The Backyard Agronomist

Soil chemical analysis

Client: James Hutchinson

Sample taken: 19 June 2015

Laboratory: Spectrum Analytic, OH, USA

Location: Longley Organic Farm

Soil analysed: 9 July 2015

Test method: Mehlich 3 extraction[1]

Results - VEGETABLES

	Vegetable Beds	Target
Cation Exchange Capacity (CEC)	13.0	
pH soil	6.1	*6.5*
Organic matter (OM)	4.9%	
Phosphorus (P)	91 ppm	40-70 ppm
Potassium (K)	319 ppm 6.3%	175 ppm 3.5%
Magnesium (Mg)	232 ppm 14.8%	188 ppm 12%
Calcium (Ca)	1440 ppm 55.2%	1774 ppm 68%
Sodium (Na)	71 ppm 0.3%	<3%
Sulphur (S)	15 ppm	35 ppm
Boron (B)	1.1 ppm	2.0 ppm
Zinc (Zn)	16.6 ppm	7.0 ppm
Iron (Fe)	218 ppm	50 ppm
Copper (Cu)	2.6 ppm	2.5-10 ppm
Manganese (Mn)	26 ppm	18-70 ppm

The above table shows results for the soil sampled from within the annual vegetable garden beds. The targets are based on a mix of the Base-Cation Saturation Ratio (BCSR) approach, as popularised by Steve Solomon in The Intelligent Gardener, and the more mainstream approach of nutrient sufficiency. Targets that have not been achieved in this soil are underlined.

1 The method used is important, as you cannot directly compare results from one method with another.

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Recommendations - VEGETABLES

The soil is slightly acidic but has a good level of most nutrients. The amendments recommended below are once-off corrections and should be broadcast and incorporated thoroughly into the top 15cm of the soil. Additional maintenance applications of the major nutrients will be required in the future.

- **Phosphorus** is high. Additional phosphorus is unnecessary. Remove any sources of phosphorus from fertiliser (e.g. guano). A low-P nitrogen source (i.e. other than blood & bone) could be considered (e.g. blood meal, if available).
- **Potassium** is high and has increased dramatically since last year. Remove any sources of potassium from fertiliser (e.g. potassium sulphate).
- **Magnesium** is optimal. Do not add any additional magnesium.
- **Calcium** is low. The lime applied early this year will continue to have its effect over the next two years. Do not add any further lime.
- **Sulphur** is low.
  - Broadcast fertilise with gypsum at a rate of 45 g/m^2.
- **Boron** is low but has increased since last year. Vegetables susceptible to low boron are the brassicas, most bulb and root crops and tomatoes.
  - Broadcast fertilise with boron at a rate of 0.2 g/m^2. A source of boron is borax, which is 10% boron, so you would need 2 g/m^2 of borax.
- **Zinc** and **iron** are high. No action needs to be taken.
- **Copper** is low and has increased only a little since last year.
  - Broadcast fertilise with copper at a rate of 0.4 g/m^2. A source of copper is copper sulphate, which is 25% copper, so you would need 1.6 g/m^2 of copper sulphate. Take care with copper, as it is toxic.
- **Manganese** is marginally low. Manganese can become less available with increased pH and organic matter and in soils with high available iron such as this one. Keep an eye out for manganese deficiency, which typically shows as yellowing between the veins on the youngest leaves.
  - Do a trial at a high rate of manganese to see you get a growth response. Broadcast fertilise[2] with manganese at a rate of 10 g/m^2. A source of manganese is manganese sulphate, which is 32% manganese, so you would need 30 g/m^2.
- **Trace minerals** have not been measured by this soil test. To ensure you have enough, apply kelp meal at a rate of 10 g/m^2. An alternative is to use liquid kelp (e.g. Seasol) as a foliar spray during the growing season.

2 Manganese is best applied in a band along the row, however this is not often practical in vegetable beds.

Results - RASPBERRIES

	Upper Raspberry	Target
Cation Exchange Capacity (CEC)	19.0	
pH soil	5.2	*5.8*
Organic matter (OM)	4.8%	
Phosphorus (P)	109 ppm	40-70 ppm
Potassium (K)	180 ppm 2.3%	210 ppm 2.8%
Magnesium (Mg)	341 ppm 14.4%	245 ppm 11%
Calcium (Ca)	1606 ppm 40.8%	2320 ppm 61%
Sulphur (S)	11 ppm	20 ppm
Boron (B)	0.7 ppm	1.0 ppm
Zinc (Zn)	26.3 ppm	4.0 ppm
Iron (Fe)	189.8 ppm	75 ppm
Copper (Cu)	0.8 ppm	2.5-10 ppm
Manganese (Mn)	28.0 ppm	18-70 ppm

The above table shows results for the soil sampled from the upper five rows of the raspberry hill. The targets are based on a mix of the Base-Cation Saturation Ratio (BCSR) approach, as popularised by Steve Solomon in The Intelligent Gardener, and the more mainstream approach of nutrient sufficiency. Targets that have not been achieved in this soil are underlined.

Recommendations - RASPBERRIES

The soil is acidic and is lacking in some nutrients. The amendments recommended below are once-off corrections and should be broadcast in a band a metre wide across the row, and incorporated as much as possible into the top 15cm of the soil. Additional maintenance applications of the major nutrients will be required in the future.

- **Phosphorus** is high. Additional phosphorus is unnecessary. Remove any sources of phosphorus from fertiliser (e.g. guano). A low-P nitrogen source (e.g. other than blood & bone) could be considered (e.g. blood meal, if available, or seed meal).
- **Potassium** is low.
    - Broadcast fertilise with potassium at a rate of 7 g/row-metre. A source of potassium is potassium sulphate, which is 42% potassium, so you would need 17 g/row-metre .
- **Magnesium** is optimal. Do not add any additional magnesium.
- **Calcium** is low, which is why the pH is low. This appears to be in contradiction to past pH measurements taken on this soil. It is possible that the soil is stratified due to previous lime application on the surface. To check this, take pH measurements at the

surface, at 5cm, 10cm and 15cm deep. If the pH decreases with depth, then ensure you mix amendments well into the top 15cm.

  - Amend with lime at a rate of 300 g/row-metre.

- **Sulphur** is low. Sufficient sulphur will be provided by the potassium sulphate.
- **Boron** is low.
  - Broadcast fertilise with boron at a rate of 0.07 g/row-metre. A source of boron is borax, which is 10% boron, so you would need 0.7 g/row-metre of borax.
- **Zinc** is adequate and **iron** is high. No action needs to be taken.
- **Copper** is low.
  - Broadcast fertilise with copper at a rate of 0.25 g/row-metre. A source of copper is copper sulphate, which is 25% copper, so you would need 1 g/row-metre of copper sulphate. Take care with copper, as it is toxic.
- **Manganese** is slightly low. Manganese becomes less available with increased pH and organic matter and in soils with high available iron such as this one. Keep an eye out for manganese deficiency, which typically shows as yellowing between the veins on the youngest leaves.
  - Do a trial at a high rate of manganese to see you get a growth response. Broadcast fertilise with manganese at a rate of 5 g/row-metre. A source of manganese is manganese sulphate, which is 32% manganese, so you would need 15 g/row-metre.

Custom Fertiliser – RASPBERRIES

Corrective Applications

This recipe is to be used for correcting pH and mineral levels, as well as providing nitrogen, sulphur and trace minerals. Spread 1m wide along 10m of row and incorporate to 15cm. If the row is not 1m wide, then reduce quantity proportionally (e.g. if it is 75cm wide, then the same amount will do 13m).

Fertiliser	Weight (kg)	Volume (L)
Canola seed meal	1.4	2.2
Kelp meal	0.1	0.1
Lime	3.0	2.5
Potassium sulphate	0.17	0.125
Borax	0.007 (7g)	0.007 (1.5 tspn)
Copper sulphate	0.01 (10g)	0.01 (2 tspn)
TOTAL	*4.7*	*4.9*

Results - BLUEBERRIES

	Blueberries	Target
Cation Exchange Capacity (CEC)	14.1	
pH soil	3.7	4.0-*5.2*
Organic matter (OM)	7.1%	
Phosphorus (P)	14 ppm	80-105 ppm[3]
Potassium (K)	84 ppm 1.5%	183 ppm 3.3%
Magnesium (Mg)	231 ppm 13.6%	>150 ppm
Calcium (Ca)	514 ppm 18.2%	>900 ppm
Sulphur (S)	5.0 ppm	20 ppm
Boron (B)	0.3 ppm	1.0 ppm
Zinc (Zn)	4.2 ppm	4.0 ppm
Iron (Fe)	78.6 ppm	75 ppm
Copper (Cu)	0.4 ppm	2.5-10 ppm
Manganese (Mn)	12.0 ppm	18-70 ppm

The above table shows results for the soil sampled from the blueberry orchard. The targets are based on a mix of the Base-Cation Saturation Ratio (BCSR) approach, as popularised by Steve Solomon in The Intelligent Gardener, and the more mainstream approach of nutrient sufficiency. Targets that have not been achieved in this soil are underlined.

Recommendations - BLUEBERRIES

The soil is highly acidic and is lacking in many nutrients. The amendments recommended below are once-off corrections and should be broadcast in a band a metre wide across the row, and incorporated as much as possible into the top 15cm of the soil. In order to avoid disturbing roots, it may only be possible to mix into the top 5-10cm. Additional maintenance applications of the major nutrients will be required in the future.

- **Phosphorus** is low. However, attempting to increase soil phosphorus may reduce colonisation by mycorrhizal fungi. So long as there are no signs of phosphorus deficiency, do not add additional phosphorus.
- **Potassium** is low.
    - Broadcast fertilise with potassium at a rate of 10 g/row-metre. A source of potassium is potassium sulphate, which is 42% potassium, so you would need 24 g/row-metre.
- **Magnesium** is slightly high. Do not add any additional magnesium.

3 A higher level of available phosphorus is needed in low pH soils. However, this does not account for the presence of mycorrhizal fungi and such high levels may adversely affect plant root colonisation.

- **Calcium** is low, which is why the pH is low.
  - Amend with lime at a rate of 100 g/row-metre, mixing as far as possible into the top 15cm. Repeat the pH measurements annually to see if the pH at depth (to 15cm) is changing and to ensure the surface pH is not too high.
- **Sulphur** is low. Sufficient sulphur will be provided by the potassium sulphate.
- **Boron** is low.
  - Broadcast fertilise with boron at a rate of 0.1 g/row-metre. A source of boron is borax, which is 10% boron, so you would need 1 g/row-metre of borax.
- **Zinc** and **iron** are adequate. No action needs to be taken.
- **Copper** and **manganese** appear to be low, however at this pH these are more available, so no action needs to be taken.

Results – NEW VEGETABLES

	New Veg	Target
Cation Exchange Capacity (CEC)	8.3	
pH soil	4.0	*6.5*
Organic matter (OM)	3.7%	
Phosphorus (P)	11 ppm	40-70 ppm
Potassium (K)	89 ppm 2.7%	135 ppm 4.3%
Magnesium (Mg)	148 ppm 14.8%	120 ppm 12%
Calcium (Ca)	296 ppm 17.8%	1130 ppm 68%
Sulphur (S)	8.0 ppm	23 ppm
Boron (B)	0.5 ppm	1.0 ppm
Zinc (Zn)	2.7 ppm	4.0 ppm
Iron (Fe)	161.1 ppm	50 ppm
Copper (Cu)	1.0 ppm	2.5-10 ppm
Manganese (Mn)	9.0 ppm	18-70 ppm

The above table shows results for the soil sampled from the area proposed for new vegetable beds. The targets are based on a mix of the Base-Cation Saturation Ratio (BCSR) approach, as popularised by Steve Solomon in The Intelligent Gardener, and the more mainstream approach of nutrient sufficiency. Targets that have not been achieved in this soil are underlined.

Recommendations – NEW VEGETABLES

The soil is very acidic, with low levels of nutrients and organic matter. Given the acidity and low fertility, consideration could be given to using the area for blueberries rather than vegetables. The amendments recommended below are once-off corrections and should be broadcast and incorporated thoroughly into the top 15cm of the soil. Additional maintenance applications of the major nutrients will be required in the future.

- **Phosphorus** is low.
  - Broadcast fertilise 6.5 g/m^2 of phosphorus. A source of phosphorus is guano, which is 11% phosphorus, so 60 g/m^2 would be required. Alternatively, apply blood and bone at 220 g/m^2, which will also provide a good amount of nitrogen.
- **Potassium** is low.
  - Broadcast fertilise with potassium at a rate of 10 g/m^2. A source of potassium is potassium sulphate, which is 42% potassium, so you would need 24 g/m^2.
- **Magnesium** is optimal. Do not add any additional magnesium.
- **Calcium** is very low.
  - Amend with lime at a rate of 450 g/m^2 if using guano, or 500 g/m^2 if using blood and bone.
- **Sulphur** is low, but sufficient sulphur will be provided by the potassium sulphate.
- **Boron** is low. Vegetables susceptible to low boron are the brassicas, most bulb and root crops and tomatoes.
  - Broadcast fertilise with boron at a rate of 0.1 g/m^2. A source of boron is borax, which is 10% boron, so you would need 1 g/m^2 of borax.
- **Zinc** is low.
  - Broadcast fertilise with zinc at a rate of 0.3 g/m^2. A source of zinc is zinc sulphate, which is 17% zinc, so you would need 7 g/m^2 of zinc sulphate.
- **Iron** is high. No action needs to be taken.
- **Copper** and **manganese** appear to be low, however at this pH they are more available, so no action needs to be taken. Once the pH of the soil is more neutral, the soil should be re-tested to check on these nutrients.
- **Trace minerals** have not been measured by this soil test. To ensure you have enough, apply kelp meal at a rate of 10 g/m^2. An alternative is to use liquid kelp (e.g. Seasol) as a foliar spray during the growing season.

Further suggestions

I recommend re-testing your soil yearly, to check that the nutrients are being taken up by the soil. We can then make more minor adjustments as appropriate.

To get the most value from your amendments, apply lime separately from the other amendments (e.g. lime in autumn and the rest in spring). Phosphorus is best incorporated into organic matter before application, ideally in a fresh compost heap where it can be "fixed" by biological activity, or at least allowed to age in finished compost or other organic matter.

If you have access to other amendments than the ones I have suggested here (e.g. guano, blood and bone), I can help determine the optimal application rate.