Pruning Effects On Tree Growth: Growth Regulation Consequences

Dr. Kim D. Coder, University of Georgia January 1998

This publication is a synthesis of the tree growth regulation and correlation literature. General processes and systems presented here represent educational models which professionals can use to better appreciate and understand basic tree functions. These models do not represent actual physiological mechanisms, but simple theoretical means of explaining tree reactions within the environment.

Within a tree there are four functional types of growth control paths that could be pruned. Pruning (severing) each carries unique consequences for the tree and the tree manager. Deadwood pruning where living boundaries are not breached does not carry growth control and resource allocation concerns, although some mechanical problems can occur. Greenwood pruning, or the pruning of living tissue, can change, disrupt and destroy many interrelated tree command and control functions. Here, only greenwood pruning will be reviewed from the growth regulation standpoint.

Pruning Control Pathways

There are many growing points on every twig and branch. To assist in considering pruning effects, here only the primary quality of the individual twig or branch pathway will be determined. Remember that each twig or branch may have a number of different pathways presenting over the year and with changing tissue vigor and overall tree health. The four primary types of growth control pathways, and so, the four greenwood twig or branch pruning forms in a tree are: primary, active, marginal, and dormant. Dormant growing points are not specifically pruned and will not be further discussed here. Descriptions of the first three types of tissues listed above to be pruned are:

> Primary (1^{o}): The primary pathways (stem or branches) are the single or multiple terminal growing points or buds controlling the entire tree. These branches correlate supply and demand throughout the tree, generate the majority of the food along their axis, and use a majority of the soil-gathered resources.
>
> Active: The active pathways are associated with productive twigs and branches generating major amounts of food for the rest of the tree. Significant amounts of food along these pathways are stored if there is excess.
>
> Marginal: Marginal pathways (branches and twigs) may have been active at one time but because of shading, damage, or position effects, are barely generating a positive food flow along the pathway.

Example — Marginal Branch

The pruning of a marginal branch in a tree creates a wound, severs tissue connections and disrupts the growth control pathway. The remaining control field near the wound releases dormant growing points if there are

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carbohydrates available. If the branch was marginal and had been barely hanging on for several seasons, then local storage in the rays would have been depleted. What growth control pathway is present, with associated poor connections to the remaining tree, could be taken over by an active shoot above this path. This realignment to other growth control pathways will cause little disruption in the tree.

Examples — Active Branch

Pruning an active growth control pathway will disrupts many growth control processes. The local control field at the wound will release dormant growing points, initiate adventitious buds, and demand food supplies. The large growth control pathway will be partially taken over by other active and primary pathways arising from further above the wound. If the active pathway was from a small diameter branch, then the released sprouts should quickly recover the active growth control pathway that ends in the roots.

If the branch was active and large in diameter, as sprouts become self-sufficient, the growth control pathway will be reestablished from the wound downward. There will be some areas taken over by adjacent pathways, and some tissue in the stem and roots may be compartmentalized off. Large branch (heartwood exposure) wounds are periods of weak control for tree defenses and so provide pest attack opportunities. Finally, after several seasons of adjustments, new pathways are efficiently established and new connections made.

Example — Primary Branch / Stem

Pruning of primary pathways is topping and should be avoided. The whole tree disruption occurring after primary path pruning is immense and damages the tree for the rest of its life. Root shoot growth, resource allocations, and tree effectiveness to respond to environmental changes are compromised.

Pruning Impacts

Given the mechanisms of how trees adjust internally to the functional balance of shoot / root, and how the tree correlates growth processes, greenwood pruning impacts can include:

1) failure of the tree to generate food.

2) failure of the tree to generate fuel for nitrogen (and other materials like phosphorus) uptake.

3) loss of significant volumes of storage space and initiation of storage connectivity problems.

4) use of significant amounts of stored food reserves in reallocation processes.

5) major disruption and modifications of control fields and pathways (connection between shoot and root), similar to the reallocation or initialization of the system during Spring start-up — a period of confused control messages, resource allocations, and defenses.

6) control field signals are generated for immediate shoot initiation and release.

7) growth control pathway, in the short run, initially request the growth of any primary or active pathway roots where carbohydrate is available following these priorities:

   — healthy primary pathways stimulate many new growing points.
   — healthy active pathways stimulate a few growing points
   — marginal and unhealthy pathways stimulate no growing points.

8) under warm temperatures, food supplied in the transport pathway from the pruned branch will be used before the slow moving growth control field changes — a lack of switch and food synchrony.

9) growth control pathway, over the long run as shoots are rapidly expanding and generating food, requests minimal root growth.

10) new expanding sprouts generate stronger and stronger growth control pathways, disrupting primary and active pathways already functioning.

Conclusions

The summary result is the whole tree is stunted by pruning of living tissues. The stunting effect is developed by (regardless of control field effects on a few released sprouts): less shoots, less roots, less carbohydrate supply, less storage, and less nitrogen uptake. Shoot and root impacts are proportional to the amount and strength of the growth control path destroyed. Pruning should concentrate only on a few active and all marginal pathways as the primary paths will be maintained (sometimes strengthened). Timing of pruning for minimizing whole tree impacts would be dormant season and mid-summer, if pests can be minimized.

Suggested Literature On Shoot / Root Interactions and Tree Growth Control

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