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GROWING KIWIFRUIT WITH AN ENVIRONMENTAL FOCUS

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Introduction

A challenge for all New Zealand based food growers is how to merge continual science and technology improvements together to support the evolvement of modern horticulture food production methods. It is now apparent to land based food producers for the need to be much more cognoscente of a range of environmental considerations during the production of the food, as this is both what consumers and local government regulatory authorities are now demanding.

Coastal Kiwis is a certified organic kiwifruit orchard located on the coast near Opotiki, Eastern Bay of Plenty. The orchard ranges from 30-50 metres above sea level, rainfall averages around 1550mm per annum, sunshine hours average over 2000 hours, and the soils are predominantly Opotiki Sandy Loam. The orchard aims to grow quality certified organic kiwifruit for consumers in Japan, Asia, North America, and Europe. The fruit is marketed as Zespri Organic Green and Zespri Organic SunGold, and fulfils demand from fruit consumers (particularly "baby boomers" and "millennials") looking for "safe food" (food that is safe to eat and produced in a manner that is safe for the environment).

Holistic View of Food Production

The orchard was established in 2007 on land which had a history of being farmed under organic principles as part of a larger dairy farm. The greenfield development opportunity provided an opportunity to take a holistic view towards eliminating future pest host plants – three major pests for kiwifruit are "Armoured Scale", "Leafroller", and "Passionvine Hopper".

Shelterbelt species were selected based on their "host status" for these three pests. As a result the borders of the orchard were planted with *Casuarina cunninghamiana* (She-Oak) and *Cryptomeria japonica (Japenese Cedar)*. Both of these evergreen trees feature "needle" like leaves which are not desirable habitats for many species of pests (including leaf roller caterpillars, passionvine hoppers, and armoured scale), and this has assisted kiwifruit to be regularly produced to meet pest free export standards. The compromise was that other shelterbelt tree species would have grown at a faster rate, and therefore provided the kiwifruit plants with increased levels of shelter during the establishment phase.

The sides of the orchard were fenced and a small flock of organic sheep was subsequently developed in order to reduce the occurrence of blackberry growing in gully's bordering the

orchard – thus eliminating host plants for Passionvine Hopper. Today the shelter trees provide shelter and warmth to assist with fruit growing, as well as enhancing the habitat for numerous bird species (e.g. weka, black-birds, sparrows) that live in and around the orchard.

A stream flows through the property, and this was taken into consideration with development of the orchard blocks in order to minimise any spray drift into the waterway. Most of the property is fenced to keep the sheep away from the waterway, and water testing at four different testing sites is now completed on an annual basis in order to monitor water quality.

Irrigation best practice is followed and water is only applied during peak plant requirements for fruit growth if monitoring indicates that water is required. Modern sprinkler technology is used to direct the water onto the kiwifruit plant root-zones. The irrigation system is automated to limit the possibility of over-watering. Water usage is monitored through a series of meters throughout the property.

Production Goals

One of the business goals of the orchard is to balance annual production with financial and labour risks, whilst ensuring that sustainable levels of high performance are achieved each year. For these reasons the SunGold production target is 15,000 trays/ha, and the Organic Green target is 9,000 trays/ha Kiwi-start (a financial premium is offered for early harvesting of fruit that meets required market standards).

Soil Management – "Taking Care of Our Best Asset"

There are two major objectives for soil management on the property:

1. Feeding soil biology, and;
2. Ensuring adequate nutrients are available for plant uptake.

A key focus of orchard management is to ensure a wide range of "food" is made available for the many "food webs" that exist in the soil on the orchard floor. Main sources of food for the soil biology come from applications of compost, seaweed and fish fertilisers, sheep manure and various insects and birds that live in the orchard. Periodic mulching of the grass sward under the vines and on headlands, and mulching of leaf and cane material that is dropped to the orchard floor during the growing and pruning seasons also contribute food for the living organisms.

Regular monitoring of slugs and worm numbers is carried out in various blocks, along with regular visual soil assessments utilised to assess the state of the soil during key periods (including irrigation requirements). Worms play a key role in the recycling of organic matter, and are relied upon to help increase nutrient availability for plants. The large number of worms also assists to improve soil structure by making larger pores – assisting water holding capacity during the summer and drainage during the winter. Kiwifruit plants do not like "wet feet", but have a high requirement for water to be available in the root zone during critical fruit growth periods.

The soil management system ensures that nutrients are provided to plants in several forms, either from mineralisation of material that has entered the various "food webs", or by directly applying certified organic inputs. Annual soil testing (including a PH assessment) is completed, and annual fertiliser recommendations are professionally prepared separately depending on block and vine age. Visual leaf monitoring for plant health deficiencies is completed during the growing season, and remedial action is taken when necessary.

Long grass is utilised on the orchard floor to prevent *Sclerotinia* (a fungal pathogen) which can cause rots on fruit. The long grass also acts to trap any soil inputs as they are spread or applied, and the grass helps to prevent any "transfer of inputs away from the targeted root-zone area" by any heavy rain.

Nutrient Budget

The kiwifruit plant is a vigorous feeder during the spring and early summer, and the vine requirements to achieve sustainable high production of tasty and long storing fruit are approximately 200kgN/ha, 250kgK/ha, and 50kgP/ha (Parker, 2015).

The following is the total annual amount of nutrients being applied to each block on the orchard for the 2018 crop – and is a combination of various certified organic inputs:

		Nutrient Fertiliser Inputs Kg/ha/Year					
Blocks	N	P	K	S	Ca	Mg	Na
Paua, Oyster, Scallop	106	66	275	296	1019	111	9
Mussel, Tuatua	95	63	296	340	1059	111	8
Cray, Kina, L	87	61	294	339	1052	110	7
Pipi, Cockle	65	59	265	292	985	108	6

Other additions to overall soil fertility come from the breaking down of surplus canes and leaf litter during autumn. These figures have been calculated based on research completed by Ferguson and Eiseman (1983).

Nutrient Inputs from Kiwifruit Cane/Leaf (Kg/ha/Year*)					
Blocks	N	P	K	Ca	Mg
Paua, Oyster, Scallop	183	21	169	123	29
Mussel, Tuatua	94	11	87	63	15
Cray, Kina, L	94	11	87	63	15
Pipi, Cockle	94	11	87	63	15

Losses from the system occur (along with any leaching) annually with the harvest removal of up to 60,000kgs of fruit per hectare (including Class 1 and Class 2 trays). Using the method outlined by Parker (2015) [and Ferguson and Eiseman (1983)] the following estimates of nutrients being removed have been calculated.

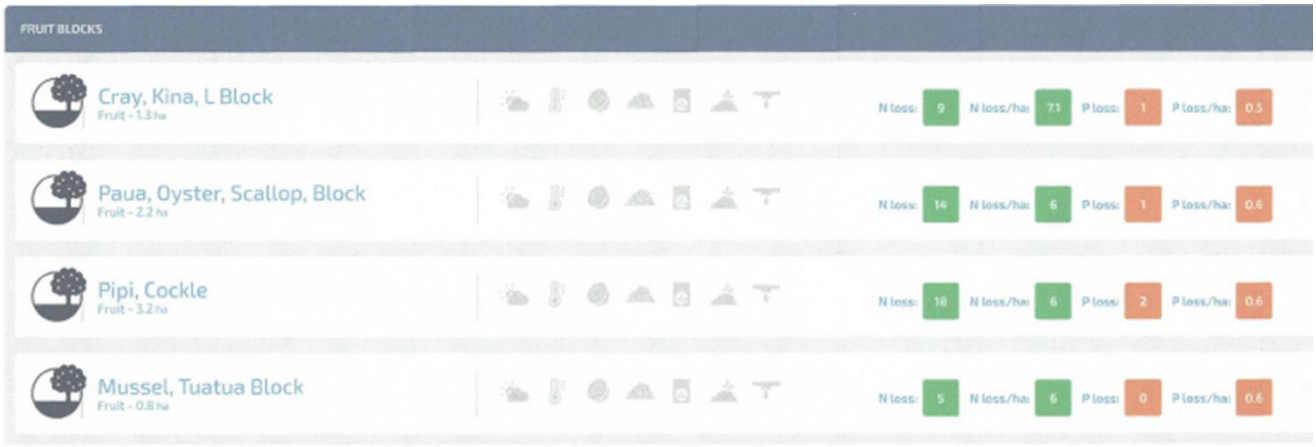
		Nutrient Removal in Fruit (Kg/ha/Year*)					
Blocks	C1 Trays/ha	Kgs/ha	N	P	K	Ca	Mg
Paua, Oyster, Scallop	15,500	55800	85	12	162	16	7
Mussel, Tuatua	8,000	28800	44	6	84	8	3.5
Cray, Kina, L	8,000	28800	44	6	84	8	3.5
Pipi, Cockle	8,000	28800	44	6	84	8	3.5

Below is a summary of the estimated figures based on the proceeding calculations – the totals show that the nutrient inputs are meeting those required to achieve sustainable high production (as estimated from previous research).

Paua, Oyster, Scallop Blocks Nutrient Inputs Kg/ha/Year					
	N	P	K	Ca	Mg
Fertiliser Inputs	106	66	275	1019	111
Cane/Leaf Inputs	183	21	169	123	29
Fruit removal	85	12	162	16	7
Total	204	75	282	1126	133
Requirements	200	50	250		

Overseer FM Results

In order to gauge the level of leaching from Coastal Kiwis Orchard all of the nutrient inputs were inputted into the latest OverseerFM programme. The output from that programme for the orchard blocks is below.



According to OverseerFM the level of Nitrogen leaching has a range between 6kgN/ha/year and 7.1kgN/ha/year depending on the block. Differences exist between results for blocks due to different inputs being used as a result of plant age and production status. This result is lower than the range of previous research completed on kiwifruit orchards by Benge and Clothier (2016). They found conventional orchards ranged from 15-20kgN/ha/year, and organic orchards around 10kgN/ha/year.

Carbon Footprint

Several methods are utilised to minimise the size of Coastal Kiwi's carbon footprint. There are 7.5 hectares of kiwifruit vines which act as carbon sinks at 6.3t/CO^2/ha (Clothier, Holmes, Muller, 2012). Rows of shelter trees total 3km and also need to be accounted for in terms of carbon sequestration (estimated 7-13t/CO^2/ha). A key management philosophy is to minimise spraying within the orchard, and combined with low levels of mowing the annual tractor usage is estimated to be 25% lower than conventional orchards. Sheep are also utilised under the vines following harvest until bud break in order to both minimise machinery usage and to minimise soil compaction. Overall, the OverseerFM programme estimated the greenhouse gas emissions for the Coastal Kiwis property to be 3.2k GHG/ha.

Summary

Coastal Kiwis Orchard has been established to produce food in a manner that meets an increasing level of consumer demand for "safe food". A holistic approach to designing the orchard system resulted in planting plant species that minimises the longer term need for use of agrichemicals to control pests, and has subsequently lowered the levels of emissions from operating machinery. Various certified organic inputs are utilised to feed the soil biology, and to ensure adequate soil fertility exists to support sustainable production levels. The combination of these deliberate strategies has resulted in the delivery of top quality export fruit (and financial returns), while simultaneously achieving measurable low environmental impacts.

References

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