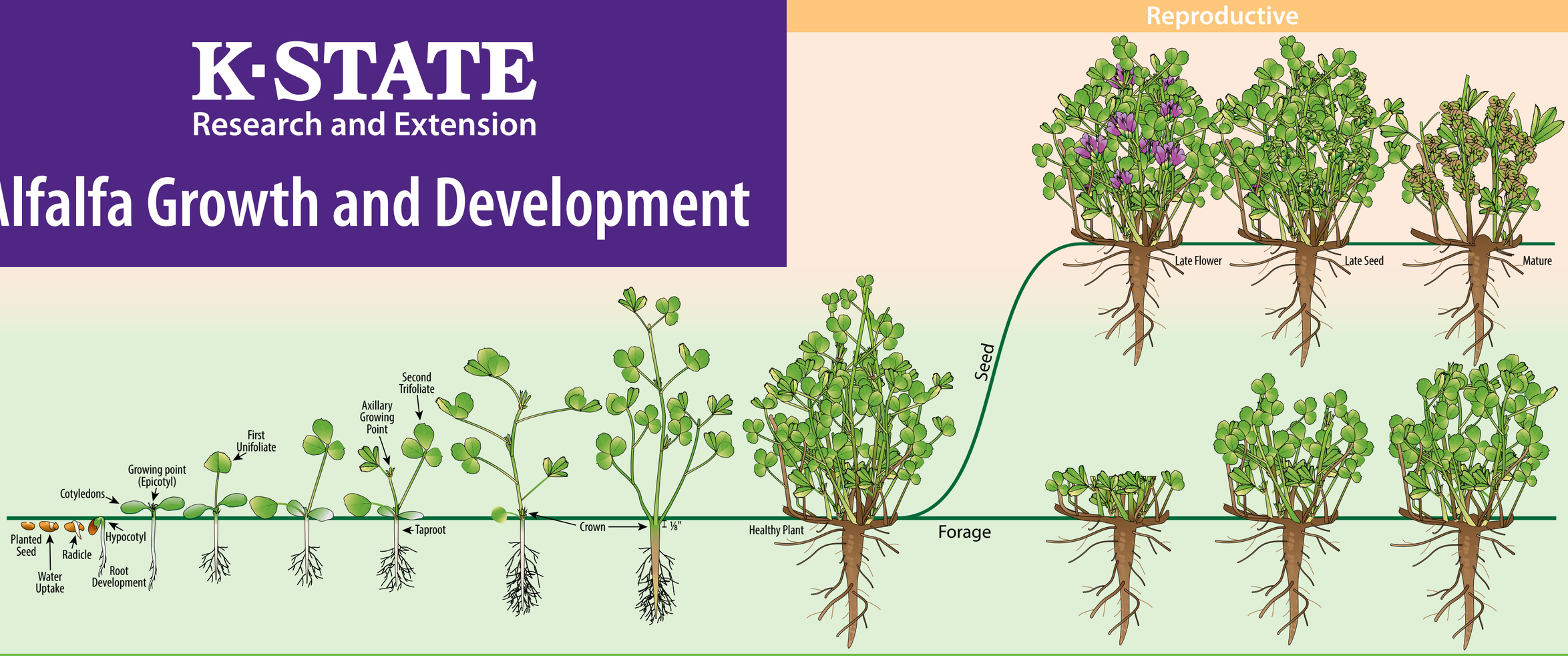
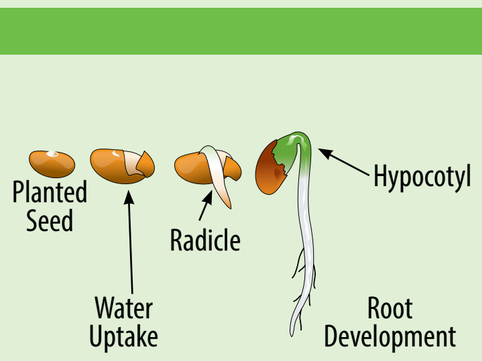
K-STATE Research and Extension

Alfalfa Growth and Development



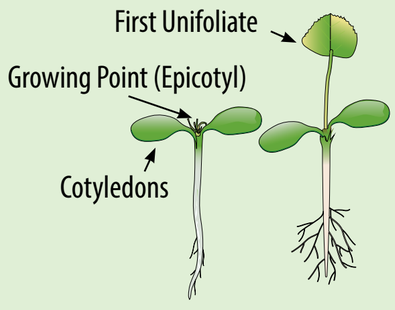
Vegetative



Germination and emergence

Water uptake occurs 24 to 48 hours after planting if moisture is available. Optimum temperature for germination is between 65 and 72 degrees Fahrenheit. The root radicle emerges from the seed, forming an unbranched taproot and anchoring the seed to the soil. As the radicle grows, the hypocotyl (initial seedling stem) straightens and elongates, pulling the cotyledons (seed leaves) and seed coat up through the soil surface.

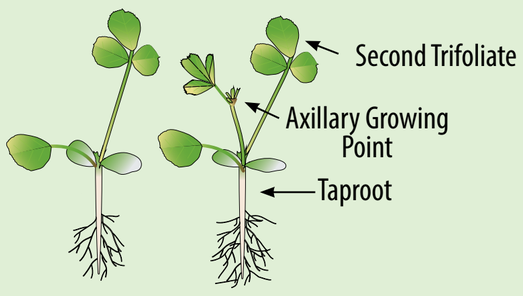
Management: Store seed at cool temperatures and low humidity. Re-inoculate with *Rhizobium* bacteria if stored beyond expiration date. Avoid direct sunlight on seeds to minimize damage to the bacteria. During the recommended planting window, sow no deeper than ½ inch and at the recommended seeding rate. Provide nutrients according to soil test. Do not plant alfalfa into an established alfalfa stand.



Seedling growth and establishment

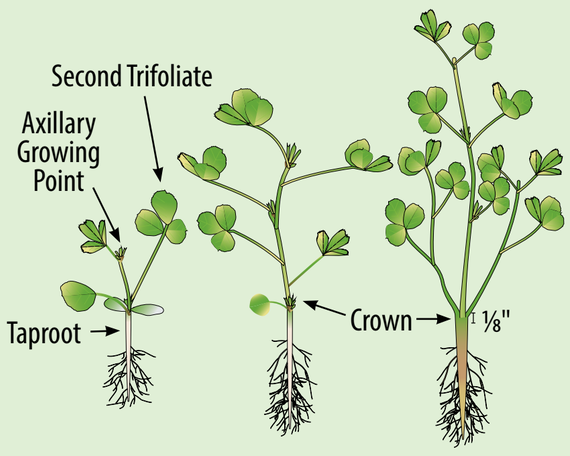
Cotyledons are the first aboveground visible structure of an alfalfa seedling. The first true leaf produced is a unifoliate leaf (single leaflet).

Management: Most commercially available alfalfa seed is treated with a fungicide seed treatment. If not, apply fungicide seed treatment to prevent seedling diseases. Ensure soil pH is greater than 6.5 to maximize forage yield and nitrogen fixation. Control weeds within the first 60 days to help prevent stand loss.



First trifoliate leaf and buds

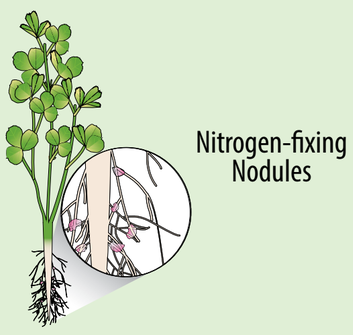
The second leaf to appear has three leaflets and is called a trifoliate. As the primary shoot develops into a mature plant, it produces alternately arranged trifoliates. At the three trifoliate leaves stage, photosynthesis is enough to meet all energy requirements by the alfalfa seedling. Axillary buds develop in the axils of all leaves and can originate a secondary stem after the three-leaf stage. Primary and secondary stems increase in length due to internode elongation.



Contractile growth and crown development

Contractile growth begins 1 to 2 weeks after emergence and completes within 16 weeks. Contractile growth is a process in which the hypocotyl shortens and thickens as a result of carbohydrate storage. This change in shape pulls both the cotyledonary node and the unifoliate node beneath the soil surface to form the crown. Outer tissues of the hypocotyl do not contract, instead they fold and wrinkle above the surface, giving the appearance of contracted roots and stems.

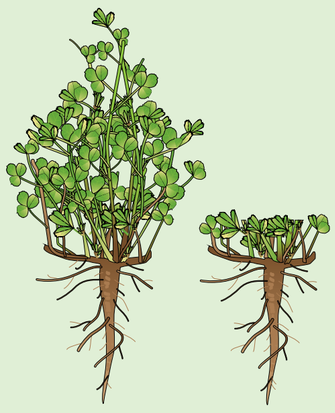
Management: Avoid planting after the recommended window (late summer) to allow enough time for crown development during the fall. Plants without a well-developed crown will not survive the winter.



Root development and nitrogen fixation

Within 4 weeks from germination, root hairs become infected with the nitrogen-fixing *Rhizobium* bacteria and nodulation begins. Nitrogen fixation, converting atmospheric nitrogen into a plant-friendly nitrogen form, occurs within these nodules. Nitrogen fixation ranges from 40 to 400 pounds per acre per year, averaging about 175 pounds.

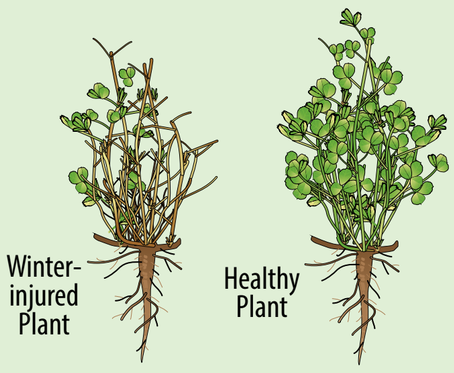
Management: To improve nitrogen fixation, ensure soil pH is greater than 6.5 and the seed is inoculated with the *Rhizobium* bacteria. Adequate soil moisture is important to optimize nitrogen fixation.



Winter hardening and winter survival

Shorter days and a minimum of 2 weeks of near-freezing temperatures are needed for dormant alfalfa to cold harden. Dormant alfalfa converts some of the starch in the crown and root into antifreeze sugars during the fall to help keep the crown, crown buds, and root from freezing during the winter.

Management: The last cutting before winter dormancy should be made so that there are 8 to 12 inches of stubble, or 4 to 6 weeks of growth time, before the average killing freeze date. This allows adequate time for root reserve replenishment. Adequate soil potassium levels improve the chances of winter survival.

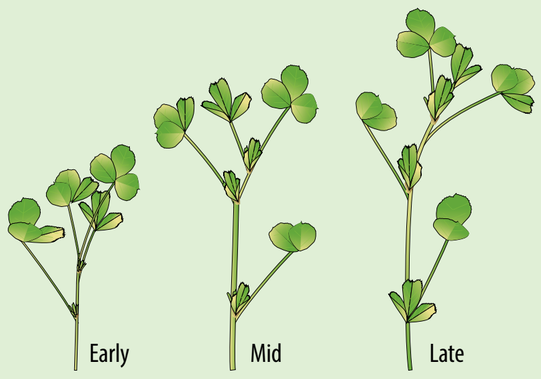


Spring green-up

Green-up occurs when crown buds start to grow in response to warm temperatures during the spring. Ideally, spring growth comes from crown buds formed during the previous summer and fall. Plant health, dormancy requirements, and fall weather conditions affect the time of spring green-up.

Management: Uneven growth indicates winter injury. Injured plants are less vigorous and lower yielding. A soil test can help determine fertilizer needs for the coming year. Potassium, phosphorus, sulfur, and boron are especially important to obtain good alfalfa production.

Vegetative



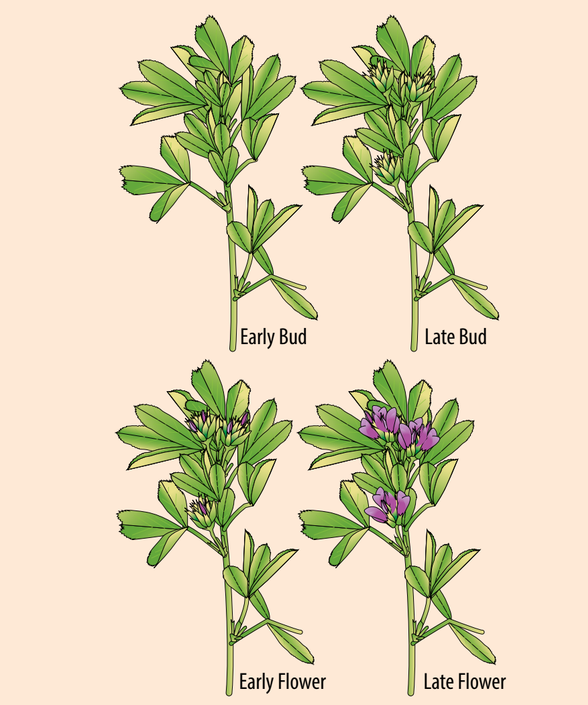
Vegetative stages

Stage 0: Early vegetative
Stem length less than 6 inches. No buds, flowers, or seedpods are visible. A tiny axillary bud is present in the junction between the main stem and a leaf or branch.

Stage 1: Mid-vegetative
Stem length ranges from 6 to 12 inches. No buds, flowers, or seedpods are visible. Axillary branch formation begins with the appearance of one or two leaves in the axil, mostly concentrated in the mid-portion of the stem.

Stage 2: Late vegetative
Stem length greater than 12 inches. Buds may be felt by touch at the growing apex but are not visible, nor are flowers or seedpods. Elongating branches can be seen in the axils of the leaves.

Reproductive



Flower bud development

Stage 3: Early bud
One to two nodes have visible buds. No flowers or seedpods are visible. Closely spaced nodes in the stem tip give flower buds a clustered appearance.

Stage 4: Late bud
The alfalfa plant has more than three nodes with visible buds. No flowers or seedpods are visible. This is generally considered to be the optimum stage to harvest high-quality alfalfa.

Flowering

Stage 5: Early flower
The alfalfa plant has one node with one open flower. No seedpods are visible. Flowering usually begins near the apex of the stem while buds are still developing rapidly above and below the point of initial flower opening. This is also a commonly recommended stage to harvest alfalfa.

Stage 6: Late flower
The alfalfa plant has more than two nodes with open flowers. No seedpods are visible.

Seed production

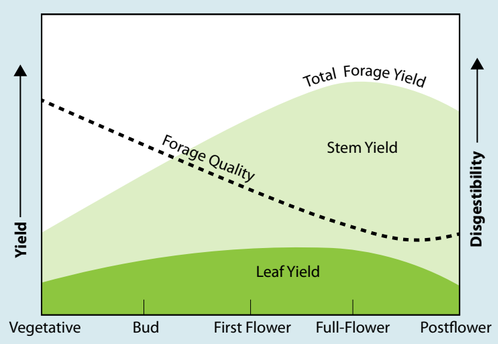
Stage 7: Early seedpod
The alfalfa plant has one to three nodes with green, spiral-shaped seedpods. Pods first appear from the mid-portion to the base of the main stem while upper nodes are still flowering.

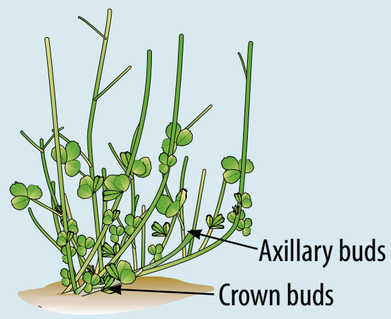
Stage 8: Late seedpod
The alfalfa plant has more than four nodes with green seedpods. The old stems are highly branched, many leaves have fallen off the plant, and the remaining ones are mostly senescing.

Stage 9: Ripe seedpod
Nodes have mostly brown, mature seedpods. Most of the leaves have been lost at this stage, and the stem is thick and fibrous.

Harvest alfalfa grown for seed production at this stage.

Cutting Management





When to cut

Considerations for deciding the optimum cutting time include forage yield, quality, and stand persistence. Forage yield increases until the crop reaches full flower, while forage quality decreases with maturity. The optimum time to maximize both yield and quality is late bud to 10 percent bloom, depending on the nutrient requirement of livestock species.

Management: Watch for insect pests such as alfalfa weevil and potato leafhopper, which might feed on alfalfa bud and flower, often causing producers to assume the alfalfa has not begun to form buds. Lactating cows and growing animals have greater nutrient requirements than dry cows or horses.

Growth after cutting

Following cutting, regrowth emerges from crown buds and axillary buds found in leaf axils, where the leaf joins the stem. Ideally, cutting should occur about 2 inches above the soil surface to preserve axillary buds and next cutting yield. Lower cuttings will force regrowth from crown buds only, and short cutting intervals (less than 28 days) will reduce next cutting yields.

Management: Ensure cutting height is at least 2 inches above the soil surface. Maximize stem density by avoiding cutting intervals shorter than 28 days.

Romulo Pisa Lollato, Ph.D., Assistant Professor, Wheat and Forages Extension Specialist
Doohong Min, Ph.D., Assistant Professor, Forage Management
Kansas State University Department of Agronomy

Reviewed by Johnathon D. Holman and Anserd J. Foster, Kansas State University; and Don Ball, Auburn University Emeritus

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