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 anchooring 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: Slow seed sprout at cold temperatures and low humidity. Re-locate with Rhizobium bacteria if stored beyond expiration date. Avoid direct sunlight on seedbed to prevent moisture damage to alfalfa bacteria. During the recommended planting window, use no deeper than 1/2 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 cotyledon (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
This second leaf appears as three leaflets and is called an axillary bud. As the primary shoot develops into a mature plant, it produces alternately arranged trifoliate leaves, thre-flowered racemes, flower stalks, and seedpods. The outer tissue of the hypocotyl do not contract, instead they fold and vvinkle above the soil surface, giving the appearance of contracted root and stems.

Contractile growth and crown development
Contractile growth begins 1 to 2 weeks after emergence and continues within 16 weeks. Contractile growth is a process in which the hypocotyl and internodes grow by a result of carbohydrate storage. This change in shape pulls both the cotyledonary node and the unbranched node beneath the soil surface to form the crown. The upper portion of the hypocotyl does not contract, instead the nodes fold and vinkle above the soil surface, giving the appearance of contracted root and stems.

Management: Avoid planting after the recommended window (late autumn) to allow enough time for crown development during the fall. Plants with a well-developed crown will not survive the winter.

Root development and nitrogen fixation
Within 6 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 root system to sucrose (a form of sugar) 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 frost 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 warmer 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: Unfavorable 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 stages
Vegetative stage
Stage 0: Early vegetative
Stem length less than 6 inches. No buds, flowers, or seedpods are visible. A tiny unbranched bud is present in the junction between the main stem and a leaf or branch.

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

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

Flower bud development
Stage 3: Early bud
One to two nodes have viable buds. No flowers or seedpods are visible. Closely spaced nodes in the stem for five flower buds a closed 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 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-section 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 for seed production at this stage.

When to cut
Considerations for deciding the optimum cutting time include forage yield, quality, and stand persistence. Forage yield increases until the crop reaches fall harvest, 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 pods. Lactating cows and growing animals have greater nutrient requirements than dry cows or heifers.

Growth after cutting
Following cutting, regrowth emerges from crown buds and auxiliary buds found in leaf axils, where the leaf tips form the stem. Ideally, cutting should occur about 2 inches above the soil surface to preserve auxiliary 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.