ARGOS

AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

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Differences in soil quality within kiwifruit orchards

Jayson Benge and Peter Carey

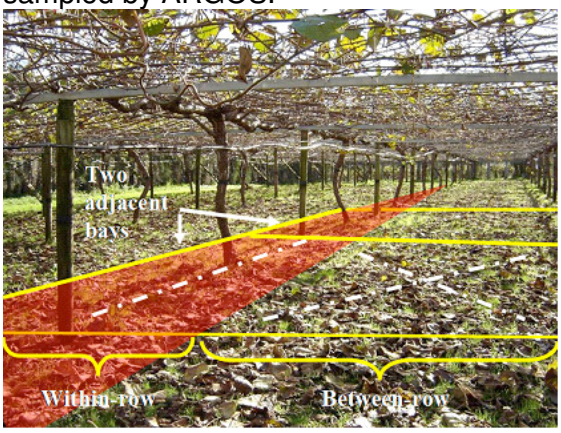
Introduction

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 (12 Green, 12 Green Organic and 12 Gold). Within each orchard, two different areas were sampled under the canopy as these can be managed very differently. These areas were within-row (WR; under the leaders) and between-row (BR, alleyways) (Figure 1). Here the main differences between the sample areas are presented.

Sampling

Within each orchard, three soil monitoring sites (SMS) were established in each of three randomly selected blocks i.e. 9 SMS per orchards. A SMS is two adjoining bays running lengthwise (about 4.5m wide and 10m long). At each SMS, the two different areas were sampled. In conventional orchards, the WR areas are often referred to as herbicide strip areas because of the application of Glyphosate there. Sampling occurred once in winter in each of 2004 and 2006 with the two-year mean values presented here. Samples for lab analyses were collected using a standard 0–15cm horticulture corer. At each SMS, soil structure and earthworms were visually determined in soil removed from a small hole (15cmx15cmx20cm). Soil bulk density at depths of 0–7.5cm and 7.5–15.0cm was also determined by weighing large core samples (of known volume) before and after drying.

Figure 1. The two areas in kiwifruit orchards sampled by ARGOS.



Findings

Soil chemistry

The WR areas had more Olsen and Resin P levels (Table 1) for all three orchard types. It's possible that these areas are receiving more P but this is speculative as usually growers don't intend for more fertiliser to be applied within-row. Overall, the WR areas also had a lower cation exchange capacity (CEC) and consequently the soil held fewer cations.

Soil biology

Total C, nitrogen (total and mineralisable), microbial content and substrate, and earthworms were all higher BR (Table 2) for

all three orchard types. A likely contributing factor is greater organic matter inputs there. For example, prunings are often kicked into the BR areas, away from the WR areas, for mulching into the soil. In the organic orchards, it is likely that the BR areas are mowed more frequently which would also mean greater organic matter inputs. In the conventional orchards, the use of herbicide WR would contribute to lower organic inputs.

The metabolic quotient (the ratio of microbial content and activity) was higher WR which may have been due to lower levels of substrate there for the microbes to feed on.

Table 1. Soil properties which were significantly greater within-row.

Property	Units	WR	BR
Olsen-P	mg P kg^{-1} soil	57	43
Resin-P		124	97
C/N	ratio	12.1	12
Metabolic quotient	ratio	58	44

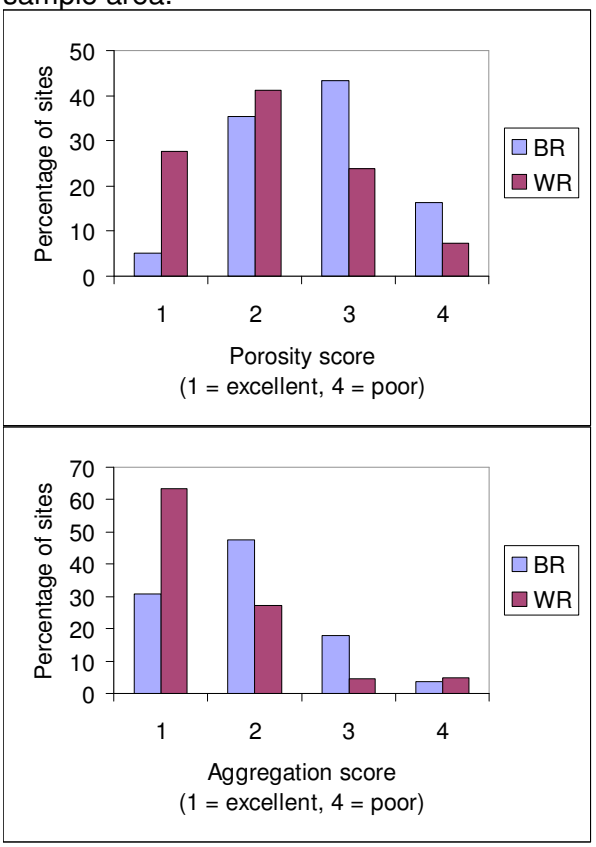
Table 2. Soil properties which were significantly greater between-row.

Property	Units	WR	BR
Total C	w/w %	5.2	5.7
Total N		0.44	0.48
Mineralisable nitrogen	g kg^{-1} soil-N	23.1	25.7
CEC	cmol kg^{-1} soil	18.1	19.0
Ca		11.6	12.7
K		0.73	0.77
Soluble-C	mg C kg^{-1}	142	150
Microbial biomass-C		334	444
Microbial biomass-N	mg N kg^{-1}	68	87
Earthworms	No. m^{-2}	77	114

Soil structure

Visual soil assessments revealed soil porosity and aggregation to be better WR for all three orchard types. This is illustrated in Figure 2 by the higher percentages of sites WR that received a score of 1 (excellent). These differences are likely due to greater traffic between-rows compacting the soil even though grassing can ameliorate some of this through root turnover and earthworm activity creating new aggregates and pore space.

Figure 2. Percentages of soil monitoring sites which received either a score of 1, 2, 3 or 4 for porosity and aggregation, for each sample area.



Conclusions

Significant soil differences were observed between areas within orchards. In particular, soil biology was better in the between-row areas where soil structure was not as good (but not adversely so it would seem). These results provide evidence that management interventions which enhance soil organic matter will also favour soil life and can mitigate some of the more damaging effects of management.

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.