Recycled Organics Unit

SUMMARY SPECIFICATIONS

Product Specifications and Application Guidelines for Compost Mulches for Orchard Production in NSW

Department of
Environment and Conservation (NSW)

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1 What is composted mulch?

Composted mulch refers to composted products that are used as surface application around plants and are not incorporated into the soil. The general characteristics for composted mulch are defined in the 3rd Edition of Australian Standard AS 4454 for *Composts, Soil Conditioners and Mulches* (Standards Australia, 2003).

Compost is produced from organic materials that have undergone controlled aerobic and thermophilic (hot) biological transformation to achieve pasteurisation and a level of maturity specified in AS 4454. Pasteurisation refers to the thermal destruction of pathogens (disease organisms) and weed seeds that may have been present in the original materials. AS 4454 addresses all general risks that can otherwise be associated with poorly manufactured products sold as "compost" Important to note is that AS 4454 does not specify products to optimise performance for any particular application, that is the purpose of this complementary specification.

A list of bulk compost suppliers in NSW is available
http://www.recycledorganics.com/product/selector/suppliers.htm

2 Purpose of product specifications and application guidelines

These product specifications and application guidelines are targeted at maximising agricultural performance from the application of composted mulches for orchard production in NSW, specifically for apple, peach and nectarine orchards. These specifications build upon the Australian Standard AS 4454, and recommend additional specifications for different regional soil and climatic conditions in NSW.

This guide specifies preferred mulch characteristics, application rates and application timing to support growers to select and apply mulch that will deliver performance and value.

3 Benefits of composted mulch

The potential benefits summarised below are achievable only from the proper application of composted mulch products that have suitable chemical, physical and biological characteristics, that are applied at an appropriate rate (i.e. thickness and width of mulch layer) and timing (as related to cropping cycle) as documented in this specification.

Many of the performance benefits arise from the presence of a thick (up to 10 cm) blanket of predominantly coarse woody composted mulch that has been sanitised and biologically stabilised via hot composting. Such characteristics provide a long lasting surface cover, and avoid fundamental risks associated with unprocessed organic amendments and products that have not been effectively pasteurised to destroy weed seeds, plant and human disease organisms, and may contain a range of compounds that are toxic to plants.

Benefit	Benefit range	Reasons for benefit
Reduces weed growth*	60 to 100%	Physical presence of mulch layer on the soil surface suppresses emergence and growth of weeds. Weed suppression improves as the thickness of mulch layer increases, provided particle size grading of mulch meets documented specifications.
Reduces irrigation water use and reduces risk of crop failure*	By 30% or more	Mulch layer reduces solar radiation and wind speed at the soil surface reducing water evaporation. Increase in organic matter improves soil aggregation, porosity and pore size distribution that results in increased storage of water. Under irrigated conditions these benefits result in more efficient water use and enable reduced irrigation water requirement (irrigation reduction will depend upon climatic conditions, soil types, irrigation system and farm management practices). Under non-irrigated and/or dryland conditions this benefit reduces incidence and degree of plant stress, and reduces the risk of crop failure and increases likelihood of producing market quality crop.
Reduces soil temperature fluctuations*	**Up to 3 degrees**	Physical presence of mulch buffers soil temperatures reducing soil temperature fluctuations. This results in more even soil temperatures which reduces plant stress (benefits of which are documented above).
Reduces soil erosion and nutrient loss*	Up to 100%	Mulch cover protects the soil surface layer from the direct impact of rain and wind, reducing soil erosion compared to bare soil, avoiding associated loss of nutrients, and preventing land degradation.
Improves overall soil health and land productivity.	By 5 to 25%	Composted mulch contains >50% organic matter on dry weight basis. Increase in soil organic matter improves soil aggregation and soil structure; reduces surface crusting and sealing and increases water infiltration of hardsetting surface soils. This also improves water percolation and drainage of heavy clay soil types; and increases water holding capacity and reduces water percolation of sandy soil types.
Provision of nutrients (fertiliser value)	From 20% to 80% of requirements particularly phosphorus and potassium	Composted mulch contains macro and micronutrients. These nutrients are mainly present in organic form and some in inorganic form. Inorganic nutrients become available immediately while nutrients in organic form are released slowly over time as composted products undergo further microbial decomposition in the soil. The decomposition of organic matter and release of nutrients are influenced by climate, soil types and farm management practices. Nutrients are supplied in a slow release form over 2-4 years, however the highest nutrient contribution is in 1st year. Composts can also make mineral fertiliser programs more effective by reducing nutrient loss through leaching and topsoil erosion. Composted mulch application can significantly replace use of fertilisers particularly phosphorus and potassium. Contribution of mulch nutrient should be accounted for fertiliser applications. Crop and soil nutrient monitoring in accordance with NSW DPI *Fertiliser Replacement Strategy* is required for application of supplementary fertilisers.
Reduce pest and disease incidence	A range of soil borne diseases	Composted mulch increases population, diversity and activity of beneficial microorganisms. This reduces potential for pathogen growth via increased competition for nutrients; predation and parasitism; and induced systematic resistance against diseases in plants. This can reduce incidence and severity of pest/disease and associated risk of crop failure and loss.

*__Note:__ The benefits provided in the table are achieved from the physical presence of a long lasting mulch blanket of up to 10 cm.

4 Soil types

Soils used for fruit production in the Greater Sydney, Central West and Murrumbidgee regions are highly variable. Soil types under fruit production across these regions have been arranged into 4 general groups with consideration of relevant soil characteristics of soil texture, soil structure, drainage, water holding capacity and soil fertility. Each soil group requires different composted mulch product specifications and application rate. These readily identifiable general soil groupings are provided below:

- **Moderately structured clay subsoils with hardsetting surface condition-duplex soils (*Soil Group 1*)** – Soils with moderate water holding capacity, moderate permeability and low to moderate soil organic matter (SOM) levels.
- **Well structure clays (*Soil Group 2*)** - Well drained soils with moderate water holding capacity and moderate soil fertility.
- **Rapidly drained and highly permeable sandy soils** (***Soil Group 3***) – Soils with low water holding capacity, high permeability and low to very low SOM.
- **Imperfectly to poorly drained low lying soils (*Soil group 4*)** – Soils with slow permeability, generally sodic, have low to high salinity and prone to waterlogging.

5 Composted mulch specifications for orchards in NSW.

These product specifications for composted mulch build upon the existing general compost product standard, AS 4454 (Standards Australia, 2003). These specifications are targeted at maximising agricultural performance and grower value specifically for orchard applications in NSW. These specifications provide

- General product specifications consistent with AS 4454 (Standards Australia, 2003);
- Additional product specifications that are important to maximise agricultural performance for orchard applications, including
    - particle size grading and application rate;
    - nutrient value and loading rate; and
    - nutrient availability and application timing.

5.1 General specifications consistent with AS 4454

Specifications consistent with AS 4454 (2003)	Units	Limit
pH	-	5.5 to 8.0
EC	dS m^{-1}	<2 (≤ 1 preferable on sensitive sites)
Moisture content	% wet weight	>25 (preferably < 50)
Organic matter	% dry weight	>50
Germination test (plant toxicity)	mm	≥60
Glass, metal and rigid plastics of size greater than >2 mm	% dry matter (w/w)	≤ 0.5
Plastics light, flexible or film >5 mm	% dry matter (w/w)	≤ 0.05
Stones and lumps of clay ≥5 mm	% dry matter (w/w)	≤ 5
Plant propogules/pathogens		Temperature based pasteurisation
Chemical contaminants	ppm dry weight basis	Refer NSW EPA Biosolids Guidelines (NSW EPA, 1997) for relevant requirements for agricultural application

Note that relevant test methods are documented in AS4454

5.2 Additional specifications for peach and nectarine orchards in the Greater Sydney and Murrumbidgee regions

Additional specifications		Soil group 1[1]	Soil group 2[2]	Soil group 3[3]	Soil group 4
Product specifications common to both regions					Mulch application is not recommended on this soil group in both regions
Particle size grading[5]	mm	15% (<10 mm); 85% (>10 mm); min 45% >16 mm; max 5% (>100 mm) particles.	15% (<10 mm); 85% (>10 mm); min 45% >16 mm; max 5% (>100 mm) particles.	30% (<10 mm); 70% (>10 mm); min 30% >16 mm; max 5% (>100 mm) particles.	
Product specifications for the Greater Sydney region					
Application rate (maximum)[9]	Depth (cm)	7.5	7.5	7.5 to 10.0	
	Width (cm)	75 to 100	75 to 100	75 to 100	
Total N loading[6] (associated N availability year 1 of application)	kg/ha	200-360[7]	200-360	200-480	
	kg/ha	(40-72)[8]	(40-72)	(40-96)	
Total P loading (associated P availability year 1 of application)	kg/ha	51-101	51-101	45-90	
	kg/ha	(20-41)	(20-41)	(18-36)	
Total K loading (associated K availability year 1 of application)	kg/ha	68-90	68-90	60-120	
	kg/ha	(54-72)	(54-72)	(48-96)	
Application time	Sydney region	August to September			
Product specifications for the Murrumbidgee region					
Application rate (maximum)[9]	Depth (cm)	7.5	7.5	7.5	
	Width (cm)	75 to 100	75 to 100	75 to 100	
Total N loading[6] (associated N availability year 1 of application)	kg/ha	68-360[7]	68-360	68-360	
	kg/ha	(13-72)[8]	(13-72)	(13-72)	
Total P loading (associated P availability year 1 of application)	kg/ha	51-45	51-45	51-45	
	kg/ha	(20-18)	(20-18)	(20-18)	
Total K loading (associated K availability year 1 of application)	kg/ha	68-90	68-90	68-90	
	kg/ha	(54-72)	(54-72)	(54-72)	
Application time	Murrumbidgee	September or later			

[1] **Soil group 1** - Moderately structured clay subsoils with hardsetting surface conditions.
[2] **Soil group 2** - Well structured clays.
[3] **Soil group 3** - Rapidly drained and highly permeable sandy soils.
[4] **Soil group 4** – Imperfectly or poorly drained soils mainly located on low lying areas.
[5] Note that <10mm refers to particles passing though a 10mm sieve, >10mm refers to particles being retained by a 10mm sieve and >16 mm refers to particles being retained by a 16 mm sieve.
[6] Total nutrient loading rate in kg per ha. Note this is not the total amount of nutrient available for plant use in first year. Nutrients from compost are released over 2 to 4 years. The highest nutrient release is in the first year, the associated nutrient availability in the first year is identified directly beneath each respective total nutrient loading.
[7] Note that the large variation in fertiliser requirement per hectare results from different planting densities, tree maturity/size, and resulting yield per hectare. The "Composted mulch nutrient contribution calculator" developed by ROU in MS Excel 2000 should be used to calculate annual NPK fertiliser contribution from mulch based on the concentration of N, P and K in composted mulch to match the fertiliser practices of an individual grower. This will inform growers how much N, P and K needs to be added as complementary mineral fertilisers each year after compost mulch application, and to avoid excess nutrient application. The calculator is available on line at www.recycledorganics.com/product/agriculture/mulchnutrcalc.htm
[8] Whilst nutrient contribution is based on best information available, it will not be accurate for any specific site as release of nutrients will vary with climate and site conditions. It requires normal nutrient monitoring in accordance with DPI *Fertiliser Replacement Strategy* to inform suitable fertiliser application rates for your site.
[9] Agronomic performance would generally prefer application widths of 75-100 cm however reduced widths of 50-75 cm may be more economical for growers.

5.3 Additional specifications for apple orchards in the Central West and Murrumbidgee regions

Additional specifications		Soil group 1[1]	Soil group 2[2]	Soil group 3[3]	Soil group 4
Product specifications common to both regions					Mulch application is not recommended on this soil group in both regions
Particle size grading[5]	mm	15% (<10 mm); 85% (>10 mm); min 45% >16 mm; max 5% (>100 mm) particles.	15% (<10 mm); 85% (>10 mm); min 45% >16 mm; max 5% (>100 mm) particles.	30% (<10 mm); 70% (>10 mm); min 30% >16 mm; max 5% (>100 mm) particles.	
Product specifications for the Central West region					
Application rate (maximum)[10]	Depth (cm)	7.5	7.5	7.5	
	Width (cm)	75 to 100	75 to 100	75 to 100	
Total N loading[6] (associated N availability year 1 of application)	kg/ha	265-353[7]	265-353	265-353	
	kg/ha	(53-71)[8]	(53-71)	(53-71)	
Total P loading (associated P availability year 1 of application)	kg/ha	95-126	95-126	95-126	
	kg/ha	(38-50)	(38-50)	(38-50)	
Total K loading (associated K availability year 1 of application)	kg/ha	**38-50**[9]	**38-50**	**38-50**	
	kg/ha	(30-40)	(30-40)	(30-40)	
Application time	Central West	September or later			
Product specifications for the Murrumbidgee region					
Application rate (maximum)[10]	Depth (cm)	7.5	7.5	7.5	
	Width (cm)	75 to 100	75 to 100	75 to 100	
Total N loading[6] (associated N availability year 1 of application)	kg/ha	105-141[7]	105-141	105-141	
	kg/ha	(21-28)[8]	(21-28)	(21-28)	
Total P loading (associated P availability year 1 of application)	kg/ha	42-56	42-56	42-56	
	kg/ha	(17-23)	(17-23)	(17-23)	
Total K loading (associated K availability year 1 of application)	kg/ha	63-84	63-84	63-84	
	kg/ha	(51-68)	(51-68)	(51-68)	
Application time	Murrumbidgee	September or later			

[1] **Soil group 1** - Moderately structured clay subsoils with hardsetting surface conditions.
[2] **Soil group 2** - Well structured clays.
[3] **Soil group 3** - Rapidly drained and highly permeable sandy soils.
[4] **Soil group 4** – Imperfectly or poorly drained soils mainly located on low lying areas.
[5] Note that <10mm refers to particles passing though a 10mm sieve, >10mm refers to particles being retained by a 10mm sieve and >16 mm refers to particles being retained by a 16 mm sieve.
[6] Total nutrient loading rate in kg per ha. Note this is not the total amount of nutrient available for plant use in first year. Nutrients from compost are released over 2 to 4 years. The highest nutrient release is in the first year, the associated nutrient availability in the first year is identified directly beneath each respective total nutrient loading.
[7] Note that the large variation in fertiliser requirement per hectare results from different planting densities, tree maturity/size, and resulting yield per hectare. The "Composted mulch nutrient contribution calculator" developed by ROU in MS Excel 2000 should be used to calculate annual NPK fertiliser contribution from mulch based on the concentration of N, P and K in composted mulch to match the fertiliser practices of an individual grower. This will inform growers how much N, P and K needs to be added as complementary mineral fertilisers each year after compost mulch application, and to avoid excess nutrient application. The calculator is available on line at www.recycledorganics.com/product/agriculture/mulchnutrcalc.htm
[8] Whilst nutrient contribution is based on best information available, it will not be accurate for any specific site as release of nutrients will vary with climate and site conditions. It requires normal nutrient monitoring in accordance with DPI *Fertiliser Replacement Strategy* to inform suitable fertiliser application rates for your site.
[9] Figures in bold indicate that nutrient loading from mulch application can exceed nutrient application rate commonly applied via growers' fertiliser practices. Excess nutrient, particularly nitrogen can be detrimental for grape production and/or environment. Nutrient loading can be varied by selection of composts with higher or lower nutrient content, and variation in application rate (depth or width). Reduced application width of 50-75cm may be considered to avoid excess nutrient loading.
[10] Agronomic performance would generally prefer application widths of 75-100 cm however reduced widths of 50-75 cm may be more economical for growers.

6 Application guidelines

6.1 General

- Composted mulches are applied on the soil surface around the plants after planting.
- Avoid application of composted mulches on heavy soil types that are prone to waterlogging.
- Composted mulches can be applied any time of the year. However maximum benefits to crops should be achieved from applications in August to September in the Greater Sydney region, and September or later in the Central West and Murrumbidgee regions.
- Avoid direct contact between mulch and tree trunk as this can result in stem rot.

6.2 Risk avoidance

Excess application rate

- Application of mulches at excessive thickness (>10 cm depth), or application of composts with excessive proportion of fine particles can:
    - Reduce water infiltration into soil,
    - Support weed growth,
    - Suffocate soil, which will have detrimental effect on plant growth, and
    - Increase frost damage (no evidence of risk at ≤10 cm deep application rate).

Excess soil moisture

- Mulch can exacerbate waterlogging of poorly drained soils by reducing soil water evaporation,
- Excess soil moisture from prolonged rainfall can promote excessive vegetative growth in spring, potentially delaying fruiting, and
- Approaching harvest, reduced soil moisture aids development of fruit maturity, the effectiveness of mulch risks delaying fruit maturity by prolonging soil moisture after heavy rain events approaching harvest.

Other

- Excess N can cause problems for fruit maturation and quality. Nitrogen contribution from mulch should be taken into account in nutrient budgeting.
- Composts with high EC levels can cause phytotoxicity and increase soil salinity. EC levels specified for composted mulch avoid risk of increasing soil salinity.
- Temperature based pasteurization required under the Australian Standard (AS4454) destroys pathogens and plant propogules that may be present in raw materials.

7 Integration into farm management practices

The following recommendations are provided to support integration of composted mulch application into annual orchard management practices. These recommendations are relevant guidance for all orchards, and all mulch applications:

1. It is suggested that growers start with a small area of application to identify and resolve any issues of application and integration into farm management practices at small scale, and to identify and realise the benefits of reducing irrigation and fertiliser requirements. Growers are encouraged to apply mulch to an area managed as a unique block or row to enable benefits (such as reduced irrigation) to be realised. This enables growers to make informed decisions for subsequent broader application of composted mulch based on financial benefit through reduced inputs, financial benefits due to improved quality and market price, and reduced risk of crop failure.
2. Growers are encouraged to target mulch applications to poor performing areas in the first instance, as mulch application has shown to increase yield and quality even with reduced irrigation application.
3. Whilst the mulch blanket is expected to provide agricultural performance for up to 4 years at higher application depths, the longevity and duration of performance is based on anecdotal evidence rather than applied trials. The performance longevity of mulch will require monitoring over time to quantify value to growers and to confirm optimum reapplication period.
4. Growers commonly reduce or stop irrigation to reduce soil moisture, which assists in maturation of fruit. The period required for reducing soil moisture for tree rows will be different to that required for bare soil. Soil moisture approaching harvest should be monitored to manage soil moisture under mulched rows.
5. Data shows no increase in risk of frost damage at recommended application rates and shows reduced risk of frost damage compared to straw mulch. Growers should report any problems that arise.
6. Estimated nutrient contribution from compost is based on comprehensive review of international literature. The rate of nutrient release from compost will vary due to climate, soils and management practices. It is not suggested that the figures calculated here will be accurate for any specific property, but figures provide a general estimate on basis of current data. Soil testing and/or leaf analysis and normal nutrient monitoring in accordance with NSW DPI Fertiliser Replacement Strategy should continue be used to better inform site specific performance and application of mineral fertilisers.

8 References

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