HARVEST MANAGEMENT OF LEGUMES AND GRASS FORAGES

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The energy needed for regrowth of perennial forages in the spring comes from stored reserves of total nonstructural carbohydrates (TNC). These food reserves are also used by plants to develop cold tolerance, to live over winter and to initiate growth after each cutting. TNC reserves derived from photosynthetic activity are stored in various plant tissues which varies according to plant species.

When alfalfa commences growth in the spring, TNC energy stored in the roots and crowns is used in the formation of new top growth from crown buds. Depletion of these energy reserves continues until the plant is 6-8 inches tall. At this stage the alfalfa plant is able to photosynthesize more than sufficient energy in leaves to meet growth requirements and begins to replenish TNC storage in the roots. Storage continues and reaches its highest level in the roots, usually about the full bloom growth stage (Fig. 1).

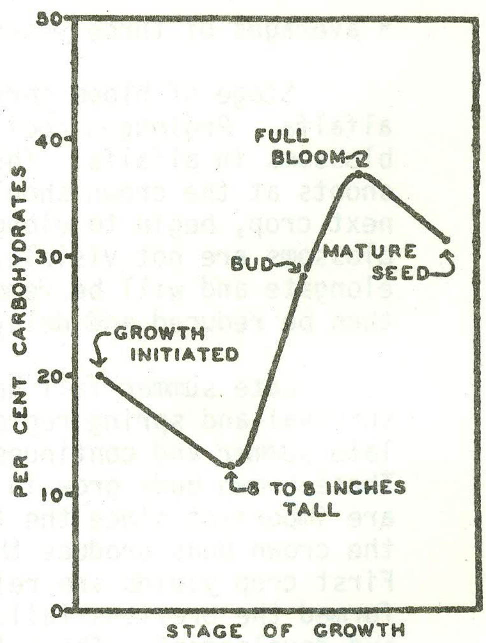

Fig. 1. Changes in the percentage of total nonstructural carbohydrates in the roots of alfalfa from the initiation of growth in the spring to the stage of seed formation (Wisconsin data).

After the first crop is cut the process of TNC food reserve depletion and renewal is repeated for each successive new growth. Quality of first spring harvest of established alfalfa is highest at the early bud stage but seasonal yield of forage and total digestible nutrients (TDN) are maximized by delaying the first harvest until the one-tenth bloom stage (Table 1).

Careful management of new seedings is especially important in the seeding year to ensure a long-lived productive stand. New seedings should not be harvested until plants have come to at least the one-half bloom stage to ensure adequate storage of TNC in the roots. This management should be followed for all harvests in the seeding year. Established stands of alfalfa can survive earlier harvesting in the spring than that recommended for new seedings. Removal of first cuttings at the full bud stage in the spring does not reduce the annual forage yields appreciably and may be necessary to spread the harvest period of each cut or may be desirable to improve forage quality and to prevent overmature hay crops. Because the effects of early cutting are accumulative, the practice of cutting at early growth stages should be rotated among alfalfa fields. Alfalfa stand will not be reduced from a single cut at the bud stage provided successive cuttings are permitted to reach at least the one-tenth bloom stage of maturity.

Table 1. Dry matter yields and nutritive value of alfalfa harvested at different maturity stages (Pennsylvania data).

Maturity Stage at First Harvest	Dates of First Harvest*	Dry Matter tons/acre		TDN % First Harvest	Total TDN Yield lbs/acre
		First Harvest	Total (3 harvests)		
Early bud	May 10-13	0.69	3.13	71.4	3834
Full bud	May 14-17	1.13	3.83	70.9	4823
First blooms	May 20-24	1.62	4.57	63.1	5645
1/10 bloom	May 27-June 1	2.26	5.11	61.6	6143
1/2 bloom	June 4-13	2.18	5.05	55.9	5837

* averages of three years data

Stage of bloom serves as a useful index for determining when to harvest alfalfa. Prolonged cool moist cloudy weather can delay the appearance of blossoms in alfalfa. Thus when these conditions occur the activity of new shoots at the crown should be checked. If these shoots, which will form the next crop, begin to elongate, the first harvest should be removed even though blossoms are not visible. If delayed, these new shoots will continue to elongate and will be removed with the forage harvest. The next harvest would then be reduced and delayed.

Late summer-fall harvest management of alfalfa is critical to winter survival and spring regrowth. Crown bud number begins to be determined in late summer and continues to increase until the alfalfa plants go dormant. These crown buds grow in length and size until the winter dormant stage, and are important since the following spring the rhizomes formed by growth of the crown buds produce the stems and leaves which yield the first hay crop. First crop yields are related to the number of crown buds and rhizomes formed the previous fall, therefore management should be to promote the crown bud development. The buildup of TNC reserves in crowns and roots is also important for winter survival and spring regrowth. Thus fall management should allow a minimum period of 6 weeks for regrowth before the first killing frost. If growth is such that blossoms appear late in the fall no harvest should be taken until after a killing frost since any regrowth would deplete TNC reserves.

Spring growth of birdsfoot trefoil originates from overwintering crown buds similar to that found in alfalfa. Stems for successive harvests also originate mainly from auxillary buds at the crown. However, some regrowth may occur from buds formed in the axils of the leaves on the old stems. Under a hay management system when the first harvest was removed at 1/2 to full bloom, Pennsylvania data shows highest forage yields were obtained for the season with a 6-7 week harvest schedule. With hay management cutting heights of about 2 inches seem to be most satisfactory for birdsfoot trefoil. Cutting at this height will save some green leaves and auxillary buds so that more rapid regrowth takes place.

Red clover and alsike clover form tiller-like branches at the crown in late summer and early fall. The following season's growth arises from these overwintering tiller branches. Under favorable climatic and soil conditions these tiller branches frequently develop into floral stems during the seeding year which may set seed during the fall period. This depletes the root reserves and such plants seldom survive into the next season. Management of these legumes during the late summer and fall period of the seeding year should be to prevent floral stem and seed formation. This can best be accomplished by clipping or grazing. In established stands hay crops should be removed at the early bloom maturity stage.

White clovers including ladino are spread by stolons and are best suited for grazing. They have shallow root systems and thus do not tolerate droughts. White clovers will not persist under dense shade of companion grasses so grazing management should be to prevent the grass getting so tall that it smothers out the legume.

Grasses, like legumes, have different growth habits. Differences exist among the grasses in extent of root systems, storage of total non-structural (TNC) and recovery capacity after cutting. Reserves of TNC, stored in leaf sheaths and stem bases in orchardgrass and tall fescue, in swollen basal stem internodes (haplocorms) in timothy, and in underground creep stems (rhizomes) in smooth bromegrass and reeds canarygrass, decrease with the initiation of growth in spring and after cutting. Percentages of TNC increase as perennial grasses mature toward flowering and seed formation. Studies with timothy and bromegrass have shown that lowest levels of TNC occur during early stages of stem elongation and are highest at seed maturity (Fig. 1).

Grasses differ in the structure and arrangement of leaves and growing points, which markedly influences their response to cutting and grazing management. Tall growing grasses, including timothy, orchardgrass and bromegrass have most of their photosynthetic area high on the plant and hence, if cut short, are almost totally dependent on stored carbohydrates to produce recovery growth. The short growing grasses, including Kentucky bluegrass and some other turf grasses, have most of their leaf area near the soil surface and are not totally defoliated with close cutting. Thus more of the energy needed for recovery growth is obtained from the remaining photosynthetic surface and less from stored reserves. Short growing grasses are more tolerant of frequent close cutting or grazing than tall growing grasses. In mixed sward tall growing species will dominate with hay crop management because they shade out the short growing species.

The regrowth and survival of grasses after cutting is also influenced greatly by the position of the young shoot apices and growing points. When the shoot apices are removed by cutting, subsequent growth must come from new basal axillary tillers. Lack of persistence of timothy and smooth bromegrass in mixtures with alfalfa when cut three or more times annually has been attributed to the growth stage of the grasses when the alfalfa is harvested at its optimum cutting stage of early bloom. Decreased production is obtained when timothy and smooth bromegrass are cut from the beginning of internode elongation to inflorescence emergence. During these growth stages, shoot apices are above cutting height and TNC reserves are low. Basal axillary tillers are not present for regrowth since they are not formed until about the anthesis stage. Thus grass regrowth may be delayed two or more weeks and the weakened plants cannot compete with rapid regrowth of the companion alfalfa.

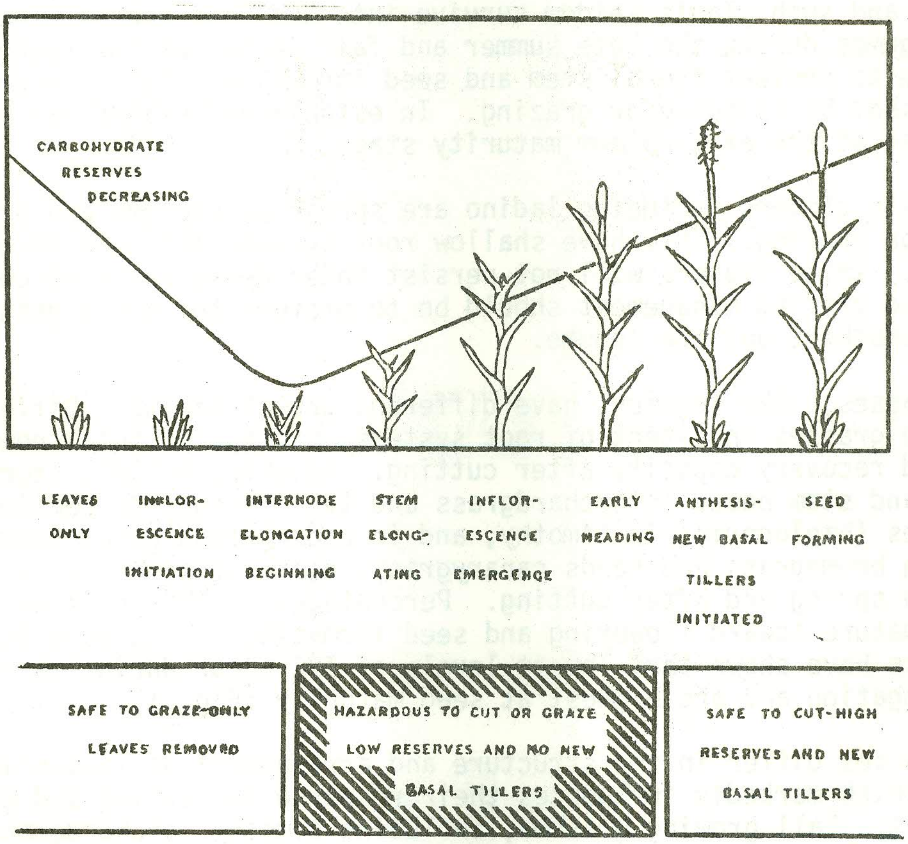

Fig. 1. Diagramatic representation of the timothy shoot development during spring growth.

Orchardgrass recovers rapidly when cut at almost any stage during primary growth of spring including the early stages of stem elongation. In orchardgrass there is less apical dominance expressed by the main flowering shoots and new basal tillers are produced throughout the spring period so shoots in different stages of development are present at any given time. When orchardgrass is harvested, recovery growth is from the production of new leaves and the elongation of cut leaf blades on the stubble. These new leaves develop rapidly so photosynthesis is only interrupted for a short period. Like orchardgrass, reed canarygrass and tall fescue appear to continuously form new tillers and it is thought this is why they persist with three cuts annually where timothy and smooth bromegrass would be thinned.

Height of cutting appears to be more important with timothy and smooth bromegrass than with orchardgrass, reed canarygrass and tall fescue. A higher stubble height after cutting timothy and smooth bromegrass of 3-4 inches is probably more important when these grasses are grown in mixture with alfalfa than when grown as pure stands.

Ideally the first hay crop harvest of grasses should be taken as soon as possible after the plants become fully headed for best grass growth and recovery. With further delay quality declines rapidly as stems become coarse and dry. The aftermath growth of orchardgrass consist only of leaves and hence quality will be high. Thus since orchardgrass is more tolerant of early cutting than timothy it might be best for quality forage to harvest earlier than early heading. This would shift forage production so less is removed in the first crop and more of it comes in the aftermath. Aftermath growth of orchardgrass is confined to vegetative growth since a chilling requirement is necessary for flower bud initiation. Hence quality of second crop orchardgrass will be higher than forage from a delayed first cut crop. When grown in mixtures with legumes, time of cutting is dependent upon the stage of legume maturity for optimum legume growth and persistence. When grasses are grown alone without legumes, adequate growth is only obtained after large additions of nitrogen fertilizers.