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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

Achievement

TOTAL 11

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 level of acidity of your soil and will determine the amount of nutrient availability in soil. pH has a level of 1 to 14 with 1 being very acidic, 7 being neutral and 14 being very basic. Soil pH affects the soil properties as it influences how well the soil chemical, physical and biological properties work. Depending on how well the soil properties work will determine plant growth as they need very specific results for maximum growth. A soil's nutrient status and retention is decided by the soil's pH level, for example a pH level of 6.5 will give the soil the best nutrient status and retention as it's a good balanced level being neutral but that slight acidity. To adjust soil pH you can apply lime or fertiliser, lime lowers acidity whereas fertiliser adds acidity. In Dairy farming we want maximum pasture, crop and plant growth as dairy cows need to produce a lot of milk and they make this from getting nutrients and energy from grass and crops, so therefore the farmers need to produce a lot of food for a cow to keep up with the high milk demand.

(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 that can be carried out in dairy farming to modify soil pH can be applying lime. Applying lime is the process of limestone being crushed up into granular powder and being applied to soil via either truck, quad or aeroplane. In this case the soil may be too acidic and its production rate may be stunted, it's not as healthy as it can be and is dry and not producing enough succulent grass or crop this is when the farmer should apply lime to lower the acidity of soil to ideally 6.5, this will then give the soil maximum nutrient status and retention and the soil will be able to take in more nutrients and therefore give a high yield and production rate. Carrying through "Liming" will overall increase the health of the soil and create better and more consistent production also by doing this management practice will show Tiakitanga as the farmer is showing respect for the land and doing their best to ensure the land is healthy and looked after, this will benefit the farmer and/or future farmers and the land will be healthy and suitable to use in the future as it is well cared for. Showing respect to the land is very important as the land needs to be cared for to be able to give back to us and supply our needs, so for an understanding looking after our land will not impact and influence the land but also us ourselves.

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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 used to avoid soil pugging and compaction is Cultivation. Cultivation is done by using heavy machinery to turn over top soil and make it into a crumb texture. Doing Cultivation in dairy farming will help avoid soil compaction or pugging as once the soil has been compacted it will turn over the soil and bring it back up to a healthy state where the soil structure can regenerate and pore spaces can be made for good aeration and drainage so the soil can respire. This will also make it harder for cows to pug the soil as the soil wont be as compacted and wet and will be able to be used for longer. Once again this is showing Tiakitanga as it is respecting the lands health and is maximising land production and duration.

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

B I U

Clay soil is more susceptible to soil compaction and pugging as clay soil has the smallest pore spaces giving them more vulnerability, they don't have as much room between soil particles as sand and silt meaning clay gets squashed easier and oxygen and water don't have enough room to move through the soil profile making it hard for the soil to respire which therefore leads to a wet, cold soil which becomes pugged from stock.

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

B I U

In dairy farming pugging and compaction of soil are a huge risk as a lot of stock (cows) in one soil area that is poorly aerated and drained can lead to huge damage to the soil and it's health. Compaction and pugging occurring can completely disrupt the soil as it damages the soil structure and properties which furthermore leads to ruined yield and production. In dairy farming there is a high demand in food for the cows and with compaction and pugging occurring this restricts the demand and leads to farmers seeking other food sources to meet the desperate demand. The effects of this is much more than decreased production but also can cause a permanant damage to the soil.

- (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

An evaluation of Cultivating the soil is that turning over the soil can restore and restart the soil and it's health. It can save it from endangerment and help increase it's production. This can be caused as cultivating the soil will break up the structure and help the soil regain a healthy structure and let the pore spaces be able to allow oxygen and water to move through, allowing respiration and transpiration to occur giving the soil it's best chance at high nutrient intake and uptake from the roots and good production to produce food for the cows. This is the best example of Tiakitanga as the farmer is doing his best to let the soil do it's best, they are considering the soil's health and production rate and doing what they can to increase all aspects of this which will eventually pay him back for a longer and stronger time duration and high production rate.

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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    
Composition and structure affects soil temperature as it determines how much space is available for oxygen and water to move through the soil's profile. The temperature is based on how much oxygen and water is in the soil profile and too much of it can cause the soil to be too hot or cold. Ideally we want the soil's temperature to be around 18 degrees Celsius but anyway from 18 to 30 is good, below 6 degrees Celsius is too cold and above 30 degrees Celsius is too hot. The soil needs to be the right temperature to be eligible for respiration, transpiration and photosynthesis. These are very important for a soil's health and production and needs to be just right for the best result. Soils with bigger pore spaces often have better temperature as there is more space for water and oxygen to move through, whereas smaller pore spaces in soils can risk it being too hot or cold. Soil still needs to have a pretty warm temperature for rate of reactions to occur as warmer temperature leads to faster rates of reaction which impacts germination and photosynthesis.

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

B I U    
Biological properties in soil are Organic matter and Living organisms these depend on the soil's temperature. Living organisms like earthworms tunnel through the soil but like bigger pore space soils better as it is easier. They tunnel through and it creates aeration and drainage for the soil.

(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 that would best modify soil temperature would be drainage. Drainage is done by artificially removing excess water and creating space for drainage to occur in soil. Drainage would be ideal to modify temperature as it ensures the soil isn't accessing too much water which can lead to temperature being too hot or cold. This will keep the soil at an ideal temperature of 18 degrees Celsius and this will maximise plant growth as there will be faster and more consistent rates of reactions, respiration, transpiration and photosynthesis. This will increase plant growth as the soil and plant has their best opportunity at nutrient availability and can take in for nutrients to be able to grow. Overall carrying through drainage to the soil is greatly representing Tiakitanga and everything the farmer does and considers is for the land and it's well being, they are showing how important the land means to them and giving the land it's best chance of health and future service to them and/or future farmers. In the end all the farmers hard work and dedication to the land will give back to him as the land will serve them good time and result. Showing Tiakitanga is also a bonus financially as it won't be as expensive to upkeep the land as it won't have as much problems as it is well looked after so therefore it is a bonus to the farmer just as much as the land, soil and plants.

Achievement

Subject: Agricultural and Horticultural Science

Standard: 91930

Total score: 11

Q	Grade score	Marker commentary
One	A4	Candidate shows an understanding that soil pH is the level of acidity in the soil, and this can be managed by using lime. The response shows the candidate understands that adding lime will decrease the acidity of the soil. For a Merit, the candidate needed to explain why changing pH optimises plant growth.
Two	A4	Candidate understands that pugging and compaction can lead to poor pasture yield and that cultivation is a practice that farmers use to restore the soil. For a Merit, the candidate needed to link soil physical properties that are modified by cultivation to optimise plant growth.
Three	A3	Candidate shows some understands that drainage affects the soil temperature by removing excess water but has not stated whether removing water will make the soil warmer or colder. For a more solid achieved, the response needed to show how removing water will increase the air in the soil and therefore warm the soil.