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2

91290



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## Level 2 Agricultural and Horticultural Science, 2018

### 91290 Demonstrate understanding of techniques used to modify physical factors of the environment for NZ plant production

9.30 a.m. Wednesday 28 November 2018  
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of techniques used to modify physical factors of the environment for commercial plant production in New Zealand.	Demonstrate in-depth understanding of techniques used to modify physical factors of the environment for commercial plant production in New Zealand.	Demonstrate comprehensive understanding of techniques used to modify physical factors of the environment for commercial plant production in New Zealand.

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 attempt ALL the questions in this booklet.**

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 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.**

Excellence

TOTAL

21

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## QUESTION ONE: GLASSHOUSES

Glasshouses are used to control the physical environment for plant production.

### Modern glasshouse



Source: [http://www.wintergardenz.co.nz/uploads/3/0/5/9/30594579/7436057\\_orig.jpg](http://www.wintergardenz.co.nz/uploads/3/0/5/9/30594579/7436057_orig.jpg).

- (a) Describe how the level of carbon dioxide can be controlled in glasshouses.

Carbon Dioxide is controlled through pumps and ventilation. Pumps add more carbon dioxide into the glasshouse and can be automated to turn on when they fall below a certain level, and ventilation (opening windows/vents) decreases CO<sub>2</sub> by putting it back into the atmosphere //

- (b) Explain the effect of carbon dioxide enrichment on crop yield.

Carbon Dioxide enrichment helps to increase crop yield. Carbon Dioxide is used in the photosynthesis process which converts  $6\text{CO}_2 + 6\text{H}_2\text{O} \xrightarrow{\text{sunlight}} \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$  into glucose which is then broken down into energy which is then used to grow. By adding more CO<sub>2</sub> to the plant's environment, ~~it does~~ it ensures that it doesn't become a limiting factor in this process. It allows plants to have plenty of Carbon Dioxide to use in this process to speed up energy production, which in turn speeds up growth which allows the plant to produce fruit growth more at an increased rate, ~~mean~~ which at harvest leaves more ~~fruit~~ fruit available to pick //



Two methods used to control light levels in glasshouses are diffused glass and temporary sprayed glass coatings, such as whitewash, as shown in the photographs below.

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Regular (left) and diffused glass



<http://www.agf.nl/nieuws/2015/0203/smartglass.jpg>

Whitewash



[https://www.redusystems.com/public/upload/application\\_techniques/image/Helikopter.jpg](https://www.redusystems.com/public/upload/application_techniques/image/Helikopter.jpg)

- (c) (i) Explain why light levels need to be controlled in a glasshouse.

Light needs to be controlled in a glasshouse for two important reasons. The first is that sunlight is used in the photosynthesis process to split  $H_2O$  into  $H^+$  and  $O^-$  in the light dependent stage of energy ~~process~~ <sup>production</sup>. Without sunlight the plant wouldn't be able to produce the energy it requires to grow and it wouldn't produce any product. The second reason is that glass magnifies the intensity and heat given off by light. The glass magnifies the light directly onto the plants. This can cause the plants' leaves and stems to burn and become damaged. It can also burn fruit produced by a plant causing it to be damaged and to lose its ~~at~~ aesthetic appeal. The ~~intensity~~ <sup>heat</sup> of the light ~~also~~ increases transpiration which makes the plant dehydrate and they shrivel up and die. This transpiration takes water from the plant which also ~~increases~~ <sup>decreases</sup> photosynthesis slowing plant growth. Finding the right level of shading in a glass house is vital to maximise plant growth and minimise death and damage.



- (ii) Justify the use of ONE of these methods in terms of economic and environmental factors for new and existing glasshouses.

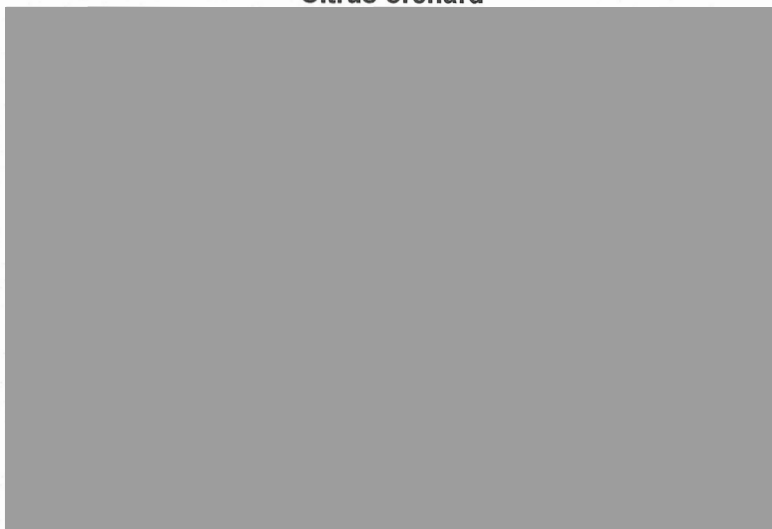
Diffused Glass is a better option than whitewashed glass. Economically diffused glass is better as it is a permanent installation. Once it is installed it stays and only needs replacing if it is cracked or becomes damaged in any way where as whitewashing is temporary and will require redoing periodically which in the long run will cost a lot of money. The diffused glass will be more expensive now as it is specially made, it is cheaper than having to respray the whitewash. Diffused Glass also provides a constant even sunlight protection whereas the whitewash could be applied unevenly and as time goes on can wear away. Environmentally diffused glass is a better option. Whitewashing is done by a chemical that is sprayed onto the glass. If it is windy the chemical could blow onto the soil around the glasshouse or into nearby waterways. The whitewash chemicals could be poisonous or irritant to skin/animals and the flakes that peel off the glass as it wears off can be harmful/toxic to the soil and the organisms that live in it. Whereas the diffused glass has no environmental effect. Whitewashing also requires buying the chemical and in some cases a helicopter to apply it to the roof of the glasshouse which makes it even more expensive //



## QUESTION TWO: CITRUS

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Citrus orchard



Source: [http://www.uncleggong.com/data/file/bod\\_33/236990270\\_mKLpJoSw\\_Farmer27s\\_005.jpg](http://www.uncleggong.com/data/file/bod_33/236990270_mKLpJoSw_Farmer27s_005.jpg)

- (a) Describe how the use of reflective mulches in commercial orchards increases the quality of fruit.

Reflective mulch is used in orchards to ensure that the fruit ripens evenly all over. The topside of fruit is exposed to more light than the underside and so ripens quicker leaving the fruit ~~even~~ unevenly ripe. The risk is to let the underside be slightly underripe or the top be overripe. Reflective mulch reflects sunlight back under the fruit so that the fruit becomes ripe all over at the same time, reducing the risk of having under or over ripe fruit.

Citrus are generally not tolerant of 'wet feet'. An orchardist has the choice of using either mounding or subsurface drains to control soil water levels.

- (b) (i) Describe the effect of drainage on plant growth, and explain how this will impact on crop yield, quality, and timing.

Drainage removes excess water from the macropores space in the soil. This helps to increase the crop yield as growth is not hindered by mould or other water diseases and the plant is able to focus solely on producing fruit. Less disease by excess moisture also helps to decrease the



amount of fruit that goes mouldy or is effected by disease. This also improves the quality of the fruit as they are less diseased and the plant is healthy. Drainage helps improve timing as the whole orchard is at the same moisture level all through which means that the growth and ripening rates is more uniform.

- (ii) Justify the use of either mounding or subsurface drainage in a citrus orchard by comparing and contrasting the two methods in terms of economic and environmental impacts.

Subsurface drainage would be a better option to use on the Citrus Orchard than mounding. This is because it disturbs the plants less. Mounding would require plants to be moved and planted ~~at~~ higher and older more established plants wouldn't respond well to this. Mounding would also not be fully effective at draining all excess water as it can only drain away water that sits at the height of the mound as the trees roots go much deeper. The subsurface drainage can be ~~adjusted~~ put in the exact right spot to drain water away from underneath the roots to ensure the whole root system has a dry enough soil to grow in. The installation of subsurface drainage can be cheaper to install than mounding. Mounding requires a lot of digging and machinery whereas subsurface doesn't require as much. Less machinery requires less money. Mounding also effects the top of soil which could result in a loss of productive land. Subsurface does require more maintenance and if plastic is chosen it is ~~not~~ as environmentally friendly but there are environmentally friendly options and the benefits outweigh the negatives.

E7



## QUESTION THREE: VITICULTURE

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## Vineyard

Source: <http://www.instituteofhospitality.org/wp-content/uploads/2018/06/01-vineyard1.jpg>.

- (a) Describe what a microclimate is, and explain its effect on vineyard production.

A micro climate is when a small area of land has ~~diff~~ its own unique weather conditions than the larger surrounding area due to the specific land shape. This ~~is useful for effects~~ vineyard production as it can sometimes make weather hard to predict and with a delicate crop like grapes can have a big effect on business if you get it wrong but microclimates can be useful to vineyards if the area/region they are in isn't suited for a vineyard. Microclimates usually increase temperature and are drier which in places like Otago where it is usually too cold & wet for grapes ~~and~~ a microclimate can allow a vineyard to be established and grow well.



A vineyard owner can use either helicopters or frost sprinklers to prevent frost from damaging the grapes.

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USE ONLY

- (b) Justify the use of ONE of these methods to manage frost in vineyards by comparing and contrasting it with the other method.

Selected method: Frost Sprinklers.

In your answer:

- explain how both helicopters and frost sprinklers modify the environment
- analyse the practices in terms of economic, social, and environmental impacts.

Frosts usually occur in high pressure weather systems where hot air rises and cold dry air sits at ground level, making water especially in plants freeze, killing buds and leaves and severely damaging fruit.

Frost sprinklers spread water over plants constantly and as the water cools it lets off just enough heat energy to stop buds from dying and before the water freezes which would kill the bud, more water replaces it - must be kept constant until temp. rises.

A helicopter flies over the plants and circulates the air. The pressure from the helicopter pushes the warm air down and it mixes with the cold air raising the temperature around the plants enough to stop frost setting.

Using frost sprinklers is a lot cheaper than flying a helicopter. Helicopters are expensive to hire and run and using them for a night costs a lot and if you use them for multiple nights a year the cost can really start to add up. Frost sprinklers are also a permanent investment so installation and set up may be a lot but once they are there they pay for themselves in saved product. One off cost rather than a cost everytime.

A helicopter requires a person to stay up and

E7



Extra space if required.

Write the question number(s) if applicable.

ASSESSOR'S  
USE ONLYQUESTION  
NUMBERQuestion 3, b continued

...and fly it at night, which can be dangerous. ~~A~~ A helicopter is also very noisy as it is flying low and hovering and if near a town or settlement can disturb other people's sleep. A sprinkler does not make anywhere near as much noise and once turned on can continue by themselves without someone needing to stay up. //

Helicopters burn fuel to fly and they require a lot of it to stay up in the air. This will increase the CO<sub>2</sub> output into the atmosphere and the noise can disturb wildlife and stock on neighbouring farms. Sprinklers are also a waste of water and could increase the leaching from the vineyard. ~~This~~ This can be solved if a drainage system collects this water and recycles it for use at another time. A pump may need to use some fuel to pressurise water but this has nowhere near the effect that using a helicopter does. //



## Excellence Exemplar 2018

Subject	Level 2 Agricultural and Horticultural Science		Standard	91290	Total score	21
Q	Grade score	Annotation				
1	E7	<p>The candidate fully explains the effect on carbon dioxide enrichment in relation to plant processes and growth rates.</p> <p>The candidate justifies the grower's decision to use diffused glass as opposed to sprayed glass coatings taking into account the economic and environmental impacts of the use of diffused glass and sprayed on coatings.</p> <p>The response could have been improved by explaining the economics of diffused glass in more depth.</p>				
2	E7	<p>The candidate fully explains how drainage effects plant growth in relation to plant processes and crop quality.</p> <p>The response could have been improved by explaining with more depth and clarity how timing is affected by drainage techniques.</p> <p>The candidate justifies the use of subsurface drainage as opposed to mounding to improve the crop yield.</p> <p>The response could have been improved by more depth in the explanation of environmental factors regarding drainage.</p>				
3	E7	<p>The candidate justifies the use of helicopters as a frost-prevention method and analyses its effect on the environment and the community.</p> <p>The response could have been improved by a more accurate and clear description of a microclimate.</p>				