Effect of Pre-plant Tillage on Pistachio Development Under Drip Irrigation

2007 Progress Report for the California Pistachio Commission
December 15, 2007

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INTRODUCTION: No published data on the benefit of preplant tillage exists for pistachios in California. Common wisdom for more than 60 years has been that a "good" orchard development should have some kind of ripping/deep tillage to a depth of 3 to 6 feet prior to planting. For many soils with hardpans and other layered structures this "just makes good sense" when considering the mechanics of root development and water penetration. Some older research was indeed carried out under flood irrigation (reported in Begg, et al., 1998) and found that tree size and yield in walnuts under flood irrigation increased in proportion to the amount of mixing in the top 4 feet of rootzone – with the least benefit given by ripping, slip-plowing next and deep moldboard plowing giving the greatest benefit.

Fast-forward to 1997 and the installation of a deep ripping (to 6 feet) trial in Arbuckle for a new planting of almonds using microsprinkler irrigation (Edstrom and Cutter, 2004). Even though this soil has a pronounced hardpan and should benefit from slip plowing, as of the 2004 harvest there has been no real yield difference between treatments. The major difference between this and earlier trials is the microirrigation. The high frequency, uniform application of water on a more precise irrigation schedule appears to compensate for the soil moisture advantage that deep tillage provided under flood irrigation.

Typical soils being developed for pistachios in the San Joaquin Valley often have a "graduated" profile that will shift from a clay loam to a fine sandy loam (or vice versa) over the top 4 feet of the rootzone. It is not uncommon to find loose "caliche" layers of high lime (and sometimes gypsum) content or thin layers of silt in this zone on the Westside. Some plow or "disc pans" are occasionally found, but rarely do we encounter the kind of hardpan found in the Arbuckle Area.

QUESTION: Are we really gaining any benefit from the $150 to $400/acre that is often spent for deep tillage prior to planting pistachios?

METHODOLOGY: This deep tillage trial was established in western Kern County in December 2005 just inside the boundary of the ancient Buena Vista Lakebed where black Buttonwillow Clay is the

dominant surface soil type. The ground has been farmed in cotton and wheat rotations for about 30 years. Soil salinity throughout the project area runs 1.5 to 5 dS/m and averages about 3.1 dS/m in the testplot area. Irrigation is supplied by a mix of canal and marginally saline well water. The soil in the area of the test plot is typical of the whole project area: Buttonwillow clay (0-2 feet) overlaying a Garces/Lethent clay loam (2-4 to 6 feet) with a weak caliche layer about 6 to 10 inches thick around the 3 foot depth. A Kimberlina coarse to fine sandy loam underlays the entire area at a depth of 5 to 7 feet. Tree rows were laid out and bagged with tillage treatments imposed directly over the row. A two-foot band of sulfur was applied over the treatments @ 15 ton/ac and incorporated to a depth of about two feet. UCB rootstock was planted March 2006 to an 17 x 20 foot spacing and flood irrigated the first year as the grower was unable to capitalize the drip system until December 2006. Standard tillage for the whole project was a slip plow down the tree row with a 15 inch shoe penetrating 42 to 50 inches. A 1.5 ton/ac rate of fine soil sulfur was applied in a 2 foot wide band over the slip trench (equivalent to 15 ton/applied acre) and incorporated to a depth of 20 to 24 inches with a modified furrowing shovel mounted to a 36 inch chisel shank to reduce alkalinity in the tree row. Drip tubing with 4, 1gph emitters was installed January 2007.

Trial tillage treatments consisted of: 1) Auger only: no deep tillage. Row marked with furrowing shovel, sulfur applied as above and incorporated with second pass of same shovel. Standard 3 point hitch auger to be used at planting same as all other treatments. **2) Cotton chisels:** standard gang of seven, 36 inch chisels, one pass down the tree row to a depth of 30 inches. **3) Slip plow (Control):** single slip plow 42 to 50 inch depth as used on rest of project. **4) Triple slip:** slip plow treatment down tree row (as above) with an additional pass 6 foot on either side. A final fourth pass was repeated down the center (tree row) pass to achieve a 60 inch penetration and further fracture the profile. This treatment is meant to be similar from the benefit gained by "straddle ripping" after slip plowing. **5) Backhoe to 7 feet:** *(installed as a subplot in the Triple Slip treatment)* a 3 x 51 foot trench to 7 feet was excavated along the space that will be occupied by trees 4, 5 and 6 (counting from the West). This subplot provides for replicated observations on trees receiving the maximum amount of deep tillage possible.

RESULTS: A total of one pre-irrigation and three in-season irrigations (18 inches total) were sufficient to supply trees with adequate moisture in this heavy black clay in 2006. By the end of the first season the rootstock circumference for the most intensive tillage treatments averaged 4.76 cm; a significant 18% advantage over the auger and chisel only treatments (Figure 1).

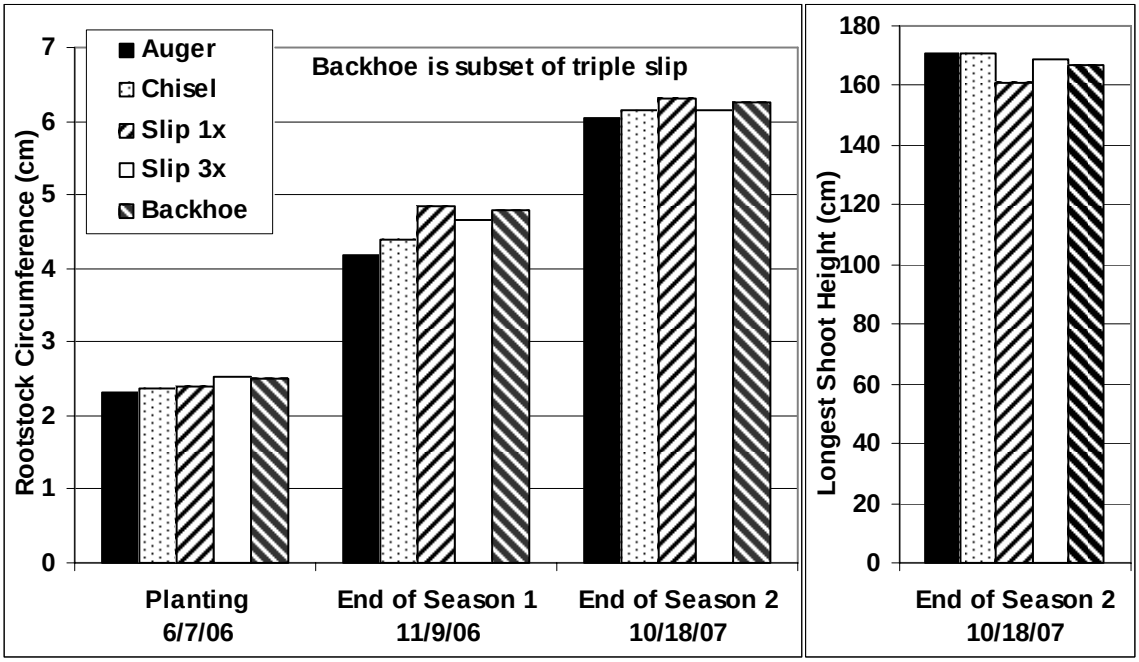

Fig. 1. Rootstock circumference and tree height for all deep tillage treatments.

For the same treatments tree height (Kerman scion or UCB shoot) averaged 94.9 cm; an 11% increase. These differences were not obvious to the eye as you walked through the trial area and are very small in terms of overall biomass. Composite soil salinity to 60 inches averaged 2.3 dS/m and 7.6 pH. End of season tissue nutrient concentrations were optimal and virtually the same for **Auger** and **Backhoe** treatments at 2.4% N, 0.22% P and 2.0% K. By the end of 2007 there were no differences in rootstock circumferences (averaging 6.2 cm) or tallest shoot height (at 168 cm, Figure 1). Applied irrigation was 8 inches. (2007 soil and tissue analyses pending.)

CONCLUSIONS AND PRACTICAL APPLICATIONS

Typical deep tillage costs run $150 to $400/acre depending on the soil and intensity/depth of modification. This will only increase as diesel costs continue to climb. A $300/ac investment over a 30 year orchard life @ 5% interest is eventually worth $1,297/ac. That's $300,000 cash for a 1,000 acre development with an eventual investment cost of $1.3 million. Of course, at $2/lb for splits this is only 862 lbs/ac of pistachios, basically 50 lb/ac/yr for 20 years to pay for the tillage. We all pay for insurance, and preplant deep tillage may fall into that category. No one thinks they'll die tomorrow, but once you're "planted" it's too late to buy life insurance!