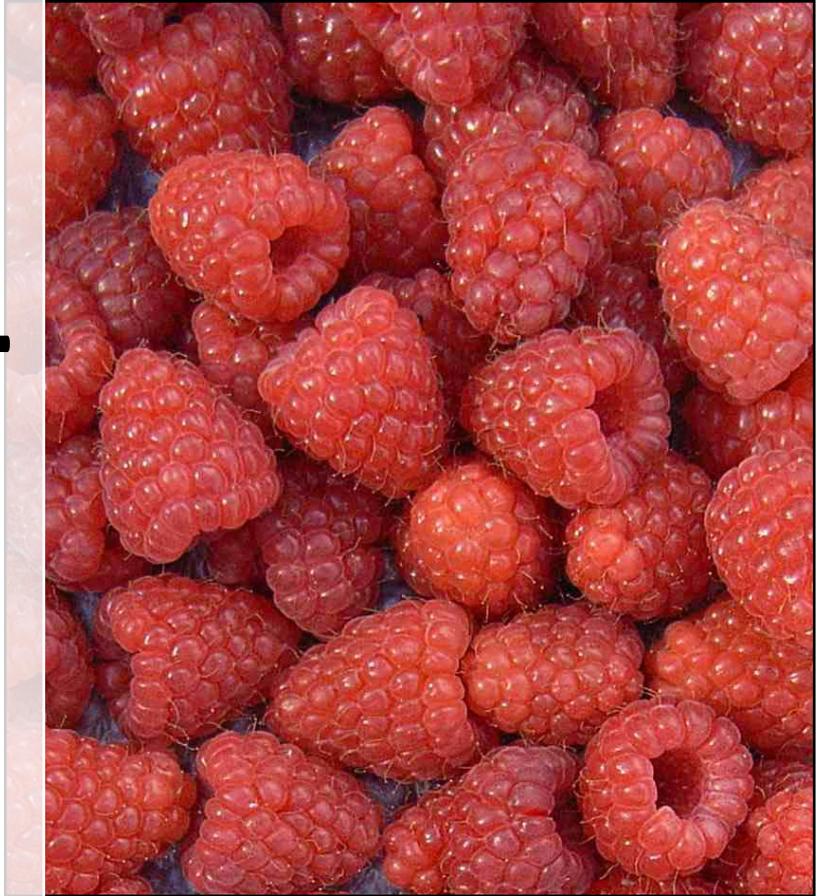


Soil Remineralization Forum

Lynn Baird & Dr. Robin Szmidt

Report 2008



This report summarises the findings from studies commissioned by SRF in 2007 and 08.

Soil Remineralization Forum

SRF
c/o Kuttner (UK) Ltd
29 Miller Road
Ayr, KA7 2AX



Soil Remineralization Forum_____

Project Update: December 2008

The following is a summary review of projects commissioned by the Soil Remineralization Forum (SRF). Where indicated, full technical reports are available, depending on the agreement with contractors. Co-sponsored projects may be subject to some restrictions depending on contractual terms previously agreed with third-parties. Academic reports may be embargoed due to the time required for other precedent publication, for instance in submission for a higher degree or as papers to an academic journal.

The following text is derived from the reports submitted to SRF. Modifications may have been made to adjust style or presentation but not to alter the conclusions of the contractors. While full reports may be requested from SRF, charges may apply. Please contact us for more information.

This summary report is freely available but may not be used in whole or in part for commercial gain. If you wish to publish commentary on this work please first submit draft copy for our review.

www.reminforum.org.uk

email: remin@kuettner-uk.com

Soil Remineralization Forum
c/o Kuttner (UK) Limited,
1st Floor, 29 Miller Road,
Ayr,
South Ayrshire, KA7 2AX,
Scotland.
☎ +44 (0) 1292 283543



SRF001 (30/01/2007)

The effect of greenwaste compost and rockdust on the yield and quality of an organic oat crop and on soil chemical, biological and physical properties

Contractor : SAC, Aberdeen

Project Manager: Dr Audrey Litterick

Location: Aberdeenshire

Timescale: Summer 2007

Co-funder: WRAP

SRF provided funds to add extra treatments to a trial already funded by WRAP to view the effects of PAS 100 compost on the quality and yield of an organic oat crop. This work, carried out in Bielside, Aberdeenshire contained the treatments of a control, two rates of greenwaste compost and a standard rate of prior-stacked farmyard manure. The SRF funding allowed a further three treatments to be added; one of rockdust only and two rates of compost with rockdust. Seven treatments were applied to the field four times in a fully replicated, randomised block design. This work was to determine whether PAS 100 quality compost, and/or rockdust affected:

- Organic oat crop yield and quality;
- The availability of plant nutrients in soil
- Soil microbial activity;

and give a financial appraisal of oat growing with and without compost.

The trial was carried out with the amendments applied at typical rates used in commercial production and compared with oats grown with the standard application of manure treatment and an untreated control.

The assessments made during and following the trial:

- Soil tests before and after cropping (soil respiration, pH, organic matter, total N, P, K, available P, K, Mg and Ca soil texture and soil structure.
- Fortnightly records of crop growth stage and general crop growth.
- Fortnightly pest and disease assessments



- Crop yield and quality at harvest.

The results are detailed in the full report giving comprehensive assessments of the work and analysis carried out. The key findings include detailing of the benefits of PAS 100 compost when applied to a sandy loam soil with low phosphorus and potassium levels, particularly the higher of the two rates when compared with the control. The higher rate was equal to stacked manure at 10t/ha. This has potential for organic grower where there is a shortage of phosphorus and potassium. However, PAS 100 compost may be a more expensive choice when compared to use of conventional fertilisers, depending on the grade of compost, haulage and the mechanisation used for spreading.

Rockdust is also relatively expensive on a nutrient-for-nutrient basis and is bulky and heavy to apply. In agricultural terms there was no clear evidence from this one-year trial that plant-health or yield was improved. Chemical analysis of the rockdust showed low concentrations of available magnesium, calcium and some trace elements but not enough is known about the role of these minerals in the given time span. There appeared to be some trend of rockdust-enhanced soil microbial activity, measured by substrate-induced respiration or nitrification. However, these results were not statistically significant compared to untreated plots or plots containing only manure or compost.

Further work using different soils and sites was recommended to test nutritional quality of oats and microbiological activity between treatments and over the medium to long term. Even though there was no statistical difference demonstrating clear benefits of rockdust, results indicate there are some trends that require to be further investigated.



SRF003 (12/4/07)

Quality factors of the fruit of Strawberry plants treated with Volcanic Rock dust

Contractor: HortiCS

Project Manager: Colin Stirling

Location: Aberdeenshire

Timescale: Summer 2007-08

This project examined whether volcanic rock dust can supply additional minerals within a fertiliser programme. This project was an assessment on any benefits to strawberry plants and to the quality of fruit produced by the addition of volcanic rock dust at the planting stage in the first year of production.

The site chosen was 140m long and was made up of 16 beds (1.82m c/c) in a randomised layout. The surface of each bed section had a surface of c.1.2m×5m. A compound fertiliser applied at the time of producing the beds to provide 37.5kgN/ha, 37.5kgP₂O₅/ha, 65kgK₂O/ha. The application rates for rock dust were comparatively high in order to reveal results in the first year. Applying on the surface allowed the rock dust to be incorporated to the roots of the plants while surface fines could leach into the soil over the course the year.

On the 15th May 2007 nine replicated plots were treated at two depths of rock dust 10mm, 20mm and a control. Soil samples were taken for analysis and the beds made up and planted as per standard practice with a herbicide and fertigation programme.

A truss assessment was carried out in July 2007 to assess the variability of plant material and at the time of harvest, August 2007.

Assessments were carried using soil analysis, truss counts, leaf analysis and an evaluation of the sensory properties of fresh strawberries. Samples of fruit were rated for appearance, flavour, aftertaste, mouth feel and overall acceptability, firmness, shelf-life and soluble-solids (Brix) testing.

In summary, the 'exceptionally wet' weather had a major impact on the fruit which was of poor quality and in short supply on many plots. Results showed no significant differences between treatments. Post-harvest soil samples were collected from the plots (autumn 2008) for further analysis. For a total of 34 parameters spanning plant growth and development as well as soil minerals and nutrient, both total and available, no statistical differences were detected in plots amended with rockdust when compared to controls.



SRF004

SEER Field Research Continuation 07-09

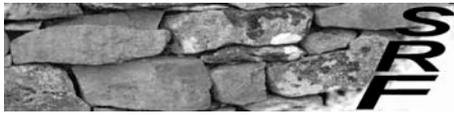
Contractor: SEER Centre Trust

Project Manager: M. Thomson

Location: SEER Centre, Enochdhu, Nr. Blairgowrie

Timescale: 2007 - 2009

This was an award of funds to cover the work of the SEER Centre Trust for maintenance of , and access to, the grassland research plots at the SEER Centre for 2007-end 09'. These long-term plots form the core resource of a number of elements of research at SEER, principally that undertaken by the University of Glasgow. The SRF support pays for rental and upkeep of the experimental grass plots which includes manure application, electrical fencing, bailing of grass and other SEER costs.



SR F005

Remineralization of Protected Raspberries

Contractors: Active Compost Ltd / Angus Horticulture Ltd / Thomas Thomson Ltd

Project Manager: Dr Robin Szmidt

Location: Blairgowrie

Timescale: 2007-08

Co-funder: Angus Horticulture

'This is a project combining studies on the potential benefits of soil-remineralization with a premier Scottish crop of economic and human-health value. The trial was carried out on the crop of a leading grower under 'high-input' conditions. The crop was grown under unheated protection using so-called 'Spanish tunnels, which were uncovered for the winter and non-cropping periods.

The trial consisted of an application of two different rates of rockdust, (equivalent to 2 and 10 tons per acre) plus a control applied prior to planting in three crop tunnels as a fully replicated block in a Latin Square design. Substrate analysis was required at beginning and end of trial to measure macro, micro, heavy metal and PTEs¹. A broad range of assessments were carried out over two growing seasons from planting in 2007. Assessments related to both gross yield and quality, both of fruit and plant-growth, i.e. new growth, in-field disease symptoms, overall plant development and yield as early, mid and late season when compared to the untreated crop as a control. In addition soil analysis at harvest to give possible trace element differences and sensory testing to rate raspberries for quality. A total of 67 parameters were examined spanning:

Crop yield over 2007 and 2008

Fruit quality

Plant performance / health

Soil nutrient status (available and total)

PTEs

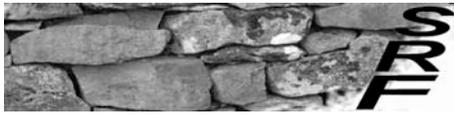
¹ PTEs: Potentially Toxic Elements



Around 10,000 individual data points were recorded from the plots which were laid out in a randomised Latin Square design and subject to comprehensive statistical analysis.

Only two parameters showed any statistically significant difference, with fruit length and colour (purpleness) being enhanced in plots supplemented with rockdust.

Further analysis is being undertaken to examine clusters of factors, such as all PTEs. Results of this assessment of existing data are expected early in 2009.



SRF006 (12/4/2007)

The Suitability of Rockdust for Use in Top Dressing Mixes for Fine Turf

Contractor: Angus Horticulture

Project Manager: STRI

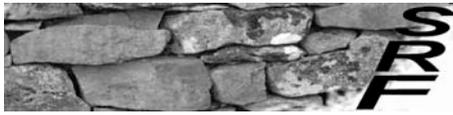
Location: Bingley

Timescale: Summer 2008

Co-funder: Angus Horticulture

This project was carried out at the UK's premier research and development centre for the sports-turf industry, STRI. Completed in July 2008 the project was to apply top dressings to a sports-turf trial in a randomised block design using various treatment mixes. The top dressing treatments included 2 different rock dusts, in two different percentages and/or sand, peat and green compost. Each dressing was replicated 3 times and there were four different applications. Golf wear was simulated to give the amount of wear the green would receive in a normal year.

The final report concluded a year of stringent test work and assessment. Incorporating rock dusts in a top dressing mix produced very small inconclusive effects. It was considered by the research contractor that further work should concentrate on particle size and long term effects which were outwith the scope of this trial programme.



SRF007 (20/04/2007)

Effect of rockdust on microbial activity in field plot sites

Contractor: University of Glasgow

Project Manager: Dr T.H. Flowers

Location: University of Glasgow, Dynamac Corporation, Kennedy Space Center.

Timescale: Summer 2007

This project was an addition to the research programme and field experiments carried out at the SEER Centre by the University of Glasgow, Department of Chemistry 'to examine the effects on the microbiological and carbon turnover in the soils'. The research forms a concluding part of an ongoing PhD project. SRF funding enabled the researcher to carry out experimental work at the Dynamac Corporation research facility at Kennedy Space Center, Florida, USA as well as the University of Glasgow.

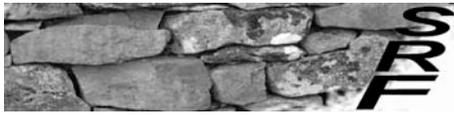
Objectives:

- Incubate soil and measure endogenous respiration using traditional techniques
- Carryout BDOxy-CLPP (un-supplemented) analysis on these samples to correlate the two techniques
- BDOxy-CLPP carbon source supplemented analysis to test functional differences between treatments
- Nutrient limitation – supplemented BDOxy-CLPP analysis

Soil samples were collected from the SEER Centre experimental plots in Perthshire for subsequent analysis under permit at the USA facility. The experimental plots had received an annual application of fertilizers from 2004 to 2006 and half the plots had previously received defined rock dust applications in 2003.

Analysis of the various soil amendments was carried out using BDOxy-Community level physiological profiling which was used to test differences in soil microbial communities, potentially due to rockdust addition.

Results show that although rockdust amended soils did not exhibit significant increases in microbial activity there were differences in the type of microbial community activity. This apparent trend requires further investigation into the role of soil microbial communities as influenced by organic amendments and organic-mineral interactions in soils. Furthermore this could potentially relate to soil carbon-cycling. Further research is required. The full results of this research are currently embargoed subject to submission of the relevant PhD thesis to be examined early in 2009.



SRF008 (28/05/07)

Supplementation of Bioremediation using Mineral Fines

Contractor: CLARRC

Project Manager: Mr Colin Cunningham

Location: The University of Edinburgh: CLARRC

Timescale: 2007-08

Co-Funder: LEONARDO Scholarship

Soils contaminated by petroleum hydrocarbons and polycyclic hydrocarbons; such as diesel, can be treated by bioremediation by co-composting with organic wastes and /or microbial cultures which metabolise the hydrocarbon pollution and return the soil to a safe condition. This project tested the hypothesis that rock dusts may have the potential alone or in combination with other amendments to enhance soil microbial activity and therefore enhance pollutant degradation / enhance bioremediation.

CLARRC set-up small-scale biopiles of hydrocarbon contaminated soil; 13 in total in an unheated greenhouse at the University of Edinburgh. Each 'biopile' consisted of 85 Kg of sieved soil (4mm) and each represented a different treatment and was a combination of conventional nutrients (N and P), organic amendment (anaerobic digestate liquid) and two different rock dust applications.

Monitoring of the biopiles consisted of soil toxicity testing using seedling germination and concentrations of oxygen and carbon dioxide measured using a landfill gas analyser. Temperature measurements were also monitored.

Some mineral fines (rockdusts) have been shown to increase the metabolic rate of composting. For this project, two sources of rockdust and anaerobic digestate liquid (ADL) were tested together and separately as an alternative to the most commonly used bioremediation nutrient amendments. The project gave some innovative results. While conventional nutrient-use resulted in improvements compared to controls, of particular interest was the combination of anaerobic digestate liquid and rockdust. The greatest Total Petroleum Hydrocarbon (TPH) reduction was observed in biopiles co- treated with ADL and rockdust. Results were statistically significant for those treatments using ADL + rockdusts and ADL alone. The TPH reduction using these treatments was twice as much as in the controls and 20% greater than the rest of the amendments tested. The trend in polycyclic aromatic hydrocarbons (PAH) was similar to the



TPH result, even though these compounds tend to be recalcitrant. Reductions were significant for treatments using ADL + rockdusts, ADL alone and ADL plus conventional nutrients ($\text{NH}_4\text{NO}_3 + \text{KH}_2\text{PO}_4$).

The trial highlighted a potential new use for by-products from the quarry / remineralization sectors as well as the organics-recycling industry as amendments for the bioremediation of hydrocarbon-contaminated soils.



SRF009 (27/05/2007)

Remineralization Project Cooperation

Contractor: SRF

Project Manager: Dr Robin Szmidt

Location: Sweden

Timescale: 2007 –

This project is to assist the process of international liaison at a scientific and technical level

- Outputs Expected:
- Input to programme planning for the Swedish researchers
- Evidence of sound scientific research in this area of study
- Access to large scale research data
- Acknowledgement of the Soil Remineralization Forum
- Outreach of SRF activities to an international audience
- Presentation of Forum activities at workshops/ seminar/ group meetings in Sweden
- Interpretation of Swedish data in a Scottish context

SRF010 UK Site Visits

This funding is to enable contact and management of SRF projects.



SRF011 (21/01/2008)

WIREC 2008 sponsorship and presentation

Contractor: Dr. L. Sikora

Project Manager: SRF

Location: USA

Timescale: 2008

Dr Larry Sikora attended the Washington International Renewable Conference 2008 (WIREC 2008) on behalf of the SRF, presenting the interests of the Forum to an international audience. Delegates came from more than 70+ countries from around the world, with the total number of delegates more than 9000. SRF co-sponsored the Remineralize the Earth side-event on Remineralization within the WIREC meeting. The conference was a global opportunity for US national and international government officials, academics and business representatives to meet and discuss resource-use, renewable energy and related issues on a global scale. Of particular interest to the remineralization sector were resource-use issues such as the fertiliser industry, soil protection and biofuel / biocrop vs. food production.

A full report of the networking and liaison arising from the event was filed by Dr. Sikora and details of the event can also be seen at:

<http://www.wirec2008.gov>



SRF012 'SEER Centre/ Kindrogan Field Studies Centre Soil Remineralisation Education Project, Stage 1'

Contractor: SEER Centre

Project Manager: Mr Alan Grant

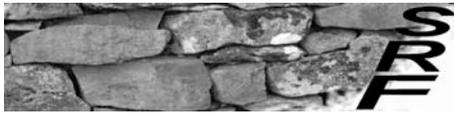
Location: Enochdhu, Blairgowrie

Timescale: 2008 -2009

This project is stage 1 of a proposal to set up an education project initially at the SEER Centre in association with the Kindrogan Field Studies Centre to provide short courses on soil remineralisation and organic growing. To enable the realisation of the project Temple Lewis has been contracted to identify the funding necessary for the realisation of the project (Phase 2) and outline the framework required between Kindrogan and the SEER Centre to enable the courses to progress to a 2008 - 09 start.

Reports received have detailed the opportunities with Oatridge College for accreditation of courses to run as part of their own programme with SEER assembling and delivering the course work. Courses would be aimed at professionals working in the agriculture/ environmental sectors in the first instance. The Kindrogan Field Studies Centre and SEER Centre are in the process of working out detail for the short courses.

At the time of writing, the draft project has been outlined, costs identified and some potential external funding sources contacted. A further progress report is awaited. The project is progressing with a view to implementation in 2009, subject to further funding and / or re-application to SRF.



SRF013 (03/11/2008) WRAP proposal:

Compost and Mineral Blends as a Topsoil Substitute and Landscape Planting Mix

Contractor: Kuttner (UK) Ltd

Project Manager: Ms L Baird

Location: Dumfries and Galloway, South Ayrshire

Timescale: 2008 – 2010

The following is the basis of an application to WRAP, awarded subject to contract.

While PAS 100 sets the standard for compost products, from a user's perspective, it may not guarantee performance. In some situations, such as a bulk planting mix and soil improver in high quality at-risk areas many composted materials do not perform satisfactorily. Examples include new development construction sites and planting areas. Many construction areas have poor or very poor soil conditions yet contractors may be expected to create high value landscaping in a short period of time. They may face penalty clauses and obligatory re-planting in the event of plant failure. Plant failure may be due to a range of factors such as lack of uniformity of soils and improvers, mineral imbalance and poor physical structure. Penalties resulting from failure of new commercial landscaping can exceed the cost of the initial planting (J. Gordon, personal communication) and so there is a significant motivation to use good materials in this soil-sector. In addition contractors are more likely to win the job if they have good environmental credentials, for instance by using composted / recycled materials.

In parallel there is strong circumstantial evidence that some types of recycled minerals can contribute significantly to plant establishment in new-build areas.

The project will further develop blends of compost and minerals based on reject quarry fines (rockdust) creating balanced soil improvers, conditioners and planting mixes. This can be an important addition that would create planting mixes that the market requires.

This project is being established at this time, reports to follow.