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**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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“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 ( $P_n$ ), stomatal conductance ( $g_s$ ), and the rate of transpiration. The reduction in  $P_n$  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 °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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‘Truth lives for ever so as God’



2.2.2.4	Photosynthesis	8
2.2.3	Vegetative growth	9
2.2.4	Reproductive growth	11
2.4.1	Fruit growth and yield	11
2.3	FRUIT QUALITY	12
2.3.1	Effect of water deficit on soluble solids	13
2.3.2	Effect of water deficit on titratable acidity	13
2.3.3	Effect of water deficit on fruit colour	14
2.3.4	Effect of water deficit on fruit firmness	15
2.3.5	Effect of water deficit on ethylene production	15
2.3.6	Storage life and disorders	16
2.3.7	Effect of water deficit on mineral concentration	16
2.3.8	Effect of water deficit on volatile compounds	17
2.3.9	Irrigation timing	18
2.3.9.1	Early-season deficit irrigation	18
2.3.9.2	Entire-season deficit irrigation	19
2.3.9.3	Late-season deficit irrigation	19
2.3.9.4	Postharvest deficit irrigation	19
3.0	MATERIALS AND METHODS	20
3.1	EXPERIMENTAL SETUP	20
3.1.1	Lysimeter facility	20
3.2	PLANT MATERIAL	21
3.3	SOIL MOISTURE	21
3.4	LEAF WATER POTENTIAL ( $\Psi$ )	22
3.5	PHOTOSYNTHESIS AND STOMATAL CONDUCTANCE	22
3.6	CANOPY TEMPERATURE AND CANOPY-AIR TEMPERATURE DIFFERENCE	22
3.7	VEGETATIVE GROWTH	23

3.7.1 SHOOT GROWTH	23
3.8 REPRODUCTIVE GROWTH	24
3.9 FRUIT QUALITY UNDER DEFICIT IRRIGATION	24
3.9.1 Total soluble solids	24
3.9.2 Titratable acidity	24
3.9.3 Fruit colour	25
3.9.4 Flesh firmness	25
3.9.5 Fruit ethylene evolution and CO <sub>2</sub> production	25
9.6 Fruit mineral composition	26
3.9.7 Volatile compounds	27
3.11 STATISTICAL ANALYSIS	28
4.0 RESULTS AND DISCUSSION	29
4.1.1 Soil water content	29
4.1.2 Leaf water potential	29
4.1.3 Photosynthesis and stomatal conductance	34
4.1.4 Rate of transpiration	34
4.1.5 Canopy temperature and canopy air temperature	34
4.1.6 Vegetative growth	37
4.1.7 Fruit growth	41
4.1.8 Shoot vs Fruit growth	44
4.2 FRUIT QUALITY	45
4.2.1 Fruit firmness	45
4.2.2 Total soluble solids	46
4.2.3 Titratable acidity	47
4.2.4 Mineral composition	47
4.2.5 Colour	50
4.2.6 Ethylene evolution and CO <sub>2</sub> production	51
4.2.7 Volatile compounds	52

5.0 GENERAL DISCUSSION AND CONCLUSION 57

LITERATURE CITED 62

# ABBREVIATIONS

A	- Surface area of the fruit (m <sup>2</sup> )
ABA	- Abscic 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 <sub>a</sub>	- External CO <sub>2</sub> concentration (μmol mol <sup>-1</sup> )
C <sub>i</sub>	- Intercellular CO <sub>2</sub> concentration (μmol mol <sup>-1</sup> )
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 <sub>s</sub>	- Stomatal conductance (mol CO <sub>2</sub> m <sup>-2</sup> s <sup>-1</sup> )
H	- Hue angle (°)
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
P <sub>n</sub>	- Rate of photosynthesis (μmol CO <sub>2</sub> m <sup>-2</sup> s <sup>-1</sup> )
SEM	- Standard error of the mean
T	- Rate of transpiration (mmol m <sup>-2</sup> s <sup>-1</sup> )

TA	- Titratable acidity (% malic acid)
T <sub>a</sub>	- Air temperature (°C)
T <sub>c</sub>	- Canopy-air temperature (°C)
T <sub>c</sub> -T <sub>a</sub>	- Canopy-air temperature difference (°C)
TCA	- Trunk cross-sectional area
TDR	- Time domain reflectometry
TSS	- Total soluble solids
VPD	- Vapour pressure deficit
θ	- Soil volumetric water content (m <sup>3</sup> m <sup>-3</sup> )
Ψ	- Leaf water potential

## LIST OF FIGURES

Figure 1. Changes in soil volumetric water content ( $\theta$ ) during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Arrow indicates the start of LD. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

Figure 2. Changes in predawn leaf water potential during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Vertical bars represent pooled standard errors of means based on four replicates except for C which was based on eight replicates before LD started. Arrow indicates the start of LD.

Figure 3. Changes in noon leaf water potential ( $\Psi$ ) during the early season (A) and late-season (B) for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Vertical bars represent pooled standard errors of means based on four replicates except for C which was based on eight replicates before LD started (A).

Figure 4. Changes in A) rate of photosynthesis and B) stomatal conductance during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Arrow indicates the start of LD. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

Figure 5. Changes in A) rate of transpiration and B) leaf internal  $\text{CO}_2$  concentration ( $C_i$ ) during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Arrow indicates the start of LD. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

Figure 6. Changes in A) canopy temperature and B) canopy air temperature difference during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Arrows indicate the start of LD. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

Figure 7. Changes in shoot length during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Arrow indicates the start of LD. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

Figure 8. Cumulative fruit growth during the season for control (C), entire-season deficit (ED), and late-season deficit (LD) treatments. Arrow indicates the start of LD. Vertical bars represent the pooled standard errors of means based on four replicates per treatment.

Figure 9. Titratable acidity 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.

Figure 10. Ethylene evolution 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.

Figure 11. Concentration of volatile compounds in the fruit juice 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.

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

Table 1 Growth and return bloom for control (C), entire-season deficit (ED), and late-season deficit (LD) of 'Braeburn' apple trees. Column values followed by the same letter are not significantly different at 5% level.

Table 2 Firmness for control (C), entire-season deficit (ED), and late-season deficit (LD) of 'Braeburn' apples. Column values followed by the same letter are not significantly different at 5% level.

Table 3 Influence of irrigation treatment on some fruit attributes for control (C), entire-season deficit (ED), and late-season deficit (LD) of 'Braeburn' apples. Column values followed by the same letter are not significantly different at 5% level.

Table 4. Changes in the concentration of fruit minerals (mg g<sup>-1</sup> dry wt) for control (C), entire-season deficit (ED), and late-season deficit (LD) of 'Braeburn' apples. Column values followed by the same letter are not significantly different at 5% level.