Carbon in Orchards Soils Team

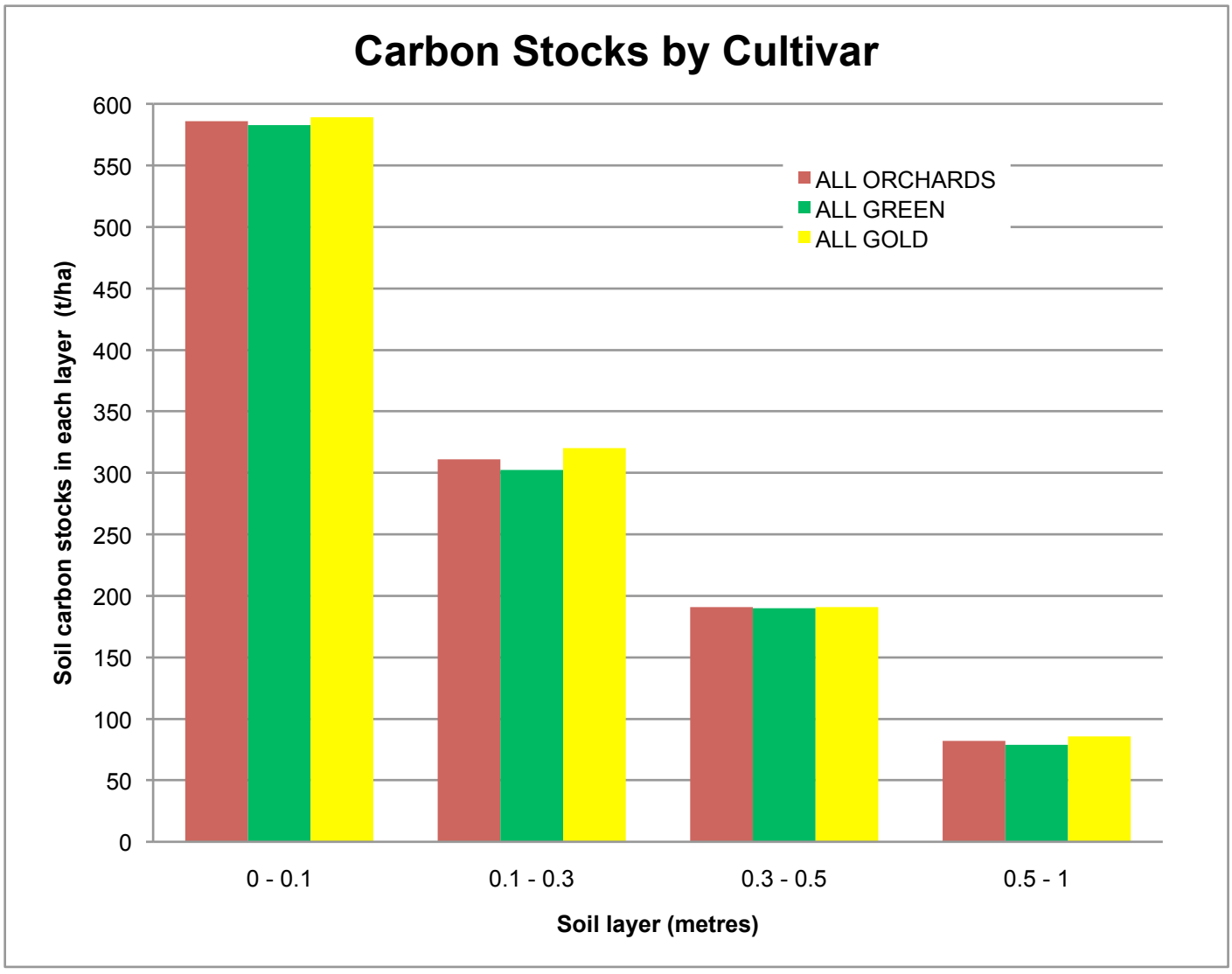
We have recently completed the laboratory measurement of carbon levels in the soils sampled from 40 orchards in the Western Bay of Plenty. In this trial we have included a total of 40 orchards, which allowed us to compare 20 HORT 16A Gold orchards with 20 Hayward orchards; 20 integrated managed orchards with 20 BIO-GRO certified orchards; and 20 orchards with fine textured soils with 20 orchards with coarse textured soils.

The COST team would like to thank all the growers who have allowed us to sample soils from their orchards, and for making the time to supply us with details regarding management, inputs, and yields.

This work is even more relevant now that soil carbon and the standing biomass of kiwifruit vines and shelter belts will be able to be included in the new ISO standard on carbon foot printing.

It is important to note that the results given are for soil carbon (C) stocks, not carbon dioxide (CO_2) equivalents. Often when people are talking about carbon they talk in units of "CO_2 equivalents". The conversion factor from C to CO_2 is 3.67, meaning soils containing 200 t/ha C are storing (sequestering) the equivalent of 734 tonnes of CO_2.

Results & Discussion:



There is no significant difference between soil carbon levels in Gold versus Green orchards. However, average carbon levels in Gold orchards are higher at each depth than in Green. Anecdotally Gold is believed to produce more carbon than Green, as the canopy is mulched after pruning. However, a large amount of this additional growth is not returned to the soil as it dries out on the soil surface and the carbon is lost to the atmosphere. It is also possible that the more vigorous growth of Gold results in more shading of sward species and therefore less root growth and less carbon storage by sward plants.

It had been assumed that organic management orchards would have higher soil carbon levels because of the use of compost etc. However, a large number of integrated kiwifruit orchards also use compost. The biggest increase in carbon in the soil is due to plants growing roots through the profile, and as such integrated orchards may grow bigger root systems due to higher levels of N fertilisation, resulting in greater root growth.

Considering all 40 orchards, we found that the standard error of soil carbon stocks down to 1m is as high as 1.3 kg/m^2. Therefore, in order to track changes on an annual basis in the region, carbon levels would have to change by at least this value. We think that this is highly unlikely as other research has shown that soil carbon stocks under pastoral land-use in NZ down to 1m change on the order of 0.1 kg/m^2 a year.

Previous work (available at http://www.plusgroup.co.nz/allophonic-soil-carbon.html) has found that kiwifruit orchards sequester significantly more carbon at depth in the soil profile than pasture and arable soils.

These results show that the only statistically significant difference is between the groups of soils with coarse textures, and those with fine textures. They also show that significant amounts of carbon are stored at depth in soils growing kiwifruit. For example, only about 60% of soil carbon down to 1m depth is stored in the top 0.3m that is traditionally measured under the Kyoto protocol.

The trial has included two orchards with both old (30 years plus) and new (less than 7 year) vines, and in these orchards the carbon stocks are significantly higher in the older plantings than in the newer plantings. This will be used to determine the rate of change of carbon sequestration in kiwifruit orchards for the ISO 14067 foot printing protocol.

The study found that the biggest variability was present in the subsoil (shown in the graphs above as larger standard error of the mean (SEM) "I" bars, suggesting that one of the most important features in a kiwifruit orchard for maintaining and improving carbon in the topsoil is the presence of a healthy sward cover.

Now our challenge is to understand which orchard practices affect soil carbon levels and how they can be changed over time. We also hope to assess orchard inputs and management systems to see if these correlate with soil carbon levels.

We are also calculating the amount of carbon that is present in the shelterbelts in the orchards, and how these affect the carbon levels in the soil.

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