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Mulching – is it worth it?

Jonathan Dixon, Toni Elmsly, Fiona Fields, Derek Smith, Andrew Mandemaker, Anne Greenwood, Henry Pak and Jonathan Cutting

Avocado Industry Council Ltd, PO Box 16004, Bethlehem, Tauranga E-mail: jonathandixon@nzavocado.co.nz

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SUMMARY

Greenwaste mulches affect avocado tree growth and roots through small incremental changes in phenology and the soil from mulch to mulch. Trees growing under greenwaste mulches had a tendency for greater trunk growth, more roots, and an increase in some minerals and for more earthworms in the soil than the minimal mulch, leaf litter and post peelings mulches. The greenwaste mulches had considerable quantities of nutrients and may act as slow release fertilizers. The mulches evaluated did not prevent or slow down the drying of soil and cannot be considered as a substitute for irrigation. We believe mulches made from greenwaste make suitable mulches for avocado trees.

Key words: greenwaste, phenology, weeds, roots, soil moisture, minerals

INTRODUCTION

Mulching has been widely recommended for avocado orchards in NZ as based on overseas research (MOORE-GORDON et al, 1997) and anecdotal evidence mulches are considered to improve yield, maintain soil moisture over summer and improve root numbers and function. However, mulching has become more difficult to justify as a standard orchard activity due to a reliable supply of inexpensive mulch becoming harder to obtain. Questions have also been posed over the effect different types of mulches have on the movement of fertilizers into the soil. Many types of mulch are composed of materials low in nutrient value, in particular nitrogen, that may reduce or alter the amount of ground applied fertilizer reaching the soil (VOCK et al, 2001).

Greenwaste may be the answer to obtaining a reliable supply of inexpensive mulch. The greenwaste companies Living Earth Ltd and Revital Fertilisers are processing an increasing supply of greenwaste. These companies produce compost but have a waste stream of the oversized compost fraction. With increasing pressure on landfills there is also a need to see if pasteurized but un-composted greenwaste could also be useful as avocado mulch.

To evaluate the effectiveness of the mulches used in this project we posed 4 questions

that we believed would be of most interest to avocado growers. They were: What should the mulch be made of? How much should be applied? Where should mulch be applied? When should mulch be applied? This report will only focus on the results for the first question: What should the mulch be made of?

MATERIALS AND METHODS

The same experiment was set up on each of five orchards. All the orchards were not irrigated. Mulch was applied in a standard way. Mulch was placed as an approximately 1 m wide band around the tree, centred on the drip line at about 100 mm thickness. Each mulch treatment was applied to five similar trees selected at random within a block. During the course of the trial the trees received their normal fertilizer programme for that orchard.

Seven mulch treatments were applied. They were:

Minimal mulch -regular removal of any organic material under the trees
Leaf litter -leaf litter was allowed to accumulate.

These served as controls for the trial.

The greenwaste mulches used were:

Compost -made from greenwaste and chicken manure
10 day greenwaste -un-composted but pasteurized greenwaste
Bark nuggets mixed with 20% compost
Compost tailings -the oversize fraction screened from compost
Post peelings -thin “strappy” pieces of wood readily available locally.

Post peelings also served as an additional control as an industry “standard” mulch.

The following measurements of tree growth, roots at the soil mulch interface, mulch, soil and minerals were taken over the course of the trial.

Shoot growth – shoots were tagged and the length measured from the growing tip to the nearest bud ring.

Trunk circumference – trunks were marked with a washer and the circumference measured with a tape measure.

Soil moisture – two tensiometers 30 cm and 60 cm in depth were installed under one tree of each mulch treatment on each of the five orchards.

Weeds – the surface of the mulch was rated for the average percentage cover of weeds.

Yield – individual trees were harvested according to normal commercial practice. The fruit were counted and size graded across commercial grading machines at a number of packers facilities.

Roots – root numbers were estimated as percentage coverage of a 0.5m x 0.5m area at the soil mulch interface from a random location around the tree.

Mulch breakdown – change in the depth of mulch was measured using stakes pushed into the soil through the mulch from the top of the stake to the surface of the mulch.

Minerals – leaf and soil samples were taken in April/May each year according to the standard industry protocols and were analyzed by RJ Hill laboratories, Hamilton, New Zealand. The mineral content of mulch samples were also analyzed when the mulch was first applied.

Biological activity of the soil – the numbers of earthworms in a 15cm diameter by 15 cm depth cylinder of soil taken from under the mulch were used to indicate soil biological activity under each type of mulch.

The results presented in this report are the average values across orchards.

RESULTS AND DISCUSSION

Shoot Growth

Shoot growth was unaffected by mulch treatment and differed more from year to yeat than between mulches (Figure 1).

Trunk Circumference

There was a trend for the trees that received the greenwaste mulches to have had a greater increased trunk circumference over the course of the trial (Figure 2). While the differences in trunk circumference were not significant they suggest that the greenwaste mulches would increase the growth of the trees over time.

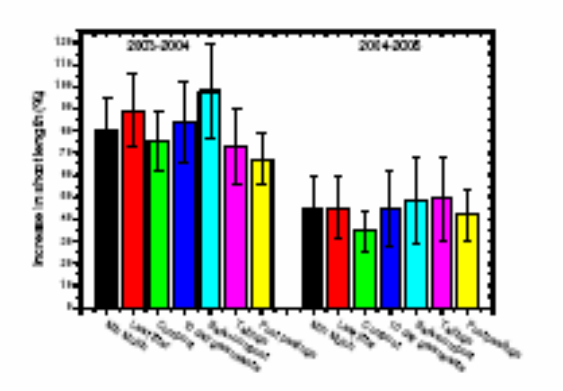

Figure 1. Increase in shoot length each year in the 2003/04 and 2004/05 growing seasons.

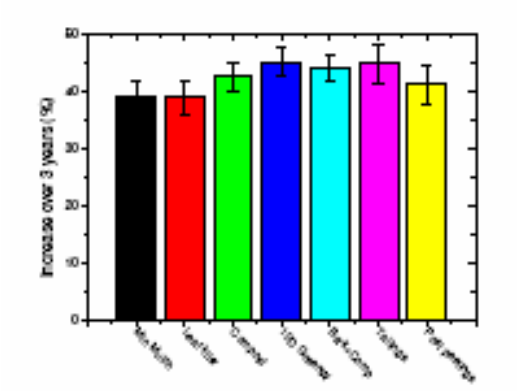

Figure 2. Increase in trunk circumference over the 3 years of the trial.

Soil Moisture

Soil moisture deficit in summer (early January under the different mulch treatments was not significantly different in either 2003 or 2004 (Figure 3). The mulches used in this trial did not maintain soil moisture deficits below -30KPa or that of minimal mulch or leaf litter. This would indicate that the mulches used in this project could not be considered as a substitute for irrigation.

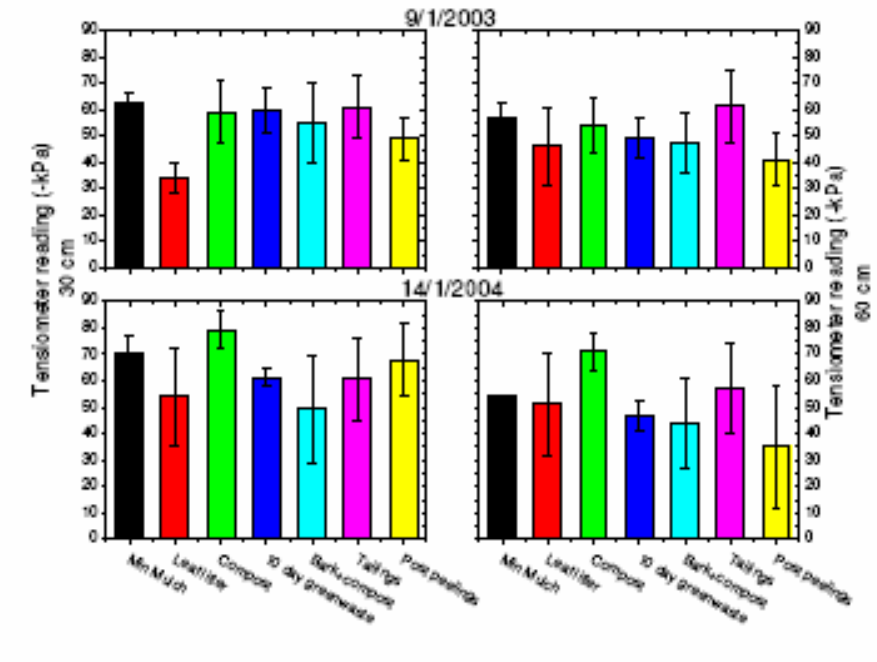

Figure 3. Aveage soil moisture deficit under each mulch treatment in early January 2003 and 2004.

Weeds

There was an overall trend for the mulches to have reduced weed cover under the trees (Figure 4). Weed coverage had a strong seasonal pattern with the most weeds appearing in spring and the least in winter. The mulches evaluated were relatively ineffective in suppressing weeds even shortly after application. A weed control program was required on the orchards in the trial.

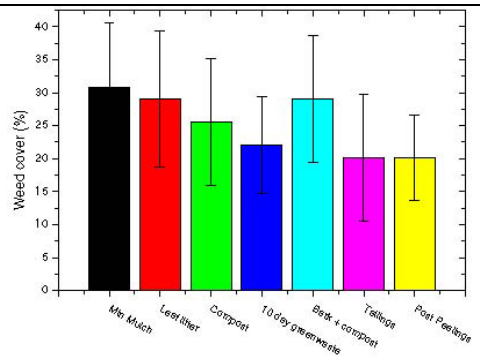

Figure 4. Average weed coverage over the three years of the trial.

Yield

To date, only two harvests have been completed with the third harvest set for the 2005/06 export season. The first harvest was shortly after the mulch was applied and will be used as a basis for comparison with the next two years harvest. Until the third harvest has been completed no conclusions can be drawn on the effect of the greenwaste mulches on yield. It is worth noting that the first two years of the trial has coincided with two poor cropping years. Early indications off a very low cropping base are that the trees with the compost and post peelings mulches had the most fruit.

Roots

There was increased feeder root coverage at the soil-mulch interface with the bark+compost, compost tailings and post peelings mulches having the most roots

(Figure 5). These mulches also had the highest wood component and appeared to have the greatest air content.

Mulch Breakdown

The different types of mulches broke down, as indicated by a decrease in depth (representing rotting and settling), at different rates that appear to depend on their composition and physical characteristics (Figure 6). The slowest breakdown was with the mulches containing the most wood or bark, post peelings and bark plus compost. Ten day old greenwaste and compost tailings breakdown the fastest with compost intermediate. The time to reach half the original mulch depth was used to indicate the approximate time when the mulches would need to be re-applied. Indications were that the greenwaste mulches would require replacement about every 2 to 3 years.

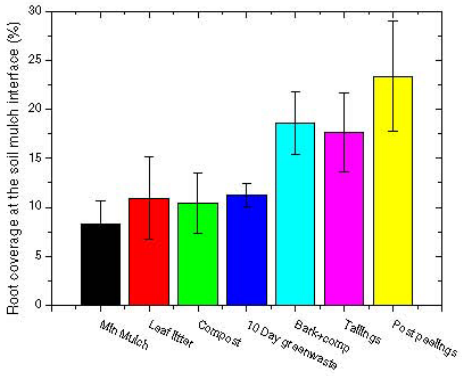

Figure 5. Average root coverage at the soil mulch interface.

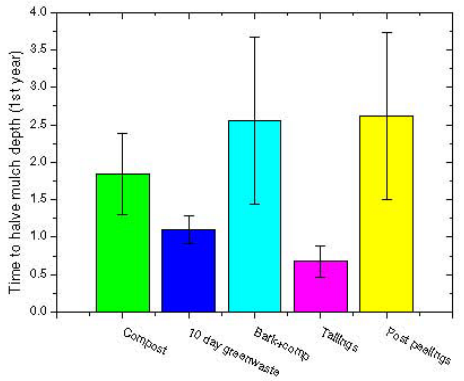

Figure 6. Average decrease in depth of mulch during the first year of application.

Minerals

The mineral nutrient content of the greenwaste mulches was high probably due to the addition of chicken manure in the compost manufacturing process (Table 1). In contrast post peelings had very little nutrient value. How quickly the nutrients are released from the mulches and become available to the avocado tree is not known. The mulches breakdown relatively slowly and it is reasonable to suggest the nutrients are released slowly effectively making the greenwaste mulches act as slow release fertilizers. The amounts of minerals in the mulches would also suggest they should be taken into account when considering an orchard nutrition programme.

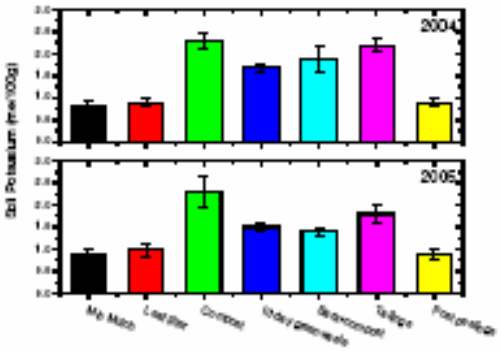

Figure 7. Average soil potassium concentration under different mulches

Despite the greenwaste mulches having a relatively high mineral content only phosphorous (P), potassium (K), magnesium (Mg) and boron (B) were at higher concentrations in the soil under greenwaste mulches than post peelings, minimal mulch and leaf litter (Figure 7). The increases in soil concentration of minerals were not reflected in the mineral content of leaf samples.

Since each orchard continued its normal fertilizer management programme during the trial the mineral content of the leaves is most likely reflecting the orchard fertilizer programme. These results suggest that the greenwaste mulches will alter the soil nutrient profile that may require a reevaluation of the fertilizer programme for individual orchards.

Table 1. Mineral content of greenwaste mulches and post peelings mulch at the time of application.

	Mulch material				
Mineral	Compost	10 Day greenwaste	Bark + compost	Tailings	Post peelings
N (kg/m^3)	8.1-6.8	3.8-3.2	5.1-3.4	5.1-4.8	1.0-0.2
P (kg/m^3)	2.5-2.1	0.7-0.4	1.2-0.9	2.3-2.1	0.07-0.03
S (kg/m^3)	1.4-1.1	1.0-0.4	0.8-0.6	1.4-1.2	0.09-0.03
K (kg/m^3)	4.3-1.6	2.3-0.7	3.4-0.7	4.9-1.9	0.8-0.1
Ca (kg/m^3)	17.3-13.1	6.2-4.7	10.2-8.9	9.5-9.2	0.7-0.2
Mg (kg/m^3)	1.8-1.7	1.5-0.8	1.3-0.8	1.3-1.1	0.2-0.08
Na (kg/m^3)	0.9-0.2	0.4-0.2	0.7-0.02	1.1-0.05	<0.01
Fe (kg/m^3)	5.5-4.2	3.9-1.8	1.7-1.7	2.7-1.6	0.2-0.15
Mn (g/m^3)	217-193	156-72	122-119	194-136	22-18
Zn (g/m^3)	114-91	85-42	110-49	122-59	9-3
Cu (g/m^3)	39-29	28-8	35-11	37-14	2-1
B (g/m^3)	15-8	7-6	12-7	10	3-0

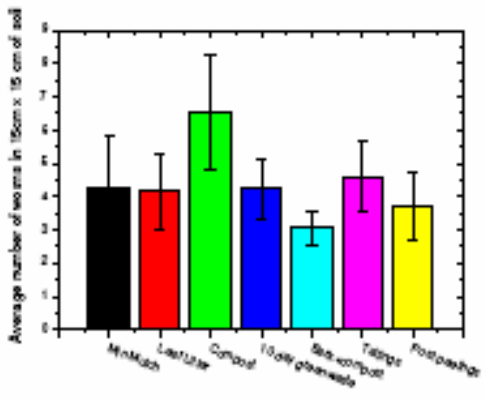

Figure 8. Average number of earthworms in a cylinder of soil 15cm diameter by 15cm deep.

Biological Activity

The number of earthworms in the soil under the each of the mulch treatments was used as a measure of the biological activity of the soil. Soils with large numbers of earthworms could be considered to have high activity while soils with few earthworms low biological activity. Average earthworm numbers greater than 5 can be considered high and average numbers below 3 low biological activity. Earthworm numbers were in the high to medium range with the compost mulch treatment having the highest average and the bark + compost mulch the least. However, these differences were not statistically significant and all the mulch treatments had reasonable numbers of earthworms.

CONCLUSIONS

Does mulching pay? We believe so, but the effects and impact of mulches are long term and therefore not easy to quantify in a commercial orchard. Mulch clearly helps to improve the root environment and root numbers. As such mulches are a useful management tool to change the soil environment. An example of this may be increasing soil biological activity as indicated by increased earthworm numbers. In general, other orchard factors appear to be more important than mulch in affecting the productivity of an avocado orchard.

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