

Assessment Schedule – 2022**Agricultural and Horticultural Science: Demonstrate knowledge of soil management practices (90919)****Assessment Criteria**

Achievement	Achievement with Merit	Achievement with Excellence
Describes soil management practices.	Links ideas to explain how soil management practices affect soil properties and plant growth.	Applies knowledge of soil management practices. This may involve comparing and contrasting or justifying a range of management practices.

Evidence**Question One: Clay soils**

Sample evidence		Achievement	Achievement with Merit	Achievement with Excellence
(a)	<p><i>Choose two properties of clay soil, and explain how they impact pasture growth.</i></p> <ul style="list-style-type: none"> • Slow drainage and /or high-water holding capacity – <u>high levels of water available in soils for dissolving nutrients and photosynthesis.</u> • Low aeration as the poor drainage means that the pores are often full of water – <u>this slows plant growth as low air limits respiration. Reduced breakdown/recycling of organic matter as micro-organisms cannot survive in saturated soils.</u> • Cooler temperature as water is slower to warm than air – <u>slows plant growth due to reduced reaction rate of photosynthesis and respiration.</u> 	Candidate describes the physical property of clay soil without expanding.	Explains how two chosen properties impact on pasture growth, see <u>underlined</u> evidence.	
(b)	<p><i>How does applying lime improve the physical properties of clay soils?</i></p> <p>Lime is calcium carbonate and is used to increase the pH of soils, reducing the acidity.</p> <p>Adding lime to clay soils (ONLY) causing flocculation, which is when the clay particles clump together. This has the following impact on clay soils:</p> <ul style="list-style-type: none"> • Increases drainage / decreases water-holding capacity, <u>as the clumped particles increase the pore size of soil and open up gaps for the water to drain through.</u> • Increases the aeration. <u>More pore spaces and less water increase the amount of air in the soil.</u> • Makes the temperature warmer. <u>Air heats up faster than water as it is less dense, so more air in the soil and less water means that the soil will heat faster.</u> • Better pH improves earthworm activity, <u>improving aeration by tunnelling.</u> 	Candidate describes some details.	Candidate explains in detail , see <u>underlined</u> evidence	

(c)	Which of the two practices is better in terms of the impact on soil properties for improving pasture growth? Explain why you have chosen this practice over the other.	Candidate describes a way of improving drainage in clay soils.	Candidate explains how a drainage system <u>improves properties of soil and plant growth</u> .	Candidate justifies why a chosen management practice is more effective.										
	<table><tr><th>Organic matter</th><th>Drainage system</th></tr><tr><td colspan="2">Advantages</td></tr><tr><td><ul style="list-style-type: none">• Adding organic matter can improve the structure of soil – <u>clay particles clump around the organic matter once it is dug into the soil, increasing the pore space and allowing the water to drain more easily.</u>• Improved drainage increases the air in soil = <u>warmer temperature = increased reaction rate = increased growth.</u>• Roots of green crops break up the soil as it grows through – <u>this reduces compaction and will further improve soil drainage further in the soil profile.</u>• Green crops / organic matter attract microbes – <u>the tunnelling of these aerate the soil = increased amount of respiration = improved plant growth.</u></td><td><ul style="list-style-type: none">• Improves the drainage in the soil – decreasing the amount of water and increasing the amount of air.• <u>More air in the soil will mean that the soil is warmer and therefore reactions will occur at a faster rate- speeding up plant growth.</u>• <u>More air will also mean that more respiration can happen – also increasing the plant growth.</u>• Micro-organisms, such as earthworms, cannot survive in saturated soils. Less water in soils will increase numbers of these, <u>further improving aeration through their tunnelling, and increasing the levels of nutrients through the breakdown of organic matter.</u></td></tr><tr><td colspan="2">Disadvantages</td></tr><tr><td><ul style="list-style-type: none">• Not as effective as drainage system – will take a long time to improve the structure enough that the drainage of clay soils improves.</td><td><ul style="list-style-type: none">• Small particles of clay soils mean that many drainage systems are not suitable.• Expensive.• Only works in the short term before they need to be replaced.</td></tr></table>	Organic matter	Drainage system	Advantages		<ul style="list-style-type: none">• Adding organic matter can improve the structure of soil – <u>clay particles clump around the organic matter once it is dug into the soil, increasing the pore space and allowing the water to drain more easily.</u>• Improved drainage increases the air in soil = <u>warmer temperature = increased reaction rate = increased growth.</u>• Roots of green crops break up the soil as it grows through – <u>this reduces compaction and will further improve soil drainage further in the soil profile.</u>• Green crops / organic matter attract microbes – <u>the tunnelling of these aerate the soil = increased amount of respiration = improved plant growth.</u>	<ul style="list-style-type: none">• Improves the drainage in the soil – decreasing the amount of water and increasing the amount of air.• <u>More air in the soil will mean that the soil is warmer and therefore reactions will occur at a faster rate- speeding up plant growth.</u>• <u>More air will also mean that more respiration can happen – also increasing the plant growth.</u>• Micro-organisms, such as earthworms, cannot survive in saturated soils. Less water in soils will increase numbers of these, <u>further improving aeration through their tunnelling, and increasing the levels of nutrients through the breakdown of organic matter.</u>	Disadvantages		<ul style="list-style-type: none">• Not as effective as drainage system – will take a long time to improve the structure enough that the drainage of clay soils improves.	<ul style="list-style-type: none">• Small particles of clay soils mean that many drainage systems are not suitable.• Expensive.• Only works in the short term before they need to be replaced.			
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General	Candidate describes a way of improving drainage in clay soils.	Candidate explains how a drainage system <u>improves</u> <u>properties of soil and</u> <u>plant growth</u> .	Candidate justifies why a chosen management practice is more effective.
<p>Clay soils are slow draining due to having small particle and pore spaces. They are also prone to becoming compacted and experiencing slow plant growth for the following reasons:</p> <ul style="list-style-type: none"> • Cool temperatures – due to the high amount of water in the soil <u>slowing down the rate of reaction for photosynthesis and respiration</u>. • Low aeration – pores are likely to have large amounts of water, which means less air. <u>This limits root respiration and reduces number of microbes in the soil</u>. • Denitrifying bacteria thrive in anaerobic soils; <u>these bacteria remove plant available nitrates from the soil, decreasing soil fertility. By improving drainage and allowing more air into the soil, these bacteria disappear and are replaced with nitrifying bacteria, which will increase plant available nitrates</u>. 			

N1	N2	A3	A4	M5	M6	E7	E8
Describes ONE idea at Achievement level.	Describes TWO ideas at Achievement level.	Describes THREE ideas at Achievement level.	Describes FOUR ideas at Achievement level.	Explains THREE ideas at Merit level.	Explains FOUR ideas at Merit level.	Justifies the practice chosen.	Justifies the practice chosen by comparing and contrasting another option.

N0 = No response; no relevant evidence.

Question Two: Nutrients

Sample evidence		Achievement	Achievement with Merit	Achievement with Excellence
(a)	<p><i>Name a method of fertiliser application, and describe how it is carried out.</i></p> <ul style="list-style-type: none"> • Mini spreader – towed behind a tractor, truck, or quad and driven around the paddock. • Aerial topdressing – fertiliser is loaded into a plane and flown over the area to spread. Usually done on steep, or remote terrain. • A liquid fertiliser applied through an irrigation system. • Broadcasting fertiliser by hand over a garden plot (must specify that it is done on a small scale). • Direct drill – fertiliser granules applied with seed at the point of drilling. 	Candidate names a method and describes how it is carried out.		
(b) (i)	<p><i>Selects the ideal range for plant growth, using the chart.</i></p> <ul style="list-style-type: none"> • Accept anything between 5.7 and 7. 	Candidate selects ideal range from chart.		
(ii)	<p><i>How does soil pH that is outside the ideal range impact nutrient availability and plant growth?</i></p> <ul style="list-style-type: none"> • Soil is slightly acidic. • Plants require a range of nutrients to be able to grow. <u>When key nutrients (such as NPK) are limited, plant growth is hindered by lack of these nutrients.</u> • Plants will grow slower when soil is too acidic or too basic <u>because even if the nutrients are available in the soil, the plants are unable to take the nutrients up and use them.</u> • Nutrients are unavailable. • This can lead to toxicity. 	Candidate explains how pH affects nutrient availability in general terms.	Explains in detail how having <u>the right pH level improves plant growth</u> .	
(c)	<p><i>Recommends one fertiliser option to improve chemical properties of the soil and pasture growth. Explains why this fertiliser is chosen by comparing it to one other option.</i></p> <ul style="list-style-type: none"> • Fertiliser is used to increase the nutrient status of soil. More nutrients means that nutrient uptake or plant growth won't be hindered by a lack of a key nutrient. • Before any nutrient is applied, a soil test should be carried out by the farmer to determine the nutrient status of the soil, and to see what nutrients need to be added. 	Candidate chooses a fertiliser and describes its properties.	Candidate chooses a fertiliser and compares it to another.	<p>Note: Students should be selecting either DAP or Cropzeal to justify.</p> <p>Candidate argues comprehensively for one product over the other by comparing.</p>

DAP	Superten 5k	Cropzeal			
Advantages					
<ul style="list-style-type: none"> Higher levels of nitrogen (17.5%) – <u>nitrogen is needed to support leaf growth and photosynthesis, which is important for pasture-based species (such as grass).</u> Higher levels of phosphorus (20% compared to 8.1%) – <u>this will mean that pasture with DAP is likely to have better root health, and growth is not limited by this nutrient.</u> 	<ul style="list-style-type: none"> Contains potassium (K) which is important for photosynthesis – <u>could also help the fruiting of crops such as turnips etc.</u> Has lower levels of nutrients than DAP – <u>less chance of leaching or applying excess nutrients to the soil.</u> <u>Environmental benefit, and less wastage (cost).</u> Contains sulphur, which is an important macronutrient in soils. Cheaper. 	<ul style="list-style-type: none"> Has a more even range / spread of nutrients, <u>which means that it will support all the essential processes nutrients are needed for, e.g. photosynthesis, root health, and fruiting.</u> If farmers needed higher levels of certain nutrients, they could apply higher levels. Less chance of wastage or leaching of key nutrients N and P. Cheaper. 			
Disadvantages					
<ul style="list-style-type: none"> Higher cost per tonne – will have to pay more to be able to apply this fertiliser. Doesn't contain K, <u>but as this is used for flowering and fruit ripening, it is not as important for pasture-based species.</u> 	<ul style="list-style-type: none"> Doesn't contain N, and has lower levels of P than DAP. <u>This could impact the germination rate as they increase germination and growth.</u> 	<ul style="list-style-type: none"> Lower levels of N and P. Many farming systems need these two nutrients in the highest levels. More expensive than Superten 5k. 			

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Question Three: Market gardens

Sample evidence		Achievement	Achievement with Merit	Achievement with Excellence
(a)	<p><i>With reference to soil texture and properties, why would market gardeners prefer to grow their produce in a loam soil?</i></p> <ul style="list-style-type: none"> Loam soils are an even mixture of clay, sand, and silt particles, <u>which means they have a good structure.</u> Market gardeners need fertile and free-draining soil to grow the vegetables. Because of their medium particle size, the soils are free draining, and have good temperature and aeration. <u>Having an even amount of water and air in the soil pores mean that air is available for respiration and water is available for photosynthesis.</u> <u>Warmer soils, due to more air, have faster reaction rates, which means the plants in them will grow faster.</u> Loam soils have good amounts of air and water. Loam soils are fertile. 	Describes why growers prefer a loam soil.	Explains why growers prefer a loam soil <u>with reference to plant growth.</u>	
(b) (i)	<p><i>How is crop rotation carried out?</i></p> <ul style="list-style-type: none"> Crop rotation is when you plant different crops in the same paddock, or plant the same crop in different paddocks, year after year. 	Describes how crop rotation is carried out.		
(ii)	<p><i>Explain the impact crop rotation has on the chemical and biological properties of soil.</i></p> <ul style="list-style-type: none"> Decreases the number of pests and diseases. <u>Crop rotation removes the host plant, and therefore the food source, and prevents the build-up of pests and diseases in the soil.</u> Increases or maintains the nutrient status of the soil. <u>Planting the same crop in the same area year after year means that the nutrients are being taken from a certain layer in the soil, causing depletion over time.</u> 	Describes the impact of crop rotation, but may only discuss one of the properties in detail.	Explains <u>how crop rotation affects the chemical and biological properties of soil.</u>	

(c)	Justify why the grower would direct drill to maintain physical and biological properties of soil and improve plant growth, instead of using traditional methods of cultivation.		Describes direct drilling and / or cultivation.	Explains how direct drilling and / or cultivation <u>impact properties of soils and / or plant growth.</u>	Justifies the use of one method by comparing it to the other.
	Direct drilling Sowing seed directly into an existing crop or crop stubble.	Traditional cultivation Preparing the soil for a new crop by carrying out a number of tasks such as harrowing, rolling, ploughing etc.			
	Advantages				
	<ul style="list-style-type: none">• Reduces chances of compaction. <u>Over time this will lead to healthier soil with better structure. It will be warmer, more aerated and enable better plant growth.</u>• Existing crop protects the soil while the new crop is being established. <u>It stops the loss of fertile topsoil through erosion.</u>• Creates a better environment for beneficial microbes like earthworms. <u>These tunnel through the soil and improve aeration (increasing respiration rate) and recycle nutrients. This improves the nutrient status and increases plant growth.</u>	<ul style="list-style-type: none">• Reduces the particle size of the soil, <u>which means that the seed is in contact with both the soil and soil water, which will increase the germination rate.</u>• Will break up any soil pans <u>and improve soil drainage meaning there is more air in soil which means more respiration and therefore faster plant growth.</u>• If weeds or existing plants have been removed, new seedlings or plants do not have to compete with existing plants <u>for sunlight, water or nutrients, which means they will be able to grow at a faster rate.</u>			
	Disadvantages				
<ul style="list-style-type: none">• New plants compete with existing plants for water, nutrients, and sunlight, <u>which may lead to reduced germination, or slower growth.</u>	<ul style="list-style-type: none">• Can cause soil compaction over time due to the <u>use of heavy machinery which breaks down the particle size of the soil.</u>• <u>Compaction will reduce soil drainage and decrease aeration. This means slower reaction rates, and less respiration.</u>				

	<ul style="list-style-type: none"> Does not remove clumps in the soil, or reduce the particle size. <u>Seeds may not all be in contact with water and soil, reducing the germination or success rate.</u> 	<ul style="list-style-type: none"> <u>Slow drainage can cause saturated soils, which are cold and have fewer microbes to recycle nutrients.</u> <u>Saturated soils can also have an increase in pests and diseases, which could damage seeds and / or crops.</u> More time or labour involved. 				
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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24