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Waste Authority Information Paper
Recycled Organics and Water Use Efficiency
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Introduction

A major driver for improving water use efficiency has been increased water demand and climate uncertainty, both of which have placed strain on the supply of water from existing resources and made provision of adequate soil moisture in urban and agricultural landscapes more difficult.

Recycled organics (such as compost and mulch derived from solid waste) can improve the moisture status of soils and can play a role in improving the efficiency of water use. Moreover, adequate soil organic matter (SOM) is a key factor in maintaining soil fertility and recycled organics can be an effective avenue to increase SOM.

Recycled organics are applied to soils as either surface applications or through soil incorporation, with mulches (in raw form or as processed products) best applied to soil surfaces, while composts and other recycled organics products can be applied to soil surfaces or incorporated into soils.

Each combination of recycled organic amendment type, receiving soil type and amendment approach will alter the specific effects the amendment has on the receiving soil. Nevertheless, soil improvement and soil amendment with recycled organics have been associated through changes to soil properties and functions, including:

- Reduced evaporation
- Increased water infiltration
- Increased water holding capacity
- Improved soil structure
- Promotion of plant growth.

Where soils are amended with suitable organic matter (to the soil surface and/or through soil incorporation), there is the potential for better utilisation of each unit of water received.

Effects of Recycled Organic Amendment

Each of the common soil amendments derived from recycled organics affect soils differently and are considered in more detail below. However, primarily, soil surface application of mulch seeks to reduce soil moisture loss through evaporation, while soil incorporation of finer textured recycled organics products (such as compost) aim to increase a soil's water holding capacity and improve soil structure. With respect to water infiltration, both types of amendment can affect soils for different reasons, with mulch assisting all soils and soil incorporation of compost benefiting finer textured soils more than sandy soils, as sands often already have higher water drainage characteristics. Promotion of plant growth can also assist water use efficiency, through increased water capture and reduced unproductive water losses, which is a wider effect of introducing suitable organic matter into soil.

Surface Amendment

Reduced Evaporation

Where a mulch layer is applied, it changes the rate of evaporation from a soil surface. A mulch layer will partially protect a soil from exposure to solar radiation and air movements, both of which cause evaporative losses. This slowing of soil moisture loss has consequent benefits to other soil properties, including the capacity of a soil to allow infiltration and drainage of water, especially on non-wetting soils and through reducing surface crusting. Mulches can also improve the ability of a soil to support plant growth through improving the topsoil moisture status.

Surface Roughness and Soil Protection

The creation of soil surface roughness, which resists water movement overland, and which consequently assists water infiltration and reduces the risk of soil erosion, provides another reason that mulch can improve a soil. The tendency for increased surface ponding for longer periods of time can result from mulch application. Hence, mulch application is more likely to allow higher total water infiltration per unit of land area, when compared to non-mulched areas.

Also, mulches absorb most of the velocity of incoming water, which reduces damage to the soil surface, particularly for finer textured soils (with higher clay content). This can reduce the risk of soil surface crusting. Soil surface crusting normally inhibits water infiltration.

(**Note**: Composted mulches tend to have lower risk profiles, with less weed seed and plant propagule dispersion risk, along with reduced potential for soil nitrogen loss issues).

Soil Incorporation

Water Holding Capacity Effects

The capacity to hold water within a soil profile against the force of gravity relates to the texture of a soil and the level of organic matter. A soil's texture describes the ratio of clay, silt and sand particles per unit of soil. Water from irrigation or precipitation, moving through a soil profile under the force of gravity, can cling to soil surfaces, while water remaining in larger pore spaces in a soil tends to continue to drain away. The soil moisture remaining in a soil profile relates to a soil's water holding capacity, with finer textured soils (those with higher clay content) usually holding more water per unit of soil volume. However, not all stored soil water is available to plants, as some water adheres too strongly to soil particles. This becomes more of a problem for finer textured soils, even though these soils can usually provide more plant available water than sands.

Research into the relationship between soil organic matter and water holding capacity is indicates it is difficult to provide general trends for finer textured soils. However, research provides good evidence that organic matter has a positive effect on water holding capacity in sandy soils and under many circumstances this translates into increase water availability for plants.

Improved Soil Structure

Another aspect of soil improvement relates to better soil structure resulting from increased soil organic matter. Soil structure involves the aggregating characteristics and the aggregate stability of a soil. Soils can range from non-structured soils, as is the case with many sandy soils, to aggregated soils, where there exists discrete soil structures that can be characterised. Where organic matter is incorporated into soils, the range of pore and channel sizes within a soil will tend to increase. A diversity of pore and channel sizes assists adequate exchange of water and gases through a soil profile, while also allowing soil to interact and store some of the infiltrating water.

Soil organic matter is a key component in well structured soils, as organic matter provides part of a soil's adhesive characteristics, which in turn promotes soil particles being bound into larger discrete aggregates. These aggregating properties also reduce the risk of soil surface crusting. Soil surface crusting can reduce infiltration.

Indirect Effects

Promotion of Plant Growth

Promotion of plant growth can relate to organic amendments and water use efficiency. Improved plant survival and establishment has been associated with suitable recycled organic amendments and subsequent better plant establishment and vigour can be associated with more advanced root development. In turn, better developed roots can capture a larger proportion of water infiltrating into a soil. For example, the improved soil aggregating effects that can accompany an organic amendment will tend to open pores and channels in finer textured soils, which in turn allows easier root development.

Furthermore, any reduction in soil surface crusting (due to better soil aggregation) is likely to assist with plant seedling emergence.

Additionally, plant cover can change soil surface conditions to affect soil evaporative losses, water infiltration and soil structural integrity. All of which can positively effect the proportion of received water being utilised as intended.

Soil Biology

The application of recycled organics to soils can stimulate soil biological processes. Some soil biology, such as worms and other macro-invertebrates, commonly promote some soil mixing and macro-channel creation. This in turn can assist water use efficiency through better water infiltration.

Microbial soil biology can affect water use efficiency, through its association with improved soil fertility and plant health. In turn water use tends to be improved with plants in better condition (especially with respect to root development).

Conclusions

Both soil surface application and soil incorporation of suitable recycled organics can affect directly or indirectly the potential for water use efficiency improvements associated with urban and agricultural landscapes.

Mulches applied to soil surfaces should reduce evaporation from soil and allow water to pool for longer at the soil surface (to assist water infiltration). Also, mulches absorb most of the velocity of incoming water, which reduces damage to the soil surface of finer textured soils. This can reduce the risk of soil surface crusting, a soil degradation effect associated with reduced water infiltration.

Soil incorporation of suitable recycled organics can increase the water holding capacity of courser textured soils (such as sandy soils) and improve soil structure and reduce soil surface crusting for finer textured soils (which can assist water infiltration).

For different reasons, both types of recycled organics application can result in promotion of plant growth and improved soil biology and consequently have water used efficiency effects.

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