

90451



NEW ZEALAND QUALIFICATIONS AUTHORITY
 MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Agricultural and Horticultural Science, 2008

90451 Describe physical factors of the environment and techniques used to modify them for plant production

Credits: Four

2.00 pm Thursday 20 November 2008

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

<i>For Assessor's use only</i>		Achievement Criteria			
Achievement		Achievement with Merit		Achievement with Excellence	
Describe physical factors of the environment that affect plant production.	<input type="checkbox"/>	Explain how physical factors of the environment affect plant production.	<input type="checkbox"/>	Explain how physical factors of the environment affect plant production.	<input type="checkbox"/>
Describe techniques used to modify physical factors of the environment for plant production.	<input type="checkbox"/>	Explain how techniques used to modify physical factors of the environment improve plant production.	<input type="checkbox"/>	Justify techniques used to modify physical factors of the environment for plant production.	<input type="checkbox"/>
Overall Level of Performance (all criteria within a column are met)					<input type="checkbox"/>

You are advised to spend 40 minutes answering the questions in this booklet.

Refer to the resources on pages 2–3 to answer all questions in this booklet.

- Resource One provides information on a Central Otago orchard.
- Resource Two provides information on stonefruit (apricots, cherries, nectarines, peaches and plums) production.

Central Otago provides an environment that allows growers to produce high yields of export-quality stonefruit such as apricots, cherries, nectarines, peaches, and plums.

Physical factors of the environment existing at bud formation, flowering and fruit set will determine the potential **yield** of the stonefruit crops. Physical factors of the environment existing during the growth and development stages of the fruit will influence the **quality** of the fruit.

There are times when growers must use special **production techniques** to modify physical factors of the Central Otago environment to enhance stonefruit production.

RESOURCE ONE: SITE DATA

Mean monthly climatic information for a Central Otago orchard

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air temperature (°C)	17.1	17.1	15.1	11.3	7.0	2.9	3.0	5.5	8.9	11.5	13.9	16.0
Minimum air temperature (°C)	10.6	10.5	8.7	5.1	1.5	-1.7	-1.8	-0.4	2.9	5.5	7.6	9.9
Maximum air temperature (°C)	23.5	23.8	21.5	17.5	12.4	7.5	7.9	11.4	15	17.5	20.2	22.1
Soil temperature (°C) at a depth of 10 cm	16.5	15.5	13.3	9.2	4.9	2.0	1.2	2.4	5.7	9.9	13.2	15.5
Precipitation (rainfall) (mm)	29	22	40	34	35	26	23	24	27	41	26	43
Ground frosts (number)	1	2	3	10	19	26	27	26	19	12	6	2
Sunshine (hours)	228	213	193	153	112	83	93	146	165	192	213	220
Relative humidity (%)	69.8	76.0	76.2	85.0	85.9	88.6	90.5	86.5	75.6	67.8	68.0	68.2

Other climatic and site information for a Central Otago orchard

Topography	Mostly flat with some gentle slopes
Soil type	Well drained loamy soil
Mean annual wind speed (km / h)	6
Mean annual gale days (wind speed of at least 63 km / h)	3
Growing degree (°C) days in growing season	900–1 300
Chill units over winter period	1 400

RESOURCE TWO: STONEFRUIT PRODUCTION REQUIREMENTS

Flowering time	Mid-late August to mid-October.
Harvest time and method	Most ripen between mid-November and mid-January. Hand-picked.
Pollination method	Apricots, nectarines, and peaches mostly self-fertile. Cherries and plums mostly self-incompatible. All are insect pollinated.
Water requirements	Needs adequate moisture during growing season. No tolerance to being waterlogged.
Drought tolerance	Moderate. Prefer dry summers and autumns. Apricots and cherries prefer below 700 mm of rain, while peaches, nectarines and plums need 700–900 mm annually.
Temperature requirements	Temperate fruit. Needs heat accumulation above about 850 growing degree days (heat units). Winter chilling requirement of 600–1 200 hours or more.
Sunshine requirements	Full sun. However, fruit can be prone to heat damage.
Soil requirements	Prefer moderately loamy deep soil that is well drained with a pH of 6.5–7.0.
Nutrient requirements	Fairly demanding for nutrients. Adequate nitrogen required for good crops.
Wind tolerance	Moderate.
Frost tolerance	Low because of early flowering.
Topography	Flat land or mild slopes preferred.
Humidity tolerance	Poor. Prefer dry areas, especially with low rainfall at blossom and at maturity.

Physical factors at bud formation, flowering and fruit set will determine the potential crop **yield** of stonefruit.

Assessor's
use only

Refer to Resources One and Two to answer the following questions.

QUESTION ONE

- (a) Describe TWO physical factors of the Central Otago environment that **increase fruit set** when producing stonefruit. (**Use data** from Resource One when describing physical factors).

Physical factor (1):

Physical factor (2):

- (b) Explain how EACH of these physical factors **increases fruit set**.

Physical factor (1):

Physical factor (2):

QUESTION TWO

(a) A disadvantage of the Central Otago environment is the chance of a **late frost**, which can have a significant effect on the **yield** of stonefruit.

(i) Describe the **damage** a late **frost** causes developing buds.

(ii) Explain how a late frost **decreases** the **yield** of a stonefruit crop.

(b) **Frost prevention techniques** available to a Central Otago stonefruit grower to protect buds from frost damage include the use of **overhead sprinklers** and **diesel heaters (stack heaters)**.

(i) Explain how **overhead sprinklers** prevent frosts and **assist** in the production of a **high crop yield**.

(ii) Explain how **diesel heaters (stack heaters)** prevent frosts and **assist** in the production of a **high crop yield**.

- (c) Central Otago stonefruit growers are under pressure to produce stonefruit in a manner that considers environmental factors. Three frost protection techniques available to stonefruit growers are the use of:
 - A wind machines
 - B overhead sprinklers
 - C helicopters.

Rank these techniques in order of their ability to **prevent** frost in an **environmentally friendly manner**.

Rank order (use letters):

- (1) _____
- (2) _____
- (3) _____

Justify your order by explaining why your highest-ranked technique prevents frosts in a more environmentally friendly manner **compared** with ONE of the other techniques.

This page has been deliberately left blank.

QUESTION THREE

Assessor's
use only

Physical factors present during a crop's growth and development will largely determine the crop's quality. Rainfall and hail near harvest can significantly reduce the quality of high-value stonefruit crops such as cherries, nectarines, peaches and plums.

- (a) Explain how rainfall can reduce the **quality** of stonefruit crops such as cherries, nectarines, peaches, and plums.

- (b) One technique available to a Central Otago stonefruit grower to protect susceptible fruit from rain is the use of **rain covers / combination cloth**.

- (i) Describe how rain covers / combination cloth would **protect** the fruit from rain.

- (ii) Explain how the use of rain covers / combination cloth could create **difficulties** with other stonefruit quality factors, such as **colour** and **disease**.

(c) Hail is an isolated event in Central Otago but hail can destroy a stonefruit crop in minutes. Some stonefruit growers protect small areas of trees from damage through the use of **hail cannons**.

(i) Describe how use of a hail cannon **protects** stonefruit from hail damage.

(ii) Explain how the use of hail cannons could provide **greater financial returns** to a stonefruit grower.

QUESTION FOUR

Growers can use a range of techniques to **modify** the environmental conditions, thereby producing high yields of **export-quality** stonefruit, such as peaches and cherries.

Three techniques used to modify environmental conditions are the use of:

- A overhead sprinklers
- B hail cannons
- C combination cloth/rain covers.

Rank these techniques in order of their ability to produce high levels of export-quality fruit at the **least financial cost**.

Rank order (use letters):

- (1) _____
- (2) _____
- (3) _____

Justify your order by explaining why your highest-ranked technique will provide high levels of export-quality stonefruit at the least financial cost **compared** with ONE of the other techniques.
