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Mana Tohu Mātauranga o Aotearoa  
New Zealand Qualifications Authority

## **Level 1 Agricultural and Horticultural Science RAS 2023**

**91930 Demonstrate understanding of how soil  
properties are managed in  
a primary production system**

# **EXEMPLAR**

**Merit**

**TOTAL 15**

## Page 1 – Pilot Assessment

### NOTE

'Soil properties' refers to physical, chemical, and biological aspects of soil.

A soil management practice is carried out by the grower to improve or modify plant growing conditions.

Choose a primary production system to answer ALL THREE questions.

Primary production system:

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

### QUESTION ONE: Soil pH

- (a) What is soil pH, and what effect does it have on soil properties and plant growth in your primary production system?

B I U    

soil pH is the acidity of soil and has a range between 4 and 10. 4 being very acidic and 10 being very basic. the ph of the soil matters for plant growth for a number of different reasons. if the soil is too acidic, micro organisms like worms and other bacteria are killed or move out of the soil. worms affect the plant growth by digging tunnels that allow roots to penetrate deeper into the soil therefore allowing them to reach more nutrients to help speed up the process of photosynthesis. if a soil is too acidic or too basic most of the micronutrients and macronutrients needed for plant processes like photosynthesis, respiration and transpiration are not available to the plant meaning the plant cannot survive. the ph of soil is found out by taking soil tests.

- (b) Evaluate a management practice used to modify the pH of soil in your primary production system.

In your answer you should consider:

- the health of the soil
- how the management practice helps optimise plant production.

B I U    

liming is a management practice used to modify the pH of the soil. lime (calcium carbonate) is basic. lime can be applied by either cultivating it into the soil to speed up the reaction rate or by spreading it on top of the soil. liming also unlocks the necessary nutrients in the soil to optimise plant growth. this is relevant to the maori value Kaitiakitanga which is to show care and respect for the land, by liming we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.

## Page 2

### QUESTION TWO: Soil compaction or pugging

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

- (a) Describe a management practice that can be carried out in your primary production system that helps **avoid** soil compaction or pugging.

B I U

a management practice that can be carried out to avoid soil compaction or pugging is spreading organic matter in the soils. spreading organic matter in market gardens can be carried out by either digging it in to the soils which is more effective or by spreading it on top of the soils as a mulch. spreading organic matter is especially effective on clay and sandy soils because the clay soils have very small particles that are compacted very close together so spreading mulch through the soil spreads apart the soil particles allowing for water to pass through and allowing air to flow in. spreading organic matter does the oposite for sandy soils, it clumps together the sand particles helping it hold on to more water and not allowing leaching which is when water carries away the nutrients. it also adds nutrients in the soil that the plants need to speed up the process of plant processes like photosynthesis and respiration. this relates to the maori value Kaitiakitanga which is to show care and respect for the land, by cultivating we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keepind the land healthv.

- (b) (i) What soils are more susceptible to soil compaction or pugging?

B I U

clay soils are more susceptible to soil compaction or pugging because they have very small particles that are compacted tightly together. this means that the soil cannot drain very well and holds on to water because of the small particles. this means that the air flow is very little in the soil because they are often waterlogged. the smaller particles means that they can compact closer together.

- (ii) What are the effects of soil compaction or pugging on soil properties in your primary production system?





B I U

the effects of soil compaction or pugging on soils in market gardens is that compacted soils hold on to water and do not drain so they are often water logged meaning there is no air flow within the soil. the optimal plant growing soil should consist of 50% organic material 25% water and 25% air so if there is more water therefore there is less air so plant processes like photosythesis happen slower. an effect that soil compaction has on chemical properties is the nutrients of the soil are not able to be reached because the roots cannot push into the compacted soil so the soil retention is low. an effect soil compaction has on the biological properties of soil is microorganisms like worms and bacteria are unable to help with the nutrient status of the soil because they cannot diq through the soil as easily

(c) Evaluate a management practice used to **restore** compacted or pugged soil properties in your primary production system.

In your answer consider how the management practice:

- optimises plant production
- ensures the long-term sustainability of the production system.





<b>B</b> <i>I</i> <u>U</u>    
<p>a management practice that can be carried out to restore compacted or pugged soils is cultivation. cultivation in market gardens is done usually by hand or using tools like rakes and shovels. it is carried out by ripping up the soil. cultivation is especially effective on clay soils because the clay soils have very small particles that are compacted very close together. this means there is little air flow in the soil and too much water. cultivation is carried out to restore compacted soils and maximise air flow in the soil for the ideal plant growing conditions. it also unlocks nutrients in the soil that the roots could not reach speeding up the process of photosynthesis. cultivation makes the soil temperature rise because it allows more air into the soil and air heats up faster than water so the soil is warmer which speeds up the process of photosynthesis. however overcultivation reduces nutrients in the soil so growers need to be careful not to overcultivate the soils. this relates to the maori value Kaitiakitanga which is to show care and respect for the land, by cultivating we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.</p>

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### QUESTION THREE: Soil temperature





Ensure reference to a **relevant** Māori concept or value, related to soil management, is included. One or more concepts may be appropriate.

(a) (i) How does the composition and structure of soil affect soil temperature?

B I U    

the composition and structure of the soil affect soil temperature because a clay soil which has very small particle sizes does not allow drainage and water to flow through which means that they are often water logged and have not much air in them. air heats up faster than water so a soil with more air and less water will heat up faster therefore clay soils are cooler. sandy soils have a very big particle size so the micropores and macropores are larger allowing drainage to happen very quickly therefore there is more air in the soil so the soil will heat up faster. therefore sandy soils are generally warmer

(ii) What are the impacts of temperature on the biological properties of soil?





B I U    

the impacts of temperature on the biological properties of soil is that microorganisms within the soil like the warmer soil so there will be more worms and other organisms in warmer soil. therefore the nutrient status in the soil is higher. the higher nutrient status within the soil means that the plant processes e.g. photosynthesis respiration and transpiration are sped up

(b) Evaluate how a specific management practice is used to modify soil temperature.

In your answer you should consider how this management practice:

- optimises plant growth
- demonstrates care for the environment.

B I U    

a management practice used to modify soil temperature is drainage. drainage can be carried out in many different ways either by above ground or below ground drainage systems. above ground drainage systems are things like open ditches and creeks, below ground drainage systems are done by mole ploughs etc and are sloped downwards to allow the flow of water and lead to open ditches and creeks. this management practice modifies the soil temperature because it carries away excess water allowing for a higher air flow in the soil. air heats up faster than water so air flow in soil is important to maximise the temperature in the soil which therefore speeds up the plant processes like photosynthesis. this relates to the maori value Kaitiakitanga which is to show care and respect for the land, by cultivating we are showing care for the soil and the plants that are to be planted in the soil which can then be fed to feed families while keeping the land healthy.

## Merit

**Subject:** Agricultural and Horticultural Science

**Standard:** 91930

**Total score:** 15

Q	Grade score	Marker commentary
One	A4	The candidate has understood soil pH and how lime modifies the acidity of the soil, but they have not understood why having an ideal soil pH will improve plant growth.
Two	M5	The candidate has explained that by cultivating the soil it will break apart the soil, improving air flow, allowing roots to reach nutrients and warm the soil. For a more solid Merit, the candidate would have linked improved air flow to respiration and plant growth.
Three	M6	The candidate has explained that drainage will remove excess water, allowing more air flow into the soil, and therefore increasing the temperature, and speeding up plant processes. This is not an Excellence as the candidate has not evaluated the use of drainage by discussing the cons or any additional benefits apart from removing water.