Nitrogen leaching from gorse to Lake Rotorua and mitigation of leaching 'spike' during gorse conversion to pine forest

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Keywords: Lake Rotorua; Nitrogen leaching; Gorse

Rotorua lakes are a resource with significant importance to iwi, local communities & New Zealand. Eutrophication has been the main cause of concern for Lake Rotorua water quality and is attributed to excessive quantities of phosphorous and nitrogen entering the lake. A shrub weed, gorse (*Ulex europaeus*), is a leguminous plant that is common in the catchment, and this plant has recently been assessed to determine its possible diffuse contribution of nitrogen to the lake.

The Bay of Plenty Regional Council (BOPRC) commissioned two studies. The first, (Magesan & Wang 2008) found that gorse could be a significant contributor to nitrate leaching to groundwater and subsequently to Lake Rotorua. This was followed by a survey mapping the extent of gorse (Male et al. 2010), which mapped the distribution of gorse and quantified and categorised the actual amount of mature gorse known to contribute nitrogen to the lake.

Conclusions have been made on the estimation of an average leaching rate for areas of mature gorse vegetation in the lake catchment. Based on trial plot results (Magesan & Wang 2008), it is assumed that an average rate of 50 kg N ha^{-1} $year^{-1}$ is leached from dense and mature gorse stands. The investigation and survey data enabled the quantification of total mature gorse cover in the lake catchment area and enabled an estimate to be made of the potential amount of nitrate leaching to ground water. About 43 tonnes of nitrogen per annum is attributable to gorse. This is approximately 8% of the 547 tonnes of nitrogen known to entering Lake Rotorua annually and has not been previously accounted for as a land use derived nitrogen source.

One suggestion made to reduce this source of nitrogen leaching is to remove or control gorse from the Lake Rotorua catchment through encouraging change of land use to a ground cover that has a low nitrogen-loss signature. It is proposed to convert gorse infested areas to pine forest. However, there remains a risk of a nitrogen leaching 'spike' during land conversion.

This paper summarises previous studies on gorse in the Lake Rotorua catchment and the current study to (a) identify the best way to manage gorse conversion in terms of nitrogen losses to ground water; (b) measure the effectiveness of a nitrogen inhibitor in reducing the nitrogen leaching 'spike' that may occur during conversion; and (c) develop best management practice to reduce nitrate leaching.

There are seven treatments at the experimental site at Whakapoungakau Land Blocks (near Rotorua airport). The experimental plots were 0.4 ha each. Two plots have DCn (a nitrogen inhibitor) which has been used to test its effectiveness in reducing any nitrate losses from gorse. All cleared and roller crushed plots have been planted out in pine trees. The seven treatments are as follows: (i) sprayed and roller crushed gorse; (ii) sprayed then cleared gorse; (iii) sprayed and roller crushed gorse with two DCn applications; (iv) sprayed then cleared gorse with two DCn applications; (v) gorse left growing as a control; (vi) gorse sprayed and left to decay; and (vii) pine tree control.

The experiment is expected to be run over two years in order to incorporate seasonal differences. At each of the experimental plots, four drainage flux-meters have been installed. The study commenced in November 2010 and water samples are being collected monthly for analysis of nitrate, ammonium, dissolved organic nitrogen and total nitrogen.

Early results are showing variability, however at this early stage coming into the autumn's high drainage season, initial analyses show that the roller crushed DCn experimental plot has a reduced nitrate loss in comparison to the other experimental plots.

The Bay of Plenty Regional Council is currently reviewing its Regional Pest Management Strategy, and is considering options for managing gorse in the Lake Rotorua and Okareka catchments. The Council also has a land use change programme underway which actively encourages the conversion of mature gorse areas to forestry in these areas. It is expected that this research will aid this land use change program, determine and develop a best management practice for managing gorse on Central North Island volcanic soils. This best practice standard will focus on mitigating the expected increase (or spike) of nitrate losses from gorse removal and forestry establishment.

Acknowledgements

We would like to thank Bay of Plenty Regional Council for funding this project and Ballance Agri-Nutrients Ltd for supplying DCn for the experiment.

References

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