Roots

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Roots are the unseen below ground part of grasses and legumes that are generally forgotten as long as pasture growth is good. Good root development is essential for satisfactory leaf growth and is affected by soil conditions and grazing management. Roots have a number of important functions other than anchoring plants so cattle do not pull them out of the soil:

(1) Absorb water.
(2) Take up plant nutrients.
(3) Store carbohydrates made by photosynthesis in the leaves.
(4) Absorbing soil nitrates and changing them to organic acids and amino acids for plant use.
(5) Production of hormones for cell growth in the other parts of the plant.

Forage species

Grasses have a fibrous root system which is heavily branched, especially in the upper soil horizons, making it well adapted for efficient uptake of nutrients and water. Warm season grasses such as bermudagrass, bahiagrass, johnsongrass, switchgrass, and pearl millet generally have roots that grow deeper into the soil than those of cool season grasses. The greater depth of rooting is important during periods of drought because it increases the volume of soil occupied by the root system and improves access to available soil water. Coastal bermudagrass roots have been measured at a depth of six feet in south Georgia, accounting for its good growth during periods of dry weather. Cool season perennial grasses differ with greater root development in endophyte-infected tall fescue than endophyte-free tall fescue or orchardgrass, thus affecting survival under severe drought.

Legumes differ in their type of root system. Alfalfa, sericea lespedeza, and kudzu have prominent taproots with fine branch roots, extending deep into the soil and accounting for the excellent drought tolerance of these perennial legumes. Red clover also has a tap root which gives it fairly good drought tolerance but the primary root becomes infected with diseases and generally causes it to die after two years. In contrast, white or ladino clover has a taproot as a seedling but it dies after a year, leaving only fibrous roots which are at a shallow depth. Thus, white clover can be fairly drought resistant the first year but after that it suffers badly during periods of moisture stress.

Some factors affecting forage plant root growth and development

In addition to species of grasses and legumes, there are other factors that may affect root development. Most roots are produced at temperatures below the optimum for leaf growth. For instance, root growth is optimum at about 80F for bermudagrass and alfalfa but 60F for tall fescue, orchardgrass, and ryegrass.

Soil oxygen concentration is critical for root activity. In a well drained soil, the soil atmosphere contains about 21% oxygen at a depth of six inches. When soil oxygen falls below 15% there is decreased nutrient absorption, below 12% new roots do not develop, below 10% the existing root tips cease growth, and at 3% there is little root function. At high temperatures, more oxygen is required by the roots. Thus, flooding or low soil oxygen causes more root damage at high temperatures. This problem is worse in clay than in sandy soils.

Forage species differ considerably in tolerance to poorly drained soils with low soil oxygen – the most tolerant ones being bahiagrass, dallisgrass, johnsongrass, tall fescue, annual ryegrass, white clover, berseem clover, and subterranean clover. Some of the least tolerant species that should not be planted on poorly drained soil are bermudagrass, pearl millet, wheat, perennial peanut, alfalfa, arrowleaf clover, crimson clover, and rose clover.

Aluminum toxicity is especially harmful to root growth. This problem occurs primarily in soils below pH 5.0 where solubility of aluminum increases sharply. Aluminum inhibits root development with root tips turning brown, and branching ceases. Aluminum also reduces uptake of calcium and phosphorus, makes it less available to cells, and penetrates cells of growing areas to stop cell division and respiration. Although the topsoil may be adequately limed, the subsoil may be very acid and inhibit root growth. forage species with considerable tolerance to aluminum are bahiagrass, bermudagrass, pearl millet, rye, annual ryegrass, kudzu, sericea lespedeza, and annual lespedeza. Most forage legumes are not tolerant of aluminum toxicity.

Hay cutting or rapidly grazing a paddock in rotation will temporarily stop root growth but this is of short duration. One of the most limiting factors to good root growth of perennial forage species is close continuous grazing, especially during the first few months after planting. Once they are well established, white clover, subterranean clover, and some grasses such as bermudagrass, bahiagrass, and endophyte-infected tall fescue that have stolons, rhizomes, or many leaves close to the ground will maintain sufficient root growth under hard grazing pressure. On less grazing-tolerant species such as alfalfa, red clover, endophyte-free tall fescue, and switchgrass, close grazing should be avoided and rest periods should be used in summer. Grazing of winter annual grasses and clovers before they are well established delays root development and can greatly reduce forage growth.

Managing root growth

Good root systems are the pump and pipeline that supply water, nutrients, and hormones for growth of plant leaves. It is important to get good equipment to do the job. One of the best ways is to select grass and legume species that will tolerate the soil conditions in a particular pasture. Adequate nutrients must be available for the roots to function. Allow plants to be well established and have deep root systems before starting to graze. On most forage species it is desirable to provide some rest periods in grazing to permit root systems to rebuild their carbohydrate reserves for future growth. Healthy growing roots are a necessary part of productive pastures.