

TREE STRESS AND THE BRONZE BIRCH BORER

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Abstract. Fast-growing, white-barked birches are more likely to suffer from drought stress, when water demand exceeds water supply, than slow-growing trees. Artificial watering and fertilization may postpone stress, and subsequent attack by the bronze birch borer, for as long as those practices are continued. Branch damage by other insects, as well as excessive trimming, may cause sufficient localized stress to trigger oviposition by the borers.

Résumé. Les bouleaux à écorce blanche dont la croissance est rapide sont plus aisément susceptibles aux stress causés par la sécheresse que les arbres à croissance plus lente lorsque la demande en eau excède les réserves d'eau disponibles. L'arrosage et la fertilisation artificielles peuvent suspendre ce stress ainsi qu'une attaque subséquente par l'agrile de bouleau tant et aussi longtemps que ces pratiques sont maintenues. Les dommages aux branches par d'autres insectes, tout comme un élagage excessif, peuvent causer un stress local suffisant pour déclencher l'oviposition par les perceurs.

There is abundant observational and experimental evidence that successful attacks by the bronze birch borer occur most frequently on trees suffering from "stress" (1). What is stress? What are the causes of stress? How long must stress persist? Can we observe stress?

Levitt (2), in his exhaustive review of the subject, stated that "biologists have adopted the term stress for any environmental factor potentially unfavorable to living organisms." And further, "the term stress in biology always has the connotation of possible injury, i.e. of irreversible or plastic strain. A biological stress may, therefore, be defined as any environmental factor capable of inducing a potentially injurious strain in living organisms."

The most common stress on plants is "drought" stress, the lack of sufficient water to maintain cell turgor and the biochemical processes of cell function. It is axiomatic that as a tree grows older and larger it requires more water. A fast-growing tree may reach the limits of "average" water availability on a given site sooner than a slow-growing tree. During periods of low rainfall, the available water is not distributed evenly throughout the crown and some drought-sensitive trees (e.g. *Fagus*, *Tilia*—no data on *Betula*) "showed the most difficulty in supplying water to their upper parts" (2,

p. 365). The lack of water in some upper branches (especially in concert with the "stress" of heavy catkin production) for even a few weeks could result in localized zones of cambial and phloem tissue degeneration. Those stressed areas, which could be virtually "invisible" to the casual observer, might be very apparent to a pregnant female bronze birch borer searching for a suitable site for oviposition and larval development.

It is of some interest that both Nielsen (3, in Ohio) and Santamour (4, in Maryland) have reported that paper birch (*B. papyrifera*) had been less frequently attacked by borers than many other species. In the Maryland test, trees of this species (northern origins) grew so slowly that they had not developed good white bark color after 10 years. It may be surmised that this slow growth rate maintained a more reasonable balance between water supply and water demand.

It has been suggested by many authors that maintaining a tree in a vigorous condition by artificial watering and fertilizing will reduce its "susceptibility" to bronze birch borers. This statement may well be true—for as long as these practices are continued. But it is a virtual certainty that at some period in time, the treated tree, now larger and more water-demanding than before, will not be supplied the volume of water it needs. This is stress, and the borers will know it long before we do. Too much water in the soil can also adversely influence water uptake, and some trees may be more susceptible than others to this type of stress.

Other insects may also cause localized stress on birch trees. Dying branches that result from the egg-laying activities of the periodical cicada or bark removal by the European hornet (5) are probably preferred sites for oviposition by the bronze birch borer.

Most birches are considered to be short-lived and shallow-rooted, although the American paper birch and river birch (*B. nigra*) normally mature (in the forest) in 60 to 75 years. Both of these species, as well as gray birch (*B. populifolia*) are

adaptable to a wide range of soil types. Still, some of the common stresses of urban landscape sites, such as soil compaction, de-icing salts, and lawn-care herbicides can also contribute to the sub-optimal growth conditions that favor attack by the bronze birch borer.

Research scientists may also cause tree stress, albeit unintentionally. By the end of the 1982 growing season, we had been sufficiently impressed by the performance (borer "resistance") of two birch progenies in our test plots that we decided to begin clonal propagation of selected individuals for distribution to commercial nurseries and for wider testing. One of these was a collection of *B. pubescens* of Belgian provenance in which only six of 22 trees has been attacked by borers during a 10 year period. The other progeny consisted of the green-leaved segregates of a 1975 cross between *B. populifolia* and *B. pendula* 'Pupurea' in which no borer attacks had been noted during seven years of testing. These trees had survived in the midst of borer devastation of our test plots and were mentioned in a 1982 paper (3) that summarized our results up to that time.

Cuttings were taken from several trees of each progeny from April through June of 1983 to determine the best timing and techniques of propagation. Larger numbers of cuttings were taken from a single select tree of each progeny in 1984. We had only limited success in propagation by traditional methods but were highly successful using micropropagation techniques. However, by

the time we had propagated sufficient numbers of these two clones for distribution, the parent trees had been attacked by borers and significant areas of their crowns were dying. Likewise, the other trees from which cuttings had been obtained had also been attacked.

Obviously, these trees were susceptible to bronze birch borer. We suspect that our trimming of the trees for cutting material caused sufficient localized stress and injury to trigger oviposition and successful attack by the borers. A few of the trees of these progenies that had not been trimmed for cuttings had still not been attacked by borers by the end of the 1989 growing season.

Literature Cited

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