Effects of Mulches on Trees

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When mulch is placed under trees, there are a number of effects that can result in benefits to the tree's culture. In grove or orchard situations these benefits occur mostly on newly planted (young) trees where there is a large area of open ground. As the canopy of the growing trees close cover on exposed ground some of the effects of mulching are diminished. The same is true for landscapes but is harder to measure experimentally because of the diverse nature of landscaped areas. We believe however, that mulching where the ground would otherwise be bare, changes the entire environment around a tree. If mulching is continued, it will make significant long term changes to the soil under the tree and to tree growth rates.

When mulch is placed around row crops, it changes the reflected light quality and quantity that reaches the young plant canopy (Decoteau et al., 1990). In our work on sycamore we found that mulches significantly increased the amount of photosynthetically active radiation at canopy level compared to unmulched trees (data not shown). As tree canopy size increases this effect will diminish to zero. However, during early establishment, light reflection may play a role in increasing growth rates.

When mulch is applied to bare soil, it intercepts and slows the movement of water droplets emitted from micro sprinklers of from rainfall. This allows more time for the water to soak in and lessens runoff. In studies of newly planted avocado, we found that trees with mulch had zero runoff while trees without mulch had significant runoff during irrigations. This is partly due to slowing water movement and partly due to the physical changes made to soil by dissolved organic carbon. As mulch degrades and is brought into lower soil profiles by earthworms and other animals it is incorporated into soil polymers that bind soil in micro-aggregates (Martens and Frankenbeger, 1990; Tisdall and Oades, 1982). The result is a long noticed change in soil--more porous and open soil that has a greater infiltration rate (Stephenson and Shuster, 1945; Robinson, 1988 and Merwin et al. 1994). We observed this in a tensiometer study of water movement in an avocado orchard. Tensiometers under mulched trees responded faster than tensiometers at the same depth near unmulched trees. This is because the soil under mulched trees had a greater infiltration rate and water reached the porous cup of the tensiometer faster (figure 1). Rapid infiltration of water and greater water holding capacity result in more efficient utilization of water resources and reduced cost to growers and landscapers.

The particle size of mulches is important if they are to be effective as weed control barriers for annual weed seeds. We found that when a fine textured mulch (biosolids compost) is used, that weed seeds will soon land in it and grow there, but that coarsely chipped tree branch mulches (eucalyptus) or even composts of chips are used, that weed seeds will not germinate and grow in them (figure 2).

When mulches are applied for weed control, there is a threshold thickness of about 3.5" that will control most annual weed seeds (figure 3). If more mulch is applied there will be no greater control. However, in thick mulch applications the control will last longer. Mulch longevity is fairly predictable. Organic substrates such as yardwaste lose carbon at about 66%

by weight per year. This will be somewhat faster or slower depending on moisture and temperature at a given site. Mulch also disappears because of "loft" or fluffiness. If an application is put on at 6" depth, it may soon shrink to 5 or 4 inches without losing mass simply due to compaction. There appears to be little harm from applying thick layers of mulch, so it is best to apply a thick mulch layer. When mulch levels fall below 3.5 inches, annual weed seeds will start to emerge through the mulch. In thick mulches, we have often seen yellow nutsedge and bermudagrass as well as field bindweed. We have also seen eucalyptus and other tree species such as *Washingtonia* palm growing in yardwaste mulched soils. In some cases these emerged through mulch from underlying soil and in others they were brought in with the mulch. Thus, mulches are not a cure-all for weed problems but in the right situation they can control almost 100% of annual weeds.

One long sanding fallacy about wood chip mulches is that they draw nitrogen away from underlying soils thus depriving the tree from nutrition. Certainly "nitrogen draft" can occur when high C:N ratio substrates such as sawdust are **mixed** with soil. However, if mulches lay undisturbed on the soil's surface and are broken down naturally by fungi and animals (earthworms) they will in fact contribute significant amounts of nitrogen to the soil. We found in a study of citrus that as deeper and deeper amounts of yardwaste mulch were applied, the levels of nutrients were significantly increased, especially total nitrogen. There is some concern that if excessive amounts of yardwaste are used, nitrogen may be oversupplied. Since all the elements found in plants are in mulch there is also a possibility of contributing toxic ions. Correlations of salinity with mulch depth were inconsistent; not significant in one analysis but significant in another (figures 5 and 6). Somewhat of a concern is the buildup of chloride and boron. While chloride will be lost through leaching events, the chemistry of boron is more troublesome and may indicate a problem in situations where thick mulches are applied to boron sensitive crops or ornamental plants in non-sandy soils.

In the final analysis, mulching with recycled yardwastes has benefits and detriments, but we believe that the advantages outweigh the disadvantages. Mulching is however, not a horticultural panacea for growers, it is a practice that requires knowledge and more not less monitoring of an orchard or landscape to ensure that quality plants are grown. The payback is reduced herbicide, water and fertilizer applications. There are also other benefits to mulching that we have not touched on here such as reduction of root diseases.

References

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Figure 1. Response of tensiometers to irrigation in mulched (circle) and unmulched (square) soils. Bars represent the standard error of 60 replicates. (adapted from Downer et.al. 2002)

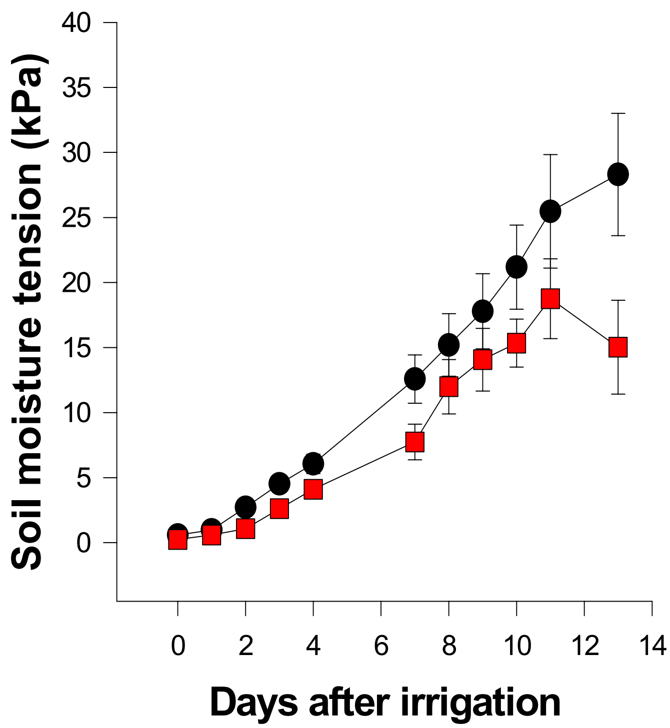


Figure 2. Bars represent percent cover in mulched plots. -mulch is unmulched; PB is pine bark; BC is biosolids compost; EC is composted *Eucalyptus cladocalyx*; FELC is fresh *Eucalyptus cladocalyx* large chips and; FESC is fresh *Eucalyptus cladocalyx* small chips. The two large bars are statistically different from other treatments but not from each other according to ANOVA and $LSD_{0.05}$.

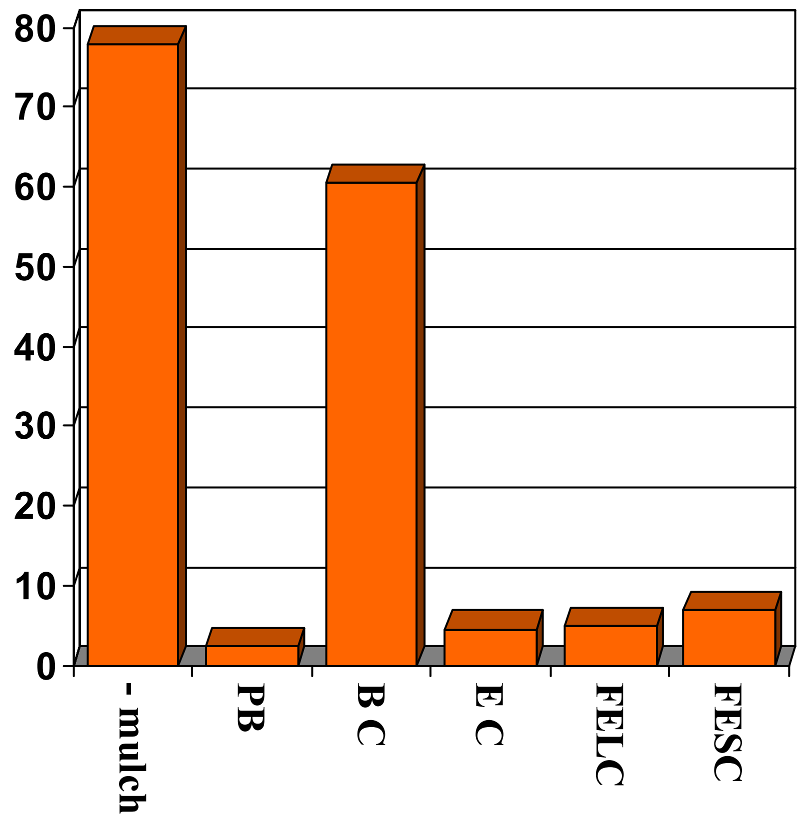


Figure 3. Weed seed germination in response to mulch thickness

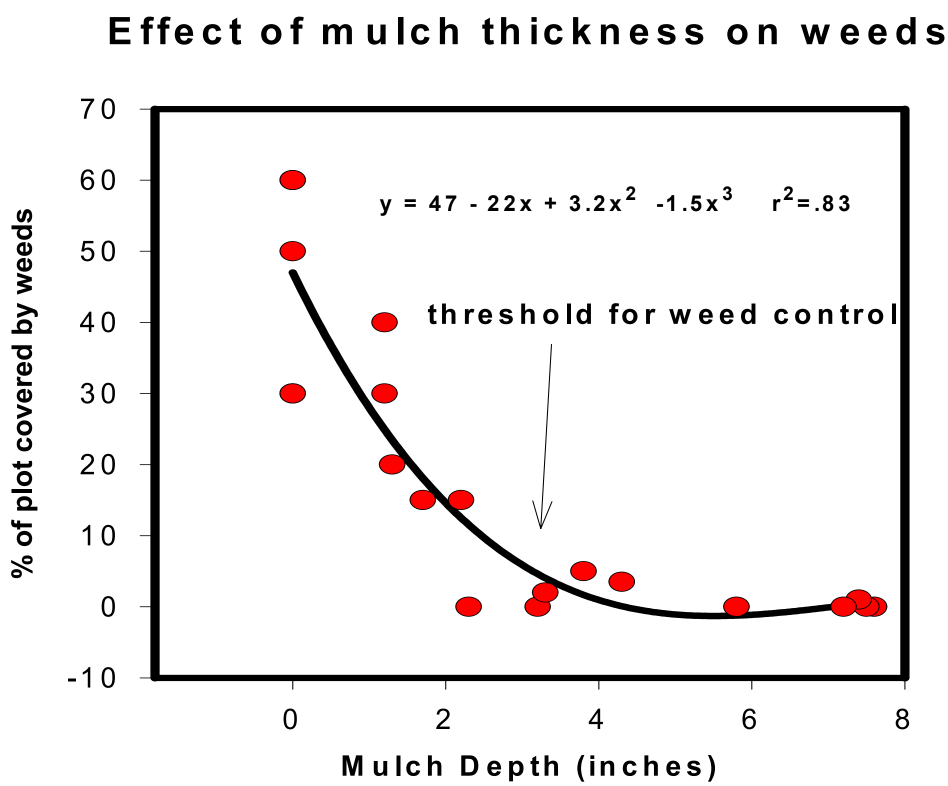
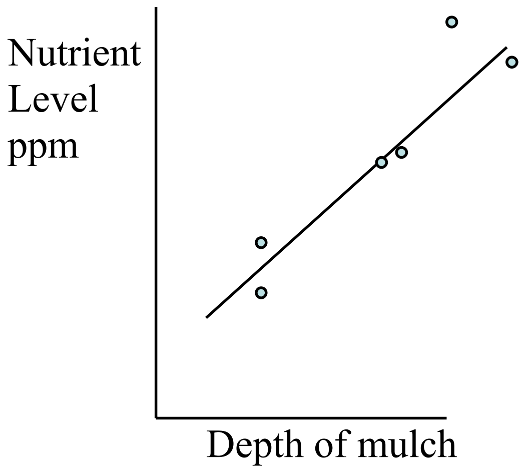


Figure 4. Relationship of nutritient level to depth of mulch application. P is the probability of a significant relationship at the ** 0.01 level.



measurement	r^2	p
• **EC**	**.129**	**NS**
• **pH**	**-.336**	**
• **Ca**	**.168**	**NS**
• **Mg**	**.338**	**
• **Na**	**-.028**	**NS**
• **TKN**	**.918**	**
• **P**	**.632**	**

Figure 5. Nitrogen, phosphorus and potassium concentration in soils underlying: 0; 1; 3; or 6 inches of mulch. The bars within a cluster are significantly different according to ANOVA and $LSD_{0.05}$ if the letters are different..

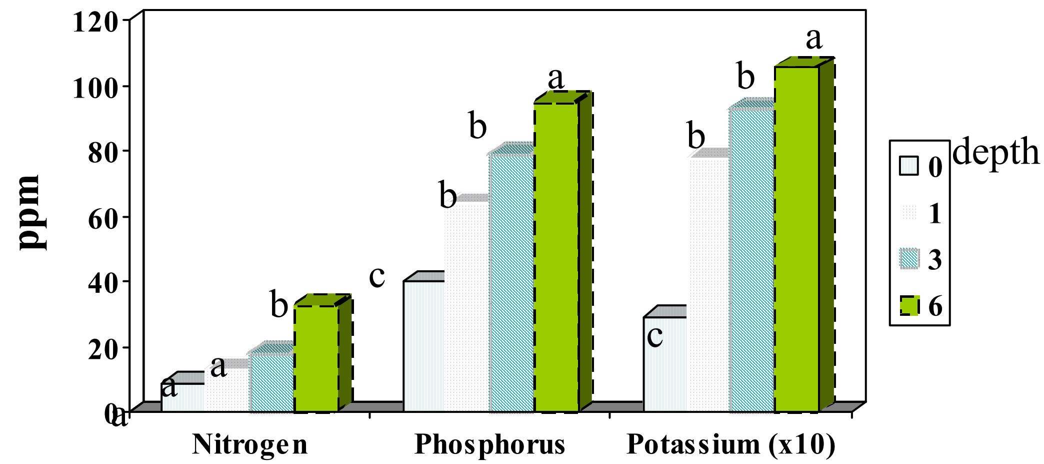


Figure 6. Effect of mulch depth on salinity and specific ions in soil profiles. Labels and statistics the same as in figure 5.