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91930



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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science 2024

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

Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of how soil properties are managed in a primary production system.	Explain how soil properties are managed in a primary production system.	Evaluate how soil properties are managed in a primary production system.

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 2–11 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 21

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INSTRUCTIONS

You must choose a **different** soil management practice to answer each question.

Ensure reference to a **relevant** Māori concept or value, related to soil management, is included in your response.

One or more concepts may be appropriate.

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

QUESTION ONE: Soil water

Choose a primary production system.

Primary production system:

- (a) (i) Name and describe a **soil type** that would **require management to remove excess water** during periods of high rainfall.

B I U

Heavier soil types will require management to remove excess water an example of these soil types is clay. Clay soils (out our 3 main soil textures clay,silt and sand) Have the smallest particles sizes, meaning that they have the smallest pore spaces. Pore spaces are the gaps in the soil between the soil particles that are filled with either water or air. With clay having the smallest pore sizes it is difficult for excess water to drain away meaning that clay soil will require management to remove excess water during high rainfall periods.

- (ii) **What impact** can excess water have **on soil properties and plant growth?**

B I U

Excess water can have a negative effect on soil properties and plant growth, this is due to a number of reasons. The ideal soil: water: air ratio is around 50% soil: 25%water: 25% air. When there is excess water the percentage of air in the soil will drop and the percentage of water will increase. This will have a negative effect on the biological properties the macro organisms and micro organisms as they require air for respiration which with excess water can result in them drowning and dying. Living organisms in the soil break down organic matter and turn it into humus, which is used by the plant to extract nutrients from. Excess water can damage the physical properties as excess water in the soil can make it more susceptible to pugging and compaction. Compact soils make it difficult for enough air to get into the soil which can again lower the respiration of living organisms along with drop the temperature of the soil as there is excess water. All of these factors that are caused by excess water will result in lower pasture growth rates as the plants aren't able to grow as fast or able to maximum their yield and quality potential meaning that there will be less feed for the cattle, dropping their production levels and making it less profitable for the farmer.

(b) Evaluate a soil management practice that is used to remove excess water from a soil in your chosen primary production system.

In your answer you should consider how the management practice:

- modifies conditions for plant growth and productivity
- improves soil conditions
- cares for the soil.

B I U     

The best suited management practice that a dairy farmer can carry out to remove excess water is drainage in the form of Novaflo. Novaflo is drainage system that works by digging a trench in the paddock with a slight gradient on it leading towards a creek. Once this step is done the farmer would then place a layer of small pebbles in the bottom the trench and then place the black pipe with small holes in it into the trench and then cover it with pebbles and fill in the trench. The pipe has small holes in it so that excess water from the soil can escape into the pipe and it is covered with pebbles so that the soil doesn't block the small holes. Drainage will have a positive effect on soil properties. The biological properties of the soil in the living organisms will have the correct amount of air and oxygen in the soil to use for respiration meaning that they will now be able to break down more organic matter and make more humus making more nutrients available for the plant and its roots. Macro nutrients will now be able to tunnel more and excrete more castings making it easier for plants to send roots down resulting in the plant having more energy for growth, the worm castings are also adding more nutrients for the plant to use for growing. The physical properties of soil will also be positively effected by the adding drainage. When a soil is saturated or above field capacity then the temperature of the soil can cool down as water is harder to heat than air. With excess water removed the risk of pugging and compaction will also decrease as there isn't as much water in the soil. This improves the condition of the soil as with soil now being at the correct temperature, field capacity for water and living organisms doing their job at breaking down organic matter as effectively as possible plants will now be able to extract as much nutrients from the soil as possible. This will result in higher plant growth rates and increased pasture yield and quality meaning that the cattle will have more feed available to them increasing their production and productivity for the farmer. Drainage however is a cost for the farmer, but the profits gained from putting in drainage outweigh the losses if it wasn't installed. With drainage the farmer will be able to produce more milk and become more profitable. Drainage shows manakitanga, which means to care. This shows manakitanga as the farmer is caring for the soil and the organisms living in it by as by removing excess water the organisms and plants can grow better now that the soil has been taken care of properly. This cares for soil as with optimal water level the soil can now provide for more organisms both above and below the soil along with the farmer themselves.

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QUESTION TWO: Soil nutrients

Choose the same or a different primary production system to answer this question.

Primary production system:

(a) How are nutrient levels tested in soil in your chosen primary production system?

B I U

Soil tests are carried by the fertilizer company (E.g. Ravensdown). The fert. company rep will come on farm and take a number of soil sample spaced out across the paddock and from different paddocks. These sample are taken by a soil probe which takes a little piece of soil that is around 5-20 cm long. These samples of soils will then be sent to a soil lab where they will be tested to what nutrients are plentiful in the soil and what nutrients are lacking. It will also test the pH level of the soil where the ideal level is between pH 5.9-6.2. A farmer could also potentially have a rod stuck in to the soil permanently to measure water levels and soil temperature at all times.

(b) Evaluate a soil management practice for your chosen primary production system that can increase the level of nutrients in the soil. This practice must be different from the one discussed in Question One.

In your answer, you should consider how the management practice:

- alters the properties of soil
- cares for the soil
- helps optimise plant growth.

B I U

Once the soil test have come back the farmer can then analysis what the soil is lacking in and what will need to be applied to rectify this. The 4 main nutrients needed in soil for growth and N(Nitrogen) P(Phosphorus) K(Potassium) and S (Sulfur). Plants can also start to show signs if the soil is deficient in something, for example the leaves on the plant will start to look yellow if the soil is lacking in nitrogen for the plant to access. If the soil is lacking in N, Urea can be applied to correct this. For P, Supaphosphate can be applied. For K, Potash can be applied and for S Supa can also be applied. All of which on a dairy farm can be applied via a fert truck with a spinning disc on the back of it to spread the fert evenly. This will altar particularly the chemical properties of the soil as it is changing the nutrient levels in the soil by increasing them to the ideal levels. Biologically this can potentially have a slight negative effect on the living organisms as applying fert can lower the pH making it acidic and potentially burn the skin and kill the organisms but this will only occur if this is repeated time after time and will take years for this to happen. This will help optimize plant growth as plants require a range of different nutrients for plant growth and they all do different things. For example Nitrogen will have a major effect on increased plant growth as N is used by the plant to increase the amount of chloroplasts and photosynthesis that occur. Photosynthesis is the process of plants turning water and Carbon dioxide into a viable energy source (Glucose). With the plant carrying out more photosynthesis plant growth will increase, due to fert being added to the soil allowing for the roots to growth faster and bigger and above ground the leaves to carry out more photosynthesis plant growth will increase due to the application of fertilizer. However applying fert is a cost to the farmer due to him having to buy the fert along with the fees from the trucking company to apply it. But the profit gained from pasture growth and productivity due to apply fertilizer outweighs what would be lost if it wasn't applied making applying fert a suitable and profitable solution for the the farmer to increase the nutrient levels of the soil. This shows Manakitanga which means to care for. By applying fert the farmer is taking care of the soil by adding nutrients to it which will help support the plants growing in that soil. This shows manakitanga as the farmer is showing to the not only the soil by the plants that grow in it along with the animals the eat the plants.

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QUESTION THREE: Soil organisms

Choose the same or a different primary production system to answer this question.

Primary production system: Dairy farming

- (a) What benefits do living organisms have on soil properties and plant growth in your chosen primary production system?

B I U

Living organisms play a massive part in soils and the quality of the soil. The macro organisms in the soil in the form of worms break down organic matter and then leave behind castings. This process is called tunneling, which leaves behind little tunnels from where the worms have been. The micro organisms break down the organic matter and create humus which is nutrient rich and good for the plant to extract its nutrients from. This has a positive effect to the soil properties. The physical aspect will be positively effected as by adding organic matter to the soil it will help improve the soil structure improving the drainage of the soil. This also has a positive effect as the tunnels made by the worms are used by the roots of the plants to send their shoots down meaning the plant has more energy for growth increase of sending down roots. The castings and humus are nutrient rich meaning that the plants will use them to gain nutrients from. The living organisms have many positive effects leading to increased plant growth. This helps with productivity and profitability as there is more feed available to the cows.

- (b) Evaluate how a soil management practice for your chosen primary production system can modify soil conditions to promote living organisms. This practice must be different from ones discussed in questions One and Two.

In your answer, you should consider how the management practice:

- improves the overall health of the soil
- helps optimise plant production.

B I U

Applying lime to the soil is a management practice that can be carried out by dairy farmers to promote living organisms. Living organisms in the soil can be negatively effected when the pH of the soil is to low and is under the ideal range of 5.9-6.2. This is because like humans the organisms can be burnt if the soil is to acidic. This will have a negative impact on the biological properties of soil and lower the growth rates of the pasture. To correct this low pH and to help promote living organisms in the soil the farmer can apply lime which is a calcium carbonate compound (CaCO_3). 1 ton of Lime per Hectare will raise the pH by 0.1 units. Lime is applied similar to fert on a dairy farm, it is done with a fert truck that has spinning discs at the back of it to spread the lime out. Once lime is applied and the pH is brought back to this optimum level it will encourage living organisms in the soil to start doing more of what they are doing, breaking down organic matter into humus. Lime can also have a positive effect on the physical properties of soil as it can cause some clay soil particles to flocculate and bind together improving drainage. Lime will also positively effect the chemical properties as it brings most nutrients like N,P,K and S back to the range where they are soluble and easy for the plant to use transpiration and take them up the roots and use for growth. Lime will encourage the living organisms to carry out more breaking down of the organic matter which will increase the soil structure along with the overall health of the soil as the soil is balanced in all aspects. With the lime being applied all properties of the soil will be positively effected as the health of the soil will have increased as there will be a much larger number of organisms living in the soil. With the soil being much healthier and nutrients being at a very high and easily accessible level plant growth will now increase resulting in more feed for the farmer to use for his cattle. In turn lime will increase pasture growth resulting in higher outputs from the cows and a higher production meaning the farmer can make more profit. However applying lime is a cost but if lime wasn't applied the farmer would be losing more money than that what it costs to apply lime. Meaning that applying lime is the best way to promote more living organisms in the soil along with increasing growth rates of the pasture so then the farmer can make more milk from the cows increasing his profits. Applying lime so Kitaikitunga, which means guardianship. This shows guardianship as the farmer is taking pride is caring more the soil and what lives in by applying lime. Lime helps make the soil be a better place for organisms to thrive. Which when the farmer does this is taking care of the soil by looking after it and keeping it healthy and productive for future generations of people and living organisms in the soil.

Excellence

Subject: Agricultural and Horticultural Science

Standard: 91930

Total score: 21

Q	Grade score	Marker commentary
One	E7	The candidate has evaluated the use of drainage, such as Novaflo, to remove excess water out of the soil. They have explained the impact that excess water has on plant growth, discussing respiration in both plants and soil organisms, soil nutrients and soil temperature. This response shows the links between removing excess water and plant growth and farm productivity. For a more solid Excellence, the candidate should have linked soil temperature to plant growth in greater detail.
Two	E8	The candidate has evaluated the use of fertiliser as a management practice to increase the nutrient status of the soil. They have linked soil nutrients to different fertilisers and have explained in depth why a dairy farmer may want to apply nitrogen to their soil. The response includes the negative aspects of applying fertiliser and explains how the productivity gained outweighs the negative aspects. There is evidence of understanding of how the farmer shows Manaakitanga towards the soil and the growing conditions of the plant.
Three	M6	The candidate has explained how the use of lime as a management practice improves soil conditions for living organisms. They have linked the usage of lime to reduce soil acidity making a better environment for living organisms. The response gives multiple benefits from using lime, not just to soil organisms but also for nutrient availability and soil structure. The candidate has shown understanding of a relevant Māori value through the explanation of the management practice. For an excellence, they would have structured their answer to fully evaluate the use of lime to promote living organisms.