CROP SCIENCE SOCIETY
OF SA INCORPORATED
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NEWSLETTER

Welcome to the June issue of the Crop Science Society of SA newsletter

In this month's newsletter we explore:

- Biochar Feed Supplement in Dairy to Increase Milk Yield and Landscape Health
- Animal Control Technology Australia – May 2021 Mice control update.
- Understanding pre-emergent herbicides and how they interact with the environment
- Herbicides and Dry sowing
- Awards and Scholarships
    - Tony Rathjen Student Contribution Award
    - Duncan Correll Crop Science Society Awards
    - John Both Award for excellence in in-field crop research
    - Yipti Foundation Awards
- Events and workshops

We hope you are keeping well. Please contact us if you have any requests for content or information.

Many thanks
Craig Davis
President, Crop Science Society of South Australia

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Biochar Feed Supplement in Dairy to Increase Milk Yield and Landscape Health

A Technical Report for the SA Dairy Industry Fund Board March 2020

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Below is an edited version of the full report

Summary
Biochar has been used a feed supplement for Beef and Dairy Cattle in Australia and Europe showing potential to reduce costs for the farmer while improving soil and pasture health (Joseph et al, 2015). Research identifies biochar as having multiple benefits within the diet of a rumen with the ability to improve feed conversion (Schmidt et al, 2019).

This project set out to investigate the economic and farm health benefit by feeding biochar to dairy cattle.

The project utilised 4 dairy's who process their milk as part of Fleurieu Milk Co and are within the Myponga catchment of the Fleurieu region. The 4 dairies utilise national herd testing with access to current and historical milk data and all have a dominant population of dung beetles burying 5 tonnes of dung/day produced by the cow herds. This project objective was to;

- investigate the changes in milk production, quality and cell count as a result of feeding biochar over 9 months (within individual dairy's) and compare to historical data
- conduct an exploratory analyses of soil properties and plant health benefits as a result of the biochar laden dung burial by dung beetles,
- calculate the economic benefit as a result of feeding biochar to dairy cattle.

By feeding biochar to cattle at two dairies and not feeding to two others (for a nine-month period in 2019) and comparing with historical data;

- There was a statistically significant increase in milk yield of 1.4 litres per head per day at one biochar fed dairy (Clark with Jersey cows) and a larger milk yield increase in the 1 and 2-year-old animals.
- In the other biochar fed dairy the project was unable to utilise the milk yield results due to a feed contaminant.
- In one non-biochar fed dairy there was a lower statistically significant increase in milk yield of 1.1 litres per head per day (with a significant effort to focus on herd health utilising a naturally higher yielding dairy cow breed, Holsteins).
- In the other non biochar fed dairy there was a decrease in the milk yield with Holsteins.

In addition initial soil and plant analysis indicated;

- There was an increase in the soil quality and plant health in the analysed paddocks of the biochar fed dairies compared with no substantial increase in soil and plant health in the analysed paddocks of the non-biochar fed dairies.
- The biochar element in the soil appears to be increasing the pH and hence perhaps farmers could also use this as an alternative source of lime and it remains in the soil for 1000 years vis lime as it leaches through the soil and needs re application to neutralise the soil ever 3 to 5 years.
- The biochar in the diet appears to have resulted in the need for less fodder likely due to the redox active reactions taking place more efficiently in the rumen (biochar is a redox active substance accepting storing and donating electrons, Schmidt et al, 2019, which could in turn increase the feed intake efficiency (Liu et al., 2012; Leng, Inthapanya & Preston, 2013). In the high-energetic diets (such as dairy) a well-balanced animal feed regime should contain multiple electron mediating substances (Sophal et al., 2013) (ie biochar).

The biochar had a positive impact on milk yield which was evident after the first month of feeding biochar. The corresponding improvements on soil and pasture quality measured are an additional bonus, in both biochar fed dairies. Additional milk yield, plant and soil health benefits would likely to continue to build if the biochar feeding was to continue. Fodder use reductions may also continue to build as the biochar changes the microbial communities in the rumen and the functioning of the biofilms on the rumen walls. Biochar in the dung may also improve pasture health and thus reduce the need for as much fodder (as has been also found by Doug Pow).

As a result of the initial soil and plant health evidence found in this trial, Climate & Agricultural Support Pty Ltd has begun a replicated soil and plant health trial looking at the effect of biochar laden dung burial vs non biochar laden dung. In this trial similar plant and soil health measurements (as per this trial) are being taken with treatments of 2 x rates of biochar in and under the dung over a 2-year period. The results will be published on the company web site by end of 2021.

The trial was funded by the SA Dairy Industry Fund which obtains funds via sale of milk through Coles supermarkets. The trial was funded for 9 months. However, additional biochar was provided by Soft Agriculture and Agspand as a financial contribution to this project. Financial support was also provided by the University of New South Wales for the analysis of the biochar's and additional analysis of the data from the dairies.

Background

Biochar has been used a feed supplement for Beef and Dairy Cattle in Australia and Europe showing potential to reduce costs for the farmer while improving soil and pasture health (Joseph et al, 2015). Research identifies biochar as having multiple benefits within the diet of a rumen.

Many consider biochar as a veterinary drug to tackle ingestion and poisoning (Schmidt et al (2019). It has a high adsorption capacity for a variety of different toxins like mycotoxins, plant toxins, pesticides as well as toxic metabolites or pathogens.

It has an “enteral dialysis” property, due to the huge surface area of the biochar and can interact with the permeability properties of the intestine (Schirrmann, 1984). Hence it has the ability for example to absorb chemicals like glyphosate found in relatively high levels in grazing animals of treated properties (Gerlach A, Schmidt HP, 2014).

Biochar is also described as having a positive impact on feed conversion as biochar is redox active and can accept, store and donate electrons (Schmidt et al, 2019). During the microbial decomposition of organic substances in the gastrointestinal tract, digestive microbes can be provided a terminal electron from biochar to enable them to get rid of surplus electrons that accumulate during the degradation of organic molecules.

A well-balanced animal feed regime should contain multiple electron mediating substances. In the high-energetic diets used in intensive livestock farming, (Sophal et al., 2013). When inert or other non-toxic electron mediators like biochar or humic substances are added to high-energy feed, several redox reactions may take place more efficiently, which could in turn increase the feed intake efficiency (Liu et al., 2012; Leng, Inthapanya & Preston, 2013).

Leng et al 2012 also suggested that electron transfer between biochar and microorganisms could be one of the reasons why feeding biochar to cows led to reduced methane emissions. The relatively large surface area and highly porous structure of biochar may provide a favourable habitat for organisms involved in a methanogenic-methanotrophic interaction, stimulating an increase in sulphide production rate (sulphur is the terminal electron acceptor in anaerobic methane oxidation, like nitrate) and therefore increasing the potential for anaerobic methane oxidation. Leng et al 2012 conducted in vitro studies which revealed methane production reduced significantly by 10 to 12.7% respectively with biochar additions to the ruminal liquid of 0.5% and 1%. Higher levels of biochar did not further reduce methane production. All experiments were conducted in the presence of 2% urea as a non-protein source of nitrogen. When urea was replaced with nitrate (6% of DM feed intake as KNO3 to supply the same amount of N), methane production decreased by up to 49%.

There are also many studies that reveal the beneficial soil, plant and biomass benefits of adding biochar to the soil (Rebbeck and Tonkin, 2020 & Rebbeck, 2018c), however application methods that involve soil disturbance can compromise soil structure and carbon content can be compromised and reduce the carbon building ability of biochar (Rebbeck, M 2018a). However in the presence of dung beetles, additional opportunities exist to build soil health and then corresponding plant and animal health through burial of the biochar laden dung of cattle and other rumen. Once biochar is fed to an animal most of the biochar is not absorbed and remains in the dung. In certain regions where dung beetles are present this biochar can be buried relatively quickly building the carbon in the soil and having beneficial microbial effects on soil health and hence pasture production (Doube and Marshall, 2014).

Researcher Mc Henry 2010 and Blackwell 2009 devised project options to integrate biochar into the diet of animals to improve meat production and investigate the opportunity for improving soil carbon and both concluded that more research was required to substantiate these opportunities.

Soil Quality

It appears that more improvements over time in soil quality were recorded in the two dairies that fed biochar, while a rate of soil decline were recorded in the two dairies that did not feed biochar as shown in table 16.

Table 1 : The differences in soil quality parameters measured January and again in September (taken from each of the 4 dairy case studies with or without biochar as per table 4, 8, 12 and 14 in this report. Improvements are highlighted in blue.

	Soil Test	Clarke With biochar	Hutchison With biochar	Martin No biochar	Paciti No biochar
	Change from Jan to Sept 2019	**Difference**	**Difference**	**Difference**	**Difference**
	pH 1:5 (Water)	0.47	0.7	0.27	-0.03
1	pH 1:5 (CaCl2)	0.65	0.68	0.12	-0.05
2	Organic Carbon (W&B) %	-1.51	0.17	-0.57	-0.64
3	Nitrate - N ppm	-3.2	-0.09	-14.5	-2.7
4	Ammonium - N ppm	-2.7	7.5	-1.4	-102.3
5	Ca: Mg RATIO	2.27	0.72	0	-1.08
6	Grass Tetany Risk Index	0.02	0.01	-0.01	0
7	ECEC c mol/kg	0.42	1.09	-2	-2.1
8	Calcium (Ca) ppm	140	261	-220	-220
	Calcium % Ca	5.1	11.9	0.7	5.1
9	Magnesium (Mg) ppm	-31	22	-65	-31
	Magnesium % Mg	-4.4	0	0	0
10	Potassium (K) ppm	35	27	-81	-16
	Potassium % K	1.2	1.2	-0.2	-0.1
11	Sodium (Na) ppm	-21.2	-100.6	-38	-163
	Sodium % Na	-1.6	-12.9	-0.6	-4.8
12	Exch. Aluminium % Al	-0.3	-0.01	-0.01	-0.01
13	Boron (B) ppm	0.04	0.02	-0.2	-0.2
14	Iron (Fe) ppm	-55	80	100	-17
15	Manganese (Mn) ppm	8.2	-664	6.4	1.7
16	Copper (Cu) ppm	0.39	0.29	0	0.1
17	Zinc (Zn) ppm	0.5	-1.34	-7.5	-3.6

Table 16 highlights the improvements in soil quality in blue where the dairys feeding biochar had an increase in over half of the soil quality parameters where the non-biochar feeding dairies had a decrease in the majority of soil health parameters

Some of the more significant soil quality indicators that increased at the dairies using biochar included pH, ECEC, and calcium as shown in figures 42 and 43 where the two dairies that fed biochar (Clarke and Hutchison) recording an increase in the soil pH, ECEC and calcium while those that did not feed biochar stayed the same or decreased.

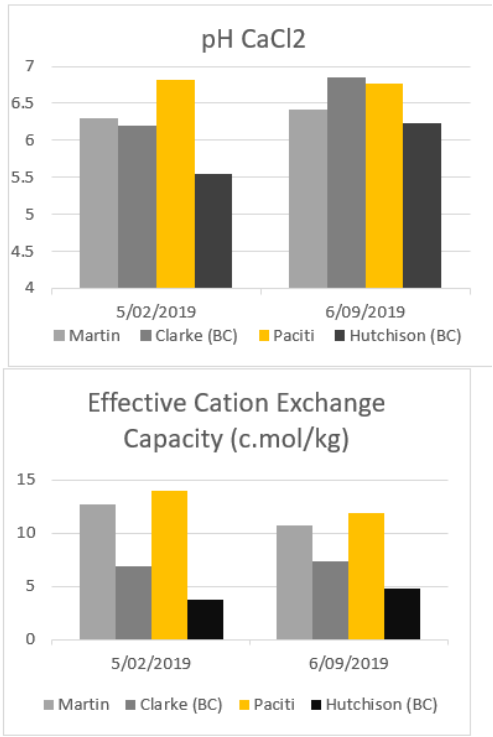

Figure 1 Soil Health indicators pH(left) and organic carbon (right) at the 4 dairies in Fleurieu Milk Co with Clarke and Hutchison being the 2 biochar fed dairies.

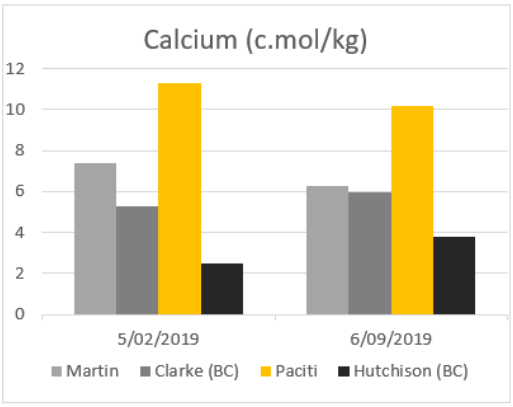

Figure 2 Soil Health indicators changes including ECEC (left) and calcium (right) at the 4 dairies in Fleurieu Milk Co with Clarke and Hutchison being the 2 biochar fed dairies.

Plant Quality

Table 2 The differences in plant health parameters measured January and again in September (taken from each of the 4 dairy case studies with or without biochar as per table 5, 9, 13 and 15 in this report. Improvements are highlighted in blue with minor changes in grey.

	Plant Tissue Element	Clarke With biochar difference	Hutchison With biochar difference	Martin No biochar difference	Paciti No biochar difference
1	Aluminium mg/kg	220	2230	20	63
2	Boron mg/kg	-2	-12.3	-1.6	-1.6
3	Calcium %	-0.14	-0.63	-0.07	-0.33
4	Chloride %	-1.4	-0.4	-0.6	-0.5
5	Cobalt mg/kg	0	0.61	0	0
6	Copper mg/kg	-3	-3.9	-3.6	0.3
7	Iron mg/kg	20	1750	-10	-290
8	Magnesium %	-0.04	-0.2	-0.06	-0.08
9	Manganese mg/kg	-66	29	28	9
10	Molybdenum mg/kg	0.9	0.06	0	0.4
11	Nitrate – N mg/kg	58	-23	-156	10
12	Nitrogen %	1.59	-0.17	1.18	-0.09
13	Phosphorus P %	0.15	0.03	0.07	0.02
14	Potassium K %	0.55	0.55	0.1	0.64
15	Sodium %	-0.74	-0.33	-0.1	0.02
16	Sulfur %	-0.05	-0.04	-0.13	-0.06
17	Zinc mg/kg	-9	-11	-23	-5

More improvements over time in plant health were also detected in the two dairies that fed biochar, as shown in table 17. The increase in the ECEC in the biochar fed dairies in the soil has facilitated the uptake of cations in the plant tissue and hence the increased measurement in the leaf tissue. Though the increase in soil calcium in the biochar fed dairies has not corresponded with an increase in plant tissue calcium but the increase in soil K has followed through in the plant tissue.

Feed Tests

The feed test results improved at 3 of the 4 dairies which can be related to the time of year, irrigation scheduling, or recent N applications as commented on within each case study. However a decrease in the NDF also helped with the feed conversion at the Clarke biochar fed dairy and a reduction in the amount of supplement fed.

Soil Health

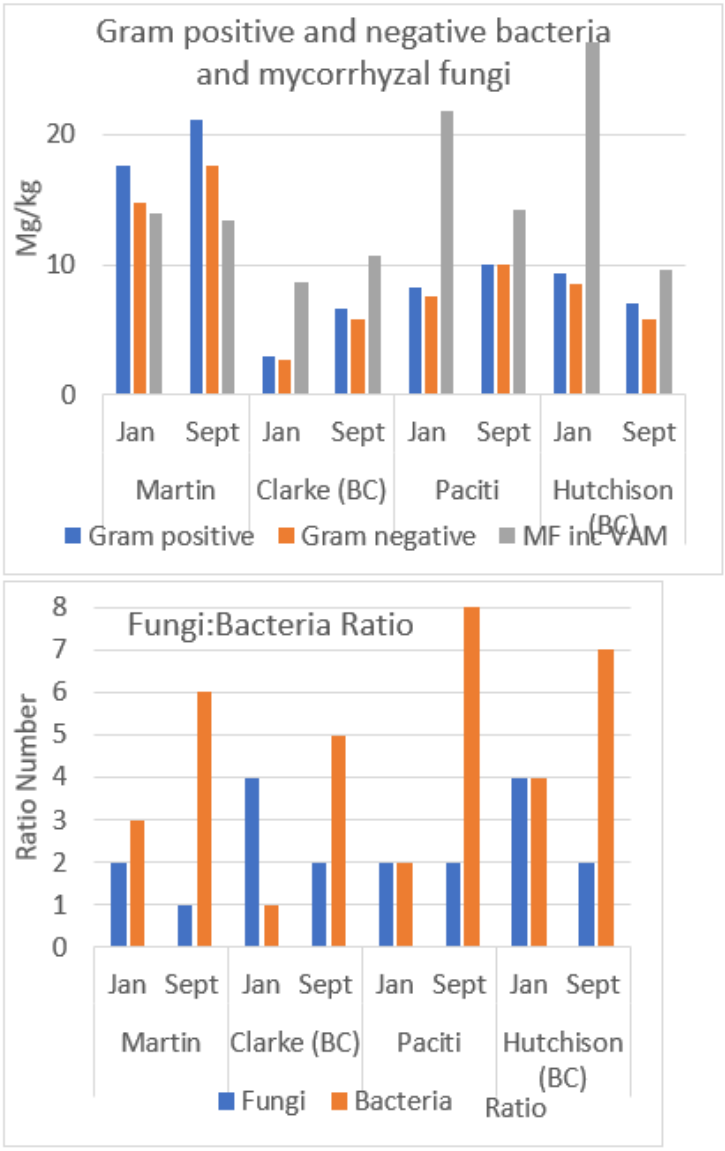

Figure 3 (left) Gram positive and negative bacteria and mycorrhizal fungi and right Fungi: Bacteria ratio changes at the 4 dairies in Fleurieu Milk Co with Clarke and Hutchison being the 2 biochar fed dairies.

The Clarke biochar dairy soil showed a positive increase in the gram positive and negative bacteria as well as a positive change in mycorrhizal fungi (MF). Martin (with no biochar), had a reduction in 2 of the 3 parameters and while Hutchison had a reduction in all 3. Hutchison did fertilise with N just prior to re-testing and this can have an impact on the bacteria and MF populations. Clarke soil started from a lower base and had more room for improvement but is now similar to that measured at the Hutchison dairy. The balance of bacteria and MF influence the Fungi: Bacteria ratio. When this is in balance (optimum 2:3) with more fungi than bacteria the plants are more able to access nutrients and minerals and the humous breakdown occurs more rapidly building soil carbon.

The fungi to bacteria ratio in the 2 biochar dairies did improve and revert to the favourable ratio with more fungi than bacteria (between Jan and Sept).

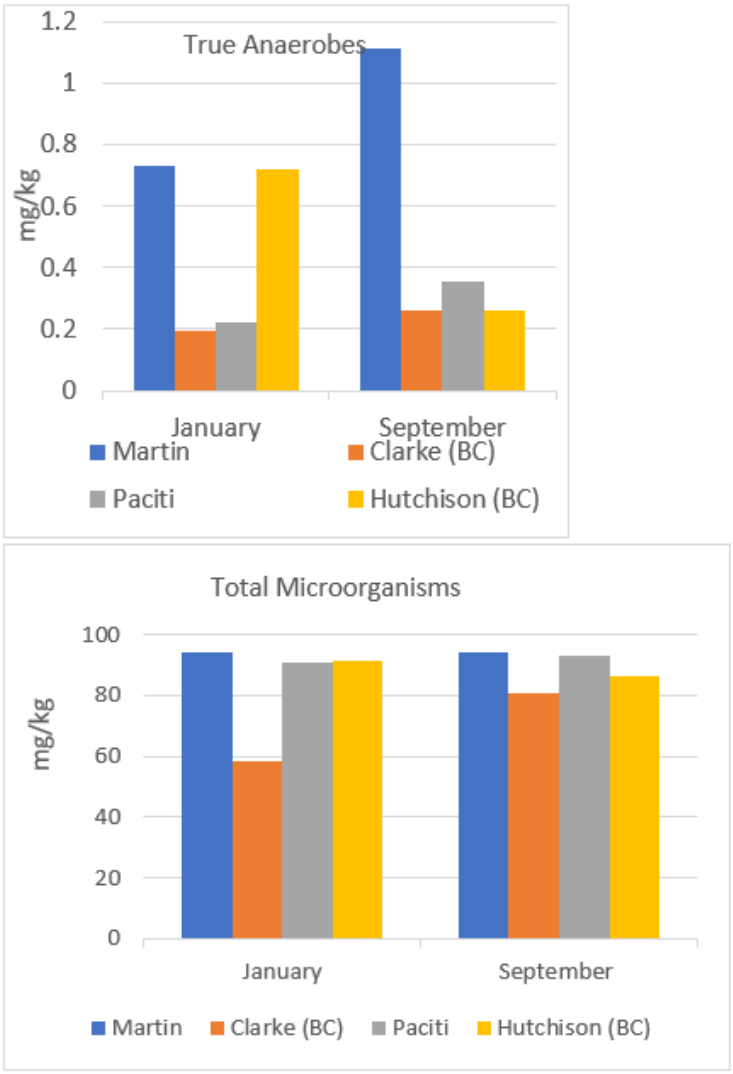

Figure 4 (left) True anaerobes (right total microorganisms) at the 4 dairies in Fleurieu Milk Co with Clarke and Hutchison being the 2 biochar fed dairies.

Small number of anaerobes (fig 45 left) in a dairy soil are likely related to water logging and over irrigation and can influence soil health. The anaerobes increased (fig 45 right) in the Clarke biochar dairy at the two non-biochar dairies. Hutchison may need to keep an eye on irrigation to promote anerobic bacteria.

The total microorganisms increased at the Clarke biochar dairy as did the microbial balance while they stayed the same or reduced at the other dairies. Hutchison did fertilise with N just prior to the second testing. Clarke has more room for improvement in soil health.

Conclusions

By feeding biochar to cattle at two dairies and not feeding to two others (for a nine-month period in 2019) and comparing with historical data;

- There was a statistically significant increase in milk yield of 1.4 litres per head per day at one biochar fed dairy (Clark with Jersey cows) and a larger milk yield increase in the 1 and 2-year-old animals.
- In the other biochar fed dairy the project was unable to utilise the milk yield results due to a feed contaminant.
- In one non-biochar fed dairy there was a lower statistically significant increase in milk yield of 1.1 litres per head per day (with a significant effort to focus on herd health utilising a naturally higher yielding dairy cow breed, Holsteins).
- In the other non-biochar fed dairy there was a decrease in the milk yield with Holsteins.

In addition, initial soil and plant analysis indicated;

- There was an increase in the soil quality and plant health in the analysed paddocks of the biochar fed dairies compared with no substantial increase in soil and plant health in the analysed paddocks of the non-biochar fed dairies.
- The biochar element in the soil appears to be increasing the pH and hence perhaps farmers could also use this as an alternative source of lime and it remains in the soil for 1000 years vis lime as it leaches through the soil and needs re application to neutralise the soil ever 3 to 5 years.
- The biochar in the diet appears to have resulted in the need for less fodder likely due to the redox active reactions taking place more efficiently in the rumen (biochar is a redox active substance accepting storing and donating electrons, Schmidt et al, 2019, which could in turn increase the feed intake efficiency (Liu et al., 2012; Leng, Inthapanya & Preston, 2013). In the high-energetic diets (such as dairy) a well-balanced animal feed regime should contain multiple electron mediating substances (Sophal et al., 2013) (ie biochar).

There were substantial economic benefits of feeding biochar at the Clarke dairy, with increased revenues of $62597 (from more milk) and a saving due to reduced fodder use to the value of $12480 = $75077 economic benefit over 12 months, less the biochar costs of $8160 = $66917 profit increase and implies a net user value of $4920 per tonne of biochar.

Future Decisions

The biochar had a positive impact on milk yield and this was evident after the first month of feeding biochar. The corresponding improvements on soil and pasture quality measured are an additional bonus, in both of the biochar fed dairies. Additional milk yield, plant and soil health benefits would likely to continue to build if the biochar feeding was to continue. Fodder use reductions may also continue to build as the biochar has a redox reaction in the rumen and also builds plant quality and feed test results. There could be a further saving if less liming needed due to the pH normalising effect of biochar and in addition less fertiliser due to mineralisation of N and P. If further incentives were provided for methane reduction this could also enhance the economical benefit of biochar feeding to dairy cattle.

The ANZ biochar initiative are working on having biochar incorporated as part of the Federal Government ERF methodologies both for use in the soil and also as a feed to reduce methane.

As a result of the initial soil and plant health evidence found in this trial, Climate & Agricultural Support Pty Ltd has begun a replicated soil and plant health trial looking at the effect of biochar laden dung burial vs non biochar laden dung. In this trial similar plant and soil health measurements (as per this trial) are being taken with treatments of 2 x rates of biochar in and under the dung over a 2-year period. The results will be published on the company web site by end of 2021.

Animal Control Technology Australia – May 2021 mice control update.

Laboratory research has been conducted into the dosage of active chemical used in Australian mouse bait. APVMA recently issued an emergency permit to allow double the concentration of Zinc Phosphide in mouse baits such as MOUSEOFF®.

There has been extensive media coverage of this research and the emergency permit.

This edition of the eNews outlines how ACTA is responding.

ACTA developing higher dose MOUSEOFF®

In response to the APVMA decision, ACTA is now working to develop a higher dose formulation of our product MOUSEOFF – the most-used broadacre mouse bait in Australia.

We advise customers that the current 25g/kg Zinc Phosphide products such as MOUSEOFF (sterilised seed quality grain based) and MOUSEOFF ECONOBAIT (unsterilised seed quality based) have proven high performance over 24 years.

In the vast majority of situations and in the research trials required for registration of the MOUSEOFF products, more than 90% of mice are killed within 1 to 2 days of application at 1kg/hectare.

These and other APVMA registered products are consistent with international use of Zinc Phosphide for broadacre mouse control using a dose of 20 – 25g/kg.

We expect pilot quantities of the higher dose formulation, MOUSEOFF® 50 ZINC PHOSPHIDE BAIT, to be available for delivery in mid-June, subject to the availability of sufficient chemical to not interrupt the supply of, and the important continued crop protection by current proven technology.

Field trials have not yet been conducted to evaluate the efficacy of the higher dose bait, and to identify the situations where it is of benefit over the current proven baits.

We have outlined factors for customers to consider below.

If you or your agronomist believe that after considering these factors, you require the higher dose MOUSEOFF 50 ZINC PHOSPHIDE BAIT please contact us to discuss the situation so that we can assist in evaluating how and where to use it.

Factors to consider;

Media reports suggest a higher dose bait will resolve issues of a small number of farmers having to apply the current baits more than once. The suggestion in the media articles to increase bait active concentration is based on claims that some mice might be averse to eating multiple grains of bait.

Dosage

ACTA's extensive field trials and farmer use over many years have found MOUSEOFF® achieves greater than 90% control within 1 to 2 days of broadcast application.

Media reports claim a mouse digesting a single grain of bait will not receive enough dose to exceed the LD50 (a lethal dose to 50% of a large number of test animals of a particular species). However, we know mice eat more than one grain. When MOUSEOFF is applied at the existing recommended amount of 1 kg/ha, there are up to 25,000 grains of bait per hectare and the mice have time to digest more bait before being affected by the first grain eaten.

Also interesting to note the recent ABC article and GRDC press release incorrectly stated as increased from 25 to 50 milligrams per kilogram instead of 25g/kg to 50/kg. This quoted dose rate is 500 to 1000 times lower than what is required to kill a mouse. This is a confusing typographical error when the information is cross referenced to the APVMA permit for a 50g/kg bait valid until May 2022.

Reasons for reapplication

There is an occasional need for reapplication of bait, which can increase the cost of mouse management. The reasons to reapply bait are not fully understood. It can arise due to a variety of factors, such as:

- reinfestation of baited areas from adjacent mouse-affected paddocks,
- migrating mice (potentially moving hundreds of metres overnight),
- not achieving buffer zones,
- failure to correctly apply the bait (e.g. block spreaders, planes flying wide swathes),
- excessively moist soil, recently reported as a suspected cause of failure,
- localised extreme mouse densities,
- abundance of alternate food, possibly reducing bait uptake.

All these factors must be investigated to determine why redosing is required rather than making the assumption that it is due to the dosage and mouse aversion.

If there are situations where repeated dosing of crops is required, please consult our MOUSEOFF brochure for methods to resolve this and contact us for advice.

Current evidence

We note that the proposed higher dose bait has not been field-tested and as such there is no proof that using it has led to a reduced need to reapply bait.

We also note that the APVMA has issued a permit allowing 3 to 5 times higher application rates of current products, which is counter to the arguments for a higher dose bait if, as claimed, mice only eat one grain.

Supply chains

As reported in previous ACTA e-news #5, the COVID-19 disruption to global supply chains has severely impacted the supply of active ingredients for mouse bait in Australia.

ACTA is concerned that the supply of mouse bait could be reduced by half if all bait supplied contained double the normal adequate dose of Zinc Phosphide. This would halve the area of crops that could be saved just to prevent the limited need for reapplication.

As such, it is critical that valid, replicated field trials are performed to determine where and when any high dose bait should be used and if it is more effective in reducing bait reapplication than current methods.

Despite our concerns, but in response to industry requests, we will develop and supply MOUSEOFF 50 ZINC PHOSPHIDE BAIT (50g/kg zinc phosphide bait), but we cannot guarantee, on the basis of current publicly available data, that use of this product will reduce the need to reapply baits.

ACTA is doing everything we can to help the agriculture industry tackle the mouse plague.

We are working around the clock to produce MOUSEOFF and have been working closely with supply chain to secure as much of the active chemical as possible.

Dr Linton Staples

Managing Director

Animal Control Technologies

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Understanding pre-emergent herbicides and how they interact with the environment

Extracted from the full article by Mark Congreve Senior Consultant, Independent Consultants Australia Network (ICAN) 0427 209 234 mark@icanrural.com.au and referenced from;

https://grdc.com.au/resources-and-publications/all-publications/factsheets/2020/preemergent-herbicide-use-fact-sheet

ALWAYS read the product label prior to use.

With the continued evolution of herbicide resistance, growers are being forced to introduce a range of different weed control tactics. A tactic that has rapidly increased in recent seasons is the use of pre-emergent herbicides, especially in the summer crop and fallow. To predict field performance of these herbicides, an understanding is needed of their chemical properties and how they interact with the environment.

The value of pre-emergent herbicides

When devising a weed control strategy, consider the use of pre-emergent herbicides as an additional tactic available to help drive weed numbers down. Used alone they usually will not achieve the objective of driving down weed seedbank numbers, but when used amongst a suite of tactics, they can be particularly effective.

Key Points

- Knowing which weeds are in the paddock and where the weed seeds are located (shallow or deep) is important in selecting a herbicide to be applied.
- Be aware of whether a herbicide is subject to volatilisation or photodegradation in order to determine an incorporation strategy that minimises loss to the environment.
- Solubility influences how much rain is required for herbicide incorporation, how easily a herbicide will be taken up by a germinating weed and crop, and if a herbicide will be subject to moving down the profile, potentially causing crop injury or loss to leaching.
- Sandy or low organic matter soils will have less binding and allow for greater herbicide availability for crop and weed uptake.
- Herbicides that bind tightly to soil and organic matter generally require higher application rates, stay close to where they are applied (unless the soil moves), and persist for longer.
- Soil pH affects how long some herbicides persist for and how available they are for plant uptake and soil binding.
- The persistence of a herbicide and the way in which it breaks down will dictate the length of residual control and plantback constraints to sensitive crops.
- Rainfall after application is important for incorporation and availability to the weeds and crop. Rainfall and temperature also affect degradation.
- Choice of application rate will affect length of residual, and possibly crop selectivity.

Factors influencing the activity of pre-emergent herbicides.

To understand how pre-emergent herbicides will perform, it is important to understand the properties of the molecule and the soil type and how they interact, and how the herbicide is broken down in the environment. Availability of a pre-emergent herbicide is an interaction between the solubility of the herbicide, the strength of binding onto soil colloids and organic matter, the prevailing climatic conditions, the environment, and the rate of herbicide applied.

Two of the key factors affecting the activity of pre-emergent herbicides are Solubility & Soil texture, cation exchange and binding.

Solubility.

Many pre-emergent herbicides are taken up by the roots of the germinating weed. For root uptake to occur, the herbicide needs to be available in the soil moisture. If the soil is dry, there is little herbicide in the soil water that is available for root uptake. This is why many pre-emergent herbicides may fail to provide good weed control under dry conditions.

Herbicides with low solubility often require larger volumes of rainfall to achieve incorporation and tend not to remain as available in the soil moisture, so they are not easily taken up by plant roots. For effective performance, they typically need very good moisture conditions after application and for the period of desired control. Conversely, herbicides with high solubility are relatively easy to incorporate with limited rainfall and generally prefer to remain in the soil moisture phase, so they are freely available to the plant or weed.

However, if the herbicide is highly soluble it will have a tendency to move with the soil moisture, so is more likely to leach or cause off-target effects. Once in the soil, the herbicide will establish equilibrium between the available soil water and binding onto soil colloids. It typically takes a couple of days for this equilibrium to establish following incorporating rainfall.

Soil texture, cation exchange and binding.

Soil texture (the ratio of sand, silt and clay) and soil organic matter will have an effect on the binding ability of herbicides (adsorption). The term cation exchange capacity (CEC) is often used as a measure of the soil's adsorption sites.

Heavier soils and soils with higher amounts of organic matter (higher CEC soils) have more binding sites and hence will adsorb more herbicide. Increased binding is likely to result in higher application rates being required to achieve a given level of weed control. This is because more herbicide is bound to soil and organic matter and therefore less is available in the soil water for uptake by germinating weeds. Increased binding also generally results in less leaching.

The strength of binding is measured by the Soil/Water Absorption Coefficient (Kd) which is the ratio of herbicide bound to the soil to that in the soil water. As binding is often highly influenced by the level of organic matter, the binding coefficient is often normalised to take into account organic carbon levels in different soils and is presented as a Soil Organic Carbon-Water Absorption Coefficient (Koc) value.

For some molecules the Koc is very sensitive to soil pH, in particular the imidazolinone herbicides which bind tighter at acidic (low) pH, making them less available for plant uptake and for microbial breakdown. Understanding both the solubility and soil binding assists in predicting the behaviour of a pre-emergent herbicide in the soil and environment

The full article and details on the GRDC tech-note can be found here;
https://grdc.com.au/__data/assets/pdf_file/0031/430987/GRDC_PreEmergentFS_Lowres.pdf?utm_source=website&utm_medium=download_button&utm_campaign=pdf_download&utm_term=National&utm_content=Pre-emergent%20Herbicide%20Use%20Fact%20Sheet

Herbicides and Dry Sowing

Professor Chris Preston – University of Adelaide School of Agriculture, Food & Wine.

When dry sowing we need a sufficiently persistent herbicide, so that any losses prior to the opening rainfall do not greatly reduce performance. While losses in true dry sowing circumstances should be low, as two of the key mechanisms of herbicide breakdown, microbial degradation and chemical hydrolysis are reliant on moisture, some losses inevitably occur over long periods. Photodegradation and volatilisation for some products pose a threat, but if good incorporation has occurred this is also low risk. On the other hand, if small rainfall events occur, they will result in a slow degradation of the herbicide, even if there is not enough rain to germinate weeds. Much depends on the time frame between herbicide application and the opening rains. Where this is short, a week or two, there is not much breakdown. Longer periods mean more herbicide is broken down.

The other concern can is what the rainfall events look like when they come. Many small rainfall events might be enough to germinate weeds, without activating the herbicide properly. If the first rain is a large event, it might move the herbicide deeper into the soil resulting in crop damage.

But I've read the label and it says rain within 7-10 days required.

If you are dry sowing, this does not apply to the same extent. These guidelines are based on the assumption you are sowing into a moist seed bed and the weeds and crop are going to get moving straight away, therefore rain is required to get the product to the weed zone before the weeds emerge. So don't panic just yet.

What products under what conditions should I consider?

If your sowing process offers effective coverage and your weeds, namely ryegrass, is still susceptible – trifluralin alone or in more preferably in mixes offers a good option. It is relatively stable when covered by soil, but it also activates quickly on rain events. A product like Sakura on the other hand, can be a bit harder to activate and remain active. If we have a rain event that promotes germination, but then it dries out again, uptake of products like Sakura can be restricted. In this situation, and in the right cropping circumstances, these products paired offer the best of two worlds – quick action and sustained performance.

Products that break down quickly are a concern in dry sowing if there is an extended period before the opening rainfall because any break down before weed germination reduces their activity. Products like Boxer Gold and prosulfocarb fall in this category. Where these types of products are used, follow up alternatives may need to be considered if weed issues present early.

Newer products on the market have mixed responses. Overwatch has characteristics that lend it to being more suitable for dry sowing situations, whereas Ultro and Luximax come with risks. Products with high mobility such as Luximax present risks if the first rainfall is substantial, as they may wash readily into the crop furrow and cause crop damage. This is not to say damage won't occur from other products, but the more mobile the herbicide, the greater the risk.

In regards to effective weed control in dry sowing there can be gains from using more than one product in pre-emergent programs. This allows one herbicide to still work even if the activity of the other is compromised. Check labels for compatibility concerns or talk with your agronomist.

Awards and Scholarships

Tony Rathjen Student Contribution Award

The Tony Rathjen Student Contribution award has been created by the SA Crop Science Society in memory of the late Professor Tony Rathjen. Tony was a founding member of the Crop Science Society and believed strongly in a vibrant interaction between researchers and farmers. During his long career, Tony was an influential mentor to many students and greatly encouraged innovative thinking and student participation in the debate of agricultural issues.

The Crop Science Society is centred around a monthly newsletter and meeting, which brings the broad agricultural community together for the dissemination of relevant new research, technical advice and emerging issues involved with crop production.

The Tony Rathjen award is designed to encourage students to present their research in a media that is immediately accessible to farmers, as well as to continue his legacy of student participation in the Crop Science Society and the agricultural community.

Students are encouraged to prepare an article for the Crop Science Society Newsletter. All student articles published in monthly newsletters will receive $100.

The recipient of the main Tony Rathjen Student Contribution will be decided in June and announced at the AGM in July.

The student who prepared the best article that highlights excellent agricultural research combined with innovative thinking will be awarded $500. The recipient will present their research at a Crop Science Society meeting.

We encourage students to become affiliated with the CSSSA and make use of the society to assist and publicise their research.

Here is more information on the application process and article guidelines, for the Tony Rathjen Student Contribution Award.

Duncan Correll Crop Science Society Awards.

Applications are invited for members to apply for a grant to attend conferences, field days, study tours or any other matter which will benefit the Crop Science Society. Awards are normally limited to $1000 per year.

Applicants will be reviewed by the President and members of the Crop Science Society Travel sub committee, who are ineligible while serving in this capacity.

Recipients of travel awards are required to provide a written report to the Crop Science Society committee within six weeks of returning from the conference or tour including a short two page summary of major findings. They are also asked to give a short presentation at a future Crop Science Society meeting.

- Applications should detail reasons for travel and how the travel will benefit the society.
- Applications can be forwarded to the secretary in writing and should be received at least two months prior to using the award.

John Both Award for excellence in in-field crop research.

In recognition of the late John Both, the Crop Science Society established an award in 2019 for significant contribution to crop protection through in-field crop research.

Nominations are invited from members to recognise a researcher that practices in-field research that has demonstrated significant and enduring contribution to crop science.

The award will consist of:

- A certificate to be presented at a Crop Science event along with an emblazoned item of clothing.
- Media coverage of the winner.

Yitpi Foundation Awards

We are pleased to announce that applications for Yitpi Foundation Awards and Grants-in-Aid are now being requested with a closing date of Monday 7th of June 2021. We would appreciate it if you would please publicise this on your relevant websites and social media platforms, as well as with your colleagues.

Guidelines for applications are attached and grants will fall within the three categories listed below;

1. Crop science research
2. Agricultural education
3. Studies of the linguistics and culture of Australian Aboriginal peoples

Further details are available from Jane Rathjen: jane.rathjen01@gmail.com or mobile 0404 062 734.

Events and Workshops

SOIL AND PLANT TESTING FOR PROFITABLE FERTILISER USE

Free workshops for growers and advisors

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

Adelaide	Monday 21 June
Maitland	Tuesday 22 June
Blyth	Wednesday 23 June
Lock	Thursday 24 June

Bordertown	Monday 28 June
Ouyen	Tuesday 29 June
Bendigo	Wednesday 30 June
Bannockburn	Thursday 1 July

Growers and advisers are invited to attend the 2021 Soil Nutrition Workshops as part of the GRDC funded Soil and Plant Testing for Profitable Fertiliser Use project.

Hear from leading researchers on:

- Educating agronomists on why/how/when to sample.
- Soil test results/findings and fertiliser responsive ratings from the project.
- The main issues surrounding P and N and achieving yield potential.
- Tactical or strategic N decisions.
- Case studies and learnings from on-farm trials in each region.

Speakers include:

- Dr Sean Mason, Agronomy Solutions
- Dr Harm Van Rees, Cropfacts
- Daniel Bell, Nutrien
- Dr Rick Llewellyn, CSIRO
- Dr Therese McBeath, CSIRO
- Dr Robert Norton, Norton Agronomic

In addition, a local agronomist will be presenting region-specific information relating to optimising soil types, testing data and constraints.

To register click here.