Assessment Schedule – 2012

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

Evidence Statement

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE	**Irrigated pasture**			
(a)	Irrigation is a technique that involves delivery of water to the pasture to maintain the soil at field capacity, to allow optimal growth of plants. If there is too little water, plants are unable to take up water and nutrients; too much water leads to waterlogged soil and a lack of oxygen near the roots for respiration. Water is also required in the plant process of photosynthesis. Under-irrigation, or irrigation giving only just enough water, leads to poor soil salinity control and increased soil salinity, with a consequent build-up of toxic salts on the soil surface in areas with high evaporation. This requires leaching to remove these salts, and a method of drainage to carry the salts away. Over-irrigation, due to poor distribution uniformity or management, wastes water and chemicals, and may lead to water pollution. By using a centre pivot irrigator, the water content can be controlled at field capacity, allowing plants optimum water levels for growth and therefore pasture production.	**Describes** ONE of the following: In (a) describes how irrigation modifies water availability in the soil to aid growth. *OR* In (b) describes how either a centre pivot irrigation system *OR* a travelling gun irrigation system is used to modify soil conditions.	**Explains** in detail ONE of the following: In (a) explains how water levels impact on other factors that influence pasture production. *OR* In (b) explains how a centre pivot system increases the production of pasture.	**Justifies** the use of a centre pivot system for a large dairy farm over the use of a travelling gun system, giving economic and environmental reasons.
(b)	Centre pivot irrigation is a form of overhead sprinkler irrigation consisting of several segments of pipe joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned facing downwards along its length. The machine moves in a circular pattern, and is fed with water from the pivot point at the centre of the circle. It allows controlled delivery of water to the pasture, to prevent over- and under-irrigation. Low application rates of 6–8 mm can be applied every day if required, reducing runoff, leaching, wind drift, and evaporation losses. Travelling gun is an overhead high-pressure sprinkler mounted on moving platforms. It uses a large impulse sprinkler or gun which rotates, and this irrigator also winches itself towards a fixed point at the other end of the paddock. This system requires more pressure, since it only has one outlet covering a wide area. Over-irrigation can result from the use of travelling irrigators, because poor distribution uniformity or management wastes water and may cause leaching of nutrients and chemicals, leading to water pollution when spreading effluent. By using a centre pivot, the water content can be controlled at field capacity, allowing plants optimum water levels for growth and therefore pasture production.			

	The travelling gun irrigator's biggest advantage is its low capital cost compared with other systems. This allows farmers to get into irrigation at relatively low cost. In addition, guns can be installed and maintained by farmers. However, because a single orifice gun is used under pressure, this system is not efficient, due to poor distribution in windy conditions, resulting in uneven water application and sometimes a loss of water via wind drift. They can be moved between paddocks, but this is labour-intensive; shifting time is significant, particularly on a large dairy farm with many paddocks. In contrast, a centre pivot has a very low labour requirement. The control systems of centre pivots allow enormous flexibility, such as changing application depths over the full circle or in different sectors, simply by programming in the specific requirements. Farm shape must suit these machines to obtain good overall coverage. Square or circular areas with no obstacles are best. Centre pivots are mostly used on the flat and although corners are not watered, sector-operated end-guns or controllable corner towers can be used to cover most of the corners. Generally, they are fed directly from the centre, so damage to pasture is limited to wheel tracks every 50 metres or so. Drive systems are usually independent, with underground electric cable or diesel motors. On larger systems, the cost per hectare irrigated is low, making them extremely cost-effective.			

Not Achieved	N1	Some writing, but does not describe irrigation.
	N2	Partial or insufficient description of how irrigation modifies the physical factors of the soil.
Achievement	A3	Describes how irrigation modifies the physical factors of the soil.
	A4	Fully describes how irrigation modifies the physical factors of the soil. Refers to oxygen or nutrients.
Merit	M5	Explains how irrigation increases pasture production through plant processes, such as photosynthesis.
	M6	Fully explains how irrigation increases pasture production through plant processes **and** refers to the quality and quantity of the pasture.
Excellence	E7	Justifies, with economic and environmental reasons, farmers' use of centre pivot irrigation on large dairy farms in preference to travelling gun irrigation. Comprehensive and integrated supporting evidence must be given for at least ONE reason, with other reasons well supported.
	E8	Justifies, with economic and environmental reasons, farmers' use of centre pivot irrigation on large dairy farms in preference to travelling gun irrigation. ALL reasons fully explained, with comprehensive and integrated supporting evidence for ALL reasons.

N**0** = No response; no relevant evidence.

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
TWO	**Glasshouse production**			
(a)	*Light* Additional artificial light can be provided in a greenhouse by using: fluorescent lamps (low heat output), incandescent lamps (used to extend daylight), or high-intensity discharge (HID) lamps (long-lasting). Light can be decreased by the use of whitewash and shade cloth. Plants respond to varying lengths of light and dark periods, as well as to the intensity and quality of light. Artificial light is used extensively to control plant growth processes under various conditions. Plants differ in their need for light; some thrive on sunshine, others grow best in the shade. Artificial light can be used in the following ways; to provide high-intensity light when increased plant growth is desired; to extend the hours of natural daylight; or to provide a night interruption to maintain the plants on long-day conditions. Increased light allows increased photosynthesis, and therefore increased growth and production. Control of light levels allows commercial crops to be grown in an area where outside production would be impossible. *Humidity* Humidity is the level of water content in the air. High humidity (over 70%) can cause diseases in tomatoes. It can be provided by misting units, damping off, and increasing the temperature. Humidity reduces the amount of water loss from the leaves and promotes rapid growth and may induce earlier and higher yields. When humidity levels become too high, excess moisture is flushed out by raising the temperature and opening vents. Open vents increase air movement and reduce the settling of disease agents on plants, thus increasing production. *Temperature* The heat (or hot water) produced by the heaters is piped through the glasshouse, where conduction from the pipes heats the surrounding air. The temperature can be reduced by using ventilation and fans. Glasshouse-grown plants generally require high temperatures during the day, and lower night-time temperatures, for good growth. Warmer temperatures enhance bee activity, thus increasing fruit set. Warm temperatures also increase the rate of photosynthesis, transpiration and respiration which produces more carbohydrates and improves fruit health, size, and colour.	**Describes** ONE of the following: In (a) how a glasshouse is used to modify light or temperature or humidity.	**Explains** ONE of the following: In (a) how changing light or temperature or humidity improves plant production. *OR* In (b) why high-value export crops are grown in a glasshouse.	**Justifies** the use of glasshouse production for a high-value export crop, giving economic reasons.

(b)	High-value crops can be exported if a demand exists, but must be of high quality, both in taste and visually. The size and shape are important for gaining the highest price, as is the requirement for blemish-free crops. Indoor production in glasshouses allows the grower to control all environmental factors, while the structure prevents physical damage caused by frosts, wind, and hail. Outdoors it is difficult to control the climatic conditions that can cause physical damage and disease, therefore affecting the size and the shape. Crops for a local market will be sold at a much lower price, so the original size and shape is not as important. Glasshouse production allows the grower to produce crops at a time of year when it is difficult to grow them outdoors, because of adverse climatic conditions or the high cost of controlling the environment. This means that indoor growers have control of market supply, and provided demand is maintained, higher prices are received. This in turn must cover high production costs to be economic, but high financial returns from the export market make glasshouse production viable. Growing in glasshouses increases local job opportunities in harvesting, grading, packing, and transportation. Glasshouses also usually provide a pleasant working environment that attracts workers who will stay, because of year-round employment. They develop the skills to pick the correct fruit on a regular basis.			

Not Achieved	N1	Some writing, but does not describe how a glasshouse modifies light, temperature, or humidity.
	N2	Partial or insufficient description of how a glasshouse modifies light, temperature, or humidity.
Achievement	A3	Describes how a glasshouse modifies light, temperature, or humidity.
	A4	Fully describes how a glasshouse modifies light, temperature, or humidity.
Merit	M5	Explains how light, temperature, or humidity modification improves plant production *OR* explains why high-value export crops are grown in a glasshouse.
	M6	Fully explains how light, temperature, or humidity modification improves plant production *AND* explains why high-value export crops are grown in a glasshouse.
Excellence	E7	Justifies, with economic reasons, why a high-value export crop is grown in a glasshouse. Comprehensive and integrated supporting evidence must be given for at least ONE reason, with other reasons well supported.
	E8	Justifies, with economic reasons, why a high-value export crop is grown in a glasshouse. ALL reasons fully explained, with comprehensive and integrated supporting evidence for ALL reasons.

N0 = No response; no relevant evidence.

Question	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE	**Outdoor production**			
(a)	*Reflective mulch* Reflective plastic strips are placed under the tree to reflect light that has penetrated the canopy back up to the fruit. The amount of light available to the fruit is increased, thus increasing sugar production (photosynthesis) and ripening, increasing the colour change. Light-reflecting mulches have been developed that will redirect sunlight from the orchard floor back up into the tree canopy. When used in the few weeks prior to harvest, value can be added to fruit that would otherwise go to juice. The obvious benefit includes better control over colour development of the crop. With this control, a grower can reduce the number of pickings for multiple-pick varieties and harvest a higher percentage of top-quality fruit. This may amount to one third of the entire crop that would otherwise go to juice. *Summer pruning* During the summer months the tree is pruned in such a way as to maximise the light which can enter the canopy, thereby increasing the light reaching the fruit and aiding ripening through increased sugar production (photosynthesis). Summer pruning is a selective training procedure aimed at weakening vegetative growth, while promoting flower initiation. It consists of cutting the current season's shoots back to 3–5 mature leaves after they have grown about a foot, and about the diameter of a pencil, and have started to become woody at the base. Flowering spurs often develop at pruning cut sites as a result of weakening the vegetative growth, but flowering is also increased throughout the tree because of better light penetration. The cost of producing the equivalent volume of fruit by enlarging the planting of a specific cultivar would be many times greater than the investment in enhanced light management practices on established trees.	**Describes** how summer pruning *OR* reflective mulch modifies light.	**Explains** ONE of the following: In (a) how summer pruning *OR* reflective mulch helps in the production of high-quality fruit. *OR* In (b) why summer pruning is a suitable method to use with a crop being grown for the local market.	**Justifies** the use of summer pruning over reflective mulch with a crop being produced for the local market, giving economic and environmental reasons.
(b)	Summer pruning has the ability to control the quantity of fruit left on the tree to develop further. It has a large effect on yield and also a potentially big effect on quality, because more sunlight can reach the inner parts of the tree. Reflective mulch is laid down in the last month before harvesting, by which time the potential yield has been set. Its biggest impact is on crop quality – mainly colouration of fruit throughout the canopy. Fruit produced for the local market is likely to sell for a much lower price than fruit produced for export. For this reason, the grower wishes to obtain as high a yield as possible, and the appearance and size of the fruit is not as important. When using summer pruning to aid ripening time, the grower is removing some of the vegetative branches and			

	concentrating the trees' energy resources on flower initiation and fruit growth. This leads to an increased yield. Another result of summer pruning is that removal of branches increases light penetration, which in turn increases photosynthesis and shortens ripening time. Under average growing conditions, fruit hanging in the lower canopy will probably get as much usable light as those fruits hanging in the open in the upper parts of the canopy. Under average conditions, the calyx end of the apple remains green for many varieties, as light does not come into the orchard at an angle low enough to colour fruit uniformly. This is not an issue for local markets, where uniformity of colour and other external attributes are less important. Reflective mulch is expensive but can last for several seasons if correctly installed, maintained, and stored following use. Eventually there is a disposal issue. The placing of the reflective plastic under the trees can lead to water pooling, and this can harbour diseases. The mulch is often laid by hand, while some summer pruning can be carried out by machinery, making it a cheaper option.			

Not Achieved	N1	Some writing, but does not describe how summer pruning or reflective mulch modifies light.
	N2	Partial or insufficient description of how summer pruning or reflective mulch modifies light.
Achievement	A3	Describes how summer pruning or reflective mulch modifies light.
	A4	Fully describes how summer pruning or reflective mulch modifies light.
Merit	M5	Explains how summer pruning or reflective mulch helps in the production of high-quality fruit by referring to plant processes.
	M6	Fully explains how summer pruning or reflective mulch helps in the production of high quality fruit by referring to plant processes *AND* ripening.
Excellence	E7	Justifies, with economic and environmental reasons, why a grower would use summer pruning over reflective mulch for a local market crop. Comprehensive and integrated supporting evidence must be given for at least ONE reason, with other reasons well supported.
	E8	Justifies, with economic and environmental reasons, why a grower would use summer pruning over reflective mulch for a local market crop. ALL reasons fully explained, with comprehensive and integrated supporting evidence for ALL reasons.

N0 = No response; no relevant evidence.

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 7	8 – 12	13 – 18	19 – 24