

Almond Roots and the Potential for Damage by Commercial Tree Shakers

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Mechanical harvesting of nuts is a routine practice in commercial almond orchards. One disadvantage of the practice is damage done to tree trunks as a result of the shaking process. Trunk-Pads were designed to prevent such wounds. A recent concern is that, in addition to trunk damage, a tree's root system should be a health consideration when evaluating possible benefits of using Trunk-Pads (K. Shackel, 2001 Conference Proceedings, Almond Board of CA). Both kinds of tree injuries eventually result in production losses, which in turn cause decreased profits to growers. Empirical analyses of contrasting root systems and their potential for shaker damage produce a surprising and alternative deduction as to a possible benefit.

To dislodge nuts, commercial tree shakers produce strong forces in two horizontal directions: forward/backward, left/right (x and y dimensions). Recently, a vertical displacement of (z) was reported by Shackel, which consisted of an "up/down" energy transfer component. This finding has implications as to (1) which of the three dimensions (x, y, or z) is most effective at dislodging nuts, and (2) which is least dangerous to a tree's health. Intuitively, *seems* vertical displacements would be least healthy to almond roots.

However, when shake forces are evaluated for potential damage, different root patterns must be considered separately. Almonds possess diffuse root patterns that grow, predominantly, horizontal to the soil surface. This is opposite to a tap root system (like a carrot) when a single, main root grows vertically. Is assume less displacement implies less root breakage. Intuitively, up/down forces on a trunk would cause more vertical root displacement to a taproot compared to horizontal roots. Alternatively, horizontal forces would cause more displacement to roots growing in the x and y planes compared to a taproot. (It's helpful to envision the many small horizontal displacements of springs at a trampoline's fringe, in response to a single and larger vertical displacement at its center caused by a "bounce".) For almond roots then it would seem a procedure that increases the up/down component at the expense of horizontal forces, would be a preferred result.

Trunk-Pads anchor in the wood of a trunk and have potential for more efficient transfer of energy from a shaker head to a tree. Though Shackel's report indicated no statistically significant differences in trunk displacement by two commercial tree shakers with and without use of Trunk-Pads, 3 of 4 horizontal measurements were less in both x and y

directions when they were used; furthermore, the decreases were found to occur concomitantly with 2 small increases (3%, 9%) in vertical displacements. ***Five of six desirable outcomes are good odds that directions of shake forces changed.*** Further, since almond trees have virtually no taproot, most increases in vertical forces would be transferred solely to treetops, where the nuts are. What could be better?

In conclusion, my trials indicated that Trunk-Pads nearly eliminated damage to trunks by tree shakes. Shackel's report to the Almond Board suggested Trunk-Pads have potential for more efficient nut removal, because they seemed to divert shaker forces from roots to treetops. New research is needed to determine which forces (x, y, or z) are most efficient at removing nuts and which forces cause the least root damage.