National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Agricultural and Horticultural Science Level 2

This exemplar supports assessment against:

Achievement Standard 91292

Demonstrate understanding of how management practices influence plant growth and development in NZ commercial production

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to demonstrate comprehensive understanding of how management practices influence plant growth and development in commercial production in New Zealand. This involves evaluating how management practices influence plant growth and development in commercial plant production in New Zealand. It may involve justifying, comparing and contrasting and analysing management practices and their impact on quantity, quality, timing, and the economics of production. The student justifies the use of thinning, with varying detail, based on the requirements of the overseas market, without which the apple industry would struggle to exist in any sustainable manner, in terms of quantity (1), quality (2), timing (3) and the economics of production (4). For a more secure Excellence, the student could provide more extensive comparison and detail using the terms of quality, quantity, timing and the economics of production.

Student 1.

Managing Practices.

Thinning is a very important practice on orchards and I consider it to be more important than the other practices such as pest and disease control because it has a large effect on apple size and colour, factors that are very important to markets [4]. Thinning using chemicals must be done carefully, correct concentration and timing, if you don't want to lose your apples but when correctly carried out the crop loading on the trees is reduced from about 1000 to 200 [1] apples and so apples have more access to water, nutrients and sunlight therefore they can grow to a bigger count size which is what most overseas market demand [2]. Spraying for diseases is also very important practice, it must be done on a regular basis in response to weather conditions especially humidity that encourages fungal diseases such as black spot and soft rots while insect pests such as codling moth are an ongoing problem. These diseases do impact on the markets that apples can be sent to. Thinning does allow for better air circulation around the trees which should reduce the risk of disease, but if this does not eventuate then spray programmes should be used such as IPM spray programmes based on a monitoring system such as traps [2].

Both practices are very important but overall you only harvest what you have grown therefore I believe that thinning is the more important practice when producing apples for overseas markets [4]. Timing of production is mainly affected by cultivar selection and all apples can be stored [3]. Thinning does restrict the number of apples but because each apple is bigger the tonnage produced may not be significantly reduced [1].

	Grade Boundary: High Merit
2.	For Merit, the student needs to demonstrate in-depth understanding of how management practices influence plant growth and development in commercial production in New Zealand. This involves explaining how management practices influence plant growth and development in commercial plant production in New Zealand. The student explains how one management practice, site establishment, influences apple tree growth and development through topography (1), soil type (2), soil fertility and nutrition (3), climate (4), and planting considerations (5). These have all been related to plant structural features and function and/or horticultural science concepts. To reach Excellence, the student could either compare and contrast two management practices or justify their decision on utilising site establishment, on the growth and development of apples as a commercial production.

Student 2.

Site Establishment and Planting Density of an Apple Orchard.

Site establishment is the most important part of the development of an apple orchard. If the site is not suitable for a apple orchard then it best not to establish an orchard on that site this is because if it s poor site then there will be a poor performance of the apple trees when fruiting.

Things to consider when establishing a apple orchard is the;

- Topography
- Soil type
- Fertility / soil nutrition
- Climate
- Planting considerations
- Water availability

All these things must be right and combine together so the site is suitable for establishment.

Topography.

The topography is the contour of the land and the shape the land has for example the high country of South Island is very hilly and has a rough topography, however, the Canterbury Plains is flat and has a very flat topography allowing good land for cropping and horticulture.

Things to consider when looking at the topography for an apple orchard is;

- Vehicle access – this means not just access for vehicles picking up the harvested apples but access in and around the orchard up and down each row for spraying of the fruit for pests and diseases, if there is no access for spray vehicles there would be little way for preventing any pests and diseases in the orchard. The apple trees will not produce the amount of apples demanded with having pest and diseases eating or affecting the fruit causing deficiencies.

- Low areas – low areas are unwanted as it may have pockets of cold air and have a lot of frosts in the unwanted time of the seasons.

- Flat land – land is wanted to be flat with rows planted North to South. This helps all the rows to be exposed the sunlight at the hottest time of the day giving all the apple trees sunlight. This issue of not enough sunlight to each tree is not so much a problem for the Hawke's Bay as it gets a lot of sunlight ours and growing hours with the long growing season. However, in Canterbury this is more of a problem because the growing season is not as long. The land also is needed to be flat so the spray vehicles can spray the trees and also in some orchards like in the South Island they can lay reflective mulch sheets

under the trees to reflect light up to lay down apples on the bottom of the tree if the land is not flat then this sheet would be hard to [1].

Soil Type.

Soils for orchards have to be good, they need to have a good pH to allow access to nutrients, good fertility, good drainage, lose friable soil (not compacted). The soil needs to be friable to allow the trees roots to penetrate down so it has more access to the nutrients this also allows in the first few years for the trees to have a good establishing structure to anchor the tree in place. Best soils for apple trees to grow in are silt or sandy loams. Most soils in these categories have a good water holding and nutrient capacity. The soils are often free draining and they drain enough to prevent root rot. The pH that soils generally like is a 5.5 – 6.5 (slightly acidic) this is tested numerous times and just before planting this can vary between different cultivars and can be recommended otherwise, but usually the pH needs to be between these points [2].

Soil Nutrition

If the soil is nutrition deficient then the young trees will struggle and plant must not proceed, as it is easier to fix when there is no trees planted. If the trees are planted then the young trees will struggle. There will be little growth and when they fruit the fruit will be at a small quantity and size. Orchards should be regularly tested for the soils pH to make sure that it is acceptable and the soil is not nutrients deficient in macro and trace nutrients [3].

Climate

Temperatures, frost, sunlight and rainfall has to be considered for an apple orchard. The site before looking at the climate must be suitable. There has to be a considerable amount of rainfall in the winter and spring, however, in summer the soil must not be to wet as the tree can easily catch diseases such as black spot or fungal diseases or even worse the apples could die. Apple trees like a cold winter and after a few hard frosts the trees can be pruned the cold winter aids the buds and gelp them to bloom in the spring. Temperatures must be moderately warm for apples with a large range between 5 – 30° Celsius this allows the cold winter as well as warm summer to encourage brix levels to increase before harvest. There should be a large amount of sunlight hours for apples to raise their brix levels and for them to gain more colour for marketing of sales. The more sunlight hours there are the better as it allows the tree to photosynthesis and this will increase growth in the apple [4].

Planting considerations

Things to consider when planting the orchard are things like what rootstock to use, the planting density, what type of tree to plant (consider the future market), pollination trees in place and the placement of wires. When choosing the tree the ting that needs to be considered is the marketing for the fruit when planted and in the future years, also how will the tree grow in the soil it may not have enough nutrients in it or it might be very fertile and the tree could grow to vigorously [5].

	Grade Boundary: Low Merit
3.	For Merit, the student needs to demonstrate in-depth understanding of how management practices influence plant growth and development in commercial production in New Zealand. This involves explaining how management practices influence plant growth and development in commercial plant production in New Zealand. The student explains generically how one management practice, provision of shelter, influences tree growth and development (1). These have all been briefly related to plant structural features and function and/or horticultural science concepts (2). For a secure Merit, the student could provide a more detailed explanation of how shelter affects the growth and development of apples such as the process of establishing and maintaining effective shelter. More reference could be included about the use of deciduous shelter, its height, porosity etc, important factors in effectiveness over time, pests and disease and maintenance in an apple orchard.

Student 3.

Provision of Shelter.

Shelter is very important aspect of an apple orchard. It is one of the contributing factors which can affect the grower's yield. The main purposes of shelter on an apple orchard are as follows;

- To reduce wind speed and ultimately moisture loss – wind plays a major role in the moisture content in the soil when there is a lot of wind and exposure in an area a lot of water is sucked out of the soil and ends up back in the atmosphere. This is not good as apples have a high demand for water and therefore irrigation would have to increase which results in increased costs for the orchard manager because irrigation increases. When irrigation increases, profits decrease because intensive irrigation is a very expensive exercise and therefore less turnover is made [1].

- To reduce wind damage to plants – Wind damage to plants is a major concern for growers as this hugely influences crop yields. This is the major talking point when it comes to discussing reasons for introducing a shelter belt system. It is fundamental for running a successful and fully profitable apple orchard. Wind damage could potentially have a detrimental effect on the apple crops productivity. Wind funnels up each apple row and moves the trees around quite substantially, this results in a lot of fruit and bud damage. Often fruit gets bruised and damaged when there is not sufficient shelter provided which lets in pests and diseases, decreases fruit quality and could ultimately lead to a relative decrease in yields [2].

A good wind break should be -

- Cost effective – economical to set up as the only major costs are the set up fees which far out reached by the benefits that the shelter belt provides. Also costs should be split with those on the surrounding properties because of the shelter being provided over a large area.

- Long lasting – have a long lasting life expectancy which means they are relatively low maintenance as well as easy for the apple orchardist to manage.

- Environmental friendly – it is expected that wind breaks will attract wild life and provide adequate shelter for the apple orchard. On top of that a good shelter belt should be able to mother and eliminate weeds.

A list of trees that are adequate shelter belts include;

- Gums
- Poplars
- Wattles
- Pines
- Cedar
- Taupata
- Macrocarpa

These are all relatively low maintenance, strong, quick growing and long lasting trees. They meet the characteristics of a shelter belt because when they are all developed they are strong sturdy trees and provide a huge amount of shelter and protection of the crop.

	Grade Boundary: High Achieved
4.	For Achieved, the student needs to demonstrate understanding of how management practices influence plant growth and development in commercial production in New Zealand. This involves describing how management practices influence plant growth and development in commercial plant production in New Zealand. The student outlines the management practice of site establishment and breaks it down into its various components such as climate (1), topography (2), and water availability (3); and describes how these influence apple growth and development (4). To reach Merit, the student could explain how site establishment influences growth and development of apples ensuring linking between sunshine hours, temperature and water.

Student 4.

1. Site Establishment.

Climate: In site establishment, climate is very important because you need a temperate climate to grow apples. You need a good amount of sunshine hours there are 2200 sunshine hours per year in Hawke's Bay with temperatures of around 18 – 25 degrees in spring / summer and winter temperatures no lower than 5 – 10 degrees. It is also good to have a low summer rainfall and a place that has low amounts of wind [1].

When the apples are ripening and colouring the trees should be put under stress. This helps to bring the brix levels up in apples and helps with the colouring of the apples [4]. Only the bright red apples that have no defects on them are picked and where the apples are diseased they are obviously binned. There is a slow decline of water in the root zone from January to harvest (picking) this helps to stress out the tree and helps with raising the brix levels and colouring of the apples. Frosts during winter are harsh this helps chill the tree for bud burst, sap flows slow this make it good for pruning as the tree loses less sap.

Topography: When growing apples it is common sense to have flat land on an orchard because trees don't grow as well when they are on a hill side and when you spray the orchard your tractor and spray unit can't slide around. You can spray the apple trees more consistently, this means you get less pests and diseases and better fruit growth due to less pests and diseases you will also have successful crop yields [4] and improved profit for the orchard. On the orchards land, it is good to have flat land for the apple trees to allow for easy access for machinery like hydra ladders, bins, tractors, spray units, and any other machinery that many be used on the orchard [2].

On the orchard you also have to makes sure that each apple tree is faster / easier, safer for the harvest person to prune and also train because these days pruning is an important management practice carried out on an orchard. On the orchard it is important to make sure the trellises are easy to erect and that the roads / tracks on the orchard are all easy to get around and easy to move machinery around the sections of the orchard.

Water availability: In site establishment there must be available water. On the orchard water is used for a lot of purposes e.g. spraying, irrigation, frost protection is also good for maintaining health of apples this helps them stay on the tree and carry on growing [3] and also processing if needed. When an orchard is sprayed you need to use water for the spray and also for irrigation when at times the whole orchard needs to be irrigated at once usually it is one a couple varieties of apples that need irrigation but still when irrigation is done a large amount of water is used to keep the apple trees in a healthy state. There is also processing that comes under water availability where some orchards have their own processing sheds and pack houses where most of the apples are graded and then exported for overseas only the top of the class apples are sent away overseas and the apples that aren't quite good enough to send overseas are kept to sell in local supermarkets and around New Zealand.

	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to demonstrate understanding of how management practices influence plant growth and development in commercial production in New Zealand. This involves describing how management practices influence plant growth and development in commercial plant production in New Zealand. The student describes the management practice of site establishment in terms of climate (1), topography (2) and soil type (3) on apple orchard plant growth and development. For a more secure Achieved, the student could provide more detailed descriptions of the factors influencing site selection when establishing an apple orchard, as the section on soil type loses its focus on apples and could apply to many crops (4).

Student 5. **Site Establishment.**

Site establishment is a very huge factor to create a variable apple orchard and business to last over time, this is because for a site to be used it must suit the growers needs by supplying a climate suitable, suitable topography, a suitable soil fertility and soil type and these must all fit together like a puzzle to establish a successful orchard.

Climate: For a site to be selected the climate must be suitable for the apple crop being grown in terms of;

- Rainfall – some cultivars are susceptible to rotting which may end in dying or diminished quality, if a high rainfall site is used.
- Sunlight hours – some cultivars need a long hot summer to ensure proper fruit ripening and to help with colour production. If sunlight house are too low growth will be stunted.
- Frost risk – fruit crops generally like a good winter frosts to kill off diseased and to aid flowering but a frost at the wrong time could wipe out a whole crop [1].

Topography: For a site to be selected it must suit the apple crop and machinery which will be used to maintain and harvest the crop in terms of;

- Easy machinery access – machinery must be able to access the site to maintain an build the crop up to harvest, if an insecticide machine sprayer could not make it way to and from the orchard then other options must be taken, either by hand spraying the whole crop or by not doing anything which will seriously deteriorate the crops produce.
- Easy pick up of produce – trucks or freight must be able get to and from the orchard easily to avoid extra costs during transportation of the final product.
- Contour – must be suitable for the crop being grown as generally a flat site would be preferred when growing apples.
- North facing – generally North facing slopes receive more sunlight, this would be especially important in areas of low sunlight or when using cultivars that thrive with more sunlight [2].

Soil Type: This must suit the crop being grown on the land in terms of;

- Soil loam – the soil loam must suit the crop as different crops require different needs, some thrive on moist soils while some thrive on drier soils, so this will determine the soil type being used [4].
- Soil fertility – must suit the needs of the grower and the cultivar he is growing and the density of this system, low fertility soils are generally used or high density systems as it doesn't allow as much growth as fertile soils on a low density system, high fertility is generally not high density as the crop usually grows too much for the systems and its requirements [3].

	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to demonstrate understanding of how management practices influence plant growth and development in commercial production in New Zealand. This involves describing how management practices influence plant growth and development in commercial plant production in New Zealand. The student briefly describes pests and diseases in a generic manner with minimal links made to apples (1). The evidence makes reference to pheromone traps used in orchards to monitor pests (2) but the details of ensuing actions are limited. To reach Achieved, the student could describe more specifically how pests and diseases affect apples, the problems they create and the management practices used to eliminate them (3).

Student 6. **Pests and Diseases.**

Diseases and pests reduce size and kill the plant and the fruit. There are 3 types of diseases, fungal, bacterial, and viruses.

- Fungal is caused by humid which mildew is responsible for example black spot his can be controlled by fungicide which only targets fungi diseases.
- Bacterial diseases are caused by wet and swelling in the fruit and start to rot, which is also controlled by fungicide.
- Virus is responsible for poor growth which has a big impact of he fruit.

This is also controlled by spraying. To help prevent this by using clean tools clean up dead leaves and branches. There are two main pest type chewing and sucking pests. Suckling pests like aphids, trhips, whitefly, mites and mealy bugs [1]. These decrease the fruit productively by the pest feed of by sucking moisture and nutrients from the plant slowing down plant processes. Before spray pesticide [3] which is a targeted spray only kill pest is done measuring the amount of pest is important because it saves money and time. This is done by using and setting up pheromones traps and once measure the amount in the trap it the numbers is about 30 pests then it is time to spray. The orchard I visited had 1 pheromone trap per 10 hectares [2]. Chewing pests chew on the plant, caterpillars, white butterfly, grass grabs, slugs, and snails are some of the small pest and large pests such as rabbits, opossum, wild pigs. To control the large pests by using traps or shoot them.