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New Zealand Qualifications Authority

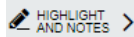
## Level 1 Agricultural and Horticultural Science RAS 2023

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

# EXEMPLAR

**Excellence**

**TOTAL 21**



## 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 how acidic or basic a soil is. Ideal soil pH is 6.5. It's important for the soil pH to be at the correct level because if soil is too acidic or basic nutrients can become locked up and insoluble meaning cant be used for nutrient uptake which increases the growth of the plant.

(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

A management practice to help the soil pH is liming. Liming is the processes of adding calcium carbonate to a soil to decrease it's acidity and bring it back to the correct pH level of around 6.5. Adding lime to a soil encourages living organisms to break down organic matter into humus which will release nutrients for the plants to take up as a part of nutrient uptake (The process of nutrients being souble and dissolved in water so plants can then take it up and use for growth) which will increase the growth of the plants. It encourages them because they can only work and break down orgainc matter if the soil is at a good pH. Lime also prevents nutrients from being locked up and insoluble. If the nutrients are locked up and insoluble they cant be used as a part of nutrient uptake and therefore plants will be lacking in nutrients which will decrease growth rates. However adding lime is an expense to the farm as they will have to buy the lime and pay for it's application if they haven't got the right tools to apply it themselves. In comparison to not adding lime the soil will lack nutrients as the micro organisms that are breaking down the organic matter into humus to release nutrients will be slowed because they cant work well under acidic conditions. It will also lack nutrients because some of the nutrients will be insoluble due to the soil being too acidic. These are two ways the soil will now lack nutrients due to no lime being added to the soil. The farmer however wont have to pay for the lime or it's application, this money could be spent on other things around the dairy farm. Adding lime to the soil is showing manakitanga to the soil because the farmer is caring for the soils needs and respecting that if they want production off the soil they need to respect and help it as well. It's very important to add lime to your soils if it is needed because it is a small price to pay for healthy soils that will be nutrient rich and not have insoluble nutrients within them. Having healthy soils full of nutrients will increase nutrient uptake which will increase plant growth and yield meaning the cows on the dairv farms production will be increased.

## 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	☰ ☷	↶ ↷
Cultivation is a management practice that prevents soil from being compacted. Cultivating is usually done by an implement called a cultivator being towed behind a tractor. The process of cultivation breaks up top soil and turns it over therefore will be breaking up and compacted soil particles.		

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

B I U	☰ ☷	↶ ↷
Soils with poor drainage such as clay soils are the most affected by compaction. This is because the soils usually have too much water and not enough air in their pore spaces which means they can be easily compacted.		

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

B I U	☰ ☷	↶ ↷
Having compacted soils will mean very small pore spaces this means there won't be much air or water within them for plant growing processes. Compacted soils tend to have very poor structure, drainage, aeration and temperature due to the small compacted pore spaces. This is because there is only room for a little bit of water in the pore space and the rest will have to drain away and because the soils that often get compacted aren't usually good at draining this may take a long time. There will also only be a small amount of air in the particles meaning the soil won't be well aerated which will mean it's cold and rates of reaction will be slowed. Having compacted pore spaces and soil particles will also mean soil structure is bad.		

(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	I	U	☰	☰	↶	↷
<p>The management practice cultivating is done by turning over over the top soil of a paddock to take away the compacted soil so that it can be restored back into healthy soil. When cultivating it breaks up the compacted soil particles and allows good levels of air back into the soil's pore spaces. If a soil is well aerated it will mean there is plenty of oxygen for the plants roots to use for respiration. Respiration creates a chemical energy (ATP) that plants use to grow. Having a well aerated soil also means that the soil will be a warmer temperature then if the soil was poorly aerated. Having a good temperature will mean that rates of reaction are speed up and the plant growing processes will be able to happen faster which will increase the production of the plants. Cultivating also helps to put the organic matter that was spread through the top soil deeper into the soil. This is important because the organic matter will help improve the structure further down in the soil which will increase pore spaces and improve the aeration and drainage deeper in the soil which is especially important for deeper rooted plants. It will also increase the nutrients being released deeper down and will help increase nutrient uptake to plants. However when cultivating there is a risk of over cultivating. This means it's been done too much and has ruined the structure of soil. It's important not to cultivate your soil too often and only when needed to ensure sustainability of your soil. Compared to not cultivating where there is no risk of over cultivating and ruining the structure of the soil for a long time but it will mean there will be a lack of organic matter spread through deeper soils which will mean poor structure and not enough water in the pore spaces for the plants to use for photosynthesis (The process of plants making glucose for themselves to use as food for growth). Also not enough air in the pore spaces for plants to use for respiration which also translates to growth. There will also be a lack of nutrients for the plants to use for nutrient uptake (transpiration). The top soil will also stay compacted with little air in pore spaces for respiration. Cultivating the soil when needed shows manakitanga because the farmer is caring for his soil and wanting it as healthy as it can be. Its very important to cultivate soil as it helps with increasing air and water in pore spaces due to it improving structure. This means it helps with all three plant growing processes which will increase the plant growth and ensure a sustainable farm.</p>						

## Page 3

### 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 a soil affects the temperature of a soil because if the soil is well aerated it will have a warmer temperature because air is easy to heat up. If a soil has bad aeration and bad drainage it will be a cool temperature because it will be hard to heat up as there is little air and more water which is difficult to heat up.		

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

B I U	☰ ☷ ☹	↶ ↷
Temperature impacts plant growth which will impact living organisms because if a soil is healthy and has good plant growth due to a good temperature the living organisms will also be healthy. If the soil is healthy and warm the living organisms will break down organic matter at a faster rate meaning it can be used faster. A good temperature also rates of reaction for plant growing process (photosynthesis, transpiration, respiration) which both living organisms and organic matter take part in.		

(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	☰ ☷ ☹	↶ ↷
The management practice adding compost is the process of adding breakdown down plant and animal waste to a paddock. This is done to increase the organic matter through a soil. When adding the compost it is adding organic matter to the soil as well. The living organisms within the soil then break this organic matter down into humus which will act like a glue to soil particles and help them hold together this will increase the pore spaces and mean they will be well aerated and have improved drainage. Soils with good aeration are warmer as they are easier to heat up than soils with minimum air. When a soil is warmer it will increase rates of reaction meaning the three plant growing processes photosynthesis (creating glucose for their own energy and growth), respiration (creating a chemical energy called ATP for growth) and transpiration (nutrients being dissolved and taken up for growth) will be speed up and therefore plant growth will be speed up which will increase the production of the farm. Compost is also dark and so is the organic matter within it this means that the sun will be attracted to it in and outside of the soil. This will heat up the soil and again increase rates of reaction however compost is very expensive to buy and time consuming for the farm to make themselves. This is a cost to the farm that could be used on other things if needed. In comparison if the farm didn't put compost through their soil it would mean one less expense but there also wouldn't be the organic matter being added to the soil to increase the pore spaces which will increase the air in soil for respiration and water in soil for transpiration and photosynthesis. All three of these things improve plant growth and production by creating an energy for growth. With the lack of organic matter the soil also won't be attracting so much sun therefore won't reach such high temperatures. Adding compost shows that the farmer is caring for their soil because they want it to be healthy with good properties. It is also showing care to the environment by using recycled materials to improve soils and the land and animals in the environment. It is important for the farmer to add compost even though it is a cost because it will majorly improve plant growth by improving the three plant growing processes which will improve production of the whole farm.		

## Excellence

**Subject:** Agricultural and Horticultural Science

**Standard:** 91930

**Total score:** 21

Q	Grade score	Marker commentary
One	E8	Candidate has evaluated the use of liming to increase the soil pH to achieve ideal soil pH. The use of lime is linked to soil properties, and the cost of lime is discussed. The consequence of not using lime has been included in the response. The response shows logical links between the management practices and soil properties that improve the health of soil.
Two	E7	Candidate has evaluated the use of cultivation to restore pugged or compacted soil. Cultivation is linked to soil properties and plant processes that will benefit from a more aerated soil. For a more solid Excellence, the candidate should have linked cultivation to long-term sustainability.
Three	M6	Candidate shows a good understanding of soil temperature, and the effects temperature has on the biological properties of the soil. For an Excellence, the candidate should have chosen a more realistic management practice for a dairy farming context that they could then evaluate fully.