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Producer Research Support

Balancing Soil Fertility

GWYDIR and MACINTYRE Resources Management Committee Inc. - GWYMAC Inc.

The Balancing Soil Fertility project looked at a range of options for restoring soil nutrient balance, with the aim of improving pasture productivity and animal performance.
It was difficult to specify the long term benefits, and justify the extra expense, of balancing soil nutrition (BSN) treatments over superphosphate application.

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The project

A joint project between GWYMAC, the Inverell District Landcare Network and North West Slopes Sustainable Grazing Systems (SGS), the aim was to test soils for major and minor nutrients imbalances, apply fertilisers to restore balance, and thereby improve pasture productivity and animal performance

Objectives

1. Measure soil nutrition parameters including Total Exchange Capacity (TEC), pH, soil humus, available phosphorous and sulphur, exchangeable cations and base saturation percent, trace elements (boron, iron manganese, copper and zinc);
2. Investigate the impact of balanced soil fertility treatment at Copeton Learning Site (black basalt soil), Ashford (traprock soil) and Bonshaw (granite soil), by monitoring changes in soil nutrition parameters;
3. Measure the quality and quantity of dry matter production from each treatment;
4. Monitor ground cover (bare ground and litter levels), canopy levels, surface sealing, plant types and soil erosion; and
5. Use the information gathered to calculate the grazing days per hectare from each treatment.

What was done

The Sites at Inverell, Ashford and Bonshaw were selected as test sites. An area at each site was split into 5 x 2 ha plots and soil tests were taken. The following five treatments were applied to the plots at each location:

1. Plot 1 – Direct drilled winter legumes + balanced soil nutrition (BSN)
2. Plot 2 – Direct drilled winter legumes + 100 kg/ha single super phosphate (received extra sub clover and arrow leaf in year 3)
3. Plot 3 – Deep ripped + direct drilled winter legumes + balanced soil nutrition (BSN) (extra 1/2kg/ha Caucasian Clover also applied)
4. Plot 4 – Balanced soil nutrition (BSN) only
5. Plot 5 – Control – no fertiliser or seed

Inverell and Bonshaw withdrew from the trial in November 2001, and only the Ashford site continued. The site at Ashford was a native and naturalised summer dominant pasture.

Fertiliser Applications

An initial fertilizer treatment was applied to each plot, followed by a maintenance application. The maintenance treatment was applied when the season was suitable and not necessarily annually.

The table below demonstrate the fertilisers regime applied to plots 1, 3 & 4, (BSN) to balance soil nutrient levels.

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Key points

- Following the outcomes of this project, five properties in the Landcare group have started using super and legumes.
- Glycine (a native legume) and native pastures responded well to both BSN and super with increased vigour.
- Legumes (particularly Rose Clover) were starting to come away after an autumn/winter drought on just 160 points of rain.
- Groundcover increased from 50% to over 70% on all but the control site (from 50%-60%).
- Where Silky Brown Top was/is dominant, litter levels are well over 1500kg/ha, which demonstrates its vigour under these treatments.
- There has been little change in the composition of native grasses (ignoring those that have been sown).

Fertiliser	Rate (kg/ha)	Major Nutrients	Amount applied	Cost ($/ha)
Lime	1000	Calcium	350 kg/ha	$60
Rock Phosphate	400	Phosphorus Calcium	36.8 kg/ha 83.8 kg/ha	$68
Borate Granular	22	Boron	3.15 kg/ha	$37.40
Zinc Sulphate Monohydrate	10	Zinc Sulphur	3.5 kg/ha 1.72 kg/ha	$12.40
Copper Sulphate Monohydrate	10	Copper Sulphur	3.5 kg/ha 1.28 kg/ha	$20
Total Cost $/ha/yr				**$197.80**

The first maintenance application for these BSN plots is detailed in the table below.

Fertiliser	Rate (kg/ha)	Major Nutrients	Amount applied	Cost ($/ha)
Lime	1000	Calcium	350 kg/ha	$60
Rock Phosphate	400	Phosphorus Calcium	36.8 kg/ha 83.8 kg/ha	$68
Borate Granular	22	Boron	3.15 kg/ha	$37.40
Zinc Sulphate Monohydrate	10	Zinc Sulphur	3.5 kg/ha 1.72 kg/ha	$12.40
Copper Sulphate Monohydrate	10	Copper Sulphur	3.5 kg/ha 1.28 kg/ha	$20
Total Cost $/ha/yr				**$197.80**

After this treatment only 130kg of rock phosphate was applied annually. Plot 2 was treated conventionally with superphosphate using the treatment plan detailed below.

Fertiliser	Rate (kg/ha)	Major Nutrients	Amount applied	Cost ($/ha)
Gold Phos 20 (applied at sowing)	62	Phosphorus Sulphur Calcium	9.92 kg/ha 12.4 kg/ha 7.32 kg/ha	$24.18
Total Cost $/ha/yr				**$24.18**

After this treatment only 130kg of rock phosphate was applied annually.

Plot 2 was treated conventionally with superphosphate using the treatment plan detailed below.

Fertiliser	Rate (kg/ha)	Major Nutrients	Amount applied	Cost ($/ha)
Single Super	100	Phosphorus Sulphur Calcium	8.8 kg/ha 11 kg/ha 20 kg/ha	$24.00
Total Cost $/ha/yr				**$24.00**

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Producer Research Support

MLA Producer Research Support offers support funding of up to $15,000 over three years for groups of producers keen to be active in on-farm research and demonstration trials.

These activities include:

- Producer Initiated Research and Development
- More Beef from Pastures demonstration trials
- Prime Time Wean More Lambs demonstration trials
- Sustainable and productive grazing grants.

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Legume Mix

The winter legume seed mix direct drilled into plots 1, 2 & 3 in mid-June 1998 was:

- 2kg/ha Seaton Park Sub-clover
- 2kg/ha Goulbourn Sub-clover
- 2kg/ha Hycon Rose Clover
- 2kg/ha Arrow Leaf Clover

Plot 3 received an extra _ kg/ha of Caucasian Clover in June 1998. In June 2001, additional Sub-clovers and Arrow Leaf Clover was drilled into plot 2 to compensate for a poor strike rate.

Grazing Treatment

The paddocks were rotationally grazed, with each plot grazed for the same number of animal days per hectare. The approach used was to graze high volumes of stock on each plot for a short time, followed by a long rest period to allow the plants to recover.

Monitoring

Annual soil testing and pasture analysis of each plot was planned.

What happened?

Due to changes in the company that conducted the soil testing and analysis, only an initial test in 1998 and a further test in 2001 were completed. Only one pasture analysis was tested, so the results were not analysed further. A second sample was collected but went mouldy before it could be tested.

Soil Fertility

Soil fertility of the control plot went backwards, showing that any treatment is better than none! Before fencing off the plots, the control plot was the highest point - where most of the sheep camped, so nutrient levels were higher there at the start. With the change in grazing management and sheep grazing the plot for only short periods, nutrients wouldn't have been deposited as heavily as before the trial started, which may have contributed to reduced nutrient levels on this plot.

Zinc and copper levels in the BSN plots increased significantly. Copper can inhibit Molybdenum uptake by plants and nodulation of legumes, which may reduce the vigour of the legumes and nitrogen fixation if levels becomes too high. It was probably unnecessary to add these nutrients in such high levels.

Calcium levels increased slightly in the three BSN plots, but decreased substantially in the super phosphate treated plot and the control plot. Boron levels increased in all but the control plot, but were still below the desired minimal level. Further applications and testing need to be performed to determine whether there is a difference between adding Borate Granular (BSN plots) or super phosphate to increase Boron levels.

Dry Matter Production

The percentage of organic matter increased in the BSN plots, but barely changed in the super phosphate treated plot, and decreased in the control plot. Observation of the plots at the start of September 2002, during a drought, showed that litter levels on the BSN + Legumes, Super + Legumes and BSN only were all good considering the season (>2 handfuls/0.1m2). At the start of the trial, litter levels were less than or around 1handful/m2. The levels on the deep ripped site and the control site were only around 1 handful.

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Discussion

The trial showed a measurable increase in pasture production, ground cover, litter levels and animal performance on all the treated plots. Both BSN and super application increased carrying capacity, which was further enhanced by the addition of legumes. Several group members have sown legumes and applied super since this trial and have been very happy with the results.

Limited data collection makes it difficult to specify the long term benefits, and justify the extra expense, of balancing soil nutrition (BSN) treatments over superphosphate application.

Deep ripping is expensive and achieved lower increases in nutrient levels than the other treatments. Groundcover and litter levels were also lower on these plots.

Litter levels improved due to grazing management and extra vigour of plants. This indicates that a general improvement in soil health will occur and future reduction in fertiliser application levels may be beneficial.

Next Steps

The landholder will apply the fertilisers to the plots again this year and next year and continue to monitor results. Future projects would ensure that the group covered a smaller area and encouraged participants to continue until the end of the project.

Possible conclusions that can be drawn from this trial are limited, as only two soil tests results for each plot (at the start in 1998 and in 2001) were collected. Pasture test results weren't analysed, because only one series of test results was received. Although results are promising, repeating the trial and performing more comprehensive testing and analysis would be required to gain definitive results on the benefits of each treatment.
Further projects may consider including a seed broadcasting treatment, which is much faster and less expensive than those previously used. This treatment has been trialed on other parts of the property since the project was completed and has shown similar benefits.

MLA also recommends

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