MORE PROFIT FROM NITROGEN

Optimising nutrient management for improved productivity and fruit quality in cherries — *Economic case study*

About the research

The More Profit from Nitrogen Program (MPfN Program) is a cross-sector partnership between four of Australia's significant agricultural users of Nitrogen (N) fertilisers: horticultural tree crops, cotton, dairy, and sugar. The program aimed to improve nitrogen use efficiency (NUE) in these industries to achieve improved profitability and environmental sustainability.

The Tasmanian Institute of Agriculture (University of Tasmania - TIA) conducted research trials on cherries at multiple sites in Tasmania, supported by Hort Innovation using the cherry research and development levy. The cherry research team aimed to better understand how N can be managed to maximise productivity and fruit quality, minimise losses to the environment and provide economic benefits to producers. This case study details how cherry growers can use N more efficiently for a better financial outcome.

Application rate and timing

Fruit yield and quality were unaffected by the rate of N applied (90 or 180 kg/ha) or how application was split between pre- and post-harvest. However, application timing did affect N distribution within the tree. Pre-harvest N application boosted fruit N concentrations while post-harvest application boosted the N content of vegetative growth (Figure 1). Much of this boost to vegetative growth was accounted for in prunings which, in the longer term, could be a recycled source of N through mineralisation.

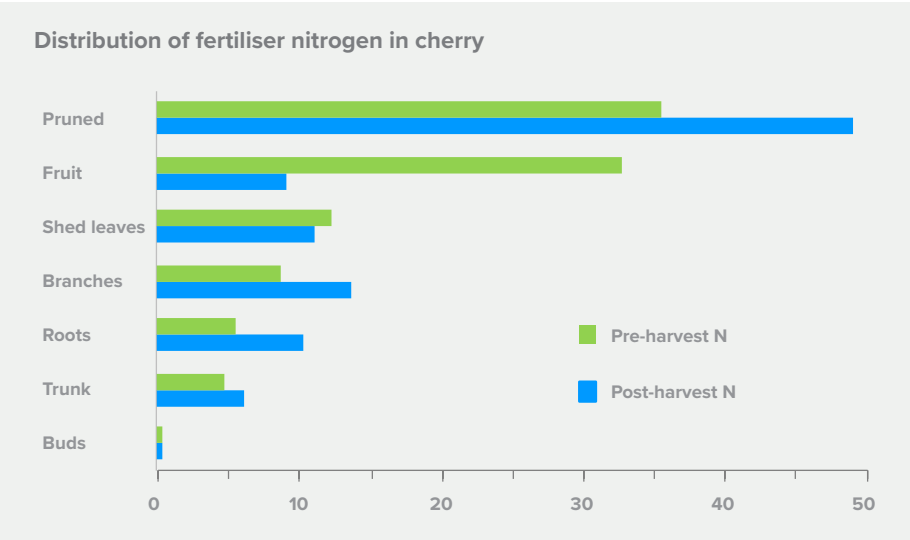

Figure 1 *- Distribution of fertiliser nitrogen in cherry over 2 seasons from nitrogen applied in season 1 as calcium nitrate via fertigation, either pre- or post-harvest, at 90 kg N/ha.*

KEY MESSAGES

- Nitrogen use efficiency was unaffected by the timing or rate of N application. Nor was fruit yield and quality over three seasons.
- N applied in spring boosts fruit nitrogen levels whilst post-harvest N application boosts vegetative growth.
- Monitoring is key for managing the N balance of an orchard.
- For an orchard density of 1330 trees per ha, and a two year average crop of 12 t/ha, the project calculated an annual N application of 91 kg/h is required to replace N removed by fruit harvest and to replenish N in storage organs.
- When compared to a current practice of 120 kg/ha this has the potential to save $205/ha in N input costs, as well as reducing N losses to the environment.

Managing N within the MPfN recommendations could save $205/ha/year and reduce the negative environmental impacts that result from losses of excess N.

How much N is needed to maintain fruit yield and quality?

- **N removed at harvest -** Fresh fruit contained 1.7 g N/kg irrespective of N rate applied. Based on a fruit yield of 12 kg/tree, this equates to 20.0 g N/tree needed to replenish N removed at harvest.
- **Tree N requirements -** Many factors can influence tree requirements for sufficient N to sustain adequate tree growth and provide an optimum yield of high-quality fruit, including climatic conditions and orchard management. This research found 8 g N/tree was required to maintain sufficient concentration of N in the storage organs.
- **Other sources of N: mineralised N -** In this trial leaf breakdown into mineralised N contributed an average 4.5 kg N/ha over a 12-month period. Further breakdown of stems would be expected in the longer term. This source of N has not been included in the N balance for economic assessment.

Analysis of farm level economic benefits

For an orchard density of 1330 trees per ha, and a two-year average crop of 12 t/ha, the fruit and tree N requirements equate to 91 kg/ha (Table 1). Reducing the rate of N application to 91 kg/ha compared to a current practice of 120 kg/ha has the potential to save $205/ha in N expenditure, as well as reducing N losses to the environment. This is based on fertigation[1] with calcium nitrate ($Ca(NO_3)_2$).

NUE

Measured over three seasons, the research found no difference in yield or quality related to N application. By maintaining yield and quality while reducing applied N, the recommended N management improves the farm NUE. Table 1 shows NUE measured as partial factor productivity (PFP_N), which is derived from fruit yield per tree (fresh weight (kg)) and N application rate per tree (kg). In the example, application of the MPfN recommendations increased PFP_N by 32%.

Laboratory testing of fruit quality

Cherry harvest at the Wandin Valley Farms orchard research site, Rosegarland, Tasmania

Orchard walks conducted by the project with cherry growers of Tasmania

Winter dormancy stump excavation at Wandin Valley Farms research site, 2018

[1] *With N content of 15.5%, priced at $1112/tonne. As N is applied through fertigation, changes in rates of N have minimal impact on application costs.*

Table 1 *— Comparison of recommended N management with an example current practice.*

	MPfN recommendations		Current practice	Change	$ change
Fruit N requirement	**Per tree**	**Per ha**	**Per ha**	**Per ha**	**Per ha**
Yield (average)	12 kg	16 t	16 t	0	$ 0
Fruit N concentration	1.7 g N/kg	-	-	-	-
Average annual removed	20 g	-	-	-	-
Uptake efficiency	41%	-	-	-	-
Fruit applied N requirement	49 g	65 kg	-	-	-
Tree N requirement					
Base requirement	8.0 g	-	-	-	-
Uptake efficiency	41%	-	-	-	-
Tree applied N requirement	19.7 g	26 kg	-	-	-
Total applied N requirement	69 g	91 kg	120 kg	- 29 kg	
$Ca(NO_3)_2$ equivalent application	443 g	590 kg	774 kg	-185 kg	$ 205
PFP_N (kg yield/kg N)	175	-	133	42	-

Monitoring key to nitrogen management

Monitoring N content is key to managing N efficiently and economically, particularly from season to season due to variations in crop load and climatic conditions. Testing of soil, leaf, fruitlet and fruit N content is recommended.

Monitoring and managing irrigation is recommended to prevent N leaching. Applying N in smaller, more frequent doses has environmental benefits by reducing the potential for leaching loss after heavy rainfall events or nitrous oxide emissions through denitrification when the soil becomes very wet.

MPfN

FURTHER INFORMATION

FOR FURTHER INFORMATION ON THE MPfN PROGRAM:

Optimising nutrient management for improved productivity and fruit quality in cherries project, contact the project leader:

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Visit www.crdc.com.au/more-profit-nitrogen

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