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91290



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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Agricultural and Horticultural Science 2025

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

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 2–8 in the correct order and that none of these pages is blank.

Do not write in the margins (//////). This area will be cut off when the booklet is marked.

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

Excellence

TOTAL 23

QUESTION ONE: Light

Identify a plant production type and management practice of modifying light.

Plant production type: Apples

Light modification management practice: Reflective mulch

- (a) Describe how your chosen management practice modifies the physical factor of light, and explain how this affects plant growth.

Reflective mulch is a sheet of plastic or other material that is placed on top of soil, underneath a plant canopy. This reflects light from the sun (as white colors reflect light) and hits the underside of the leaves. Light is a reactant that is needed for photosynthesis ($\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{sunlight}} \text{O}_2 + \text{glucose}$) which occurs in the chloroplasts (found in the leaves). The chlorophyll (green pigment in leaves) absorb the light and ~~photosynthesis~~ ^{photosynthesises} to produce glucose. This glucose is then used to make amino acids (which are the building blocks for growth), used for respiration (which produces a chemical energy ATP) or it is stored in the plant as starch. ~~ATP~~ ^{Reflective mulch} helps to increase plant growth of the apples as it increases the photosynthetic rate (due to light reaching all parts of the plant rather than just the top).

- (b) Compare the use of your chosen management practice over not using it. Consider this in terms of improvement in both **quality** and **crop yield**.

Using reflective mulch to ~~increase~~ modify light will have many improvements in the quality and yield of the apple ~~crop~~. When photosynthesis increases (hence increasing plant growth), it will also increase the rate at which

(~~grow more~~)

the fruit grows. The apples will grow larger^m and due to the increased production of glucose, it will increase the sugar content (BRIX levels) within the fruit. This improves the overall quality of the fruit ~~rather~~ compared to if the farmer didn't use reflective mulch. ~~It~~^{That} would cause the photosynthetic rate to decrease and hence the ~~fruit~~ apple produced will be smaller. ~~The~~ less glucose will also be produced and hence the fruit would be ^{more} sour and starchy; overall it would produce low quality fruit. Not only will reflective mulch increase the quality, but it will also increase the quantity of apples produced at harvest. This is because when more photosynthesis occurs, more flowers bloom and produce a larger fruit^{set} as well as the overall weight of the apple increasing due to a larger size. If the farmers where to not use reflective mulch, then the amount of apples produced would be less and the size would decrease, leading to a decrease in crop yield. Overall, farmers who produce apples should use reflective mulch as a way of modifying light as it will increase the quality and yield of products due to an increase in photosynthesis

* Adding water through a K-line to pasture will ensure that the plants stay at field capacity and hence will increase growth rates and therefore increase pasture production

QUESTION TWO: Irrigation

Choose a method of irrigation.

Irrigation method: K-line

- (a) Explain how this method modifies physical factors of the environment and impacts pasture production.

K-line irrigation is a line of irrigators that is put on the ground in a paddock. K-lines add water to the soil which is beneficial especially during summer months. All plants (including pasture) have a field capacity which is the optimal amount of water in soil for plant growth. If water levels fall below this field capacity (common during summer) then water tends to cling to soil particles, making it hard for ^{plant} roots to uptake any water. Not having access to enough water will decrease photosynthesis (as it is a reactant for it), nutrient uptake / transpiration (as nutrients need to be dissolved in water first before it can be uptaken) and turgor pressure (as water is needed to maintain rigidity in plant cells). ~~By adding~~ This will decrease growth rates, causing the pasture to become droopy.*

- (b) Justify a farmer's decision to irrigate their farm using your chosen method, taking into account the **environmental** and **economic** impacts of this practice.

Using a K-line as an irrigation method can be extremely beneficial for farmers, especially during the summer season. It will increase/maintain the growth of pasture during the dryer months ensuring that there will be feed for stock to consume. This means that the farmer will receive an economic benefit in ^{increased} production of stock (milk, meat, wool, etc). It also means that farmers will not have spend money on other feeds during the

summer such as silage, hay and other supplementary feeds.

Even though the initial cost of buying the ~~spring~~^{K-line} system may be expensive, the long term benefits and economic increase that the farmer will receive will be worth the cost. ~~However,~~

Using an irrigation method such as K-lines^m can have a negative environmental impact^{though,} as the water used can be taken from streams/ rivers. This ~~can~~^{could} decrease the water level of the stream/ river and therefore ~~an~~ effect the ~~quality~~ aquatic wildlife within it. However, using ~~irrigation~~^{K-lines} prevents the use of having to use trucks/ tractors to bring in extra supplementary feeding from elsewhere. This will decrease CO₂ immisions and hence will have a positive effect on the environment. Overall, using K-lines as an irrigation method can be very beneficial for a farmer using pasture as it ensures that plant growth continues during the summer months and stock have enough feed for production. It will increase the economic benefit for the farmer however they do need to be aware of the environmental impacts.

** K-lines also cover a large area, meaning that farmers won't have to buy lots of irrigators to cover a whole paddock

QUESTION THREE: Temperature

Identify a production type and a management practice that could be used to modify temperature in horticultural production.

Horticultural production type: ~~Strawberries~~ Tomatoes

Temperature management practice: ~~Greenhouse~~ Glasshouse

- (a) (i) Describe how the use of your chosen management practice modifies the temperature of the physical environment for your chosen horticultural production type.

~~It is a layer of organic or synthetic material that is placed on the soil underneath a strawberry plant.~~

~~It is used~~ A glasshouse is a structure made out of glass panels that can ^{by protecting it from the outside environment} modify the temperature for tomatoes. It traps heat inside, warming up the air inside and dispersing it evenly throughout all of the plants (beneficial during winter and cold nights). It also has ventilation systems that can allow cooler inside, decreasing the temperature of the air inside (beneficial during summer months). It modifies the temperature for tomatoes through providing a stable environment/temperature.

- (ii) Explain how modifying the temperature improves plant growth.

All plants have an ^{optimal} temperature range ~~at which~~ ^{at which} growth rate is highest (10-20°C). This is when all plant growing processes (photosynthesis, respiration, nutrient uptake/transpiration) occur at a fast rate. If the temperature was too cold, the plant would undergo stress and if the temperature was too hot, the plant will lose water (due to evaporation) and will become droopy. Therefore temperatures outside the optimal range will result in a decrease in plant growth which is why it is important that farmers modify temperature for constant plant growth.

- (b) Justify how the use of this management practice impacts the **timing** of harvest and the **economic** returns for the grower.

By using a glasshouse to modify the temperature for tomatoes, it will increase the growth rates[^]. This means ^{due to the protection it provides from the outside environment} that the fruit will reach maturity faster and hence will be ready when it comes to harvest. Tomatoes are a fruit that are demanded all year round so in order to meet that demand, they must maintain their optimal growing conditions^(warm temperatures) all year round. Using a glasshouse can do this for temperature as it can decrease the temperature when it gets too warm (ventilation) or it can increase it when it gets too cold (by trapping heat or using heat lamps). Glasshouses may be expensive to install initially but the long term economic benefit that it will provide due to its ability to produce all year round will be worth it for the farmer. Glasshouses also last quite a long time/are durable meaning that farmers won't have to put much economic input into it once it is installed. Overall, using a glasshouse to modify the temperature for tomatoes will ensure that growth rates are maintained all year round, increasing economic benefit for the farmer and reaching the demand/timing for harvest.

Excellence

Subject: Agricultural and Horticultural Science

Standard: 91290

Total score: 23

Q	Grade score	Marker commentary
One	E8	<p>The candidate has included links to how plant growing processes impact fruit growth, as well as references to ripening and brix (sugar) levels.</p> <p>A clear comparison has been made about the negative impacts of not using reflective mulch in apple production, showing how its absence can reduce plant growth and lower fruit quality.</p> <p>Detailed references to both quality and crop yield are present throughout the candidate's response.</p>
Two	E8	<p>The candidate has made links between the pasture growth and how this has a positive impact on stock with a link to economic benefit. This shows a clear understanding of the production system and how altering the physical factor improves production.</p> <p>References are made to the positive economic benefits in justification, which are weighed up against the negative environmental impacts. The clear response shows detailed understanding.</p>
Three	E7	<p>The candidate has clearly explained how growing tomatoes in greenhouses modifies the physical factor of temperature. Links made to both timing and economics. Adding detail around the economic cost of using greenhouses vs the economic benefit would have further lifted this response.</p>