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NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Agricultural and Horticultural Science 2025

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 2–12 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 22

INSTRUCTIONS

Read **ALL** instructions before answering.

You must answer **ALL** parts of this assessment.

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

Note: 'soil properties' refer to physical, chemical, and biological properties of soil.

QUESTION ONE: Fertiliser application → effluent application

Name a primary production system of your choice.

Primary production system: Dairy Farm

(a) How is fertiliser applied in your named primary production system? → as a fertiliser

On a dairy farm, effluent can be applied to pasture lacking in nutrients through and already existing irrigation system/pipeline. It is often a mixture comprising of mostly water, with faeces and urine from the farm mixed in. In some cases, farmers also mix essential pasture nutrients (such as N, P, K, and S) into the effluent fertiliser as well. This nutrient dense mixture is then sprayed across pasture and is absorbed into the soil, boosting growth and quality. Note: The farmer should always ensure soil has been tested first by sending a sample/s to a lab. This measures the nutrient levels, pH, saturation, and texture of the soil to ensure the correct type or amount of effluent mixture is being applied to the pasture.

(b) Explain how fertiliser impacts soil properties.

By spraying effluent onto pasture, the farmer is putting more new and diverse micro organisms into the soil. These speed up the rate of decomposition ~~in the~~ of the organic matter and effluent → into humus, meaning there is more available nutrients for the plants to absorb. This is a positive impact on the biological properties of the soil, however more nutrient availability (quantity and absorbability) is a chemical benefit, as essential nutrients such as Nitrogen (helps support leaf growth and chlorophyll, meaning better conditions for photosynthesis live process), Phosphorous (supports strong root growth), and Pottassium (not as beneficial for pasture as it supports reproduction/fruiting & flowering, however still important.) + sulfur. *GO TO BACK

(c) Justify why soil tests should be carried out before applying fertiliser.

In your answer consider:

- chemical and biological soil properties
- how applying fertiliser after a soil test can improve plant growth.

It is very important to regulary test soil when using effluent application as a management practice, due to it being an organic fertiliser. Because it is not manmade, effluent mixtures often carry harmful biological soil components such as pathogens and fungi or diseases. These can harm the pasture and livestock, meaning quality & quantity of dairy will drop. By testing the pasture soil, the farmer is ensuring the components of the soil are balanced and the correct amounts of organisms and nutrients is being added to improve plant growth. If effluent is applied without testing soil, it can damage the soil structure, ph (make it too acidic), and organisms in the soil and create a nutrient imbalance. For example, if too much nitrogen is added into pasture, the nitrates it turns into can runoff and end up in nearby waterways, causing eutrophacation ~~ed~~ and damaging the environment and pasture in our the dairy farm.
Too much nitrogen can also cause issues with growth and pasture health

When effluent has been applied, testing soil pH is important as it can become very acidic very fast. The ideal soil pH is between 5.9 and 6.2 and can be raised by applying limestone ($CaCO_3$) to pasture if ~~effluent~~ too much effluent is added and it becomes acidic.

Overall, applying effluent to pasture on a dairy farm is a low-cost ~~and~~ alternative to chemical fertilisers, as farmers already have access to large amounts of urine and faeces + an irrigation system. When done correctly, it is an environmentally responsible way to improve soil components and pasture quality. By testing soil before applying effluent, you are ensuring that the correct amounts of N, P, and K (and calcium) are being incorporated, alongside more macro/micro organisms speeding up the rate of humus production. It is the most efficient way to improve pasture quality, ~~in it~~ and in the long term improving overall soil health, milk quality and farmers profits.

→ Tiakitanga

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

Note: 'soil properties' refer to physical, chemical, and biological properties of soil.

QUESTION TWO: Compost

OM = dead plants or organisms

A vegetable grower has sandy soil and is using compost to improve their soil.

(a) Describe how compost is made.

To support growth of vegetables in this primary production system, compost can be added to improve physical, chemical, and biological properties in the soil. The ~~co~~ best compost for a vegetable garden would be a mixture of organic *dead* plant materials and decomposing micro/macro organisms. This compost also would contain mineral matters (iron, maganese, copper) which are important nutrients for soil. As these organic materials decompose (naturally and with the help of living organisms), essential nutrients are released and become readily available for absorbtion - which is how/why nutrient dense compost is made (often has a silty texture)

~~Show This man~~

(b) How can adding compost increase nutrient levels in the soil?

more water retention; more soluble

By introducing readily decomposed nutrients, the rate of nutrient absorbtion in the vegetables will increase as they do not have to wait for the OM to decompose. Nutrients such a Nitrogen, ~~Pottassium~~ Phosphorus, and Pottassium will become more plentiful, supporting leaf growth, root growth/strength, and fruiting + flowering of the vegetables. This increases growth and production rate of vegetables for more profit to the farmer. Additionally, the incorporation of silt-like compost into sandy soil can act as a binding agent (causing flocculation) for sand particles (which are the largest particles). This improves soil structure because water rentention is improved, meaning less nutrient leaching occurs and soluble nutrients (e.g. nitrates) stay readily available for roots in vegetables to absorb.

* GO TO BACK

The grower is considering replacing compost with a combination of fertiliser and irrigation.

(c) Evaluate the application of compost, compared to irrigation and fertiliser application.

In your answer consider:
- the long-term effects on the soil
- vegetable growth.

Without incorporating the silty compost to sandy soil, the soil is very prone to ~~#~~ nutrient leaching and poor water rentention. Even though chemical fertilisers can act as a binding agent, the impacts would not be as great as using compost. This will negatively affect vegetable growth as plants do not have access to as much water to photosynthesise or nutrients (soluble) to support growth. The long term affect of this on the soil is that nutrients will continue to drain from the soil, leaving it lacking and devoid for next years crops and the years to coming, meaning less/no profits for the farmer because production has stunted.

By applying chemical fertilisers instead of organic compost, the farmer has more control over what nutrients and minerals are entering the soil. ~~however it also means~~ and By testing soil samples before ~~hand~~ applying, the farmer can know exactly what fertiliser to apply for optimum growth. Irrigating the ~~soil~~ vegetable garden can help improve soils ~~sand~~ structure and photosynthesis rates, however sandy soils cannot retain the water long enough for this to occur, and may drain out any nutrients the fertiliser added. In the long term, applying expensive fertilisers to boost nutrient avaliability will be a waste of time and money if soil & particle size/ structure in too big and porous to retain anything long enough for it to be soluble.

In terms of costs, profit, and soil structure/long term health, adding organic compost is the cheapest and most optimal way to improve both water retention and nutrient availability. ~~as~~ It provides smaller pores to hold water/air, and better living conditions for macro/micro organisms to thrive + continue ~~to~~ decomposing other OM into humus. More soluble nutrients means more plant growth & vegetable production.

After evaluating all of these factors, the benefits of compost are better for the lowest cost (assuming the farm already has ~~plant~~ plant waste) and improves production & profits the most. Using fertiliser and irrigation may cause more harm than good, as living organisms struggle with harsh fertilisers and may die. Also, the sandy soil is not a suitable structure or particle size for the combonation of fertiliser and irrigation, meaning costs are wasted on a solution which does not help growth or ~~production~~ Production, quality, meaning loss of overall profits.

→ tiakitanga

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

Note: 'soil properties' refer to physical, chemical, and biological properties of soil.

QUESTION THREE: Soil structure and water

Name a primary production system.

Primary production system: Dairy Farm

For your primary production system, choose a management practice from the list below that may help to improve drainage of the soil.

- Installing a drainage system
- Cultivation
- Application of lime
- Application of effluent
- Using a multi-species sward

Chosen management practice: Installing a drainage system (French Drain)

(a) With reference to your chosen primary production system, describe how this management practice is carried out.

On a dairy farm, ~~th~~ installing French Drains in the pasture is an effective management practice to improve the drainage of the soil and pasture production. French drains are installed by first find the lowest slope of the pasture which the water can drain into, and digging a trench there. This trench then has small stones placed in the bottom, and a prefarated pipe next with mesh over the holes. Once that is placed in the trench, more stones are put in to fill the trench. When there is excess rainfall, water can runoff into the drain and is then carried away into an allocated area, ~~per~~ preventing field saturation. in the pipe

By caring for the soil health of the pasture, the farmer is also caring for the pasture, micro-organisms, macro-organisms and livestock health, representing the Māori concept of Tuhonoga (connectivity) as all of these components work together to make a successful primary production system.

(b) How does this management practice improve one physical and one biological property of soil?

~~Physical~~ Biological **property**: By draining out ~~excess~~ water from pasture, there is a better ratio of soil : water : air (the optimum is 50:25:25). This means that live processes such as respiration and photosynthesis can occur in the organisms, roots, and leaves of the pasture. Without enough air pores, soil organisms would have to carry out anaerobic ~~condi~~ respiration, ~~in~~ producing harmful chemicals in soil.* ~~Water is an essential input of photosynthesis which occurs in the leafy (green parts with chlorophyll parts of the pasture).~~

~~Biological~~ Physical **property**: Due to the specific heat capacity of water being different to air, draining excess water out of the soil pores means that the temperature of the soil will most likely be warmer. This is because air heats up faster than water.

Warmer conditions = more ~~org~~ microbial activity, better nutrient solubility and optimised pasture quality and growth.

* and also not reproducing as many more micro organisms to help decompose organic matter, stunting nutrient availability and growth.

Choose a second management practice from the list on page 8.

Second management practice: Cultivation

(c) For your chosen primary production system, which of your two management practices is more effective in improving soil structure and drainage?

Justify why the grower should use this management practice with reference to plant growth.

Q With all factors and components considered, French drains ~~are~~ are more effective in improving soil structure and drainage than cultivation. Although FD (French drains) are more costly to install than cultivating pasture, they are a longer term management practice which continuosly ensure pasture is not over-saturated, improving growth rate and quality. Cultivation has to be done frequently, and turning over soil can cause erosion and soil loss (in the elements). Additionally, cultivating pasture means the land is unusable for grazing until grass/pasture grows back, costing the farmer more on extra grazing, more land, or supplementary feed. FD simply allow more air into soil pores, improving soil structure and conditions for micro organisms. Cultivation however, damages structure of soil particles if over cultivated, impacting conditions of micro organisms & macro organisms, potentially killing them. FD are also better at improving physical properties by preventing pugging.

While French drains are the more ideal management practice for drainage over cultivation, it is important to ensure pasture is not ~~being~~ being over-drained, which can cause nutrient leaching as water is moving through soil too fast, and not allowing time for soluble nutrients such as nitrates to be absorbed by the plant roots. Soil erosion can also occur as top soil

is being carried away by water movement.
This shows the importance of correctly carrying out the drainage management practice of installing FD, and what can go wrong if done incorrectly. The farmer has to decides if the long term soil health and structure being improved is worth the cost. In the end, the main goal of the dairy farm is to produce large quantities of quality dairy product (milk) to maximise profits margins. To do this, pasture quality management is essential for ensuring cows have the correct nutrients to digest and produce milk, with the lowests costs on supplements possible.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

91930

1b Sometimes, adding too much effluent to pasture can cause soil pH to become acidic, harming living organisms and slowing humus production, and therefore growth.
A physical component which is benefited from effluent application is that flocculation can occur, meaning ~~larger~~ soil clumps together and forms larger pore sizes. This improves drainage and aeration of soil, supporting the live process of respiration in the pasture roots and organisms.
A biological component which can be negatively affected is that pathogens and diseases can be carried into the pasture from effluent, harming organisms and eventually livestock if pathogens spread.
Earthworms which also break down ~~humus~~ OM → humus are more present when effluent is added, and their tunnels create good aeration and ~~support root growth~~. (Physical benefit)

2b The management practice of adding organic matter compost to the vegetable garden shows the māori concept of tiakitanga, which means ~~care~~ responsibility and guardianship of our soil, organisms, and the Earth which provides the growing conditions for a vegetable farm to ~~produce~~ create quality produce for people to eat + get profit.

Excellence

Subject: Agricultural and Horticultural Science

Standard: 91930

Total score: 22

Q	Grade score	Marker commentary
One	E7	The candidate has explained how dairy farmers use effluent as a natural fertiliser. They have explained the importance of nutrients to plant growth by linking key macronutrients to their roles in the plant. They have justified the need to test the soil before adding effluent, linking over application to changes in soil pH, nutrient runoff, and harmful pathogens. More detailed discussion on how adding the correct amount of nutrients leads to increased plant production could have elevated the response.
Two	E8	The candidate has explained how compost is made, linking micro-organisms to the decomposition of organic matter. They have evaluated that applying compost would be better than fertiliser and irrigation by identifying the positive and negative aspects of all the management practices. They have linked compost to improving the structure in sandy soils and therefore improving long-term production from the soil.
Three	E7	The candidate has explained how a drainage system is installed and how it will improve the water to air ratio, as well as improve respiration for soil organisms and plants. They have also linked increased aeration with warm temperature and increase microbial activity. The candidate has justified the use of drainage over cultivation by discussing the positive and negatives of both practices. More detail discussion of how a drainage system improves soil properties better than cultivation would have enhanced the response.