organics

Controlling soil erosion on construction sites using compost blankets

FACT SHEET

During construction of residential and commercial infrastructure projects, vegetation, which protects soil from erosion, is removed during civil works. Exposure of soils to the erosive forces of wind and rain can carry soil, sediment, organic matter and nutrients into stormwater, which can reduce water quality and impact on aquatic fauna and flora in receiving waterways.

Hydromulching has traditionally been used by developers to establish a grassed surface on soils after construction works to control soil erosion. This usually involves the spray application of a mix of wood fibre or straw, grass seed, fertiliser and an adhesive in a water based mix.

This fact sheet summarises outcomes from a scientific trial performed by the University of Western Sydney[1] to compare the performance of compost applied in the form of a shallow blanket with conventional hydromulching at a glasshouse scale for controlling soil erosion and promoting vegetation establishment.

Example of a compost blanket applied to an earth embankment prior to germination of a grass cover crop on the M7 Motorway, Blacktown.

The study found that compost blankets are twice as effective as hydromulch at reducing run-off during rain events, and have comparable soil erosion control benefits. Results demonstrated that compost blankets are a highly effective and potentially improved method for controlling run-off and soil erosion on construction sites.

Developments overseas

Over the past 10 years, a number of studies and trials have been undertaken in the United States to develop niche markets for compost manufactured from recycled garden organics, manures etc. An application that has received attention involves the use of compost as an alternative and improved erosion control measure on construction sites.

Interest in using compost has come about due to the need for finding improved techniques for controlling erosion and stormwater runoff from construction sites. Hydromulching and hydroseeding have traditionally been used, but can have a variable success rate, particularly under dry and hot conditions.

In 1993, Ettlin and Stewart[2] compared a coarse and medium grade compost, leaf mulch, hydromulch, sediment fence and a bare soil control. Trials were established in Portland, Oregon at two sites with different slopes (34% and 42%). Runoff samples were collected after five storm events and assessed.

Soil loss under the compost blankets was less than that from sediment fences, and similar to that from hydromulched plots. Soil loss (measured as total suspended solids) was reduced by 97% in hydromulch plots and 96 - 99.1% in compost blanket plots compared to bare soil.

These results were confirmed by Faucette et al. (2005)3 who compared four compost blankets and two hydroseeding treatments (same as hydromulch, but without a wood fibre or straw mulch component). Compost blankets were spread to 37.5 mm depth over a sandy clay loam at a site in Georgia, USA, and were subjected to simulated rainfall (77 mm/hr) immediately after installation, at three months and at twelve months. Total run-off was lower

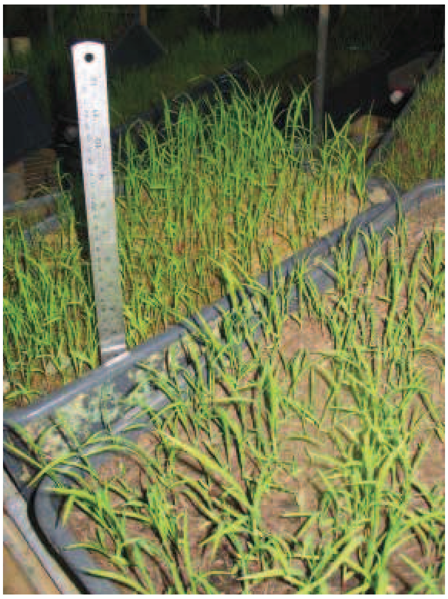

Figure 1. Establishment of the Japanese millet cover crop on non-compacted soil flats with hydromulch (left) and compost blanket (right) three weeks after application. Soil flats are positioned at the low angle of slope (20°).

under compost blankets compared to hydroseed treatments, the difference being significant at three months. Total run-off (compared to bare soil) at the one year mark was reduced by 55% under the compost blankets, and by only 30% under hydroseeding.

More water infiltrated into the soil (compared to bare soil) under the compost blankets (range 31- 51% at first rain event) than under the two hydroseeding treatments (range 20 - 24% at first rain event). The compost blankets also reduced soil loss better than the hydroseeding treatments. Total soil loss was reduced by 95 – 96% under the hydroseeding treatments, and 97 - 98.4% under the compost blankets compared to bare soil.

Given the demonstrated soil erosion control benefits of compost blankets compared to conventional techniques, and through research studies conducted by others4-9, the US EPA in 2005 established compost blankets as the new best management practice for construction site stormwater runoff control10.

Figure 2. Rainfall simulation after Japanese Millet had established on the soil flats.

Trials in NSW

The University of Western Sydney was engaged to evaluate the performance of compost blankets to conventional hydromulching under Sydney climatic conditions.

A replicated scientific trial under controlled glasshouse conditions was established, with soils constructed into soil flats to simulate a road verge construction process11, using a 120 mm clay sub-soil typical of shale soils from Western Sydney, and a 50 mm sandy loam topsoil.

Four treatments were compared:

- Compost blanket[1] with binder
- Compost blanket[1] without binder
- Hydromulch; and
- Bare soil.

Other factors in the experimental design included two angles of slope (20° and 45°) and two levels of soil compaction (uncompacted; compacted). Treatments were applied to the soil flats by commercial contractors used for field applications, with compost blankets installed at 25 mm depth, and the hydromulch to 5 mm (maximum) depth. Hydromulch was applied as per standard roadwork specifications12.

Japanese millet seed was supplied for compost blankets and hydromulch at conventional rates (20 kg/ha). After treatment, soil flats were kept in a glasshouse at the required angle, and watered twice weekly for five weeks (March – May 2006) (Figure 1). Flats were then subjected to simulated rainfall for 30 minutes, at an average intensity equivalent to 92 mm/h (equivalent to 1 in 75 year event for Sydney) (Figure 2).

1. Compost used was classified as a composted soil conditioner as defined in Australian Standard AS 4454 (2003) Composts, soil conditioners and mulches. The compost contained 100% composted garden organics.

Run-off and suspended sediment were collected; variables measured included total run-off, run-off over time (hydrograph), steady state run-off at 30 mins, soil loss, total suspended solids, total N and P in the run-off, plant density and shoot biomass.

These variables were chosen to provide a rigorous assessment of the erosion control performance of compost blankets versus hydromulching.

Run-off

The amount of run-off after a rainfall event is an important measure of product performance, as run-off can carry soil sediment and nutrients into stormwater as it leaves the construction site.

Hydromulch reduced total run-off by 14% compared to bare soil, and steady state run-off by 23%. The compost blankets gave even greater and statistically significant reductions in both total and steady state run-off. The compost blankets reduced total run-off by 46 - 49%, and steady state run-off by 49 to 53%, compared to bare soil, indicating that more infiltration occurred under the compost blankets (Figure 3). Soil compaction and the steeper slope significantly increased both total and steady state run-off, and compost blankets continued to perform better under these conditions.

Soil loss

All treatments significantly reduced soil loss compared to bare soil, by 98% for hydromulch and 99.5% to 99.6% for the compost blankets (treatment averages).

At the steep slope, soil loss was reduced by 91% under hydromulch, and even more under compost blankets (99.8 to 99.9%) compared to bare soil.

The difference in performance of hydromulch and compost blankets were not statistically different, and both performed very well in terms of reducing soil loss.

Figure 3

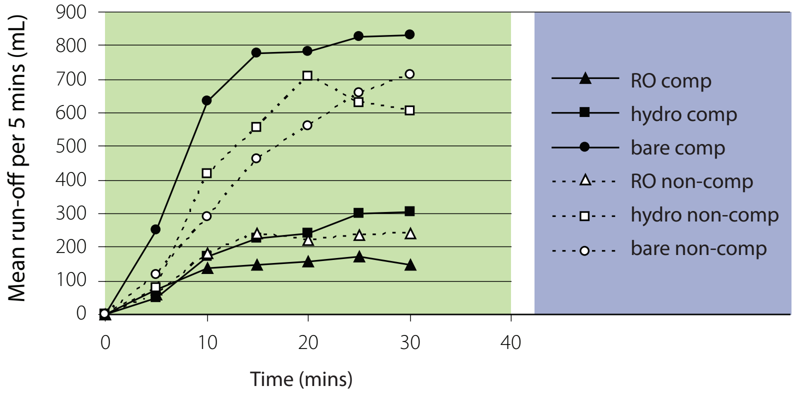

Figure 4

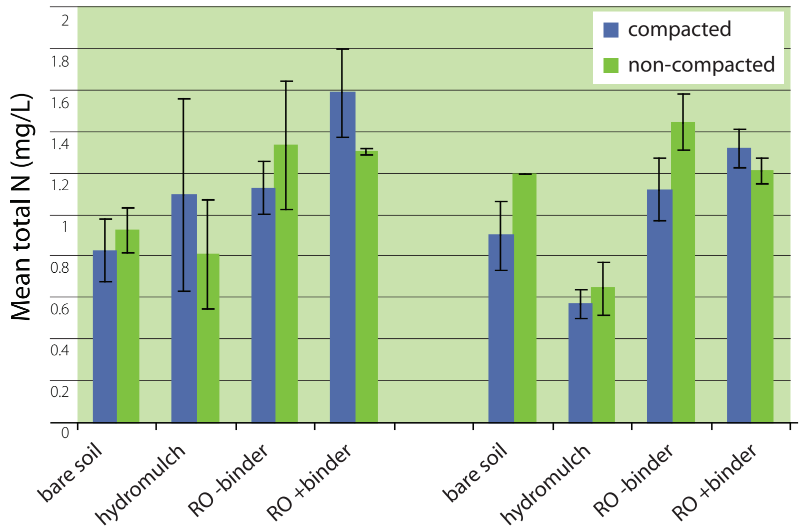

Figure 3. *Run-off over time (hydrograph) for the treatments under compacted and non-compacted conditions at the low angle of slope (20°). Data for compost blanket + and – binder treatments have been pooled. RO, compost blanket; Hydro, hydromulch; Comp, compacted; Non-comp, non-compacted.*

Figure 4. *Total nitrogen in run-off from the surface of each treatment at the low angle (20°) and high angle (45°) of slope. Bars represent standard error of the mean. RO, compost blanket ± binder.*

Total suspended solids

Total suspended solids is a measure of the amount of fine sediment in run-off, that does not settle out of water over time. Suspended solids in water reduces light penetration in the water column, and can clog the gills of fish and invertebrates.

Total suspended solids (TSS) were greatest in run-off from bare soil. All treatments significantly reduced the amount of TSS in run-off, with hydromulch reducing TSS by 98.5% and compost reducing TSS by 96 to 97.3% compared to bare soil.

Statistically, hydromulch performed slightly better than the compost blankets, though both were highly effective in reducing the amount of total suspended solids in run-off.

Nutrients in run-off

The level of nutrients in run-off is important, given that nutrients can create algal blooms and stimulate the growth of aquatic weeds in water ways.

Total nitrogen (N) was lowest in run-off from bare soil and hydromulch (0.8 – 1 mg/L), and slightly higher in run-off from the compost blankets (1.25 – 1.35 mg/L). This result was statistically significant, although the difference in performance is small (Figure 4).

Total phosphorus was lowest in run-off from hydromulch (0.3 mg/L), and higher from bare soil (0.7 mg/L); total P in run-off from compost blankets ranged between 0.3 – 0.7 mg/L, with lower values associated with non-compacted soil. Generally, there was little difference between the performance of hydromulch and compost blankets in term of phosphorus in run-off, and level of nutrients were low.

Plant establishment

Rapid plant establishment is essential on bare soil, as plant root systems play a crucial role in binding soils together, making it more resistant to erosion. Plants also contribute organic matter to soil that also helps to bind soil particles. This can be measured by plant density (plants per unit area) and shoot biomass, or the dry weight of plant material produced.

Plant densities ranged from 2,000 – 5,000 m^{-2} and were significantly reduced by soil compaction, and the compost blanket + binder treatment. The amount of shoot biomass produced on the hydromulch and compost blankets was similar, and was not statistically different. However, soil compaction significantly reduced the amount of plant material produced.

Using compost blankets in construction projects

Installers of compost blankets are available in NSW. These companies source appropriate composted materials from manufacturers, supply seed mixes to meet your specifications, and fully install the compost blanket on your site. They can also provide advice and assist in the design of your erosion control plans.

Contact the International Erosion Control Association (Australasia) via email info@austieca.com.au or website www.austieca.com.au/ for a list of service providers in your area.

Alternatively, you can contact your compost manufacturer to check on the availability of this service. A full list of quality assured compost suppliers are given in the SAI Global Ltd Certification Register, available on-line at register.sai-global.com/ and type in '4454' in the 'known standard' field.

What did we learn?

A summary of things we learnt from the trial is given below.

1 The trial, using soil flats to simulate conditions at an actual construction site produced results which were very similar to field trials undertaken in the United States.

2 Compost blankets are twice as effective as hydromulch in terms of reducing the amount of run-off after a rain event.

3 Other results from the trials clearly demonstrate that compost blankets consistently performed at least as well as hydromulching.

4 Hydromulching performed slightly better than compost blanket products for total suspended solids, total N, and total P (on uncompacted soils) in the trial. However, nutrient levels in run-off were very low. It should be recognized that whilst the compost blanket products had higher concentrations of total N and P in their run-off, they also had the lowest run-off. Thus, the total load to the environment in field trials may well be less from the compost blankets.

5 The presence or absence of binder in the compost blankets made very little difference to run-off (total, and steady state), soil loss, total suspended solids and nutrient concentrations. The only significant effect detected for the presence of binder was a reduction in plant density (but not plant growth) for the + binder treatment. The reason for this reduction in density was not clear.

6 To help develop this market, large-scale trials would assist in verifying product performance under different climatic conditions.

7 Product specifications and installation guidelines for compost blankets is required. Use of specifications and guidelines published by the US EPA[10] in the interim may be appropriate until these are developed for NSW.

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Contact details

Published by:

Department of Environment and Climate Change NSW

59–61 Goulburn Street
PO Box A290
Sydney South 1232

Ph: (02) 9995 5000 (switchboard)

Ph: 131 555 (environment information and publications requests)

Ph: 1300 361 967 (national parks information and publications requests)

Fax: (02) 9995 5999

TTY: (02) 9211 4723

Email: info@environment.nsw.gov.au

Website: www.environment.nsw.gov.au

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