HURLSTONE AGRICULTURAL HIGH SCHOOL

Trial Higher School Certificate Examination 2007

AGRICULTURE

Paper 1

General Instructions:

* Reading time - 5 minutes
* **Working time - 2 hours**
* Write using a black or blue pen
* Draw diagrams using pencil
* Board approved calculators may be used
* Write your student number at the top of each page

Total marks - 70 marks

SECTION I
25 marks
Pages 2 - 7
Questions 1 - 3
Allow about **40 minutes** for this section.

SECTION II
30 marks
Pages 8 - 13
Questions 4 - 5
Allow about **50 minutes** for this section.

SECTION III
15 marks
Pages 14 - 15
Attempt **ONE** question only from questions 6 - 9
Allow about **30 minutes** for this section

SECTION I
25 marks
Attempt Questions 1 - 3
Allow about 40 minutes for this section.
Answer the questions in the spaces provided.

Question 1. (10 marks)

Name ONE farm product that you have studied.

Name of product: milk

(a) Identify ONE quality specification that the farmer aims to meet. (1 mark)

3·95% butterfat. ✓

(b) Explain TWO practices the farmer can use to meet or exceed this quality specification. (3 marks)

The farmer can feed the cow more roughage (~~butt~~ hay) in their diet. this effectively increases butterfat procentile in the cow. the farmer may also take a more genetic approach and use jersey cows as they have a higher incidence of butterfat in their milk. ✓ 3

(a) Identify ONE quality specification that the farmer aims to meet. (1 mark)

protein % – 3.15% ✓ 1

(b) Explain TWO practices the farmer can use to meet or exceed this quality specification. (3 marks)

– The farmer could use AI using the semen of ~~the~~ high protein % bulls to improve the genetic ability of the cows to produce high protein milk ✓

– As cows are ruminants NPN such as urea could be incorporated into their diet ~~of~~ – which would be converted by ruminant microflora – which have the ability to upgrade ~~low~~ low quality protein feeds to high quality protein. ✓ 3

(b) Explain TWO practices the farmer can use to meet or exceed this quality specification. (3 marks)

Dairy Meal – This is a concentrated source of protein that can be given as a protein supplement to dairy cows to ensure high protein in milk

By-Pass Protein – Along with the dairy cows own microbial protein production + digestion, 'By pass' protein is pelleted and coated protein source that by passes the microbes digestion in the rumen to go directly to the abomasum to be used in production. ✓ 3

(a) Identify ONE quality specification that the farmer aims to meet. (1 mark)

TPC – total plate count < 15,000/ml of milk ✓ 1

(b) Explain TWO practices the farmer can use to meet or exceed this quality specification. (3 marks)

To reduce the TPC the farmer must reduce the amount of coliform bacteria that enter the milk. This can be done through thoroughly cleaning the milking shed using acid and alkaline washes to kill harmful bacteria as well as using management practices ~~to~~ when moving stock, keeping them out of muddy laneways which are breeding grounds for these bacteria. By doing these the farmer can meet + exceed the guidelines. ✓ 3

(a) Identify ONE quality specification that the farmer aims to meet. (1 mark)

low SCC (somatic cell count) below 500,000/mL ✓

(b) Explain TWO practices the farmer can use to meet or exceed this quality specification. (3 marks)

hygiene is crucial in keeping a low somatic cell count. mastitis can be controlled or prevented by.
- Teat dipping - spraying cups and cleaning teats with iodine after milking. ensure cups and teats are dry, moisture is a breeding ground for mastitis ✓
- check often for mastitis in herd. regularly RMT (rapid mastitis test). check each quarter if milk is mastitic do not include as it will have a high SCC. ✓

3

(b) Explain TWO practices the farmer can use to meet or exceed this quality specification. (3 marks)

(1) Hygenic practices in the dairy - eg cleaning the udder, wearing gloves. teat dipping in iodine etc

(2) Control mastitis - eg culling cows that are chronic mastitis sufferers ✓

3

(c) Explain how the off-farm processing of milk may be influenced by consumer demand. (3 marks)

Off farm processing is, value adding of milk may be influenced by consumer demand. Currently farmers supply according to the desires of the consumer this differs from traditional farm production. Consumers are becoming more health conscious, increase demand in low fat milk, for this means more centrifuging of ~~anti-fat~~ cream milk to obtain skim milk. Increase in low fat milk means less need for full cream milk. Consumers might prefer milk with added nutritional value eg. Omega 3. In processing this factories and producers remain work and increase production of healthy milk. Children prefer flavoured milk, if sales for this increases, processing is willing to increase production to meet consumer demands.

3

(c) Explain how the off-farm processing of milk may be influenced by consumer demand. (3 marks)

What the consumer wants plays a large part in influencing the off farm processing of milk. For example yoghurt is produced in small 'snack' size packs which are easily transportable for people to eat 'on the run' or to give to young children. Another example is 'Lite' milk a modified product aimed at people who are loosing their weight and are health conscience regarding decisions they make in purchasing products. 3

(c) Explain how the off-farm processing of milk may be influenced by consumer demand. (3 marks)

Consumers demand a continuous supply, good smell + taste, clean and cheap milk. This means that milk will be processed by being pasturised to kill bacteria and homogonised. Flavour, protein and calcium are also added sometimes to meet consumer demands from different groups eg: school children or families. The milk is packaged and a useby date is put on the carton to tell consumer when their product should be used by. 3

consumers in Asian countries demand products that are convienient so milk is processed into powder milk.

(d) Outline the off-farm processing of your chosen raw product that is needed to convert it to one named saleable product. (3 marks)

Processing of milk into Butter involves several steps.
- The milk is centrifugally seperate & cream collected.
- Cream is pasteurized by heating to a temperature of 86°C for 4 seconds.
- The cream is then cooled to below 4°C to make the next step easier.
- Cream is churned vigously and the butter milk drained off. 3
- The remain product is butter which is salted, and packaged to be sent to the consumer.

(d) Outline the off-farm processing of your chosen raw product that is needed to convert it to one named saleable product. (3 marks)

Milk can be converted into cheese as a saleable product, and this process is an example of value adding. Milk is first pasteurised, ✓ and then a lactic acid starter culture is added. The bacteria in the starter culture begin to curdle the milk, whilst the lactic acid helps to give to cheese its characteristic sharp cheddar flavour. An enzyme called rennin is also added to help coagulated the curd as it separates from the whey, which the runny liquid waste product. The curd and the whey are then separated, and ~~the curd is pressed~~ salt is added to the curd to improve its flavour, before it is shaped and pressed into the desired form. The amount of moisture (whey) that is left with the curd, and the type of starter culture used, will determine what type of cheese is made. Then the cheese is packaged and distributed for ~~market~~ sale on the market.

3

Question 2. (8 marks)

Figures 1 and 2 show the importance of soil organisms and their ability to thrive under different soil management systems.

No till means that the soil is left undisturbed whilst conventional till means that the soil is ploughed or cultivated with three or four ploughs before seeds are sown.

Answer the questions that follow.

Figure 1 Soil organism activity and residue breakdown in different tillage systems

Microflora

Bacteria and fungi have diverse metabolic capabilities and are the principal agents for the cycling of nutrients, for example, nitrogen, phosphorus and sulfur. They may be free-living or symbiotic and active in the decomposition or build-up of organic matter. They also help in the formation of stable soil aggregates.

Microfauna

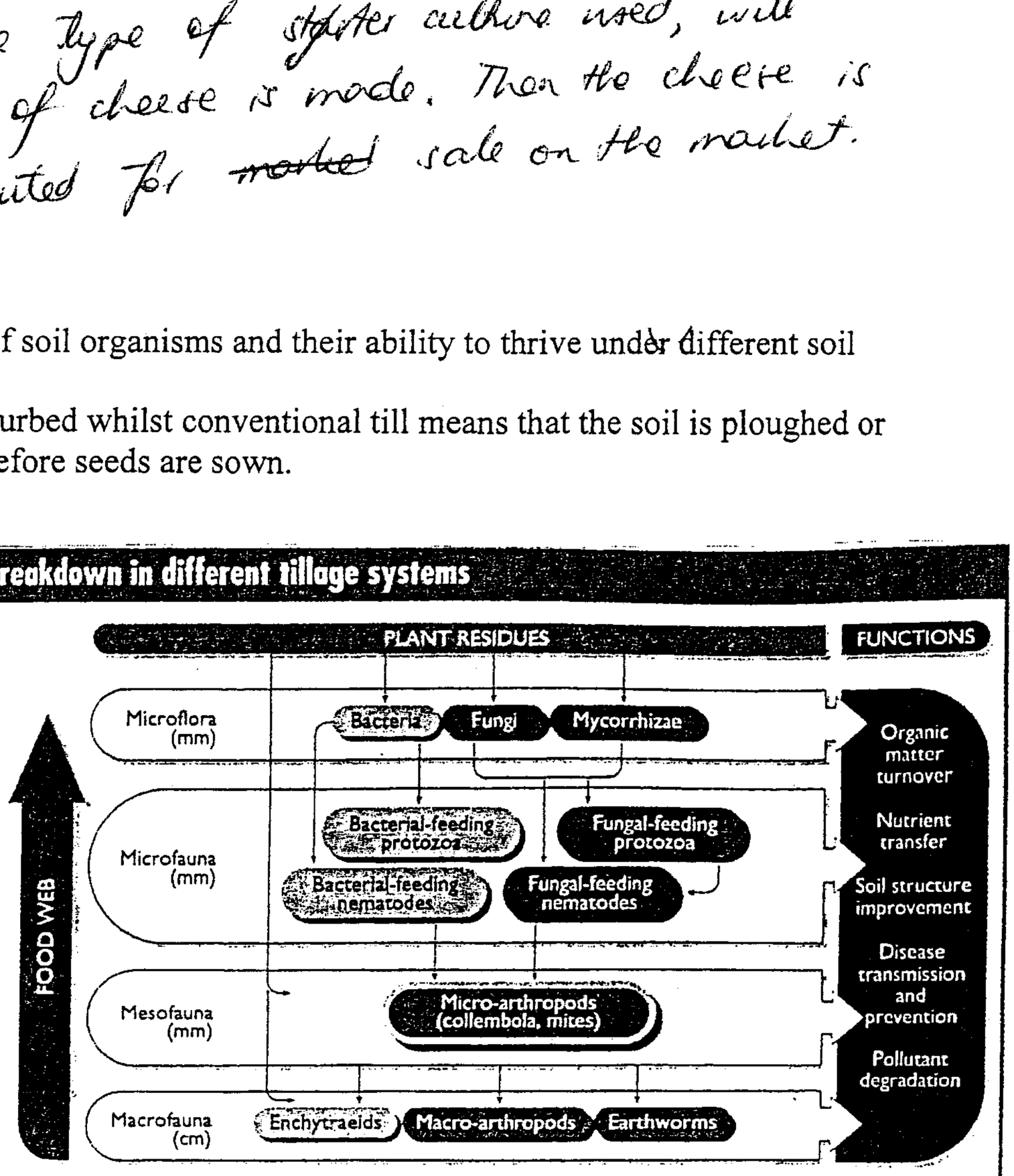
Protozoa and nematodes are a crucial link between microflora and larger fauna. They regulate the populations of bacteria and fungi and play a major role in the mineralisation of nutrients.

Mesofauna

Mites and collembola feed on litter and help fragment organic residues. They are predators of fungi and microfauna, playing an important role in regulating microbial populations and nutrient turnover.

Macrofauna

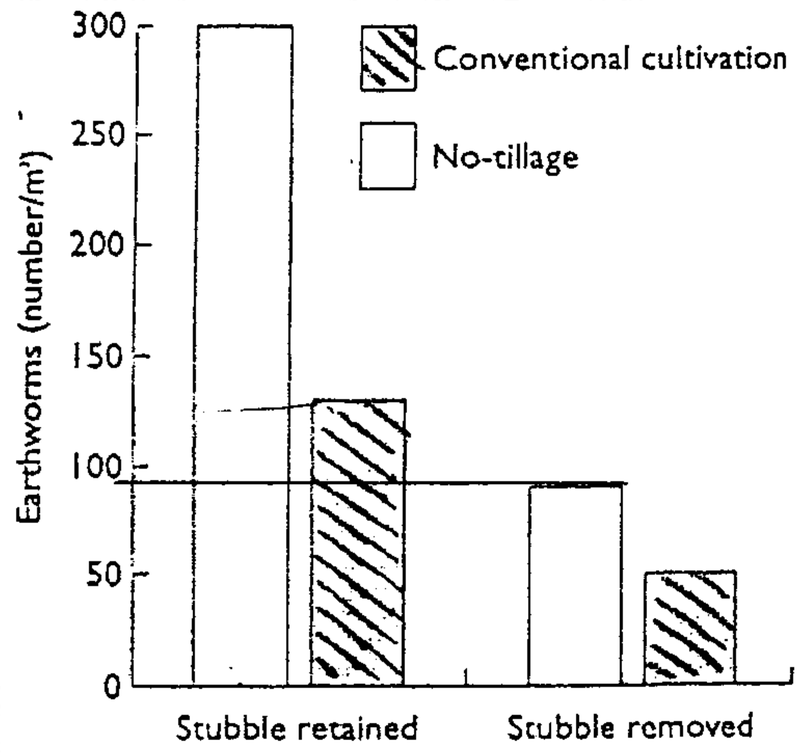
Earthworms, termites and dungbeetles, for example, are important biological agents, fragmenting organic residues and causing a large surface area to be exposed. They also aid the formation of soil aggregates and soil pores.



Source: CSIRO No-tillage Conventional tillage

(a) Stubble is the plant "left-overs" after a crop has been harvested. The farmer either leaves or burns this stubble before preparing the soil to sow the seeds of the next crop.

Figure 2 Stubble and earthworms*



* Effect of annual stubble retention and tillage on earthworm numbers. From a study carried out at Tarlee, South Australia.
Source: Co-operative Research Centre for Soil.

From Figure 2 -

Calculate the % reduction in earthworm numbers -

(i) comparing stubble retained / conventional cultivation with stubble retained / no-till.

no tillage - conventional.

300/m² − 125/m² = 175m²

reduction = 175 m² / 300

= 58.3% ✓

(ii) comparing stubble retained / no-till with stubble removed / no-till.

300/m² − 90/m² = 210

reduction = 210 / 300 ✓

= 70% ✓ (2 marks)

2

(b) **Figure 2** shows that disturbing the soil as little as possible and retaining harvested crop residues encourages larger earthworm numbers.
Explain how stubble retention and no-till can also minimize the risk of one named soil degradation problem. (2 marks)

erosion

stubble retention – protects the ground cover – top layer from agents such as wind and water that cause erosion (ie. rill / sheet erosion) - break down of organic matter into the soil also has benefits ✓ soil structure - encouraging ped formation. ✓ no-till means that the top layer of soil structure is not destroyed as opposed to complete cultivation and tillage. Though no-till the top layer is not left susceptible to erosion and this erosion risks are minimised.

2

(b) **Figure 2** shows that disturbing the soil as little as possible and retaining harvested crop residues encourages larger earthworm numbers.
Explain how stubble retention and no-till can also minimize the risk of one named soil degradation problem. (2 marks)

No till & stubble retention can minimize the risk of erosion. Minimum till prevents the constant disturbance of the soil that often leads to soil erosion. It keeps soil particles intact & prevents them from being easily removed. Stubble retention leaves plant cover on the paddock reducing the exposure of the soil to erosive conditions i.e. wind & water. ✓

2

(b) **Figure 2** shows that disturbing the soil as little as possible and retaining harvested crop residues encourages larger earthworm numbers.
Explain how stubble retention and no-till can also minimize the risk of one named soil degradation problem. (2 marks)

Stubble retention and no-till can minimise the risk of soil erosion. This because crop residues can increase organic matter levels to the soil, which helps maintain soil structure and the formation of soil aggregates. No-till prevents the over cultivation of soil, and hence prevents the soil structure from being destroyed, and prevents the breaking up of soil aggregates. Stubble retention also allows for soil cover that protects the soil from wind and water erosion. 2

(c) Use **Figure 1** to complete the following table - (3 marks)

Type of soil organism	One example of the type of organism	One direct role of the type of organism. Each of your role examples must be different.
Microflora	Bacteria ✓	Help in the formation of stable soil aggregates. ✓
Microfauna	Protozoa. ✓	Play a major role in the mineralisation of nutrients. ✓
Mesofauna	Mites. ✓	Regulating microbial populations. ✓
Macrofauna	✓ Earthworms	Help expose a large surface area of soil. Aid in formation of soil pores. ✓

3

(c) Use **Figure 1** to complete the following table - (3 marks)

Type of soil organism	One example of the type of organism	One direct role of the type of organism. Each of your role examples must be different.
Microflora	Rhizobia. ✓	recycle nitrogen nutrien. turns into usable form for plants. ✓
Microfauna	Protozoa, ✓	regulate population of microfauna (bacteria and fungi). ✓
Mesofauna	Mites ✓	feed on litter, further breardown organic matter. ✓
Macrofauna	✓ Earthworms	aid the formation of soil aggregates and soil pores. ✓

3

(d) Describe one other management practice that would encourage large and active populations of soil organisms. (1 mark)

Increased Organic Matter e.g. Green manuring. ✓ saving a green (legume) crop back into the soil before it matures.

(d) Describe one other management practice that would encourage large and active populations of soil organisms. (1 mark)

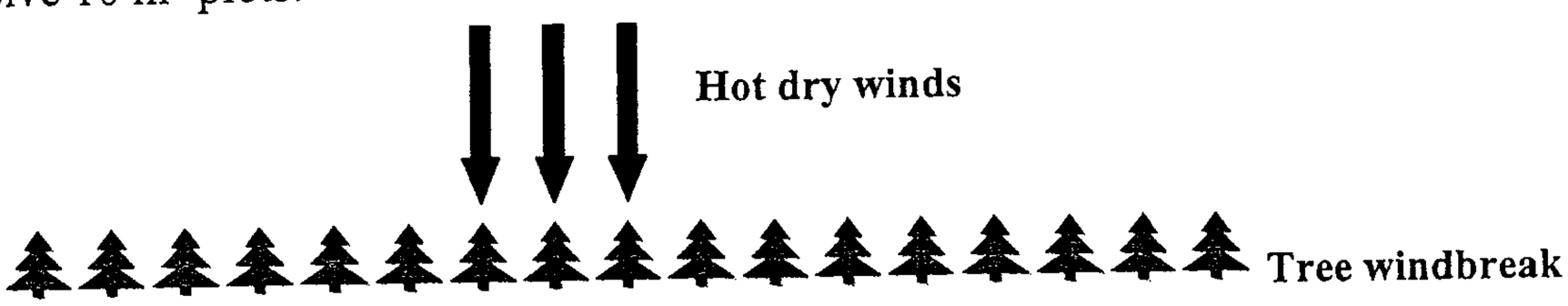
use of Organic fertilisers and organic matter ie. composts or biosol (treated human senege) can encourage large and ✓ active populations of soil organisms. Particularly negerable composts which would provide food for soil organisms such as ~~earth~~ earth worms.

(d) Describe one other management practice that would encourage large and active populations of soil organisms. (1 mark)

Soil aeration introduces oxygen into the soil which can be used by microorganisms for respiration which creates ✓ energy & allows them to live & be active & breed

Question 3. (7 marks)

An agronomist set up a pasture trial to make recommendations to dairy farmers on the south coast of NSW.
She used twelve 10 m^2 plots.



Kikuyu 100%	**Kikuyu 40% White clover 60%**	**Kikuyu 40% White clover 60%**	**Kikuyu 30% White clover 70%**
Kikuyu 100%	**Kikuyu 100%**	**Kikuyu 30% White clover 70%**	**Kikuyu 30% White clover 70%**
Kikuyu 100%	**Kikuyu 40% White clover 60%**	**Kikuyu 40% White clover 60%**	**Kikuyu 30% White clover 70%**

<u>The results obtained were -</u>

Table: Comparing the Dry Matter (DM) yield (tonnes/hectare) of three types of pasture suitable for dairy cattle.

Yields from the 4 plots of 100% Kikuyu pasture. (t/ha DM)	Yields from the 4 plots of 30% Kikuyu / 70% White clover pasture. (t/ha DM)	Yields from 4 plots of 40% Kikuyu / 60% White clover pasture. (t/ha DM)
3.8	4.0	4.2
3.6	3.9	4.4
3.8	4.0	3.9
3.7	3.7	3.9
Mean	3.725 ✓	3.9 ✓	4.1 ✓
Standard deviation	0.10	0.14	0.24

(a) Calculate the mean or average yield for each pasture and complete the table. (1 mark) ✓

(b) Explain what the standard deviations tell the agronomist about the performance of each pasture.
(2 mark)

Standard deviation tell the agronomist how the performance of each pasture deviate from the mean or average yield. If the standard deviation number is small, than there isn't a large deviation of the pasture compared to the mean, which indicates uniformity in yields and performance. 2

(c) Which pasture would the agronomist recommend. Explain the agronomist's choice. (1 mark)

30% kikuyu / 70% white clover pasture - while its average yield of 3.9 T/ha DM is lower than that of 40% kikuyu / 60% white clover (4.1), its SD is 0.14, which is more uniform than of the 40%/60% pasture. It has a more uniform line of yields, and produces a ~~good~~ yield. 1

(d) The agronomist could have set up the trial a little more carefully.
Describe the poor experimental design features used and how they could be improved. (3 marks)

- Randomisation - the agronomist should have allocated treatments in a non-biased manner. In saying this, one would have to question why all 100% pastures were situated close together, as well as the 70%/30% pastures. The agronomist needs to randomise treatment allocations more effectively
- Replication - the agronomist should replicate this experiment by increasing the number of treatments and treatment allocations, and replicating this experiment in different areas and climates of the South coast of NSW
- Standardisation - all management practices and environmental factors need to be managed as closely as possible to each other and made similar to minimise the influence of external factors. The ~~org~~ agronomist needs to be aware of the inconsistency of the three windbreaks. They do not adequately protect the 4th column of treatments, ~~what~~ from hot dry winds, whilst the tree windbreak below only borders the 3rd and 4th column of treatments. The agronomist needs to ensure standardising of windbreaks. 3

excellent

Question 3. (continued)

(a) Calculate the mean or average yield for each pasture and complete the table. (1 mark) 1

(b) Explain what the standard deviations tell the agronomist about the performance of each pasture. (2 mark)

The standard deviation shows the agronomist how varied the results of the performance of each pasture was in the scope of the group. The higher the standard deviation, the more varied the performance. In this case, the 100% Kikuyu pasture had the least varied results, (0.10) followed by the 30/70 (0.14) and then the 60/40 pasture (0.24) had the most varied results 2

(c) Which pasture would the agronomist recommend. Explain the agronomist's choice. (1 mark)

The agronomist would recommend the 70%/30% blend of pasture. Though it had a slightly lower yield than 60/40 (3.9 t/ha compared to 4.1 t/ha), it also produced much more uniform results (0.14 SD compared to 0.24 SD), which would give much more uniform yields 1

(d) The agronomist could have set up the trial a little more carefully.

Describe the poor experimental design features used and how they could be improved. (3 marks)

*Randomisation: The 3 treatments were set up in a set pattern. This meant that all 3 treatments were tested in the same type of environment ~~as each~~ within their particular groups, but tested in different environments in the scope of the trial. The treatments should have been randomly allocated to plots ~~on~~ in the trial

*Standardisation: The tree windbreak on the north boundary of the farm did not stretch the whole length of the trial plots. Heme, 3 x 70/30 plots were exposed to hot, dry winds coming in from the north, likely to affect growth. The trial should have been set up so that all 3 treatments were growing in the same climate 3

SECTION II
30 marks
Attempt Questions 4 - 5
Allow about 50 minutes for this section
Answer the questions in the spaces provided.

13½

Question 4. (15 marks)

(a) The diagram shows the relationships between two very important plant processes. (2 marks)

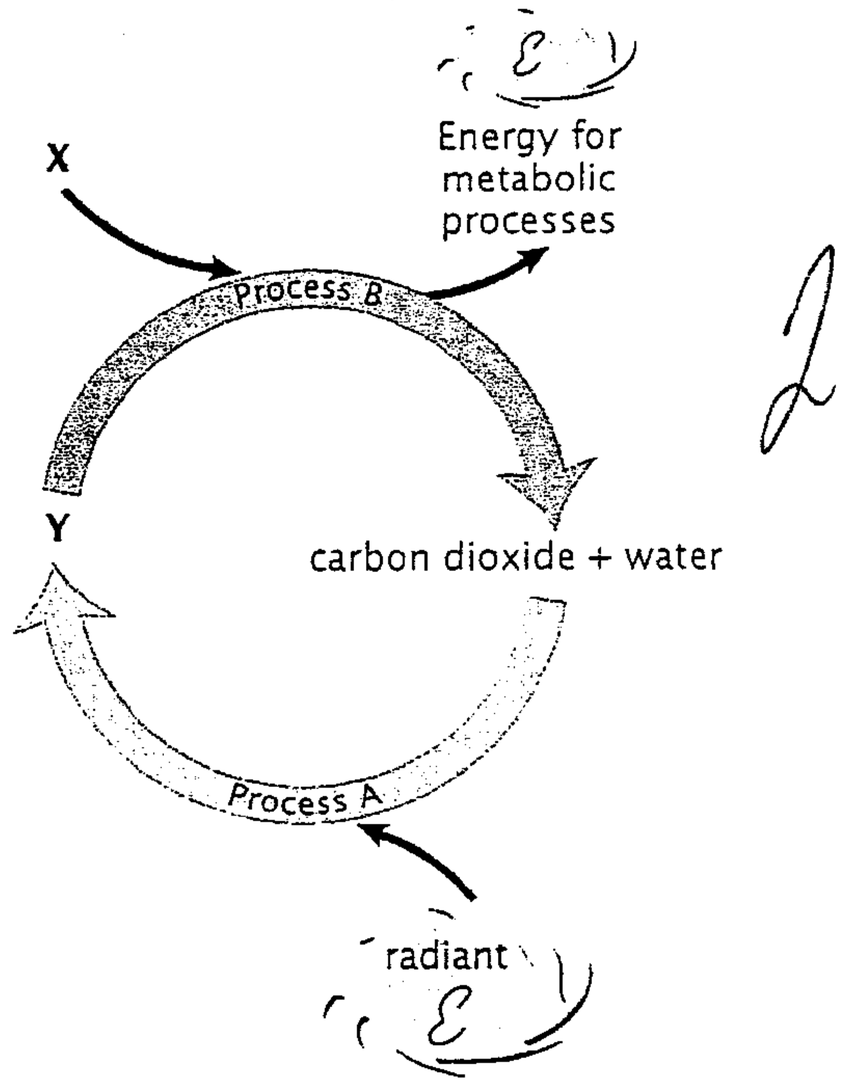
From the diagram correctly name -

(i) Process A: Photosynthesis ✓

(ii) Process B: Respiration ✓

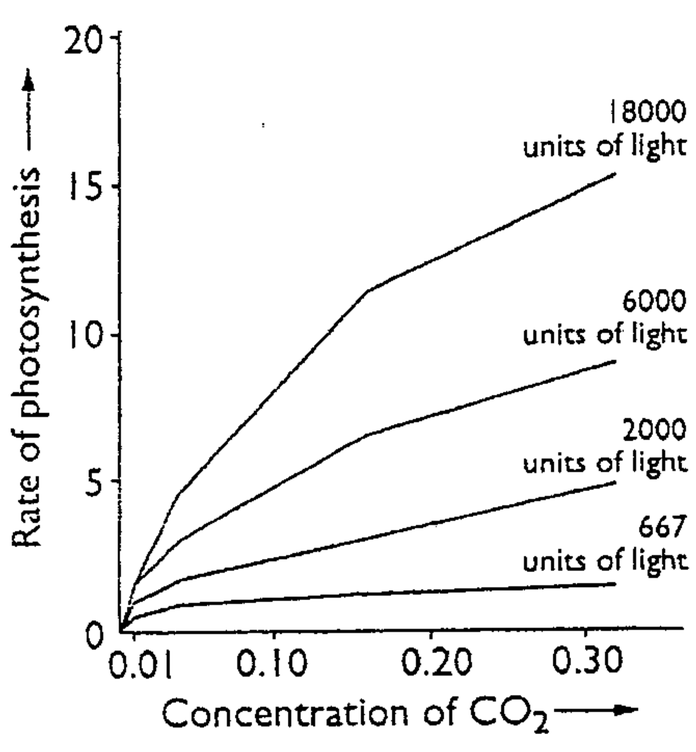
(iii) X : Oxygen ✓

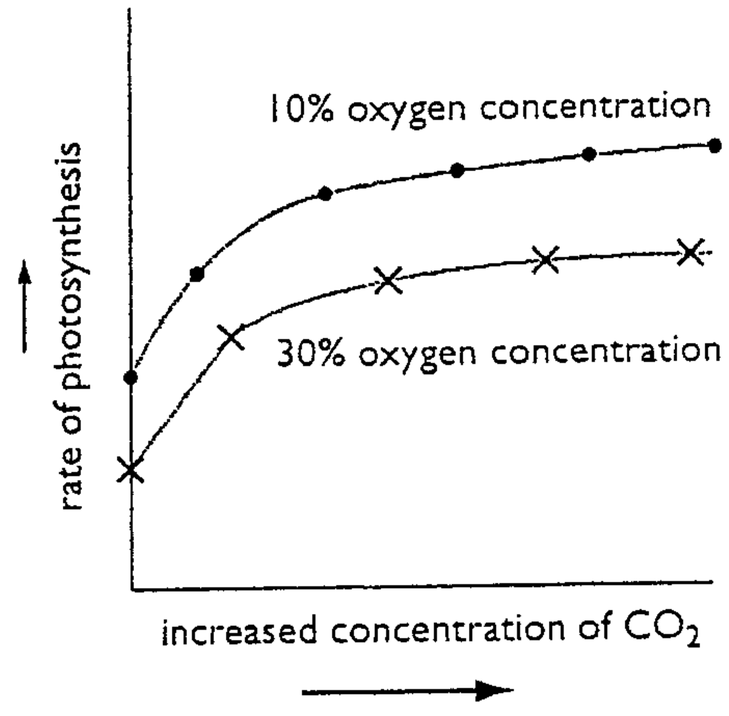
(iv) Y : Glucose ✓



2

(b) The two graphs show environmental factors that can influence photosynthesis.





State two relationships between the rate of photosynthesis and an environmental factor.

(2 marks)

One: As the concentration of CO_2 & light ✓ increases, the rate of photosynthesis increases steadily.

Two: With a steady increase of CO_2 and ~~increase~~ ✓ in the presence of lower oxygen levels, photosynthesis increases.

2

Excellent.

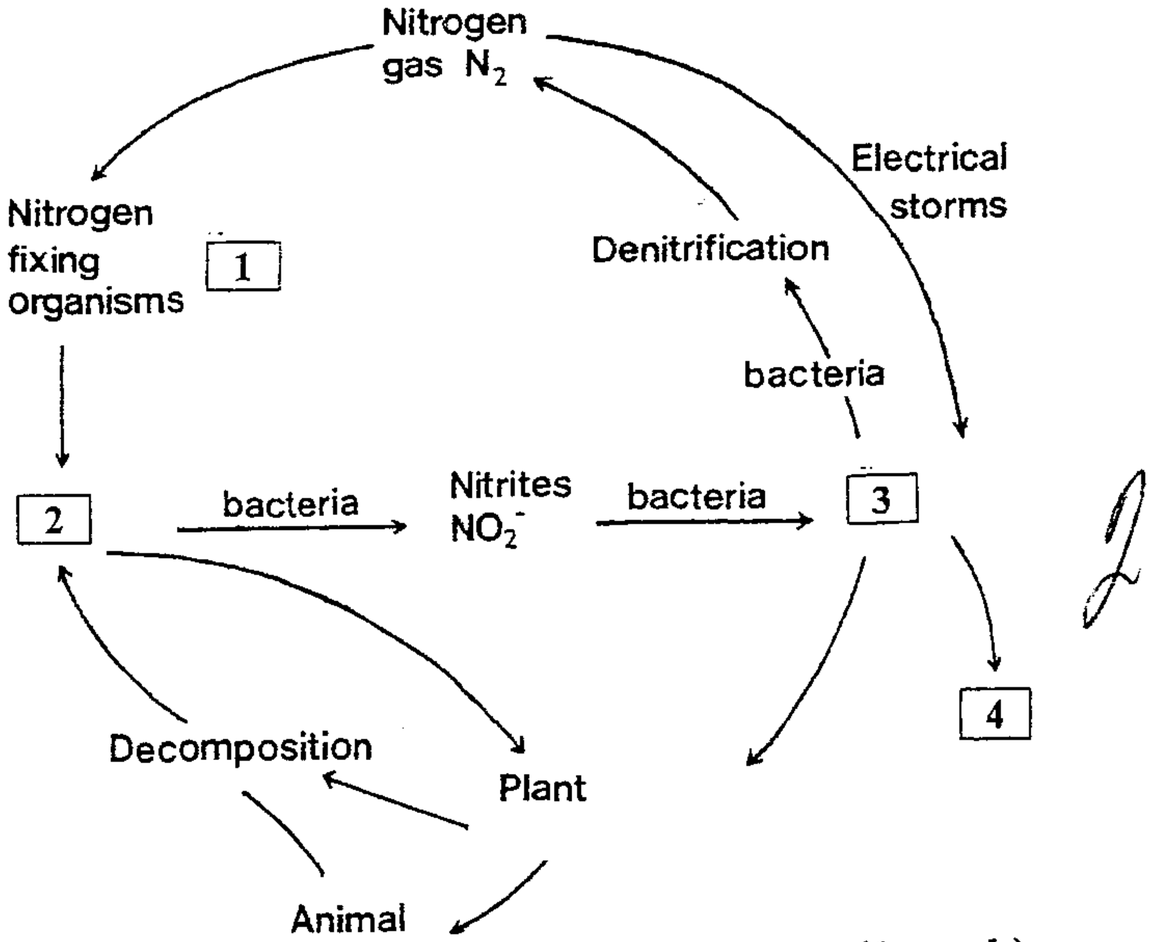
State two relationships between the rate of photosynthesis and an environmental factor. (2 marks)

One: With increased concentration of CO_2 there increased photosynthesis ✓

Two: The greater units of light the greater the rate of photosynthesis ✓

2

(c) The diagram represents the Nitrogen cycle on a farm.



Correctly identify from the diagram - (2 marks)

(i) **1**: One N-fixing micro-organism.

Rhizobium bacteria ✓

(ii) **2**: Ammonium (NH_4^+) ✓

(iii) **3**: Nitrate (NO_3^-) ✓

(iv) **4**: The process.

Leaching ✓

2

(v) Define the term mineralization: (1 mark)

Mineralisation is the conversion of OM by microbes into inorganic mineral forms ✓

1

(vi) Explain how the farmer can manage the nitrogen cycle to maximize farm productivity. (4 marks)

The nitrogen cycle can be managed by a farmer by:

* Using NPK fertiliser: This immediately increases available nitrogen in the soil, which is processed by nitrification ✓✓ and then maximises plant productivity

* Innoculating legume seeds with Rhizobium: Rhizobium bacteria are a nitrogen fixing strain of bacteria which convert ✓ atmospheric nitrogen into usuable ammonium ions through ammonification, hence increasing productivity

* Adding lime to soil: A less acidic soil (achieved by adding lime), encourages nitrogen fixation by bacteria and also makes nitrogen more soluble ✓ in soil water, making it more available for use by plants and crops

4

(vi) Explain how the farmer can manage the nitrogen cycle to maximize farm productivity.
(4 marks)

The farmer can use nitrogen-based fertilizers on soils to increase nitrogen content, plant crops (eg legumes), manage irrigation to minimise leaching. He can add lime to the soil to add calcium ions to balance out the nitrogen ions to decrease the soil acidity therefore allowing Rizobium bacteria to function correctly & to increase soil fertility (as some nutrients can't function in acidic soils). Green Manure can also be added to the soil to break down into nitrogen ions to make the soil more fertile.

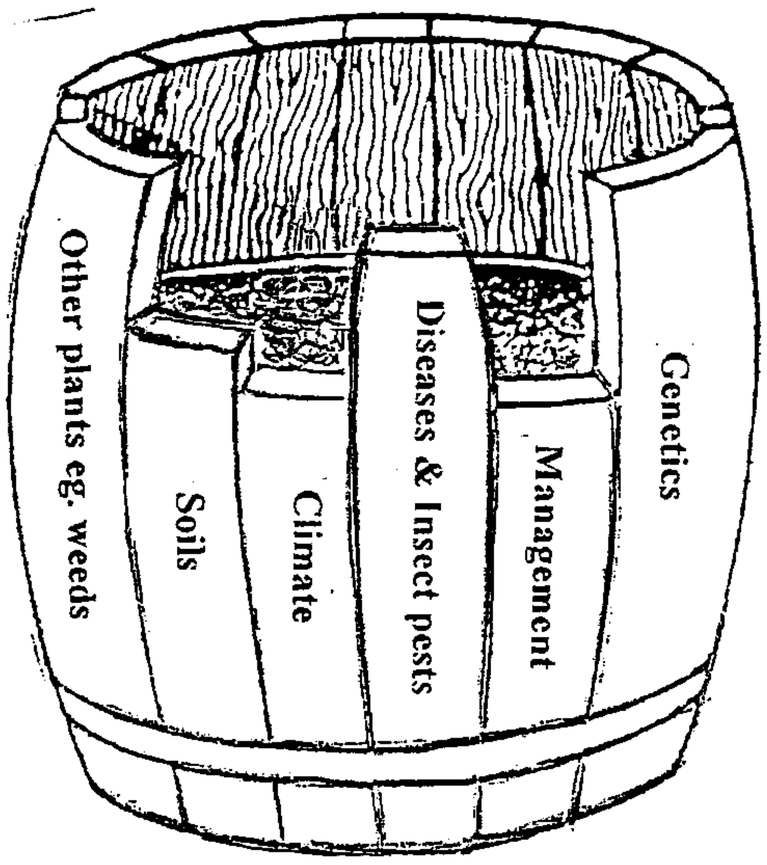
4

(vi) Explain how the farmer can manage the nitrogen cycle to maximize farm productivity.
(4 marks)

Farm productivity relies upon the adequate growth of pasture for feed and of crops. Nitrogen is an important element in allowing plants to grow and hence the supply of N & its fixation should (to be able to be used by plants) be encouraged. The farmer can innoculate legumes with nitrogen fixing rhizobium to encourage adequate supply of useable N to plants, he can also apply ammonium sulfate to fuel the nitrification process and return stubble after cropping to allow for organic matter's combustion to nitrogen fixing and nitrification. As well as this he can monitor irrigation so as to not apply too much water and hence cause leaching of the nitrates beneficial to productivity.

4

(d) The diagram shows factors that influence plant production. The structure of the barrel would vary from one crop or pasture to the next.



Using a crop that you have studied demonstrate the meaning of P = G + E

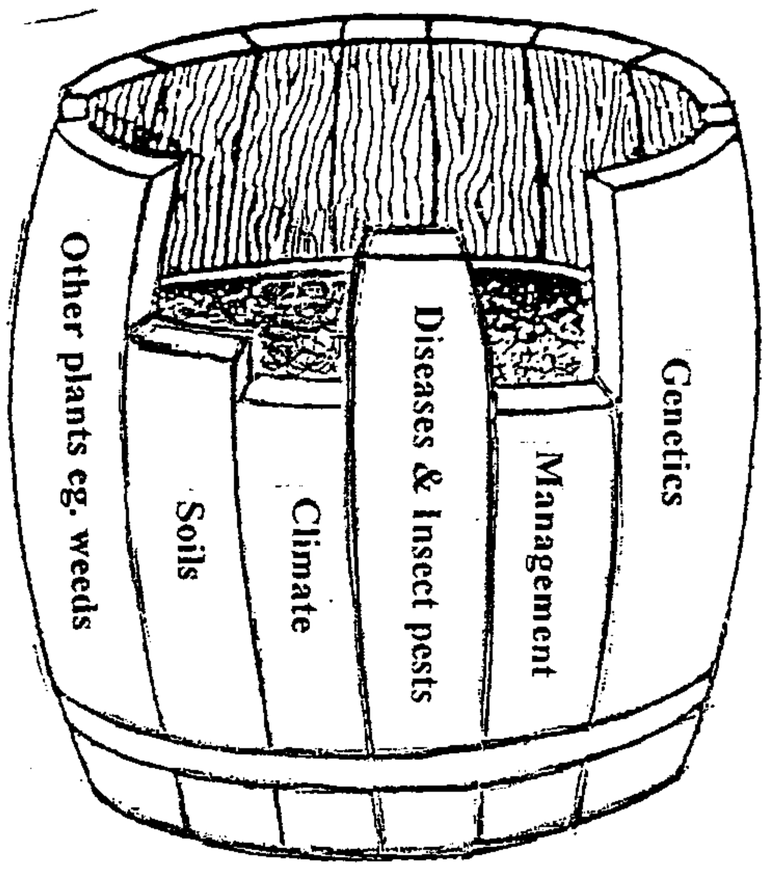
(6 marks)

Excellent

~~Factors such~~ In the production of cabbage crops, the relationship between phenotype, genotype and environment was demonstrated through management of factors that influence plant production. The genotype (genetic potential) of the plants interacted with environmental factors to result in a particular phenotype (the appearance and health of the cabbage plants.) This relationship is described by the formula P = G + E.

In growing the cabbages, an appropriate IPM system was used to minimise diseases such as black rot, and minimise pests such as the cabbage white butterfly. Chemicals were used to kill the pests, and weeds such as wild radish were removed in an act of physical management to prevent the weeds from hosting the cabbage white butterflies (acting as a reservoir). Management was further implemented to result in an optimum phenotype, of ~~plant~~ cabbages of high weight in g/head. When the environmental factors influenced plant production negatively (eg: no rain, led to lack of water availability), appropriate management was implemented, such as regular irrigation watering cans to ensure adequate water supply. Nutrient deficiencies in the soil were overcome with the addition of fertilisers, whilst soil pH was maintained at an optimum level with lime application. Cabbages planted at medium density experienced better weight and head size compared to high density treatments because of reduced competition with other cabbages, and weeds, for resources like sunlight and water. Therefore, it can be seen that the genetic potential (genotype) of the cabbage seeds combined with the control of environmental factors through appropriate management, led to an optimum phenotype in the cabbages.

(d) The diagram shows factors that influence plant production. The structure of the barrel would vary from one crop or pasture to the next.



Using a crop that you have studied demonstrate the meaning of P = G + E

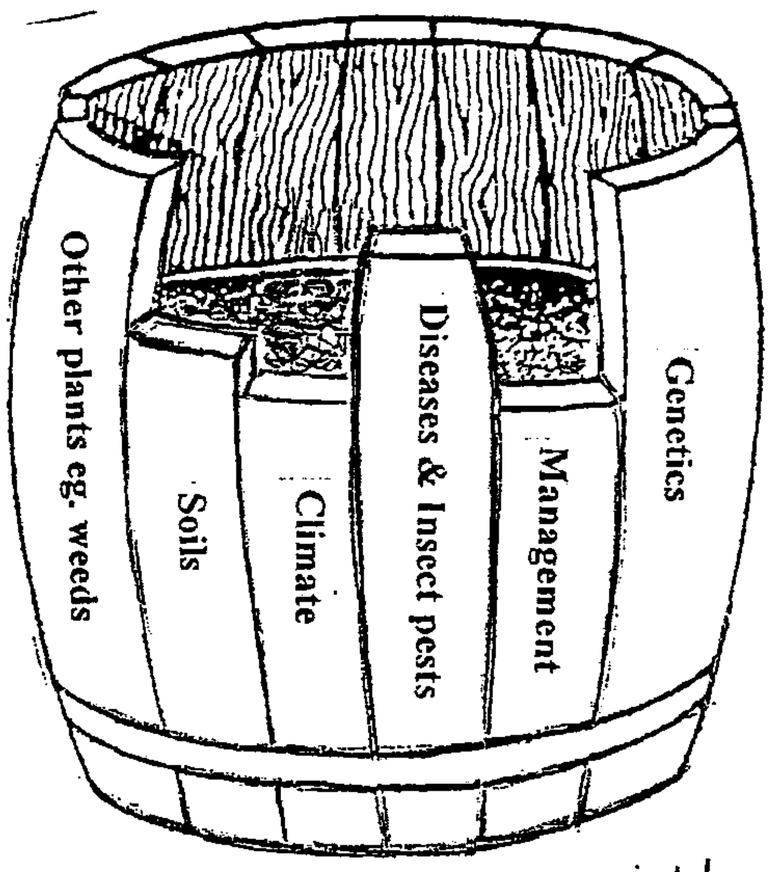
(6 marks)

The displayed productivity of lettuces (or phenotype) is a combination of genetic potential (or genotype) and environmental factors. (ie: P = G + E)

Most lettuce crops are genetically designed to grow into large healthy lettuces. However, because of management, pests/diseases, climate, soils and other plants, the lettuce crop rarely reaches its genetic potential.

Management of lettuce crops includes correct irrigation and overall maintainence of the plant. Any aspect of mismanagement, such as allowing the lettuces to get sunburn, affects the performance characteristics of the lettuce crop. Pests such as the Sowthistle aphid and diseases such as Downy Milden adversely affect the growth of the plant and hence detract from the plant its genetic potential. Climate conditions such as drought, high/low humidity and frosts, cause the lettuces to grow to a lesser extent and hence means that its characteristics will not be shown its genetic potential. Soil conditions such as clay/sand/silt ratio and nutrient levels in the soil can be sub-optimum and the lettuce will not reach ~~potential~~ its genetic potential. Lastly, other plants such as weeds can interfere with the lettuce crop and hence its phenotype will ~~affect~~ not shows full genotype potential. Thus, the lettuce crop is a good demonstrator of P=G+E, because its phenotype (displayed characteristics) is a combination of its genotype (genetic potential) and environmental factors.

(d) The diagram shows factors that influence plant production. The structure of the barrel would vary from one crop or pasture to the next.



Using a crop that you have studied demonstrate the meaning of P = G + E

(6 marks)

If management fails to employ methods that will reduce the interference of pest + disease the crop may be prone to the interference of ege peirs + diseases. yield.

The phenotype (quality + exterior characteristics) is dependent on the interaction between genetics and environment. In the cabbage ~~white butterfly~~ (~~CBW~~) genetics + environment play a major role in its productivity. However genetics determine the optimum level of producivity + ~~has it~~ this optimm can only be fulfilled if the environment is favorable. If the cabbage competes through competition (recieves interference) it may lower producivity. The competion of resources to the wild radish for light, nutrients, & water and feed may lower photosynthesis as well as producivity. If the cabbage ~~experiences~~ is over populated by black rot or cabbage white butterfly they reduce producivity. The pest & disease feed on the exterior of the plant resulting reducing leaf surface + photosynthesis therefore growth. If the soil is deficent in nutrients the plant may not recieved required nutrients for growth. Therefore it is important that the genotype + environment remain optimum in order to produce a good phenotype.

If the genetics are good due to the development of hybrid vigour the plant must be in optium environment standards otherwise risk the plants inability to reach potential.

✓ (1 or 2) More specific cabbage crop example needed

5

Question 5. (15 marks)

(a) The diagram below shows the fate of energy in animal nutrition.

Food energy	**Gross Energy (GE)**
	↓
Absorbed energy	**Digestible Energy (DE)**
	↓
Available energy	**Metabolisable Energy (ME)**
	↓
Energy for maintenance and production.	**Net Energy (NE)**

Outline the fate of energy in food eaten by a ruminant animal. (2 marks)

Gross energy is lost from ruminants as faecal wates.....
Digestible energy is lost as methane and urine.....
Metaboalisable energy is lost as heat energy while.....
the remaining energy is used for the animals maintenance
and production..... 2

(b) Compare the role of the hormones oestrogen and progesterone in the regulation of animal reproduction. (2 marks)

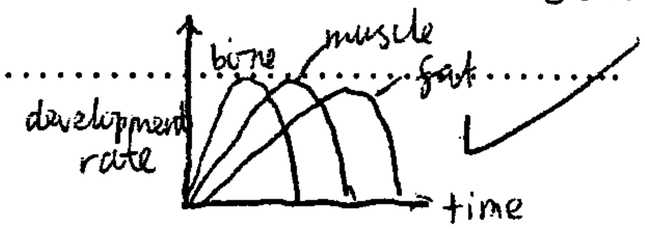
oestrogen is produced in the mature follicle while progesterone
is produced in the ~~Fo~~ ruptured follicle. Oestrogen stimulates
an animal to come on heat and also to stand for the male.
It also is responsible for uterus growth and growth and
development of ~~#~~educts + tissues in the mammary system.
Progesterone maintains pregnancy and is responsible for
development of the udder and uterus wall. excellent 2

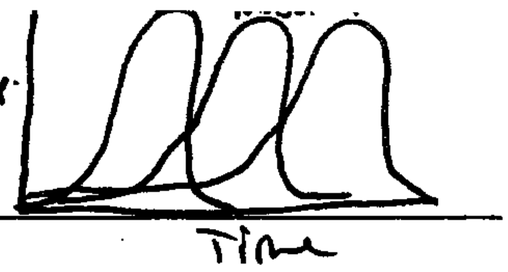
(b) Compare the rôlé of the hormones oestrogen and progesterone in the regulation of animal reproduction. (2 marks)

Oestrogen stimulates oestrus in cows, as well as stimulating mucous from mucous glands and the growth and development of udder tissue - this is through a large increase in oestrogen. ✱ whereas progesterone is low at this point. Progesterone is a hormone which maintains pregnancy through acting on the brain to stop behavioural mating instincts, as well as preventing milk let down, enlargening uterus and inhibiting production of FSH hormone. When progesterone is high oestrogen is very low. 2

(c) Describe the process of growth and development in animals in terms of bone, muscle and fat. (2 marks)

In cows, bone development and growth occurs rapidly during the ~~year~~ time from birth to puberty. Muscle development occurs most rapidly between puberty and maturity and then fat development rapidly occurs after maturity and beyond, shown the the diagram below 2





(c) Describe the process of growth and development in animals in terms of bone, muscle and fat. (2 marks)

Early in growth + development process we see a rapid development of bones + skeletal structure with muscle + fat developing slowly. Once puberty is reached we see bone at its peak with muscle filling out. By maturity, bone development is complete, muscle peaks and begins decreasing and fat is on a steady rise - see graph above 2

(c) Describe the process of growth and development in animals in terms of bone, muscle and fat. (2 marks)

Growth, the increase in size and development, the change in proportion of body parts has a distinct order. The bone is the first to form followed by muscle and finally fat. If due to negative environment e.g. drought growth is limited it will be the fat that is lost first. 2

(d) Name TWO factors that limit fertility in farm animals.
For each factor, explain ONE management practice that improves fertility in farm animals.
(3 marks)

One: Genetics - Genetics can be managed by breeding animals with a history of - high fertility or twins into the herd. Superior + fertile animals will be bred.

Two: Nutrition - Supplying a complete and balanced diet to animals in the periods before mating will ensure regular cycles and a healthy + optimun state. Eg. Vit A to males to improve sperm production/quality.

One: Disease - to improve fertility the health of the animal needs to be maximised. Drenching and vaccination reduce incidence of disease and improve fertility.

One: Temperature - High temp ↑ lowers sperm production in males → bulls ensure animals have shelter to ~~to~~ away from extreme climate conditions

Two: Nutrients → a lack of nutrients can affect the growth rate of heifers + delay their reproductive development → to improve ensure animals are receiving enough of the right types of nutrients.

(e) The following is a feed label from a bag of feed used in an animal enterprise -

Feed

Protein (%)	22.0
Digestible energy (MJ/kg)	18.0
Fibre (%)	1.9
Vitamins (A, B, C, D, etc)	Full range
Urea	nil

(i) Describe the suitability of the above feed for ruminant and monogastric animals.

(ii) Evaluate the information on the label for ruminant and monogastric animals in terms of -
* protein;
* vitamins;
* urea. (6 marks)

(e) Answer this question in the space below -

(i) *Ruminants: This feed is not suitable for ruminants. These animals need high levels of M.E and do not need a full range of vitamins, as these are synthesised by rumen microbes. Also, the feed contains low fibre and no urea, both digestible by ruminants

*Monogastrics: This feed is highly suited for monogastric animals. Since they cannot synthesise their own vitamins, a full range is provided. The feed has high protein, suitable for monogastrics. Also, monogastrics cannot process urea or fibre, so nil and very low amounts of these (respectively) are in the feed

(ii) *Protein: - Ruminants do not require a high level of quality protein in their diets, as these are provided by rumen microbes. Hence the protein in the feed is too high for ruminants.

- Monogastric animals require high quality protein and lots of it, because they have no other sources of protein (such as rumen microbes) for use

*Vitamins: - Ruminants source most of their vitamins from rumen microbe synthesis and hence do not require a full range of vitamins, as is shown on the label

- Monogastrics CANNOT synthesise their own vitamins and hence require a full range of vitamins, as shown on the feed label

*Urea - Ruminants can process urea via rumen microbes. Also urea is cheap and is provided as a source of protein in most ruminant feeds

- Monogastrics cannot process urea and would be killed by eating it. Hence the feed label shows nil urea.

6

End of section II

(e) Answer this question in the space below -

i) The feed could by used by both ruminants and monogastrics, however it is more suited to use by a monogastric as it contains no urea and the full range of vitamin which is essential in any monogastric ration. There should also be more fibre if it was to feed a ruminant.

ii) *Protein* - this is a high level of protein, needed in the monogastric as they are unable to produce their own unlike the ruminant which can use microbial protein. It is not necessary to have this much for a ruminant. The protein is sufficient to meet dietry needs.

* *Vitamins* - ration contains a full range, an advantage as these are needed by the monogastric. The full range however is unnessecary when feeding the ruminant as it is able to synthesise its own vitamins. Vitamins are needed by both animals and are therefore a valuable inclusion.

* *Urea* - Nil urea is negative if viewing as a ruminant feed as it is a valuable source of non-protein nitrogen used to create microbial protein. It is acceptable however for a monogastric ration as they cannot make use of it anyway. The feed could be improved if urea was included.

6

(e) Answer this question in the space below -

This feed would be most suitable for monogastric animals, as it provides a nutritionally complete and adequate supply of vitamins and proteins. For monogastric animals, this feed is most suitable, as monogastrics cannot synthesise protein or Vitamin B. Therefore, the high level of protein 22% and full range of vitamins is provided. Monogastrics also cannot digest cellulose, and require high energy feeds which at 18 MJ/kg, is suitable for monogastrics, anatomically and functionally speaking. This feed thus provides adequate protein and vitamins for monogastrics, whilst urea is non-essential.

For ruminant animals, however, this is different. Ruminant animals can digest cellulose through the presence of bacteria, protozoa and fungi in the rumen. Therefore do not require high energy feeds, whilst fibre present at 19% is low. Ruminants also have the ability to synthesise protein, through the ~~to~~ digestion of non-protein nitrogens, such as urea, and can whilst

microbial protein, therefore do not require high level of protein provided in the feed. Ruminants also have the ability to synthesize Vitamin B, and also therefore do not require a full range of vitamins. ✓

6

SECTION III
15 marks
Attempt ONE question from Questions 6 - 9
Allow about 30 minutes for this section

Answer the question in a writing booklet. Extra writing booklets are available.

Question 6. (15 marks)

(a) For a crop or pasture that you have studied describe the types of plant interference that could have adversely impacted on its productivity. (5 marks)

(b) For a crop or pasture that you have studied and one potential pest or disease, assess the effectiveness of the recommended Integrated Pest Management program. (10 marks)

15

Question 6

a) Lettuces

Different types of interference that impact on lettuce production include:

acting as an alternate host → plants usually weeds may harbour or support pests while the crop is not growing. As the crop begins to grow the pests transfer across and infect & infest the lettuces, significantly reducing the yield. This is seen in lettuce production through the sowthistle weed supporting the sowthistle aphid and necrotic yellows disease which significantly impact on crop yield.

competition → plants eg. sowthistle weed & wild radish may compete for resources /

5

such as nutrients, moisture and light ✓ which may reduce lettuce vigour & result in a lower yield for the lettuce crop.
allelopathic → e.g wild thornapple suppresses lettuce growth & seed germination through the release of a chemical from dead or alive leaves other plants → other plants eg tree windbreak may modify the microclimate around the lettuces by increasing humidity, making the lettuces susceptible to downy mildew; reduces windspeed which reduces seedset & pollination & may cause shedding over the crop resulting in poor growth patterns

b) lettuces feeds on lettuce ✓ sowthistle aphid ~~carries necrotic~~ leaves, significantly reducing yield after transferring across from the sowthistle weed aphid. the aphid also carries necrotic yellows viral disease which secretes a sugary juice that significantly hinders yield ✓
IPM strategies must be incorporated to maximise control and reduce chemical use & subsequently aphid resistance through incorporating a range of tools & techniques.
the recommended IPM treatment for sowthistle aphid is:
chemical → the use of pyrethrum aphid ✓ insecticide or narrow spectrum insecticide when

aphid numbers become too high determined by regular crop checks.
~~cultural~~ biological → introduce beneficial insects such as wasps and lady beetles to which help control aphid numbers.
cultural → use of companion plants to attract the aphid and stop it from hindering lettuce growth & production
cultural → avoid optimal conditions for growth eg. spring when it is warm & moist ~~&~~ times of the year when there is less wind to dislodge the aphids.

advantages

- through the use of aphid insecticide which is cheap and easy to apply aphid numbers are reduced without hampering the quality of the yield
- introduction of beneficial insects such as wasps mean that chemicals are not used which can harm the environment & lettuce growth & quality is maintained
- the use of companion plants control aphid numbers as well as maintain a quality lettuce crop & thus farm profitability ~~that~~ & production which is sustainable
- the southside aphid IPM program does not use mechanical means such as cultivation which ~~reduce~~ hinders the soil structure ~~of the~~ & may have detrimental effects on lettuce growth due to the particles falling in the pores reducing water infiltration & thus hinder growth

disadvantages

- use of pyrethrum aphid insecticide ~~means has dev~~ can have a damaging impact on the environment as it may especially when sprayed on windy days enter the watercourse & have an adverse effect on aquatic life.
- use of the insecticide also means that aphids may develop a resistance which means that lettuce growth may be hindered in future generations due to the ineffectiveness of the insecticide
- use of insecticide also may leave a residue on the lettuce crop which is unappealing at sale.
- the introduction of wasps & ladybeetles may be costly & time consuming.

Judgement

The IPM strategy for sawthistle aphid is although through the use of insecticides potentially harmful, the use of other techniques including avoiding optimum conditions for growth & planting companion plants reduce insecticide use whilst helping to maintain a productive & profitable yield. Thus the strategy is very effective

(6) (14)

(A) For cabbages, plant interference has come in the form of plant competition for water, light and nutrients, allelopathy and plants acting as alternate hosts.

Plant interference can adversely affect productivity, because the plant has to compete for the small amount of essentials. For example space, though there was limited spacing between each cabbage, this caused firstly for the plants productivity to increase, to an extent and then decrease. Likewise with water, if there isn't enough water, this could slow or stunt the cabbage growth and simularly with sunlight, if the cabbages were shaded, they would not receive enough sunlight for photosynthesis and thus decrease production.

Allelopathy is where plants release a chemical that could adversely or positively? effect its productivity. In the cabbage's case, the weed thornapple released a negative chemical that suppressed its growth. Finally, plants acting as alternate hosts highlighted in wild racket that could bring about diseases such as black rot or pests such as cabbage white butterfly. Because it is so closely related to the cabbages... plant interference, competition and alternative hosts all have adversely on cabbages.

(B) The crop studied was cabbages and IPM (the use of various methods to control pests or disease) was implemented.

Firstly, chemical control was used. this is the use of pipel on the cabbages to kill the caterpillar of the cabbage white butterfly. This is advantageous because it's an fast, quick and is environmentally friendly product. However, as disadvantage could be possibly chemical resistance where some cabbage white butterfly caterpillar survive and pass it on in the next generat

Secondly, management techniques of growing the cabbages away from where previous cabbages were grown, could prevent the carry over of ~~disease~~ soil borne diseases such as black Rot. this is a sustainable farming practice thus is beneficial to the farmer, however this technique could be costly and expensive because there is limited farm space anyway. Only one part or disease

Third, farmers could use planting of different coloured cabbages, for example purple cabbages. this has the advantage of being sustainable in the caterpillar of the cabbage white butterfly (green) cannot camouflage but its disadvantages include not being an expensive alternative and not effective in preventing alternative hosts e.g weeds. & the thornapple, wild radish

Fourth, a management practise could include use of biological control ~~ex~~, that is use of wasps in order to kill the cabbage white butterfly caterpillar. this has the advantage of being a quick, efficient alternative but has the disadvantage of perhaps the wasps ~~bathe~~ becoming out of control and a pest.

The fifth way to ~~no~~ help prevent the cabbage white butterfly is the conjunction of hand removal and adding a net over the crops. this has the advantages of being sustainable and a cheaper ~~however~~ alternative than use of chemicals, however it ~~do~~ uses more labour and time (especially in removing the net and having to pick out each individual cabbage white butterfly caterpillar).

In closing, the five methods described all have their own advantages and disadvantages. however it is recommended

to use a mixture of all five of the techniques to manage mainly cabbage white butterfly and/other diseases such as black rot to reap its full benefits, ie. in a rotational and consistant basis preventing resistance from chemicals and obtaining cost advantages. ✓

9

QUESTION (6)

14

a) CROP : Cabbage

Types of plant interference:

• Plant competition →

- For light - occurs when one plant shades another, eg, weeds shading the cabbages.
- For Nutrients - weeds taking nutrients out of the soil that could be used by the cabbages
- For water - Both as the cabbages are relatively ~~shallow~~ shallow-rooted, if weeds are deep rooted, they will take up more moisture & the cabbages will experience water stress.

• Allelopathy →

This is when one plant releases a chemical into the soil that affects the growth of surrounding plants. Eg, wild radish is allelopathic → it releases a chemical into the soil that is detrimental to the growth of cabbages & thus adversely impacts on productivity

• Acting as alternate host →

This is where one plant acts as a host for a pest/disease that affects the crop. Eg. the wild radish hosts the cabbage white Butterfly & impacts adversely on productivity by allowing the CWB to thrive & then attack the cabbage crop.

b) CROP STUDIED : Cabbage

POTENTIAL PEST : Cabbage white butterfly.

EFFECTIVENESS OF IPM PROGRAM :

(1) Chemical control → Application of chemical

PROS:

- Effectively kills CWB, ✓
- Promotes disease/pest resistance in the cabbages?

CONS:

- Potential to contaminate waterways, ✓
- Can be ~~harmful~~ harmful to insects that are not pests.

JUDGEMENT:

If applied early enough chemicals can effectively control CWB, however due to the risks they present to the wider environment, chemicals need to be applied carefully, as per the instructions.

(2) Cultural control → Planting date: plant when the CWB are less active (colder months)

PROS:

- The CWB will be less active as it prefers hot, dry conditions. ✓
- This control costs nothing to implement

CONS:

- Planting during the colder months can result in lower yields in cabbages ✓
- Planting around the CWB may be conflicting with other farm operations

JUDGEMENT:

If it is economically ~~if~~ feasible for the crop to be planted around the CWB activity it should be done as the CWB will thus

be less of a problem. However due to the fact that the cabbage crop is most likely not the only crop grown, it could be undesirable to plant around the CWB a chirky

(3) Mechanical control - Netting around the crop.

PROS:

- will keep out the CWB,
- can also provide protection from birds etc.

CONS:

- Costs associated, time associated,
- If the cabbage butterflies are already present or the eggs already laid, they will simply be trapped in with the crop.

JUDGEMENT:

The erecting of netting around the crop is effective as a prevention of CWB, not really a control of it.

(4) Biological - introduced beneficials

PROS:

- Introducing a predatory wasp will kill CWB.
- Doesn't involve chemical use.

CONS:

- Alters the environment, eg, does the farm really want all wasps present on his farm?
- Risk also of being stung by wasps, especially in the case of the Hillstone farm with the presence of children.

JUDGEMENT:

Introducing a predatory wasp is not suitable to the Hillstone farm.

(5) Sampling → checking for signs of CWB

PROS:

- Costs nothing,
- The farmer can assess the seriousness of the CWB problem.

CONS:

- Time consuming,
- Doesn't prevent or control CWB.

JUDGEMENT:

Sampling is essential for farmers to fully understand the full extent of the pest problem & thus decide upon an appropriate course of action.

CONCLUSION:

Implementing a combination of chemical, cultural, biological, mechanical & sampling comes in the form of an IPM program will best achieve the prevention & control of the CWB less damage to the environment with other with IPM as opposed to the traditional farming practices of simply applying chemicals.

(b) Crop: Lettuces, Pest: Sowthistle Aphids

The sowthistle aphid insect, which thrives around the Sowthistle weed, is a major pest to lettuce crops. In the interests of sustainable agriculture, an Integrated Pest Management Program (IPM) has been established for the management of the Sowthistle aphid and its resultant disease, the necrotic yellows virus.

The IPM program for Sowthistle aphids is divided into 5 main areas: ~~chemical~~ chemical, mechanical, biological, & cultural, and management ~~and quarantine~~. These areas contain practices that a farmer can use to manage the Sowthistle aphid.

Chemical:

Chemical management of the Sowthistle aphid is carried out by spraying affected lettuce crops with Pyrethrum insecticide, a chemical derived from the Pyrethrum daisy.

Advantages of Chemical:

* Destroys aphids on crops within a few applications
* Natural chemical, unlikely to cause harm to environment
* Small withholding period, becomes safe quickly

Disadvantages of Chemical:

* Does not take source of aphids into account
* ~~Host~~ Aphid populations will eventually build resistance to the chemical, making it useless

Mechanical:

Mechanical treatment of the Sowthistle aphid involves destroying the source of the pest, the Sowthistle weed. It also involves destroying affected lettuces by hand or ploughing

Advantages of Mechanical:

* Targets the source of the pest, driving aphids elsewhere
* Removes alternative hosts, that is, infected lettuces, so the aphid cannot use those plants as havens

Disadvantages of Mechanical:

* Expensive to production (ie: destruction of viable lettuce plants)
* May not destroy completely the source of the pest
* May drive the pest onto alternate hosts that are still close to lettuce crops

Biological:

Biological treatment of aphids involves finding a predator to the aphid and releasing it onto lettuce crops. Ladybugs are often used as biological control in lettuces

Advantages of Biological:

* No chemicals are being used, hence a "natural" crop
* Won't cause an alternate problem if predator is selected correctly

Disadvantages of Biological:

* Expensive
* Difficult to find and introduce to crop system

Superb!!

Cultural:

Cultural management of Sowthistle aphids involves the planting of a border crop around the lettuces as a barrier to the aphids. An aphid resistant crop is often used

Advantages:

* Aphids won't get to lettuces, they will attack the border crop instead
* No chemicals need be used

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Disadvantages:

* Expensive to set up and maintain
* No guarantee of keeping all aphids out of lettuce crop growing area

Management:

Management practices to combat Sowthistle aphids on lettuces are practices such as good irrigation, maintainence of crop health and soil structure

Advantages:

* Increased productivity due to healthier plants
* Aphids will have a less of a chance to successfully attack the lettuce plants
* An "overall" solution to the problem

Disadvantages:

* No disadvantages

The recommended IPM program for Sowthistle aphids on lettuces, involving chemical, mechanical, biological, cultural and management measures, is effective in destroying and managing the pest, because it takes multiple strategies into account to combat the aphids and does so successfully. as

Question 6.

a) Plant Intereference of Lettuces.

- Competition - plants next to each other will compete for water, nutrients & sunlight. ~~The~~ This includes both weeds & other crops & the extent is determined by planting densities, size → lettuces of reduced size + weight.
- Alternative hosts - when the lettuces aren't growing, sowthistle weeds host breeding populations of aphids which will infect + infest lettuces when they are growing → lettuces of reduced size & quality.
- Allelopathic - thornapples near to lettuces release poisons that can impede upon the growth of the lettuces. wild radish another weed, is also allelopathic → reduced yield/ha as lettuces die + stunted growth.
- ~~Windbreak~~ Environment modification - windbreaks near the lettuces slow windspeeds and reduce air circulation so lettuces are more susceptible to bacterial infections. They also cast shadows over lettuces, reducing the interception of light → reduced quality from disease, reduced size from less light.

Lettuces are ~~of~~ ~~field~~ grown with large planting densities and usually close together. This means the micro-climate around the lettuce could be changed (humidity, wind, light) & result in tropisms - where the lettuce will focus its growth to another area or side if conditions are not favourable. This could result in a reduced

quality product through uneven distribution of growth.

b)

Crop: Lettuce

Disease: Downy Mildew.

IPM strategies include:

Plant genetic modification: grow resistant varieties.

Husbandry techniques - cultural control:

- maintaining crop health
- ~~sa~~ using effective sanitation
- crop rotations

Mechanical control:

- physically removing infected lettuces + weeds

Biological control:

- introduce beneficials to feed on wild lettuce weeds

Sampling + quarantine:

- regular crop checks
- keeping disease out of an area where lettuces are grown

Chemical control:

applying fungicides to control the disease

Points against IPM strategies

- developing resistant varieties can prove costly & time consuming
- maintaining crop health to an optimum often means larger amounts of inputs like water & fertilisers are needed which are expensive.
- There can be problems with run-off from fertiliser applications
- physically removing infected lettuces & lettuce weeds takes time and can be quite difficult - especially if the growing area is too large.
- crop checks take time & farmers may feel it is a waste of time if the area is large. Effective sanitation meaning checking crop harvesters for downy mildew spores & seeds also takes time & effort.
- many farmers do not like change and so will prefer to stick with traditional methods over IPM strategies.
- can be costly and difficult to find introduced beneficials to feed on wild lettuce weeds ✓

Points for IPM. fungicide
- reduces broad spectrum ~~pesticide~~ applications & through a variety of control techniques &
- ~~therefor~~ reduced damage to the environment through risk of fungicide run-off + spray drift, killing wildlife.
- crop checks and sampling mean damage is ~~caught~~ spotted when it begins & before an entire paddock has been effected & ruined
- consumers are now opting for crops with a green image & so IPM with its reduced chemical applications & threats to the environment can apply to this
- effective sanitation like checking equipment for downy mildew seeds & spores minimises disease carry over & ~~can~~ so fewer areas of your farm & others will be effective
- cost effective through fewer chemical applications & fines for damaging the environment
- crop rotations ~~area~~ reduce soil born diseases & so fewer ~~pesticide~~ chemical applications, damage to environment & so more economical once again. The farmer can also make profit on whatever crop & they choose to rotate with the lettuces or through animal production by rotating with pasture
- improved crop yields from reduced disease & therefore greater profit
- it is a sustainable farming practice
- reduced resistance to chemicals

Judgement:

Although Integrated pest management strategies are initially costly ~~through~~ & time consuming through finding other means besides chemical to deal with downy mildew eg resistant lettuce varieties & beneficials to feed on weeds, in the long term it will prove extremely economical & should be a strategy sought by all farmers. Not only will ~~there~~ be lettuces be of better quality and larger ~~to~~ & Therefore bring in greater economic returns, reduced chemical applications and Therefore reduced damage to the environment means IPM is sustainable both economically & environmentally. Continual chemical applications encourage resistance also & so by ~~finding~~ encorporating numerous control techniques this is avoided & money saved on finding new chemicals when old ones no longer work. IPM will save the farmer money & by maintaining production capacities and so it is therefore a very effective strategy ✓

Superb!!

10

Question 7. (15 marks)

(a) Plant breeding systems (or methods of developing superior plants) for agriculture include -

Group A	Group B
* Inbreeding * Crossbreeding inbred lines * Crossbreeding - open pollination * Crossbreeding - wide cross	* Genetic engineering * Tissue culture * Leaf and stem cuttings

Choose one system from group A and one from group B, and compare the genetic basis for plant improvement. (5 marks)

(b) Assess native and introduced pasture species as sources of both feed quantity and quality. (10 marks)

Question 7.

~~(a)~~ crossbreeding -wide crosses

- triticale
- wheat x rye
- ↓ ↓
- prod cold resistance
- pure bred plants
- hybrid vigour
- new gene combinations
- superior to parents.

tissue culture

- genetically identical
- large numbers
- rapid growth
- allows for testing & improvement
- produces one even like
- exact same as parent plants.

a) Plant breeding systems each have advantages in improving the genetic basis of plant crops. Crossbreeding to create wide crosses focus on creating new gene combinations whereas techniques such as tissue culture can rapidly create large numbers of genetically identical plants.

Crossbreeding involves crossing two different plants to create a new variety. ~~This is the~~ To produce wide crosses they are typically plants of different species. The pure bred plants are crossed and

the offspring display superia traits than either parent plant.
This is the result of heterosis or hybrid vigour. The genes from either parent combine, resulting in a plant with new gene combination and different characteristics. Crossbreeding aims to create gene combination that result in increased production (yield) quality, resistance to pest and diseases and improved climatic adaptibility. This is the case in a well known example of wide-crossing, triticale. It is a cross between wheat and rye. The new genes introduced in this species has resulted in an improvement in plant production. The new species displays the high yield of the wheat plant whilst also demonstating the resistance to the cold and hardiness of the rye.
Tissue culture is vastly different to wide-crossing in that it focusses on producing a large number of plants which have the exact genetic makeup of the parent plant. Tissue from the parent plant is taken and grown on an agar medium, thus there is no pollination so no new genes are introduced. It allows large numbers to be grown very rapidly. This assists in testing new plants to determine there suitability. It aims to improve plant production by rapidly testing new varieties for desired traits. It Tissue culture is able to create rapid gains in plant improvement. It also produces a highly uniform line of plants which is highly desirable.

b)	induduced	native
quantity	+ more productive + breeding.	less responds quicker to rain better in drought condition
quality	• increased nutrition + more!	• reasonable nutrition
	• legumes	

b) Native and Introduced pasture species each have advantages and disadvantages when it comes to feed quantity and quality.

Native pastures such as kangaroo grass and mitchell grass provide a reasonable quantity of feed but is less than that of the introduced species. They do however handle the climate much better as they have adapted over many years and respond much quicker to rain following drought then other species. This means that they are able to provide a greater quantity of feed during times of drought but are more vulnerable to overgrazing. Whilst providing a reasonable amount of feed they are insuffient on their own to provide adequate feed for the animal. Native pastures tend to provide plenty of bulk however and are a good source of roughage.

The quality of native pastures is questionable as they tend to have a lower nutritional value then introduced pastures and are less palatable to the animal. They still provide a reasonable level of ~~nutrition~~ nutrition and cannot be disregarded in favour of introduced pastures. Introduced pastures include

many legume species which are much more nutritious and palatable. They are able to provide the animal with a much higher quality of feed from the pasture then most native species are able. This makes Introduced pastures a valuable inclusion. Not only do they increase ~~nutrition~~ to pasture quality but some such as legumes add nitrogen to the soil, further stimulating plant growth.

Introduced pastures also tend to be more productive then native pastures but do require higher levels of inputs to gain this increase in feed quantity. They are often cross-bred species which display hybrid vigour, hence the increased yields of dry matter. They have been specifically bred overseas to suit there environment but can be a costly way to increase pasture quality and quantity as seed may be expensive. They are still however an important source of feed in any pasture.

Both native and introduced ~~pastures~~ species are important sources of feed ~~quality~~ quality and quantity in any pasture. For a pasture to be sustainable it needs to contain both pasture types as the benefits of one make up for the negatives of the other in order to create a valuable source of pasture.

TE

Question 7:

(15)

(a)

Crossbreeding via open pollination and tissue culture make use of different genetic bases in attempts to improve plant production.

Open pollination crossbreeding makes use of naturally crossbreeding plants, which frequently have mechanisms in place to prevent self-pollination. When different plants are bred together, this widens the gene pool, allowing for a greater diversity in plant characteristics and plant performance. This is advantageous because it increases the variety of genetics and capabilities in the plant's genotype, which means that it is not restricted to survival in one environmental location. This is unlike pure bred inbred lines which may survive in one region or area for many generations, and hence finds ~~their~~ homozygous and uniformity to be a benefit.

Plants that are cross bred through open pollination have their pollen transferred by wind or insects. If they are first inbred to achieve a pure line, then deliberately crossed by breeders to produce cross bred offspring, the offspring generally display hybrid vigour, or heterosis, making them superior to their parents.

Tissue culture makes use of a small section of a plant, such as an auxillary bud, that is grown on a sterile agar medium. This produces genetically identical clones that are exactly uniform. This is advantageous because plants that are uniform will generally perform in identical ways in a particular environment. This is of benefit to plant breeders who ~~could~~ can produce large numbers of identical plants from a small section of one plant.

Therefore, crossbred plants make use of a wider gene pool, whereas plants produced from tissue culture rely on the genetic uniformity obtained amongst clones. However, despite this difference, both forms of plant breeding systems use their particular genetic basis in an attempt to improve plant production, appropriate to particular types of plants in particular environmental conditions. 5

(b)

Native and introduced pasture species both present advantages and disadvantages to farmers.

Native pasture species are advantageous because they are highly adapted to the Australian environmental conditions and climatic extremes, such as drought or frost, because originated here. ~~They~~ They are cheaper to afford than introduced species, and require very little inputs, such as fertilizers and water. They also last all year around. They are resistant to pest and diseases.

However, native pastures have the disadvantages of having low feed quality, and low quantity. They produce very little leaf, they are not very palatable, and they are not as nutritious as introduced pasture species. Also, they cannot withstand heavy grazing.

On the other hand, introduced pasture species are very palatable and nutritious, they can be bred to be resistant to certain pests and diseases, and to survive in particular environmental extremes. Their feed quality is very good, and because they can withstand heavy grazing, they are good sources of feed quantity also. Introduced species allow farmers to increase the carrying capacity of their land.

However, the disadvantages of introduced pasture species is that they are expensive. This is because hybrids are usually expensive to produce. Also, introduced pasture species require a great level of inputs, such as fertiliser, since they only thrive on fertile soils, and irrigation, and pesticides, herbicides, etc. Furthermore, introduced pasture species are never as well adapted to the environment or climate as native species.

Therefore, in tems of both feed quality and quantity, introduced pasture species are clearly preferable to native pasture species. However, in terms on sustainable management, which is important to every farmer, it is evident that the farm system must make use of both native and introduced pasture species on different paddocks. This would reduces losses from the disadvantages of one type of pasture species, and native species would be an ideal source of feed in times of environmental extremes such as drought, where highly nutritious feed like introduced pastures would be deficient

10

TE

Question 8. (15 marks)

(a) Describe how organic matter can improve the physical and chemical characteristics of a soil.
(5 marks)

(b) Define "sustainable farming."
Assess the effectiveness of sustainable farming practices that have now been adopted by many farmers.
(10 marks)

(12½)

Question 8.

a) Organic matter is dead matter of plants and animals. It has a negatively charged surface allowing the attachment of cations such as Mg^+, K^+ etc. via adsorption. Thus, it increases the nutrient content (ie fertility) of a soil when added. Also, it has the ability to form bonds between peds due to it's Al^{3+}, Mg^+ & Ca^+ complexes. Thus it has a 'gluey' structure integral in it's ability to form aggregates & peds. This increase pore size assisting in water drainage and soil aeration. Also, it acts as a buffer regulating pH for an optimum environment for plant growth. (4)

b) Sustainable farming is the preservation of a parcel of land so that it can be reused.

Some sustainable farming practices are:

1) No / Minimum Tillage.
2) Incorporating organic matter.
3) Use of drip irrigation.
4) Retention of stubble.
5) Planting of deep rooted trees / plants.
6) Prevent compaction via trampelling.
7) DRY root watering
8) Use of integrated pest management.

ii) Minimum / No Tillage ensures that the topsoil is left undisturbed meaning that peds and aggregates are left in tact. This is a controversial adaption into farms as there are still many farmers who still believe in conventional tillage as the best method. Hence soil structure is preserved leading to less erosion, ~~weather~~ etc. ✓

iii) Incorporating organic matter improves soil structure by forming aggregates and peds due to it's gluey structure. It assists in improving soil aeration and fertility. It is cheap and also acts as a pH buffer so plants have optimal pH conditions. ✓ D.Sadu.

iii) Use of drip irrigation prevents the roots of the plant from being saturated and excess water drainage into the soil and into the water table. This prevents the water table rising and hence soil salinity from occuring. However, the equipment is expensive to install and the ~~relief~~ geography of the land may prevent such a system to be implemented on the farm. ✓

4) Use of retain stubble — reduces erosion by preventing the top soil from being exposed to the to wind and rain. It is also integral in improving structure and as it decays, provides organic matter for the soil. However this means that a farmer cannot immediately plant another crop as must wait.

5) Planting of deep rooted plants will take up any excess water and prevent the water table from rising. This prevents the underground water from bringing up it's soluble nutrients and leaving it on the surface after evaporation. This act method however is time consuming and it's results are not seen until the tree has reached maturity ie time is required for roots to grow.

6) Farmers can fence off an area at a time to prevent compaction of the soil from trampelling of animals. This allows the soil to retain it's structure ie aggregate size and prevent the top soil from being eroded. Also, trampelling also reduce pore size of the soil meaning water logging could occur. Thus, this allows the soil to reform after it has been used. However, this means that animals must be moved from one part of the farm to another which can be time consuming

7) Dry root watering means that water is provided to one side or part of the root system leaving the other side dry. This allows to conservation of precious water. However, when this is done, the plant excrete a hormone to drop ~~them~~ it's leaves due to the extra stress which may decrease ~~of~~ yield. Disadv, cost of initial pipes etc.

8) Using IPM will allow the effective treatment of pests and diseases. It prevents the potential build up of resistance to a particular chemical or pesticide. This is done by using an ~~ver~~ variety of techniques such as husbandary: manual removal of weeds, biological - eg us of the Bt gene in cotton, & use of crop rotation to break that period of infestation, techniques pesticides such as ~~or~~ each chemical & the use of dipel. ~~Thus, by using an IPM strategy~~ However, this may be costly that using just one pesticide.

Thus many sustainable farming practices have been effective in improving the sustainability of the land. Even though there are some disadvantages, the advantages far outweigh these, in that they allow the land to remain be reused for many years to come ✓ 8½

Question 8 (15 marks)

Organic matter is consists of te remains of dead microbes, and is rich in nutrients and minerals. Organic matter will slowly turn to humus after a period of time.

The chemical characteristics of organic matter is one that is important. It's structure is one of a negatively charge colloid, and hence has te following advantages:

1.) Negatively charged allows better holding capability of ions such as Al^{3+}, Na^{+}, K^{+} etc, which thus holds and sustains nutrients in te soil which can readily be supplied to plants.

2.) Te negative charge also holds onto ions and prevents it from leeching away, hence saving te former money and effort for additional fertilisers.

3.) Te organic matter also acts as a buffer, in which it's negative charge, collects H^{+} ions responsible for acidity in soils, and thus it helps reduce acidity.

Te physical character characteristics of organic matter is one that improves it's structure, and has te following advantages:

1.) Te negative charge binds soil peds tageter hence, making colloid particle have larger air spaces, which improve water infiltration and penetration of plant roots.

2.) organic matter supports a larger variety of micro organisms and hence, this improves soil structure, with te abundance of micro-organisms eg - Earth worms.

3.) Organic matter colloids also, ~~are~~ repell each other due to similar charges, hence, aration is improved. Cultivation is a process which results in a decline in this, hence destroying soil structure.

Hence it can be seen that OM. improves te chemical and physical characteristics of soils.

V good Answer (5)

Question 9. (15 marks)

(a) Describe the genetic benefits gained from linebreeding, inbreeding and crossbreeding in animals. (5 marks)

(b) Evaluate THREE management practices that are components of an Integrated Pest Management program for an animal disease you have studied. (10 marks)

Question 9

a) Various genetic benefits are gained from linebreeding, inbreeding and crossbreeding in animals. These genetic benefits will be described ~~below~~ below.

Linebreeding is a system of breeding in which one sire is bred successively down generations. The genetic ~~benefits~~ benefits gained include a uniform line of animals, as well as the offspring inheriting the superior trait off its parent.

Inbreeding refers to mating closely related animals. Its genetic benefits lie in the fact that there is a very limited gene pool. This method produces a highly uniform line of ~~to~~ animals, with offspring inheriting their parents superior genes. This means that superior genes can be bred across the herd.

Crossbreeding involves breeding un-related animals of different breeds. This type of breeding produces a phenomenon called ~~heterosis~~ heterosis, otherwise known as "hybrid vigour," where the ~~offspring~~ offspring show superior performance as compared to their parents. This is a result of the ~~offspring~~ offspring inheriting the best genes from both parents.

b) An Integrated Pest Management program is a holistic approach to pest management, utilising a variety of different strategies to reduce pest numbers and use of chemicals, thereby reducing the impact on the environment. In terms of mastitis, an IPM program may involve the following strategies: chemical, genetic and hygeine.

Chemicals are used in both the prevention and treatment of mastitis. As mastitis results from staph or strep bacteria entering the teat canals, preventative measures to ensure cleanliness of the udder is a prerequisite. This will involve udder teat dipping and wiping to clean the udder and kill bacteria, and needs to be done both before and after milking.

~~Chemicals~~ Chemicals are also used in the treatment of mastitis. Antibiotics or penicillin are directed into the teat canal of already infected cows, in a bid to kill the bacteria & in the teat. Chemicals may be viewed as a quick, effective and cheap method of mastitis control, however, the farmer needs to consider both chemical resistance and effect on milk production.

Chronic cases of mastitis are those cows which fail to respond to treatments. Repeated use of antibiotics may result in a chemical resistance, as the bacteria can adapt to survive and multiply in numbers that greatly overcome the effect of antibiotics. Over time, chemically resistant bacteria may form.

Chemicals may also mean a loss in milk production. Whilst mastitis infected milk may be fed to calves, antibiotic-infected milk must be thrown away, as antibiotic-free milk is a quality criteria in milk production, whilst feeding antibiotic-

infected milk to calves may again result in bacteria over time becoming chemically resistant.

Genetic control is a long-term option in the control of mastitis. Whilst this is not yet possible to breed mastitis-resistant and mastitis-free cows, farmers may breed cows which are less susceptible to mastitis. This may involve breeding cows that do not have long, droopy udders (as these may run across the ground picking up bacteria). Long-term breeding of less susceptible cows certainly is an option to consider, as the cost of maintenance of mastitis control is reducably factored in.

However, while this is a long-term option, genetic breeding of less susceptible cows is a long-term process for long-term results. Results are not obtained quickly, so the farmer must instigate a lot of time and labour into producing these cows.

Hygiene and cleanliness is a must in mastitis control. This method involves the hygiene of the dairy parlor, the milking machine, laneways and paddocks.

The dairy parlour must be kept in hygienic condition. This means cracks in the ground where bacteria can dwell needs to be fixed, milking machine regularly maintained, cups properly washed and replaced if damaged, as well as the personal hygiene of the milker ensured. Lanes and paddocks may need to be cemented, as waste matter in long grass, as well as mud, may surely contain bacteria which can infiltrate the cows udder. It is therefore a requirement that hygiene

is maintained in the cleanliness and maintenance of dairy parlour milking machines and lanes and paddocks. Teat dipping and cooling crops is another factor to consider in hygiene.

Although hygiene is essential, it ~~is often time~~ involves a consistent effort in ~~time~~ time and labour, ~~as~~ as well as cost of maintenance because it involves time and human labour, regulation of hygiene may not always be consistent, as labourers are prone to mistakes. Therefore, it is not always a consistent method.

In evaluating these methods, an I P M programs involves utilising a variety of controls. Any farmer should know that he/she cannot solely rely on one method. All 3 mentions control strategies of chemicals, operator and hygiene need to be utilised to overcome chemical resistance, chemical use and mastitis. ✓ Excellent work. 10

TE

Paper 2

General Instructions:

* Paper 2 should be attempted only by students who have studied the electives
* Reading time - 5 minutes
* **Working time - 1 hour**
* Write using a black or blue pen
* Write your student number at the top of each answer booklet.
* Use a separate answer booklet for each of your two electives
* Extra answer booklets are available

Total marks - 30 marks

* Attempt TWO questions from questions 1 - 6
* Allow about 30 minutes for each question.

Total marks - 30
Attempt TWO questions from Questions 1 - 6
Allow about 30 minutes for each question

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

Question 2 - Animal Management (15 marks)

(a) Describe how objective measurement of animals is a necessary activity if animal productivity is to be improved. (3 marks)

(b) Describe how ONE breeding technique is used to manipulate reproduction in farm animals. (4 marks)

(c) State the aim of one study of a current technique/technology which is advancing productivity in animal production systems.
Outline the findings of this study.
Assess the appropriateness of the methods used to carry out this study. (8 marks)

a) ~~Objective managent is m~~

Objective measurements are measurement ~~made~~ that are ~~not~~ objective. It is ~~not~~ not based on a judgement or observation and can be repeated. ~~For example, if~~ This ensures no bias and it that the measurement is true to the animal. In the Dairy Industry, objective management is used ~~by~~ in the herd recording and ABV's. Herd recording is used to determine the milk production and how it can be improved. It is used as a basis for ABV's and ~~the~~ helps in the farmer ~~in make~~ in decision making. ~~The farmer~~ From these results, the farmer can determine ~~weather~~ whether to cull the cows as the herd recording will indicate if they are producing (low milk) ~~enough~~ low producing in protein or ~~by~~ fat. ~~As~~ As these cows are unproductive, culling them would be more effient to the animal productivity of the farm. Furthermore, it can be used to make decisions ~~of~~ on which cows to select for ET or AI. ABV's are ~~an~~ also ~~asset~~ in the animal productivity as it allows farmer to select a straw of seamen from the cow which has the best animal productivity ~~in~~ terms of milk production (kg / cow), ~~Protein~~ protein and fat production (% / ~~cow~~ L / cow).

b) Artificial Insemination is a breeding technique available to manipulate reproduction in farm animals. Initially the cows may have progesterone implants inserted so that the ovulation of a number of cows may be synchronised. When the implants are removed the cows come on heat ~~and~~ they may be inseminated. This is done by a vet or an experienced technician and involves inserting an AI gun containing

see a straw of semin into the cow and releasing it so that the semen may fertilise the egg that is present. This method means that reproduction may be manipulated so as to produce superior offspring. It controls when the cow comes on heat and that the ~~of~~ egg is fertilised with the appropriate. In this way it gives the farmer the ability to control the reproduction of his herd in order to gain the maximum benefits. By manipulating reproduction in this way it allows for greater farm productivity. Artificial insemination is an effective breeding technique to control and enhance the reproduction of a farm animal. 1/2 1/2

c) Aim: to determine the effect of heifer size at mating and calving on milk production in the first lactation. ✓

This trial carried out in west gippsland Victoria found that if the heifers were suitably grown to conceive at the time of mating then there was minimal impact on milk production during their first lactation. These findings demonstrated that equal feed should be given to both cows and heifers as size has little impact on milk production. 2 ✓ ✓

This trial was carried out in West Gippsland, all farms where in the same area, each group of cows ~~and~~ and heifers were fed the same pasture of crimson clover and perennial ryegrass and where subject to equal management practices. Thus the trial was standardised as much as possible. It was further standardised as the ~~two~~ same two men carried out the measurements at joining and calving and milk production results where collected through objective herd recording.

The trial was replicated using 16 groups of cattle on 16 different farms, each of a similar size. The trial was carried out over two years with consistent findings being made. Thus the trial was

appropriately replicated but perhaps could have been trialled in another area.

There was no need for randomisation as the ~~th~~ entire population of cows and heifers were used in measuring and recording milk production. The mature cows where the control to which the milk production results of the heifers were compared to

The methods used to carry out this trial where appropriate for the situation although some ~~that~~ experimental practices where not as desirable as the could have been. For example head size did vary slightly between farms and it cannot be ensured that all management was exactly the same as different farmers do things slightly differently. Despite these difficulties the way in which this study was carried out was appropriate in the situation.

Question 5 - Plant Management (15 marks)

(a) Describe the process of reproduction in flowering plants. (3 marks)

(b) Roots, stems and leaves are the main organs of plants. Select ONE of these organs, and explain how its cellular anatomy relates to the function of the organ. (4 marks)

(c) State the aim of one study of plant breeding or related research in advancing productivity in plant production.
Outline the findings of this study.
Assess the appropriateness of the methods used to carry out this research. (8 marks)

Question 5: 11/12

(a) Reproduction in flowering plants is a 5 step process: flowering, pollination, fertilisation, fruit forming and germination. Once a plant has flowered, insects or birds will be attracted by the colour and scent of the petals and will become dusted with pollen from the anthers of the flower. This is pollination. When the insect or bird visits a neighbouring flower, some of the pollen on its body adheres to the sticky stigma of the flower. The pollen grain, sustained by the stigma, grows a tube down to an ovule in the ovary and the male ~~gametes~~ nucleus travels through this tube into the ovule, fertilising it. Once fertilised, the flower wilts and dies, and the ovule forms into a seed. The ovary will then become dry and hard or fleshy.

This is the formation of fruit. Animals and birds scatter the seeds by way of eating the fruit, or else the seeds are dispersed in some other ways such as being blown by the wind etc. Once in contact with soil, the seed absorbs water and opens up, releasing a radicle (root), plumule (shoot) and one or two cotyledons (leaves). Sustained by built up nutrients in the seed, the plumule breaks the surface of the soil, called germination. The radicle produces more roots through cell division and the cotyledons open and photo-synthesis begins.

(b) Leaves:

Leaves are made up of many different parts. The outside layer ~~(epidermis)~~ is made up of ~~a~~ ~~waxy~~ clear waxy cuticle and then an epidermis. The waxy cuticle provides protection to the plant and is clear to allow sunlight to travel through it to reach chloroplasts located further within the leaf. The epidermal layer is made up of tightly packed cells which protect the leaf by not allowing the entry of harmful pathogens.

The mesophyll is made up of 2 layers — palisade layer + ~~sponge~~ spongy layer.

The palisade layer is made up of cylindrical shaped cells containing chloroplasts which adjust themselves to ~~increase~~ maximise the amount of light they receive.

The spongy mesophyll is far more spread out to allow air flow between the cells linking them to the stomata.

The veins in the leaf are strong structure which provide support to the leaves + maintain their shape.

Inside the veins is phloem + xylem which transport nutrients and water between the cells and the roots.

The stomata in the leaves are mainly located on the underside of the leaf and open and close in response to the amount of water loss required. Being on the underside of the leaf means they don't loose as much water through transpiration.

Roots

- root hairs are very closely & densely positioned to massively increase the surface area of the root system to absorb water & nutrients.
- large surface area of the root hairs allows the particles to anchor the root more firmly to the ground.
- epidermis is without a waxy cuticle to allow it to absorb water & nutrients
- cortex - cortical cells are thin walled & large & expand and fill readily with food to store the products of photosynthesis

(c) Study: Scion-rootstock lemon trial in Arizona.

Aim: To determine which scion-rootstock combination is best for the Arizona growing area in terms of yield, adaptability and vigour.

Findings: It was found that:

- There was no statistically significant difference between the 5 combinations in terms of fruit quality
- Yield was highest in the macrophyll-lisbon rootstock-scion combination and lowest in the marriza-lisbon combination

c) aim: determine which rootstock-scion combination produced the best features eg. growth, yield to provide the feundation for the lemon growing industry in arizona.

Findings

- no statistical difference in fruit quality for any of the root-stock scion combinations
- macrophylla-lisbon had the best ~~quality~~ yield
- carrizo-lisbon had the lowest yield
- Fruits were tested for juice pH, peel thickness, brix %, size, blemishes

Methods

~~stand~~ no control → lemons had not been grown previously in the area

standardisation → site was laser levelled,

- 10×10m spacings between each row and tree
- all trees were subjected to the same soil eg. fertility, structure, infiltration
- ~~watering was~~ trees were irrigated at the same time at the same rate
- all trees were subjected to equal fertiliser rates (NPK) and pruning

randomisation

- 'a complete randomised block' was used with treatments randomly allocated within each row.

replication

- 10 trees of each rootstock-scion combination (1/row)

advantages

- standardisation eg. laser leveling & equal spacing was appropriate to as there all the results were solely attributable to the treatments
- randomisation

use of a randomised complete block reduces the impact of bias in the allocation & sampling

- replication

the 10 rootstock-scion combinations were appropriate as it reduced the impact of chance or random errors and made the trial more valid

disadvantages

- no control - although lemon trees had not previously been grown in the area, the researchers could have compared their results to a successful rootstock-scion combination in a similar area. A control is vital in determining the validity of the results, it indicates the impact of the treatment being tested.
- not enough replication → 20 trees of each rootstock-scion combination should've been grown to increase the reliability of the experiment & reduce the influence of random errors on the results
- long term comparison - to more effectively determine the best rootstock-scion combination the productivity levels (eg. size and yield) should've been tested

over a period of say 15 years.
- to further increase the appropriateness of the methods ~~the 2 different types of roots~~ and to determine the optimum combination greater varieties of rootstocks should have been tested 5

judgement 5

The methods used, despite the use of no control were very appropriate, particularly with reference to the ~~heavy~~ ~~data~~ extensive use of standardisation and the use of a randomised block. However, the methods could've been more appropriate through greater research & replication

Question 6 - Sustainable Land and Resource Management (15 marks)

(a) Describe how an Australian land capabilities system can be applied to ensure sustainable land use. (3 marks)

(b) Describe the farming practices that produce acidified soils. (4 marks)

(c) Describe ONE study of an innovative technology or practice that assists with the conservation and efficient use of water in agricultural production systems.
Outline the findings or results of the study.
Describe the method(s) that was used to present the data. (8 marks)

(a) Australian land capabilities provide simple criteria to place types of land in groupings according to the lay of the land. Group 1 indicates a highly productive, fertile soil which does not need to employ sustainable practices The higher the grouping, the less productive the land is & the greater the sustainable practices that must be used to manage, maintain & restore the land. Each category suggests the sustainable practices that should be used & the best enterprises for the farm For example, Hurlstone is a group IV land capability, due to its gentry undulating hilly slopes & few occasional low valleys. As a result of this land capability assesment, it is known that it is suited to animal grazing (dairy) & the growing of occasional fodder crops (oats for winter & sudax for summer) It also indicates that the farm should (& does) use minimal tillage, pasture mulching & soil aeration to ensure sustainable land use. This increases the sustainability & productivity of the farm (3)

(a)

An Australian land capabilities system is designed to assist farmers in deciding the best way in which to use their land in a sustainable manner. Sustainability in agriculture requires that not only is adequate productivity is maintained and profits earned, but also that resources such as the land and the environment is maintained and conserved so that it can remain productive and useful over a long term period of time.

Certain types of land are suitable for certain types of agricultural production. This is mostly related to the slope of the land (though not restricted to.)

Land capability classification systems use either 5 classes or 8 classes to decribe the type of agricultheral production suitable for a particular type of land in order to ensure sustainability is maintained. Farmers can use a land capability assessment system to classify their land, and determine what forms of agriculture are appropate.

Famers should not extend beyond the capablity of a particular area of land by perfoming agricultheral practices that the land cannot support. By exceeding the capability of the land, sustainable land use is no longer being ensured, and long degradation such as soil erosion can occur. Farmers should match up their various ag. production systems with sections of their land that is capable of supporting it, in order to maintain sustainability. For instance, Class 1 land has very little restrictions on use, however Class 4 land either above ground or sub-surface level dippers. This formation of irrigation was maintained for roughly two weeks, and then the irrigation swapped to the other half of the root system. This cycle was maintained/continued thraghout the entire season.

* The effect of drying half the rootzone of the grape veines was to trick the plant in responding to water stress. A chemical response was generated in the roots, and absicsic acid (ABA) produced in the leaves as a result, which encouraged the partial stomatal closing in the leaves, as well as reduced canopy leaf vigour. This prompted the grape vines into using water more efficiently, as well as displaying many of the positive responses to water stress, such as improved fruit quality — this was a side affect unexpected by the researchers, Loveys et al. However, it has contributed in making PRD a very positive technique that holds much potential, not only for grape varieties, but also for other horticultural crops such as oranges and pears.

~~But~~ Because one half of the rootzone is still irrigated continually, the plants did not actually suffer reduced yield or production or quality.

Loveys et. al. found that, with the PRD technique, water usage was cared by up to 40-60%. Crop yield was maintained without significant losses. Meanwhile aspects of fruit quality such as colour, acidity and brench size were markedly improved. Shoot growth was also significantly reduced, which is a beneficial result of PRD because it reduces ~~to~~ the size of the canopy, which allows more sunlight to reach the crop and increase photosynthesis.

Because of current drought conditions throughout Australia, the cost should be limited to grazing, and have soil conservation practices on it, such as contour banks to prevent water run off. outstanding. (3)

(b)

There are a number of farming practices that produce acidified soils.

A major cause is the inappropriate use of nitrogenous fertilisers, such as sulfate of ammonia, NPK, and urea. This causes soil acidification when ~~&~~ an excess of nitrates are available in the soil, more than the plants require for use. In this case, instead of nitrates being taken up by plant roots, they are unused, and are leached out of the soil.

The result of this is that hydrogen ions are left behind in the soil in an excess ratio. Excess hydrogen ions in the soil is what causes soil acidification.

Another cause of soil acidification is the introduction of legumes into the crop and pasture rotation. Generally, the introduction of nodulating legumes is beneficial, because they convert nitrogen into an available

form for plant use. But similarly to the above scenario, if excess nitrates exist in the soil, they will be leached out, and leave the soil in a more acidified state than before.

A ~~Foo~~ third farming practice that produces acidified soils is the accumulation of organic matter in the topsoil over many years of farming. Organic matter provides many benefits to the soil, but one disadvantage is that when it decomposes, it produces weak organic acids that can contribute to an already acid soil and reduce the pH even further. This is why soil acidification has gradually increased over the years, in correspondance with OM accumulation.

A fourth farming practice that can lead to acidified soils is the removal of hay from a pasture paddock. ~~Hay~~ Many agricultural products such as hay are slightly alkaline, and their presence can alleviate a soil acidification problem. However, when they are removed, the acid soil is left behind with no basic products to balance out the low pH of the soil, and this aggravates the problem. Hay cutting in particular is a common major agricultural process that causes soil acidity.

There are other farming practices, such as superphosphate fertiliser application that can encourage the growth of legumes, or the build up of effluent wastes in a dairy, both of which ~~are~~ contribute to soil acidification. But the above 4 practices discussed are the major ones. outstanding. ~~4~~ (4)

(c)

1996 originally started, later revised 2000

The Partial Rootzone Drying (PRD) Trial conducted in Victoria, Australia seeks to assist farmers in the conservation of water, and in improving water use efficiency in plant agricultural production systems.

The trial was orignally developed as an attempt to reduce grape vine canopy vigour, however its ability to improve water use efficiency has been much more significant.

The PRD trial was undertaken on grape vines with split-root systems. By separating each half of the root systems of vines in separate pots, one half was kept dry, whilst the other was drip irrigated, using of irrigation water is increasing. Hence, this PRD technique holds a great deal of potential for horticulturals and farmers also over NSW and Australia. Because it improves water use efficiency by up to 50%, it would be very useful for farmers in reducing costs and hopefully increasing profits, because less water would be needed. Furthermore, the saving of water is a major current issue, and the value of water has been made very clear to Australians all over due to the drought. The ability of PRD to save water up to 50% is a great benefit, not only to farmers, but to the environment.

The results of the PRD Trial were presented in tabulated form. This was a simple, straightforward method of data presentation adopted by Loveys et al. In the table, the values/results obtained in the Control and in the Treatments were clearly compared. Very significant differences in values between the control and the treatment samples were identified further with asterisks, to emphasise the positive findings of the PRD Trial.

Variables were clearly listed in the table to show the improvements in fruit quality and water use efficiency achieved.

Perhaps Loveys et al. could also have produced a graph to present their data, which would have had the advantage of providing a visual comparison of results, that could be evident at a quick glance. However, graphs were not really necessary, and the method of tabulation sufficed.