Growing Mountain Peppers: the effects of living mulch vs purchased mulch

Jindivick 2018

Australian Government | National Landcare Program

Demonstrating Sustainable Farm Practices

Mornington Peninsula | wpcln Western Port Catchment Landcare Network | South Gippsland Landcare Network

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Summary

The aim of this three-year demonstration was to determine whether the use of mulches could increase production of the bush foods Mountain Pepper (*Tasmania lanceolata*), Lemon Myrtle (*Backhousia citriodora*) and Davidson plum (*Davidsonia johnsonii.).* The demonstration compared the use of purchased mulch applied at 2 different rates, along with living mulch, to see which had the better outcome.

Introduction

A 2007 Rural Industries and Research and Development Report estimated that the bush food industry had a gross production value of between $5 million for native foods and $10 million for native food and essential oils (RIRDC, 2008).

Jindi Farm Bush Foods is located in Jindivick and run by Leslie Smith. Prior to the purchase of the farm in 2012, the bushfood orchard consisted of mainly Mountain Pepper and Lemon Myrtle. The orchard was in the establishment phase so there were no products marketed or sold.

Figure 1 Jindi Farm map displaying orchard area

Jindi Farm now specialises in growing and value-adding Australian bush food products. Leslie grows Mountain Pepper, Lemon Myrtle and Davidsons Plum, along with Warrigal Greens, Macadamia Nuts, and native herbs. They're grown in an area sheltered by a natural bush environment. For many years Leslie has been growing, harvesting and using native foods in a wide variety of bush food products such as Dukkah, spice mixes, relish, jams, dips and baked goods. The bush food business commenced in 2013 selling both raw products and value-added products.

The bushfood orchard at Jindi Farm

At Jindi Farm, Mountain Peppers, Lemon Myrtle and Davidson Plums are planted in 14 rows totaling approximately 900 lineal metres. Each row is irrigated with pressure compensating hoses (due to the slope). The trees are between 3-10 years of age. Leslie believes that for ease of picking the trees should be kept no more than 2 metres in height. Lemon Myrtle, which is also grown in the rows, is kept to about 2-3 metres in height.

Figure 2 Mountain Pepper plants

There have been numerous challenges in managing the orchard, which have included low water supplies for irrigating the trees, and deer from the neighbouring forest entering the plantation and rubbing against the trees, resulting in ringbarking, broken branches and even death of the trees. The soils of the area are light sandy to gravelly loams derived from weathered granite of the Baw Baw pluton of Devonian geological age (400 my).

Figure 3 Lemon Myrtle Blossom

The demonstration

Leslie researched growing bush foods in more detail and wondered whether the Mountain Pepper, a mid-storey rainforest tree, would grow in an open situation where there was no canopy protection.

The idea for the demonstration was to replicate a forest litter system with deep mulch, which would provide an ecosystem where the Mountain Pepper trees might thrive.

One of the first things Leslie did was to erect a substantial fence along the East side of the farm to try and prevent deer entering the property from the neighbouring forest. This significantly reduced the impact of deer entering and damaging the orchard, but hasn't completed eliminated the problem.

After the fence was erected 115 Mountain Pepper plants were planted to fill gaps where plants had previously died due to lack of water or damage by deer.

Two rows of Mountain Pepper trees were planted with a 'Living Mulch', which was hoped would act as a groundcover to preserve soil moisture and provide an alternative to purchasing composted mulch and importing it onto the farm.

Figure 4 Fencing to keep out deer

Figure 5 Pepper Berries

Figure 6 Looking down the mulched Pepper Berry rows

Warrigal Greens, a native spinach, was chosen for as the living mulch as it is a native bush food and would theoretically provide multiple benefits. Warrigal Greens (*Tetragonia tetragonioides*), often called New Zealand Spinach, are a bush food groundcover that usually grows in full sun, but is adaptable to part shade. It was expected that it could grow in similar conditions to the Mountain Pepper on Jindi Farm.

Three rows were spread with composted mulch at a high rate (depth 200-300mm).

Another three rows were spread with composted mulch at a lower rate (depth 100-200mm).

Two control rows were also established with no mulch of any type.

Figure 7 The orchard layout

The original demonstration plan was to also divide the irrigation system into two sections - high levels of irrigation and low levels of irrigation - and monitor the results. This did not occur due to a lack of water. As a result, all rows received the same level of irrigation.

Pepper production (by weight) was monitored under the different systems, along with soil moisture and plant vigour.

Note: Due to unexpectedly dry conditions the Warrigal greens did not survive, and at the end of the demonstration there were no surviving plants.

Figure 8 Warrigal greens acting as the living mulch

Comment on the analysis of the composted mulch

Composted mulch

The composted mulch was supplied by PineGro in the Latrobe Valley. It was a dark colour and clean from contaminants which can often be found in purchased mulch. The mulch supplied good levels of organic matter, which increased moisture absorption and released reasonable levels of nitrogen, potassium and calcium into the system. The heavy mulched rows had about 3 cubic metres applied per row to a depth of 200-300mm, while the light mulch had 1.5cubic metres applied per row to a depth of 100-200mm.

The analytical results are tabulated below.

Table 1: Analysis of the composted mulch used in trial vs a typical compost

Nutrient	Composted mulch	Typical compost analysis
Nitrogen %	1.4	2
Phosphorus %	0.28	0.5
Potassium %	0.91	0.8
Sulphur %	0.35	<0.5
Carbon %	24.2	30
Calcium %	1.81	3

Nutrient	Composted mulch	Typical compost analysis
Magnesium %	0.52	0.5
Sodium %	0.23	<0.2
Conductivity dS/m	4.4	No limit
pH	7.3	5-7.5
Carbon: Nitrogen ratio	17.3	<15

Testing Protocols

Planned monitoring of the soil included:

- soil tests at the beginning and end of the trial,
- moisture and temperature monitoring across the un-mulched and mulched beds (this didn't take place due to due to unforeseen circumstances),
- a measure of both the yield and the weight of the Mountain Berries across the control and the light and heavy mulched areas.

Observing the growth of the Warrigal greens was also important to see whether their growth habit satisfied the characteristics of a living mulch medium (Sanders, 2017). Due to insufficient moisture they died.

Analysis of results

Physical observations
The initial soil assessment taken in 2014 indicated a sandy gravelly topsoil with depth about 200m. The soil had poor physical characteristics with the most prominent soil constraints identified as a low moisture-holding ability due to its texture as described above, leading to moderate compaction.

At the conclusion of the trial the soil in both the heavy and light mulched areas were significantly darker in colour with an increase in organic matter. This indicated that Humic compounds had leached from the mulch that were beneficial to both biological activity and nutrient mobilisation.

Soil analyses

Heavy Mulch
Changes observed in the soil over the trial period between the control and heavy mulch rows:

- pH increased from 5.14 in the control to 6.91
- Calcium increased from 167mg/kg to a desirable 1562mg/kg
- Magnesium increased from 73mg/kg to 540mg/kg
- Potassium from 22mg/kg to 1095mg/kg
- Olsen p from 3.3mg/kg to 74mg/kg
- Colwell P from 10mg/kg to 242mg/kg
- Nitrate N for 0.7mg/kg to 6.1mg/kg

- Total nitrogen from 0.24 % to 0.6%
- Organic matter increased from 8.5% to a high 17.7%
- Effective Cation Exchange increased from a low 5.44 to a high 26.9
- Exchangeable Calcium increased from a low 26.6% to an improved 56.5%
- Exchangeable Magnesium increased from 15.6% to 24.5%
- Exchangeable Potassium increased from 3.2% to 16.1%
- Exchangeable Aluminium decreased from 39.7% to a favourable 0.3%

Note Exchangeable magnesium in the control area increased from 15.6% to 24.5% under the heavy mulch, which is not seen as a beneficial move. CEC magnesium over 15% may impact negatively on soil structure.

Light mulch
Changes observed in the soil over the trial period between the control and light mulch rows:

- pH increased from 5.14 in the control to 5.63
- Calcium increased from 167mg/kg to a desirable 917mg/kg
- Magnesium increased from 73mg/kg to 335mg/kg
- Potassium from 22mg/kg to 175mg/kg
- Olsen p from 3.3mg/kg to 29mg/kg
- Colwell P from 10mg/kg to 135mg/kg
- Total nitrogen from 0.24 % to 0.53%
- Organic matter increased from 8.5% to a high 16.7%
- Effective Cation Exchange increased from a low 5.44 to a high 16.32
- Exchangeable calcium increased from a low 26.6% to a desirable 62.6%
- Exchangeable Magnesium increased from 15.6% to 27.2%
- Exchangeable Potassium increased from 3.2% to 8.6%
- Exchangeable Aluminium decreased from 39.7% to 1.3%

Living mulch (Warrigal Greens)
Changes observed in the soil over the trial period between the control and living mulch rows:

- pH increased from 5.14 in the control to 5.58
- Calcium increased from 167mg/kg to 358mg/kg
- Magnesium increased from 73mg/kg in the control to 117mg/kg
- Potassium increased from 22mg/kg to 105mg/kg
- Organic matter increased from 8.5mg/kg to 9.5mg/kg
- Sulphur increased from 4.8mg/kg to 6.3mg/kg
- Effective Cation Exchange increased from 5.44 to 6.87
- Exchangeable calcium increased from 26.6% to 47.2%
- Exchangeable magnesium increased from 15.6% to 21.1%
- Exchangeable potassium increased from 3.2mg/kg to 8.6mg/kg
- Sodium decreased from 3.5% to an improved 2.3%
- Aluminium decreased from 39.7% to 17.9%

Pepper Berry yield and quality

Both the yield and quality of the Pepper Berries was variable during the demonstration. It was, however, noticeable that the Mountain Pepper trees that were well-shaded by a large

eucalypt were taller and stronger trees. This demonstrates their environmental niche as a low-mid storey rainforest tree. Heavier mulched trees in this area tended to yield more, and larger berries.

Leslie estimated that the trees that were shaded and had heavy mulch, yielded about 25% more in weight.

Despite heavy mulch, most of the Pepper Berry trees in the open died, indicating that shade and sufficient water were not available.

The Warrigal greens died due to a lack of water. Although drought hardy and heat tolerant they do prefer a free-draining organic-rich soil, top-dressed with mulch to help retain moisture.

Budget for the demonstration site

Table 3. Cost to establish the demonstration

Site preparation	$3,000
Production Warrigal greens	$400
Fencing	$1,800
Irrigation controller	$450
Irrigation	$647
Additional Pepper and Davidson plum trees	$1,055
TOTAL	**$7,352**

The landholder paid for capital items, including the erection of the deer proof fence, irrigation equipment, and much of the site preparation.

Summary

The demonstration was not able to grow the Mountain Pepper plants successfully in open conditions through replicating forest conditions with heavy mulching. However, it did demonstrate that its natural niche environment is essential for optimising its growing potential. Given the survival, good growth and yield of trees that were shaded and mulched, the possibility of utilising this knowledge may allow further trials to provide successful outcomes.

The addition of the heavy and light mulch had very positive effects on the soil chemistry, with pH and most nutrients increasing substantially. The leaching of elements from the mulch appeared to be re-stocking the soil nutrient bank.

Key learnings

- Shade and water appear to be more critical to the successful growth of Mountain Pepper trees than mulch/litter under the base of the trees
- Mulch increased the moisture retention, but not enough to support tree growth
- The Pepper Berry size and yield increased with shade, moisture and mulch
- Mulch significantly improved both soil physical and chemical characteristics

- Warrigal greens may have persisted if sufficient water was available thus protecting the soil and possibly increasing soil moisture

References

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This project is supported by Western Port Catchment Landcare Network through funding from the Australian Government's National Landcare Program