Kiwifruit (*Actinidia* spp.) vine and fruit responses to nitrogen fertiliser applied to the soil or leaves

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Abstract

Dry matter concentration (DM%) of the fruit is a primary indicator of quality for kiwifruit (*Actinidia* spp.), lower levels being associated with inferior tasting fruit. Carbohydrates and particularly starch, are the main component of dry matter in the fruit of *Actinidia* spp. In plants, N fertilisation can reduce carbohydrate levels and increase succulence. Therefore high levels of N fertilisation could reduce fruit DM% by reducing its dry matter accumulation and increasing its water content. High rates of N fertiliser applied to kiwifruit vines (*A. deliciosa*) over four seasons tended to produce larger fruit (5% heavier on average over the four seasons) mainly due to increased water content with less effect on total dry matter contents. Consequently DM% was reduced from an average over the four seasons of 16.1% in the unfertilised (control vines) to 15.6% in fruit from the N fertilised vines. However, vegetative vigour in terms of the weight of shoots was increased by up to 150% by N fertiliser. Biostimulants applied as foliar sprays and surplus water supplied to the soil appeared to alter the balance between dry matter and water accumulation in the fruit in a similar way to soil-applied N fertiliser. It is concluded that increases in fruit size induced by N fertilisation, biostimulants, surplus water, and even girdling are at least partly due to the creation of increased hydraulic gradients between the vine and fruit leading to increased water uptake by the fruit. Other effects on fruit of high rates of soil-applied N fertiliser included reduced ascorbic acid, oxalate, and epidermal phenolics. Reductions in levels of these compounds and the generally increased succulence of N fertilised vines may increase the susceptibility of the vines to pests and diseases. In contrast to soil-applied N, foliar sprays of N applied during early fruit development stages increased fruit growth with no apparent effect on vegetative vigour. Aqueous solutions (1% w/v) of both urea and potassium nitrate were effective forms of N for foliar application and could increase fruit fresh weight by between 6 and 10% depending on the season and number of applications. It is estimated that the use of foliar-applied N during early fruit development could represent an increase in crop value of between $3600 and $15,000 per hectare depending on size and yield. Foliar-applied N shows promise as an alternative way to manage the N nutrition of kiwifruit with favourable effects on fruit quality since dry matter accumulation in fruit tended to increase proportionately with increased water uptake. Foliar application of N can also avoid some of the adverse environmental effects associated with the soil application of soluble N fertilisers.

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List of Abbreviations

BK	Benefit Kiwi®
CPPU	N-(2-chloro-4-pyridyl)-N'-phenylurea
CV%	coefficient of variation
DAFB	days after full bloom
DPBB	days ‘post’ or after bud break
DM%	dry matter concentration
DW	dry weight
EC	electrical conductivity
FC	field capacity
FN1, FN2	foliar-applied N at time 1 or time 2, abbreviation used in Experiment 1 in Chapter 6.
FW	fresh weight
HATS	high affinity transport system
HN	high nitrogen (high rates of N fertiliser) treatment
HN+SF	high nitrogen plus spring-applied fertiliser treatment
LN	low nitrogen (nil N fertiliser) treatment
LN+SF	low nitrogen plus spring-applied fertiliser (Chapter 3)
LNF	low nitrogen plus foliar urea treatment (Chapter 7)
MN	moderate rates of N fertiliser treatment (Chapter 7)
MNF	moderate rates of N fertiliser plus foliar urea treatment (Chapter 7)
N	nitrogen
N1-N4	potassium nitrate (foliar treatments at times 1 to 4)
NAA	1-Naphthaleneacetic acid
NO_3^-	nitrate
NR	nitrate reduction
NUE	nitrogen use efficiency
	New Zealand daylight saving time

NZDST	photosynthesis
Pn	soluble solids content
SSC	soluble solids as percentage of DM%
SSFDM%	soil organic matter
SOM	surplus water treatment (Chapter 8)
SW	titratable acidity
TA	urea (foliar treatments at times 1 to 4)
U1 – U4	un-watered (control) treatment (Chapter 8)
UW	water
W	fruit water potential
Ψ_{fruit}	leaf water potential
Ψ_{leaf}	osmotic potential
Ψ_{s}	vine water potential
Ψ_{vine}	

Table of Contents

Contents

List of Tables

List of Figures