THE EFFECT OF DEFICIT IRRIGATION ON WATER RELATIONS, GROWTH, AND FRUIT QUALITY OF'BRAEBURN' APPLES (*Malus domestica* BORKH.) GROWING IN LYSIMETERS

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By

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"Om Sai Sri Sai Jaya Jaya Sai"

Dedicated to my grandpa

ABSTRACT

This project investigated the feasibility and practicality of using deficit irrigation (DI) at different times of the growing season on water relations, growth and fruit quality of 'Braeburn' apples grown in lysimeters. Five-year-old trees on MM. 106 rootstock were subjected to three irrigation treatments in a completely randomised design. The treatments were: Well-watered control (C), deficit irrigated for the entire season (ED), and deficit irrigated late in the season (LD) from 102 days after full bloom (DAFB) to harvest.

Both ED and LD trees developed a lower predawn and midday leaf water potential than C trees. For LD and ED trees towards the end of growing season, reduction occurred in the photosynthesis (Pn), stomatal conductance (g_s), and the rate of transpiration. The reduction in Pn was caused by stomatal and non-stomatal factors. Deficit irrigation caused an increase in canopy temperature (T_c) and canopy-air temperature difference (T_c-T_a) in ED and LD. Fruit growth was not affected by DI although shoot growth and increase in trunk circumference were significantly reduced under DI. Deficit irrigation also reduced mean fruit weight at harvest as well as return bloom.

Deficit irrigation increased the concentration of fruit soluble solids and volatiles, decreased that of N, and did not have any effects on the concentration of P, Ca^{2+}, Mg^{2+}, and K^{+}. The ED and LD treatments resulted in more advanced fruit maturity based on higher ethylene production and TSS concentration. Firmness was higher in LD and ED fruit than the C fruit after 12 weeks of storage at 1 ^{0}C.

This study showed that water deficit late in the season may be used in apple production with improved fruit quality in terms of increased TSS, firmness in storage, and higher volatiles without adversely affecting on fruit size.

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Thanks Mum.

'Truth lives for ever so as God'

TABLE OF CONTENTS

ABBREVIATIONS

A	- Surface area of the fruit (m^2)
ABA	- Absicic acid
ACC	- 1-aminocycloprpane-1-carboxylic acid
ANOVA	- Analysis of variance
C	- Control
CD	- Crop density (grams of fruit per unit trunk cross sectional area)
C_a	- External CO_2 concentration ($\mu mol\ mol^{-1}$)
C_i	- Intercellular CO_2 concentration ($\mu mol\ mol^{-1}$)
CRD	- Complete randomised design
DAFB	- Days after full bloom
DI	- Deficit irrigation
ED	- Entire-season deficit irrigation
ET	- Evapotranspiration
GLC	- Gas liquid chromatography
GLM	- General linear models
g_s	- Stomatal conductance ($mol\ CO_2\ m^{-2}\ s^{-1}$)
H	- Hue angle (^{0})
HPLC	- High performance liquid chromatography
IR	- Infra red
L	- Lightness (%)
LD	- Late-season deficit irrigation
MPa	- Mega Pascal (1 MPa = 10 bars)
n	- Number of observations
Pn	- Rate of photosyntheasis ($\mu mol\ CO_2\ m^{-2}\ s^{-1}$)
SEM	- Standard error of the mean
T	- Rate of transpiration ($mmol\ m^{-2}\ s^{-1}$)

TA	- Titratable acidity (% malic acid)
Ta	- Air temperature (^{0}C)
Tc	- Canopy-air temperature (^{0}C)
T_c-T_a	- Canopy-air temperature difference (^{0}C)
TCA	- Trunk cross-sectional area
TDR	- Time domain reflectometry
TSS	- Total soluble solids
VPD	- Vapour pressure deficit
θ	- Soil volumetric water content ($m^3\ m^{-3}$)
Ψ	- Leaf water potential

LIST OF FIGURES

Figure 12. Carbon dioxide production for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

LIST OF TABLES