

Long-Shoot/Short-Shoot Phenomenon in Woody Plants

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Abstract—Shoot growth in shrubs is often overlooked as an important component of phenological development in woody plants. However, shoot growth dictates the pattern of growth of deciduous trees or shrubs, especially following defoliation or canopy damage. In general, woody shoots are divided into short- and long-shoots. Short-shoots, sometimes called “spurs,” are reproductive shoots (in other words, spurs on an apple (*Malus pumila*) tree). The long-shoots, sometimes called “watersprouts,” are vegetative shoots. From a management perspective, herbicidal control of shrubs (in other words, mesquite (*Prosopis glandulosa*)) with long-shoots is highly ineffective. All of the energy synthesized by the plant is translocated to the long-shoot and converted to structural materials; in other words, stem growth. Similarly, one could postulate that browsing during the long-shoot stage would not significantly impair shrub viability if the shrub was healthy and vigorous at the time of browsing. Likewise, pruning shrubs during long-shoot growth (in a lawn or garden) stimulates “wolf-like growth” of the shrub. In contrast, herbicidal control of shrubs during the short-shoot stage usually conveys a high degree of success. Likewise, pruning or defoliation during the short-shoot stage significantly reduces fruit production.

Long-Shoots/Short-Shoots

Shoot growth in woody plants is seldom considered in management decisions relating to grazing, browsing, chemical control, mowing, and so forth. Likewise, it is seldom considered an important component of phenological development in woody plants. Yet, the type of shoot growth, especially following defoliation or crown damage, dictates the growth pattern of a deciduous tree or shrub when they initiate spring growth, fruit production, or resprouting.

This paper is not intended to present new scientific results or as a literature review of research that has been conducted on the subject. Rather, it is an opportunity to describe long- and short-shoots and to present some management implications relating to long- and short-shoot growth patterns. For a basic understanding of long- and short-shoots (fig. 1), the reader is referred to Dahl and Hyder (1977) and Dahl (1995).

In general, shoot growth of woody plants is divided into long- or short-shoots. In woody plants, long-shoots are vegetative shoots and short-shoots are reproductive shoots. Long-shoots grow very rapidly (and remain vegetative) and

are called watersprouts in some species. They are major energy sinks during rapid growth and internode expansion. In contrast, short-shoots are sometimes called “spurs” (as in apple (*Malus pumila*) trees) and are the shoots that bear

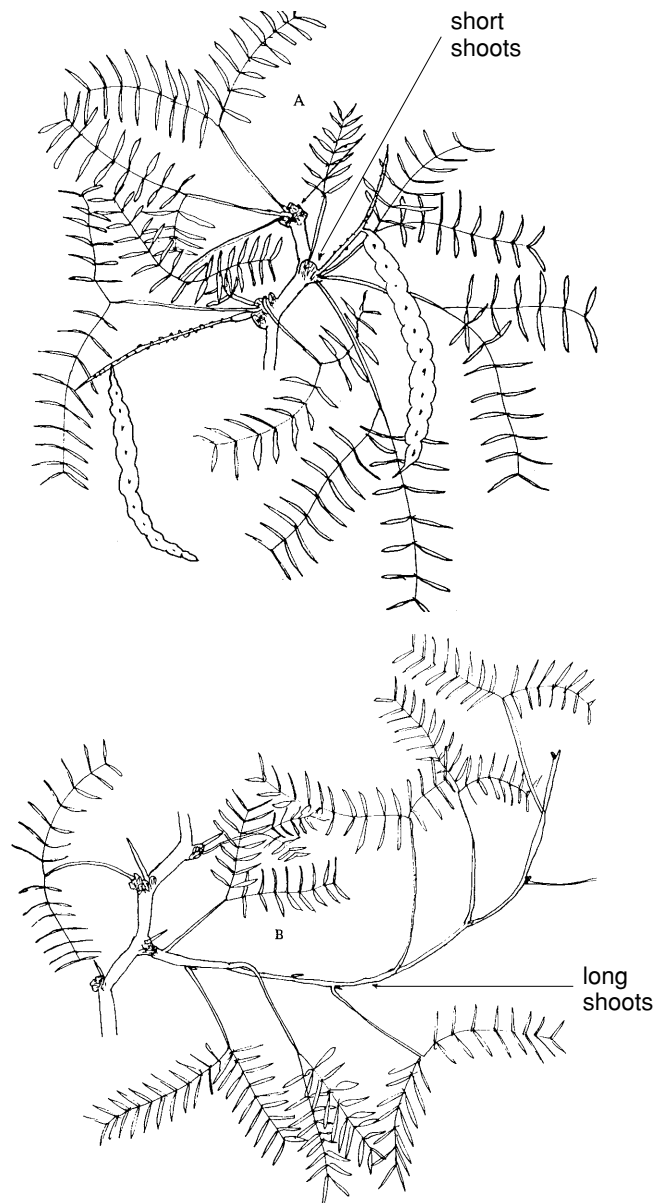


Figure 1—(A) Mesquite stem with predominantly short-shoots (note almost total absence of internode elongation); (B) mesquite branch with a long-shoot showing typical internode elongation. Source: Dahl 1995.

In: McArthur, E. Durant; Fairbanks, Daniel J., comps. 2001. Shrubland ecosystem genetics and biodiversity: proceedings; 2000 June 13–15; Provo, UT. Proc. RMRS-P-21. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

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fruit. Internodes are compressed and elongation is minimal. Therefore, they are reproductive rather than vegetative shoots. Since they are not rapidly expanding shoots, they are not major energy sinks.

From a management perspective, it is important that one recognize long- and short-shoot stages in plant development. Any form of defoliation, damage, or injury to the shoots of woody plants will stimulate long-shoot development. When long-shoots are rapidly growing, they require a great deal of energy that is synthesized by the plant to produce structural materials in the long-shoots (in other words, stem growth). Since these shoots are vegetative, shoot removal by grazing, browsing, or even mechanical mowing during the long-shoot stage would not be particularly detrimental to the tree or shrub if the tree or shrub was healthy and vigorous at the time of shoot damage or removal. Pruning shrubs in the long-shoot stage, by whatever means (even in a lawn setting), often stimulates "wolf-like growth" of the tree or shrub.

Foliar application of herbicides to resprouting woody plants in the long-shoot stage usually results in ineffective control. Since foliar-applied herbicides are generally translocated with the photosynthate (in other words, carbohydrate) stream, the herbicides would primarily be translocated to the shoots along with the carbohydrates for synthesis of structural material and not to the perennating organs and tissues that must be killed by the herbicide if chemical control is to be effective.

On the other hand, defoliation or injury to the shoots of woody plants in the short-shoot stage can be quite damaging to a tree or shrub. Damage or removal of the short-shoots of woody plants can significantly impair subsequent growth of a tree or shrub. Any removal or damage to a shoot during the short-shoot stage can significantly reduce fruit production and development of new buds from which the subsequent year's growth and fruit production will originate.

Since the shoots are not primary sinks for photosynthates during the short-shoot stage, the photosynthates (in other words, carbohydrates) are translocated to the perennating lateral buds (including basal buds) and storage tissues. Therefore, chemical control of trees and shrubs is usually quite successful when herbicides are foliar-applied during the short-shoot stage (assuming that all other physiological and environmental conditions are appropriate for control).

Interestingly enough, long- or short-shoot status of woody plants is not necessarily related to chronological age of the tree or shrub. For example, often one hears that control of resprouts should not be planned for 5 to 7 years post-resprouting, particularly in mesquite (*Prosopis glandulosa*). However, our research indicated that dormant mesquite shredded to ground level resprouted in the spring and produced short-shoots during the first year of resprouting (Beck and others 1975). Foliar-applied herbicidal control was equally as effective on the first-year resprouts (short-shoots) as it was on 7- and 14-year old resprouts.

Without damage or defoliation to the shoots of woody plants, trees and shrubs grow very methodically. The main stem (or bole) of trees and shrubs is the first order long-shoot. Stems branching off of the first order long-shoot (or lateral stems) are second order long-shoots. Lateral stems branching off of second order long-shoots are third order long-shoots. Usually as the order of long-shoots increase, fewer and less vigorous long-shoots are produced. By the time the trees and shrubs attain either fourth or fifth order long-shoots, they produce no lateral long-shoots, only short-shoots. These short-shoots bear no long-shoots.

In summary, recognition of long- or short-shoot growth is imperative in making woody plant management decisions. How woody plants respond to grazing, browsing, mowing, pruning, or herbicidal control depends upon whether they are in the long- or short-shoot stage. As resource managers, we should become cognizant of how trees and shrubs grow and incorporate that knowledge into our management plans.

References

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