Assessment Schedule – 2021

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 management practices are used in a named production system and / or used to modify production.	**Explains** the effect of a management practice in a named production system and / or used to modify production.	**Justifies** the use of a management practice by comparing and contrasting techniques in production systems, and / or how they are used to modify production.

Evidence

Question ONE	Evidence for Airflow
(a) (i)	**Describes** how management practices are used to modify air flow in a named production system. These are potential examples; other methods to modify air flow can be accepted. *Artificial shelterbelts* Artificial shelterbelts are constructed from tall poles and artificial fabric, such as polythene strung on wire. A key feature of artificial shelterbelts is that they are designed to slow wind movement, not stop it. Solid barriers are less effective, as the wind bounces over them and causes turbulence, which can damage plants. An ideal permeable shelterbelt will allow 50% of the wind to pass through. This slows the movement of air, and reduces the damage to crops on the other side of the shelter. *Pruning* Many fruit, such as kiwifruit vines and citrus, benefit from pruning to open up space to allow air movement through the plant to reduce conditions that favour fungal diseases such as botrytis. Trees are shaped (depending on the variety) to open up the canopy, and unproductive / diseased branches are removed. *Frost fans or helicopters* These are used to reduce the incidence of frost damage. Warm air is mixed with the cold air continuously during the early morning so that no frost settles on the crop, which can cause damage to young growth.
(a) (ii)	**Explains** the effect of the management practice on production. *Artificial shelterbelts* Shelterbelts help reduce physical damage to crops. Plants, such as kiwifruit vines, are easily damaged by strong winds, and require protection. Reducing wind speed also reduces the rate of transpiration. Reducing transpiration reduces irrigation requirements and the risks of water stress. *Pruning* Humidity is decreased by allowing air to flow through the plant, and also allows sprays to achieve good spray coverage. Opening up plants to allow good airflow also allows pollinators easier access to flowers.

(b)	**Selects** a management practice used to modify air flow, and justifies its use in terms of **quality and timing**. Includes economic and social factors. *Evidence below is given for artificial shelterbelts in a kiwifruit orchard.* Kiwifruit vines do not tolerate wind and are easily damaged. Without shelter, young vines are easily stressed, produce smaller leaves, and develop more slowly. Windy conditions lead to physical damage and allow entry points for PSA. Appropriate shelter will lead to increased temperatures, promoting growth and yield. Increased temperatures and lower wind speeds during flowering encourage bee activity and pollination, leading to improved fruit development. *Economic factors* Reduced wind speeds mean: • less physical damage – better quality fruit and increased yield. Fewer rejected fruit due to wind rub. Fewer entry points for PSA, which means a better return • warmer temperatures – increased productivity • reduced transpiration – decreased irrigation requirements, reducing costs. Artificial shelterbelts are more expensive than natural shelterbelts, but are effective immediately, and do not compete for nutrients, water, and light. Increased productivity and reduced ongoing costs. *Social factors* Artificial shelterbelts can reduce spray drift and contamination of the orchard. White artificial shelterbelts can stand out and be considered an eyesore. Green or black shelterbelts can blend into the environment.

N1	N2	A3	A4	M5	M6	E7	E8
Some writing, but does not describe how a management practice is used to modify airflow in a production system.	Partial or insufficient description of how a management practice is used to modify airflow in a production system.	Describes how a management practice is used to modify airflow in a production system.	Describes how TWO management practices are used to modify airflow in a production system.	Explains the effect of a management practice used to modify airflow in a production system.	Explains the effect of TWO management practices used to modify airflow in a production system.	Justifies the use of a management practice used to modify airflow in terms of quality and timing. Gives clear evidence for superiority of ONE aspect (economic **or** social), with the other impact well supported.	Justifies the use of a management practice to modify airflow in terms of quality and timing. Gives evidence for superiority of BOTH aspects (economic **and** social).

N0 = No response; no relevant evidence.

Excess water

Question TWO	Evidence
(a) (i)	**Describes** how TWO management practices are used to manage excess water. These are potential examples; other methods to control excess water can be accepted. *Surface drains* Surface drains include natural or artificial channels to lower the water table and / or reduce surface flooding risk. Surface drains are used to intercept run-off from higher areas, and drain surface water off the land quickly. They also collect water from subsurface drains. Surface drains include ditches, drains, and grassed waterways. *Mole drains* Mole subsurface drains remove excess water from the soil profile via networks of unlined channels, installed below the soil surface. Mole drains can only be made in heavy soils with a clay subsoil. Long-lasting channels need a clay content of 30–35%. They are made by pulling a ripper blade or mole plough through the subsoil and rely on the soil structure to support and keep the channel open. Ideally, the soil should be free of stones at the mole drain depth. Mole drains are placed across a paddock and fed into a main drain close by.
(a) (ii)	**Explains** the effect each practice has on production. *Surface drains* They must be regularly maintained to keep them flowing, and may be a hazard for machinery and animals. Care must be taken to prevent bank erosion and damage from stock access. *Mole drains* Mole drains can only be made in heavy soils with a clay subsoil. By mole ploughing in the spring, the formed mole drain and ground fracturing will dry out and harden over summer, extending the life of the mole drain throughout the coming seasons. The role of drains is to remove excess water from the soil. Once the soil is removed and field capacity is reached, the soil becomes warmer and the pore spaces are able to have oxygen for root respiration. Warmer soils mean that the rate of plant processes is increased, ensuring the plant grows and reproduces faster. If the soil is waterlogged, it only takes hours before the plant dies. In a pasture situation, cattle are able to put on weight faster due to better quality pasture. Cattle will not pug paddocks, if the paddocks are well drained and therefore the pasture can be reused faster when the grass has regrown after use.

(b)	Justifies the use of **a management practice to control** excess water in terms of **yield and timing**, by comparing and contrasting with the other practice. Considers economic and environmental factors. Waterlogged soils reduce plant growth, leading to decreased production per hectare, which in turn affects the financial viability of the farm business. Good management of drainage will optimise soil moisture, which will improve pasture production. It can improve stock health by reducing waterborne illnesses and improve stock mobility. Well-designed and maintained drains will improve water quality by reducing nutrient, sediment, and bacterial runoff. Both surface drains and mole drains are effective at removing excessive water from pasture. Surface drains needed to be fenced off to prevent livestock from damaging the banks, and must be regularly maintained to keep them flowing. Weed control is also important. Surface drains can impede machinery and remove grazeable pasture. Mole drains require soil to have a clay content of at least 30% and to be relatively stone free, and so are not suitable for all farms. They require specialised equipment and trained contractors to set up an effective drainage network. Surface drains or tile drains are still required for the mole drain to drain into. However, less pasture is lost. Mole drains result in less surface runoff, erosion, and phosphorus loss than surface-only draining. Mole drains can be a significant source of water-soluble nutrients, such as nitrogen, entering the waterways. *Environmental impact* • Surface drains have greater surface runoff, erosion, and phosphorus runoff, while mole drains can be a source of water-soluble nutrients such as nitrogen. • Surface drains need to be fenced, otherwise livestock can cause major damage, e.g. erosion to the banks of the drains. • Surface drains need weed control, and unless care is taken, can be a source of pesticides in waterways. • Surface drains help reduce the water table, reducing the incidence of pugging, protecting the soil structure, and reducing sediment and nutrient runoff. *Economic impact* • Surface drains result in a loss of grazeable surface area. • There is a cost to maintaining surface drains. Drains need to be cleared to maintain flow, as well as for weed control. • Specialised equipment and trained contractors are needed to put effective mole drains in, and they periodically need re-forming. • Drier soils warm up more quickly in spring, allowing faster and earlier grass growth, and reducing the reliance on expensive supplementary feeds.

N1	N2	A3	A4	M5	M6	E7	E8
Some writing, but does not describe how a management practice is used to manage excess water.	Partial or insufficient description of how a management practice is used to manage excess water.	Describes how a management practice is used to manage excess water.	Describes how TWO management practices are used to manage excess water.	Explains the effect of a management practice used to manage excess water.	Explains the effect of TWO management practices used to manage excess.	Justifies the use of a management practice used to manage excess water in terms of yield and timing. Gives clear evidence for superiority of ONE aspect (environmental **or** economic), with the other impact well supported.	Justifies the use of a management practice to manage excess water in terms of yield and timing. Gives clear evidence for superiority of BOTH aspects (environmental **and** economic factors).

N0 = No response; no relevant evidence.

Glasshouses

Question THREE	Evidence
(a) (i)	**Describes** TWO management practices that glasshouse owners can use to modify a plant's growing environment. There are many choices, as long as the student is clear how the management practice modifies the growing environment to enhance production. *Carbon dioxide enrichment* When plants are actively photosynthesising, they can drop the carbon dioxide levels in a glasshouse below that of normal atmospheric conditions (400 ppm), which slows photosynthesis, slowing growth and development. To counter this, glasshouse owners can add extra carbon dioxide into the glasshouse until levels reach 1000 ppm. Carbon dioxide can be captured from combustion. In New Zealand this is normally from natural gas or coal. The filtered exhaust is then pumped back into glasshouses. New technologies are also looking at storing carbon dioxide in lime to be released when needed. Carbon dioxide can also be added through the use of tanks or dry ice. *Supplementary lighting* Supplementary lighting can be used to maintain peak production in times of extended poor weather and during winter months, when days are short. Modern LED light can emit wave lengths that are ideal for photosynthesis at a much lower power usage than older light sources, such as high-pressure sodium lights.
(a) (ii)	**Explains** the effect on plant production. *Carbon dioxide enrichment* • Carbon-dioxide enrichment allows the plant to maintain high levels of photosynthesis resulting in extra dry matter, earlier flowering, and higher fruit yields. *Supplementary lighting* • Supplementary lighting allows growers to grow crops year-round, when it would otherwise be difficult or impossible to get reasonable yields, and can see an increase in yield of up to 50% on an annual basis.
(b)	**Justifies** the use of a glasshouse management practice in terms of **crop yield and quality**, by comparing and contrasting with another practice. Considers economic and environmental factors. When plants are actively photosynthesising, carbon dioxide becomes a limiting factor beyond what ventilation can provide. Carbon dioxide enrichment systems are often tied in with heating systems and utilise a waste product that the grower might otherwise have to pay carbon credits for. When the carbon dioxide level is low, it becomes a limiting factor, so even if supplementary lighting and heating is provided, photosynthesis is still reduced, slowing growth and the development of dry matter. Supplementary lighting can be very expensive to install and run, even with newer LED technology being much more efficient than older lighting technologies. However, it does allow growers to produce plant products out of season, when returns are at their highest. LED lighting wavelength recipes can be used to focus the plant on what the grower wants, e.g. to focus on fruit or flower development. They can be adapted through the lifecycle of the plant, optimising plant growth and development. Supplementary lighting can also be used during extended periods of poor weather, ensuring consistent results throughout the growing season and between growing seasons.

	Economic • Carbon dioxide is often a limiting factor in glasshouses, so the addition of it will boost photosynthesis, which will increase yields. • Carbon dioxide is a waste product from heating, which is frequently needed as well. • Supplementary lighting is very expensive to install, $180–$300/m^2, but can see a 50% increase in annual production. • Modern LED lighting systems are much more efficient than older systems. • Supplementary lighting allows growers to produce out-of-season produce when prices are high, and to maintain production through extended periods of poor weather. • Glasshouses allow crops to be grown out of season, resulting in a higher economic gain. *Environmental* • Modern LED lighting systems consume much less energy than previous systems, but are still significant users of electricity. • Lighting systems can produce lighting pollution, and local regulations can prohibit their use without blockout screens. • The carbon dioxide used in glasshouses is often a waste product from the heating systems used, especially in the North Island, where natural gas is used.

N1	N2	A3	A4	M5	M6	E7	E8
Some writing, but does not describe how a management practice glasshouse owners use to modify a plant's growing environment.	Partial or insufficient description of how a management practice glasshouse owners use to modify a plant's growing environment.	Describes how a management practice glasshouse owners use to modify a plant's growing environment.	Describes how TWO management practices glasshouse owners use to modify a plant's growing environment.	Explains the effect of a management practice on plant production.	Explains the effect of TWO management practices on plant production.	Analyses the use of a management practice in terms of yield and quality. Gives clear evidence of ONE aspect (environmental **or** economic), with the other impact well supported.	Analyses the use of a management practice in terms of yield and quality. Gives evidence of BOTH aspects (environmental **and** economic).

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