

Name: _____

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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"/> |
| 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"/> |
| 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.

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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**.

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QUESTION THREEAssessor's
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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**.

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(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.
