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Differences in soil quality between conventional and organic kiwifruit orchards

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Introduction

ARGOS is undertaking a long-term investigation of the sustainability of agriculture in NZ. As part of this, soil quality has been monitored across 36 kiwifruit orchards i.e. 12 conventional 'Hayward' (Green), 12 organic 'Hayward' (Green Organic) and 12 conventional 'Hort16A' (Gold).

Sampling occurred once in the winters of 2004 and 2006, and at the same randomly located soil monitoring sites (i.e. bays) each time to minimise spatial variation between years. At each soil monitoring site, samples were collected from within the rows (under the leaders) and between the rows (in the alleyways). The results for these different sample areas are presented in a previous research note (#44).

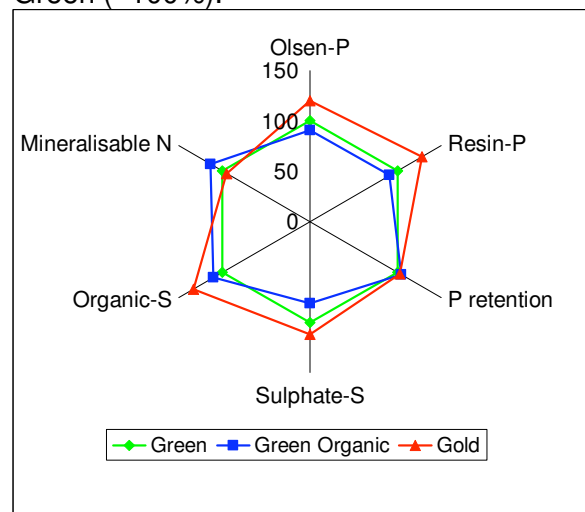
Results

Two-year average values are presented here. Radial graphs are used to show the relative difference of Green Organic and Gold to Green (which makes up about 80% of the national canopy area).

Soil chemistry

Gold orchards had significantly more Olsen-P, Resin-P and Sulphate-S than Green Organic with Green being intermediate (Figure 1). Green and Gold did not differ significantly which was not surprising given the fertiliser inputs were similar (data not presented).

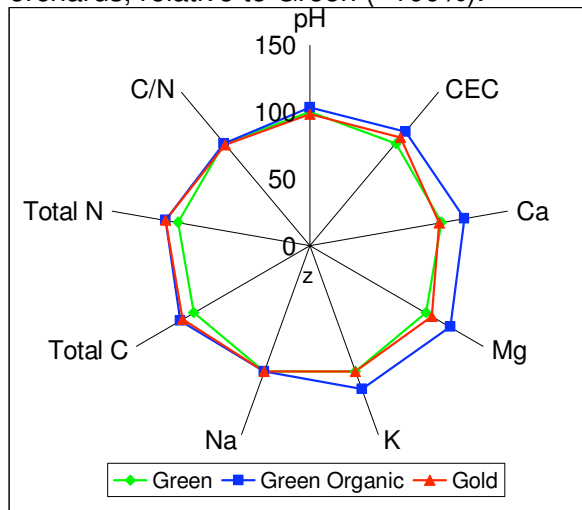
Figure 1. Soil P & S values for Green Organic and Gold orchards, relative to Green (=100%).



Green Organic orchards had significantly more organic matter (Total C & N) than the Green orchards (Figure 2) because of greater applications of organic matter in the form of compost, and to a lesser extent fish. On average, about 6 tonnes per ha of compost and 2,000 litres per ha of fish was applied annually (in the 2003/04 to 2005/06 period). Gold orchards also had significantly more soil organic matter than the Green orchards possibly because of greater levels of leaf litter and prunings although this was not measured. When soil organic matter was expressed on a volumetric basis, there were no statistical differences between systems (i.e. Green = 62, Green Organic = 63 tonnes and Gold = 64 tonnes per canopy

hectare). This is due to the Green Organic and Gold soils having a lower bulk density (Figure 3) reflecting that as organic matter builds up, the soil becomes both more porous and deeper.

Figure 2. Soil organic matter and cation values for Green Organic and Gold orchards, relative to Green (=100%).



The higher soil organic matter for the Green Organic and Gold orchards would have contributed to the higher cation exchange capacity (CEC) of these soils relative to Green allowing them to hold onto more cations. The significantly higher pH of the Green Organic orchards would have contributed to a higher CEC there.

Soil biology

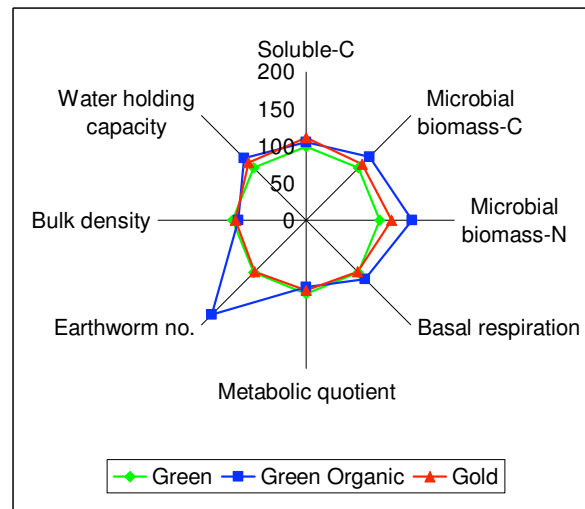
Green Organic orchards had a significantly higher microbial population (microbial biomass- N and/or C) (Figure 3) because of the greater organic matter. However, no differences were observed in microbial activity (basal respiration) which may have been due to the lack of difference in the amount of substrate (soluble-C) for the microbes to feed on. Consequently, the ratio of microbial content and activity (metabolic quotient) did not differ between systems. Significantly more earthworms were found in the Green Organic orchards which was likely because of the regular use of organic inputs especially compost.

Soil physical condition

The Green Organic orchards had soil with the lowest bulk density, highest water content (at field capacity), and highest

proportions of good and excellent scores for soil porosity and to a lesser extent soil aggregation (data not presented). The regular use of organic inputs like compost is likely to be the main contributor to this effect. Greater earthworms may have also lowered the bulk density in the Green Organic orchards.

Figure 3. Soil physical and biological values for Green Organic and Gold orchards, relative to Green (=100%).



Conclusions

Overall, there were few significant differences in available nutrient levels between organic and conventional systems demonstrating that long-term soil fertility can be maintained under organic management. Indeed, benefits to soil properties accrued from the addition of organic matter (e.g. compost) under organic management including better soil structure, greater organic matter and microbial biomass, and more earthworms.

For more information about ARGOS visit www.argos.org.nz or contact the programme leader Jon Manhire jon@agribusinessgroup.com

This document is based on the following paper: Carey, P.L., Benge, J.R. and R.J. Haynes. 2009. Comparison of soil quality and nutrient budgets between organic and conventional kiwifruit orchards. *Agriculture, Ecosystems & Environment* 132: 7-15.