Carbohydrate Food Reserves and Leaf Area in Regrowth of Orchardgrass

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The yield and longevity of stands of adapted varieties of perennial grasses and legumes under favorable soil and aerial environments are often restricted by adverse grazing and mowing practices. The rate of regrowth of perennial forage plants right after mowing or grazing has been largely explained by two factors: (a) leaf area index and concurrent light interception or (b) reutilization of reserve carbohydrates stored in rhizomes, stolons, stubble, and/or roots.

The ratio of surface leaf area in square feet per square foot of soil area was named by Watson (12) as the "leaf area index" (LAI). Data by Brougham (2) show that for any LAI, regrowth (daily dry matter accumulation) of defoliated ryegrass occurred at a maximum rate where light interception by leaves was near 100%. Closely clipped plants had low LAI's; hence, daily dry matter accumulation was low. Such associations between LAI and daily growth rate have been established by others (1, 3, 4, 5, 6, 12). These workers also showed that the optimum LAI differs with plant species. Accumulation of an LAI beyond that needed to intercept 95 to 100% of the light may result in sufficient self-shading to reduce dry matter accumulation per unit of time.

The reutilization of carbohydrates, that accumulated in basal areas of perennial grasses and legumes, for regrowth following defoliation has been established by many workers. It is surmised that such soluble carbohydrates are used for respiration and synthesis of new leaves and stems; the proportion of carbohydrates used by each of the two processes is not known. Sprague and Sullivan (8, 9) showed that water soluble carbohydrate food reserves in stubble and roots of ryegrass and orchardgrass were reduced as new growth was initiated after defoliation. There was a subsequent restoration of food reserves. Structural carbohydrates, such as cellulose and hemicellulose, did not function as reserve substances for respiration and/or synthesis of new plant tissue. The chief reserve carbohydrate of most cool season grasses is fructosan (7, 8, 9, 10, 11). Fructosan is an oligosaccharide of 25 to 30 fructose units with a 2:6 linkage terminating as a glucose unit (7).

The studies associating LAI with rate of dry matter accumulation per unit of time of clipped or grazed perennial forage plants have invariably ignored food reserves. Likewise, studies associating regrowth rate of clipped perennial forages with organic food reserves have not considered LAI. We have postulated that carbohydrate food reserves and LAI are involved in regrowth of defoliated perennial grasses and legumes. A technique to study this interrelationship and data to support it are presented in this paper.