Assessment Schedule – 2022

Agricultural and Horticultural Science: Demonstrate understanding of techniques used to modify physical factors of the environment for NZ plant production (91290)

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Describes how techniques modify physical factors of the environment for commercial plant production in New Zealand.	**Explains** how the use of techniques influences commercial plant production in New Zealand.	**Evaluates** techniques used to modify physical factors in terms of economic and / or environmental and / or social impact of commercial plant production in New Zealand. This may involve **comparing and contrasting** or justifying the use of the techniques.

Evidence

Question ONE: Healthy soil

	Sample evidence
(a)	*Chooses two techniques used to modify the physical properties of soil and explains the effect each technique has on plant growth in terms of crop yield and timing.* **Use of lime to cause the flocculation of clay particles** Lime is made from ground limestone. It is normally applied to the surface of grass / soil using a truck or trailer, although planes can also be used. While lime is primarily applied to adjust the chemical properties of soil, it also has an effect on the physical properties of clay soils. Lime causes the fine particles of clay to bind together, creating air pockets, and allowing the soil to drain better. This also makes it easier to cultivate and allows for roots to penetrate. Freer draining soil warms earlier in spring, allowing for earlier growth and germination, while the increased air pockets promote respiration in the plant roots, allowing for faster growth. **Cultivation** Cultivation of soil is any process that involves turning over or tilling the soil. Depending on the desired result and the end use of the soil, there are a number of different methods used to cultivate the soil. Commercial cultivation typically uses power harrows or rotary hoes to break up the large clumps of soil and turn it over. Used correctly, cultivation can create a fine seed bed for even germination of seeds, open up soil for drainage, or incorporate organic material.

(b)	*Selects one of the techniques from part (a) and discusses its use in terms of its economic and environmental impact.* Soil cultivation is an important management practice that is used to modify the physical properties of soil and needs to be carried out correctly to ensure that negative environmental outcomes don't take place. It provides a fine tilth so the seeds can germinate evenly. It can break up compacted soil to allow better drainage and root growth. **Economic** • Cultivation can be a considerable cost to the farmer. In arable farming, cultivation and seed drilling account for around 20% of the total cost. Seeds account for 10–15% of the costs and so it is important to create the best conditions possible for productive plants. • Some crops, such as carrots and parsnip, require well-cultivated soil to ensure they meet market requirements. Without cultivation, the crops won't grow straight, which is demanded by consumers. • Cultivation can open up the soil to allow better root development and drainage, allowing for better growth, increasing yield. **Environmental** • Cultivation, when used incorrectly or poorly managed, can be detrimental to the environment. Regular cultivation exposes more soil to the air, which mineralises soil organic matter, allowing soil carbon to be lost as CO_2. • Cultivation can leave soil vulnerable to erosion, with the compacted soil under wheel tracks acting as channels. • Soil compacted by cultivation can lead to the formation of a pan that leads to ponding and poor drainage. • Cultivation can be used as an alternative to herbicides, reducing the use of agrichemicals.

N1	N2	A3	A4	M5	M6	E7	E8
Some writing, but does not explain how a technique is used to modify the physical properties of soil.	Partial or insufficient description of techniques used to modify the physical properties of soil.	Describes how a technique is used to modify physical properties of soil.	Describes how TWO techniques are used to modify physical properties of soil.	Explains the effect of a technique and its effect on plant growth.	Explains the effect of TWO techniques and their effect on plant growth.	Discusses the use of a technique in terms of economic or environmental factors. Provides clear evidence for superiority of ONE aspect, either quality or timing, with the other impact well supported.	Discusses the use of a technique used to modify the physical properties of soil in terms of economic and environmental factors. Provides clear evidence for superiority of BOTH aspects.

N0 = No response; no relevant evidence.

Question Two: Frost

	Sample evidence
(a)	*Chooses two frost protection techniques and explains how each technique is carried out.* **Helicopters** When inversion layers form, cold air can be trapped at lower levels while the air above is warmer. Crop growers can use helicopters to draw down air from a warmer inversion layer. This air movement warms the atmosphere around the plants and prevents frost from forming on the buds, leaves, and fruit. This prevents damage in the fruit and buds caused by expanding ice crystals. **Irrigation** Frost sprinkler systems involve spraying the plants with a continuous fine mist of water as the temperature falls to freezing. This water then freezes, encasing the canes and buds in ice. As the water changes to ice on the surface of the vine, it releases a small amount of latent heat that protects the plants from any damage.
(b)	*Explains how frost protection techniques affect crop yield and quality.* Frosts occurring when fruit crops are flowering can cause damage to the sensitive buds due to expansion of water crystals in the cells. This will result in fewer flowers and less fruit. Frosts can cause the death of young shoots, which can mean growth of plant is slowed. Frosts occurring while the fruit are on the tree can cause loss of the fruit, reducing yield, or physical damage, reducing the aesthetics and increasing potential for disease to enter the fruit.
(c)	*Selects one of the techniques from part (a) and discusses its use in terms of its social and environmental impact.* Frost sprinkler systems are used on a wide range of crops to protect against frost damage – from kiwifruit to pip fruit, to grapevines. Frost sprinkler systems can also be used as irrigation systems in summer. **Social** The over-extraction of water can lead to social problems, with local communities losing recreational use of streams and rivers, and the derogation of drinking water. On the positive side, frost sprinkler systems protect crops from damage that would otherwise make the crop unsaleable and reduce the yield. This means people can be employed to harvest and process the crops, bringing money into the communities. Sprinklers have the advantage that they don't cause noise for neighbours like fans and helicopters do. **Environmental** The use of water in many growing regions is under pressure from farmers, growers, landowners, and the environment. Excessive water take can lead to low water flows and higher water temperatures, while run-off caused by excessive irrigation can lead to sediment and nutrient enrichment, resulting in eutrophication.

N1	N2	A3	A4	M5	M6	E7	E8
Some writing but does not describe how frost protection techniques are carried out.	Partial or insufficient description of how frost protection techniques are carried out.	Describes how a frost protection technique is carried out.	Describes how TWO frost protection techniques are carried out.	Explains the effect of frost protection on crop yield or quality.	Fully explains the effect of frost protection on crop yield and quality.	Justifies the use of a frost protection technique in terms of social or environmental factors. Clear evidence for superiority in ONE aspect, social or environmental, with the other aspect well supported.	Justifies the use of a frost protection technique in terms of social and environmental factors. Clear evidence for superiority in BOTH social and environmental factors.

N0 = No response; no relevant evidence.

Question Three: Wind

	Sample evidence
(a)	*Chooses two techniques that modify the environment to provide wind protection and explains how each technique affects crop quality and timing.* **Shelterbelts** Shelterbelts can reduce wind speed, leading to an increase in soil and air temperature and humidity, and a reduction in moisture loss. Lower wind speeds reduce wind damage to soil and plants. Poorly designed shelterbelts can lead to a build-up of cold air, which can cause frosts to be more severe. Living windbreaks can compete for light, space, nutrients, and water, and take up space that could be used for other plants. **Glasshouses** Glasshouses are a management practice that allows growers to almost fully control the growing conditions of plants. The glasshouses protect delicate plants like tomatoes and capsicum against wind that would otherwise break off stems and leaves. The controlled environment leads to an increase in air temperature and humidity, and allows the grower to control the atmosphere. While glasshouses are very good at protecting plants from wind, they are also very expensive and not suitable for all plant types. **Quality** Protecting the plant from wind prevents damage to the plant and fruit. A reduction in transpiration and water stress means the plant can invest more energy into fruit production. Lower wind speeds allow bees to pollinate flowers easier, resulting in bigger, better-quality fruit. **Timing** Wind control results in warmer temperatures and less stress means the plants are able to flower and fruit earlier.
(b)	*Selects one of the techniques from part (a) and discusses its use in terms of its economic and environmental impact.* Shelter from the wind is necessary for establishing and maintaining high levels of fruit and crop production, as well as ensuring the quality in many plant production systems. Unless plants are sheltered, high winds can cause damage to branches, leaves, and growing points on plants, as well as a loss of flowers. Pollination efficiency, fruit set, plant size, and fruit size can all be reduced. Excessive wind also causes fruit abrasion, increased water usage of the crop, desiccation of plants, reduced opportunity to spray, and disruption of irrigation. The set up and maintenance of shelterbelts is an expense, with artificial shelterbelts having a higher initial cost but lower ongoing maintenance costs. **Economic** Without wind protection, fruit quality is usually lower and would be unlikely to meet the requirements for export-grade fruit. Fruit takes longer to reach maturity. Poor pollination leads to smaller fruit due to lower seed count. While shelterbelts involve an initial set-up cost and ongoing maintenance costs, these are outweighed by the premium price growers can obtain for higher-quality fruit. **Environmental** Shelterbelts lower wind speed, which promotes insect activity. They can produce microclimates that favour a greater variety of species. They can also act as a habitat for native biodiversity, and as they are less disturbed by mowing and spraying, they can act as environmental refuges.

N1	N2	A3	A4	M5	M6	E7	E8
Some writing but does not describe a technique that modifies the environment to protect against wind.	Partial or insufficient description of a technique that modifies the environment to protect against wind.	Describes ONE technique that modifies the environment to protect against wind.	Describes TWO techniques that modify the environment to protect against wind.	Explains the effect of a technique that modifies the environment to protect against wind on crop quality or timing.	Explains the effect of a technique that modifies the environment to protect against wind on crop quality and timing.	Justifies a wind management technique in terms of economic or environmental factors. Clear evidence for superiority of ONE impact, with another impact well supported.	Justifies a wind management technique in terms of economic and environmental factors. Clear evidence for superiority of TWO impacts.

N0 = No response; no relevant evidence.

Cut Scores

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