Sample Investigation Plan – Marked Version

This document includes a marked example of the type of investigation plan that might be submitted in response to the specimen assessment materials provided for Unit 4. The type of mark scheme used for the planning exercise is set out on this page.

The marking points **A** to **X** are based on the marking criteria stated on page 3 of the examination booklet.

Marking Point	Marking criteria	Mark
A √	easily recognised safety procedures highlighted;	1
B √	prediction made;	1
C √	with justification;	1
D √	description of preliminary work;	1
E √	clear and in detail;	1
F ***x***	reasons explained;	1
G ***x***	clear and in detail;	1
H ***x***	at least *two* secondary sources of information identified;	1
I √	relevance explained;	1
J √	basic practical skills and accuracy;	1
K ***x***	sound practical skills and accuracy;	1
L √	range of appropriate equipment listed;	1
M √	full range of appropriate equipment listed;	1
N √	appropriate number of measurements stated;	1
O √	need for range of measurements stated;	1
P √	appropriate range stated;	1
Q √	relevant variables are identified;	1
R √	how variables to be controlled explained;	1
S √	one suitable method to display data;	1
T √	additional method to display data;	1
U √	simple data handling;	1
V ***x***	possible conclusions;	1
W ***x***	recognises sources of error;	1
X ***x***	suggests methods for improving accuracy and/or validity;	1
Marks available:		**24**

Point mark up to 24 by placing letters **A** to **X** in the margin at appropriate points. Then award 1 mark for use of scientific terminology. **Total marks available: 25**

SAMPLE WORK

Investigation into the salt tolerance of a variety of potato crop called ‘white rose’.

When performing experiments safety is an important issue
Risk assessment:
Keep bags and coats away from working area
Goggles to be worn to protect the eyes from any splashing solutions
All glass ware to be handled with care and any breakages to be cleared up safely and quickly and disposed of in the correct place.
Keep all equipment away from the edge of the bench while setting up and in a safe place away from others who may knock into it while it is not being used.

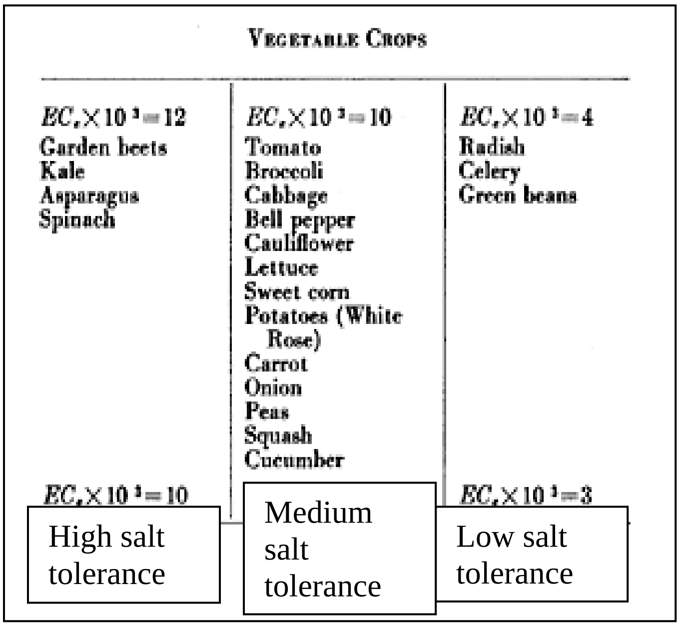
Definition of salt tolerance:
The threshold of plant salt tolerance refers to the smallest salt content of the soil, which causes the decrease of crop yield.

The salt tolerance of a crop may be appraised according to three criteria:

- **Ability** of the crop to survive on saline soils,
- **Yield** of the crop on saline soils,
- **Relative yield** of the crop on a saline soil as compared with its yield on a non-saline soil under similar growing conditions.

Earth is a salty planet, with most of its water containing about 30 g of sodium chloride per litre. This salt solution has affected, and continues to affect, the land on which crops are, or might be, grown. It is known that most plants, and certainly most of our crop plants, will not grow in high concentrations of salt. Consequently, salinity is a threat to food supply.

www.lifesci.sussex.ac.uk/teaching/biology/ cws/pfe/restricted/pfe10.pdf


VEGETABLE CROPS

$EC_e \times 10^3 = 12$	$EC_e \times 10^3 = 10$	$EC_e \times 10^3 = 4$
Garden beets Kale Asparagus Spinach	Tomato Broccoli Cabbage Bell pepper Cauliflower Lettuce Sweet corn Potatoes (White Rose) Carrot Onion Peas Squash Cucumber	Radish Celery Green beans
$EC_e \times 10^3 = 10$		$EC_e \times 10^3 = 3$
High salt tolerance	Medium salt tolerance	Low salt tolerance

EC, values given at the top of a column represent the salinity level at which a 50percent decrease in yield may be expected as compared to yields on non-saline soil under comparable growing conditions.

For example, for crops with medium salt tolerance in the division of vegetable crops, EC, values of 10 mmhos/cm. occur at the top of the column and 4 mmhos/cm. at the bottom. This indicates that crops near the top of this column will produce about 50 percent as well on a soil having an EC, of 10 mmhos/cm. as on a nonsaline soil under similar conditions, and crops near the bottom of this column will produce about 50 percent as well on soils having an EC, of 4 mmhos/cm. as on a nonsaline soil. The variety of crop we are concerned with in this investigation the White Rose potato is situated in about the middle of this column.

In applying the information in the table, it is important to remember that climatic conditions such as gaseous pollutants, soil fertility, drainage, temperature, light flux density and transpirational water loss, may influence profoundly the reaction of plants to salinity. In

addition evaluating tolerance is made more complex by variation in sensitivity to salt during the life cycle. The position of each crop in this table reflects its relative salt tolerance under management practices that are customarily employed when this crop is grown under irrigation agriculture and not the inherent physiological ability of the crop to withstand salinity under some given set of conditions that is uniform for all crops.
www.lifesci.sussex.ac.uk/teaching/biology/ cws/pfe/restricted/pfe10.pdf

Prediction:
The higher the salt concentration the lower the crop survival therefore the lower the yield and the lower the relative yield as compared to the non-saline soil.
Why?
Due to the reduced ability of the crop roots to take up water by osmosis.
$\psi = \psi s + \psi p$
ψ = water potential
ψs = solute potential
ψp = pressure potential
ψ is always negative. Water will always move to an area which is more negative than the one it is in. Solutes make the ψ more negative so increasing the solute concentration of a solution will cause more water to move into it by osmosis.
Therefore if the salt concentration of the water outside the root is lower than the salt concentration inside the root the water will move into the plant root cells to attempt to achieve equilibrium. In the same way if the salt concentration of the water outside the root is higher (more concentrated) than inside, water will move out of the plant. If however the salt concentration is the same inside and outside the root then there will be no net movement of water.

Method
Aim; to asses the growth of potato crop White rose in relation to;
- **Ability** of the crop to survive on saline soils,
- **Yield** of the crop on saline soils,
- **Relative yield** of the crop on a saline soil as compared with its yield on a non-saline soil under similar growing conditions.

Controlled variables;	Temperature	
(Must be kept the	Light	all trays to be placed in same place
same to prevent	Heat	
them from affecting	Water available amount and type will be the same	
the results)	Starting point of potato crop i.e. seeds	
	Soil from same type and batch	
	Distance of seeds from one another measured	

Variable; salt concentration

Experiment:
Equipment
White rose potato seeds x60
Soil same batch and type assume no salt in this soil or equal amounts will end up in each of the growing trays
Salt
Transparent growing trays x6
Scoop for the soil
Weighting scales
Water measuring jug
Ruler

Diagram

[The candidate did not provide a diagram]

Preliminary work
Measure out 400g of soil into the growing tray add 100ml of distilled water at a time at 60sec intervals until the soil is saturated (until the first water is seen at the bottom of the tray) record this amount.
Assume is = 400ml distilled water
In the main experiment you will need to add the same volume again to maintain saturation of the soil at 96 hour (four days) intervals.

1. Measure out the 400g of soil into each of the growing trays (x6) and label 0 - 5
2. Measure out the salt on the scales;
   1g, 2g, 3g, 4g and 5g
3. Bring to the distilled water to the boil) this means that when the salt is added it will be in solution). Measure out 400ml into 6 measuring jugs.
4. Place each weight of salt into different measuring jugs and stir until salt is dissolved. Calculate and record the concentrations g/ml.
5. Allow to cool to room temp before adding to the soil.
6. Add the saline solution to the appropriate growing tray. E.g. No salt into tray 0, 1g of salt into tray 1 etc
7. Place all growing trays on the same window ledge (same light, temp, heat, air etc).
8. Place 10 seeds into each tray 3cm apart and 2cm deep (two lines of 5) and cover each seed with the soil around it.
9. leave and re water every four days.
10. at two weeks post planting record the lengths in mm of the visible plant above the soil.

    1. Ability to survive and grow
    Measure each plant in the tray and then calculate the mean height per tray.
    Mean = $\frac{\text{height of each planted added together}}{\text{Number of plants}}$
    Repeat at weekly intervals until 6 weeks has elapsed. Plot the mean results on a suitable graph

    2. Yield and Relative yield
    How many plants have grown in each tray? Compare each salt containing tray to each other and to the non-saline tray. Record the number each week. Plot results on a suitable graph graph.

Results

	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
Concentration of salt (g/ml)						

Week 1 heights (mm)

plant	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Week 2 heights(mm)

plant	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Week 3 heights (mm)

plant	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Week 4 heights (mm)

plant	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Week 5 heights (mm)

plant	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Week 6 heights (mm)

plant	Tray 0	Tray 1	Tray 2	Tray 3	Tray 4	Tray 5
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Mean height of plants (mm)

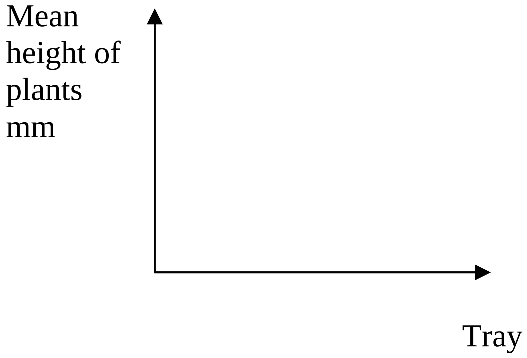
Tray	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
0						
1						
2						
3						
4						
5						

Number of plants survived

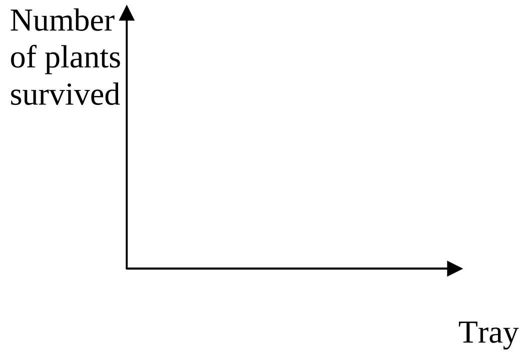
Tray	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
0						
1						
2						
3						
4						
5						

Graphs

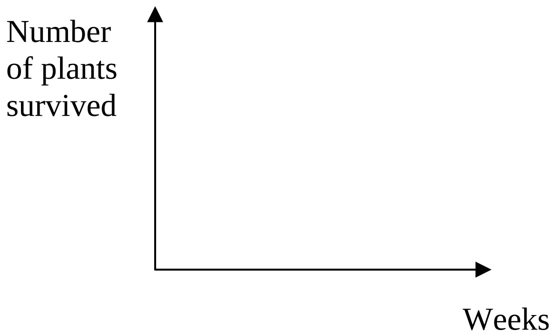
1. Ability to grow



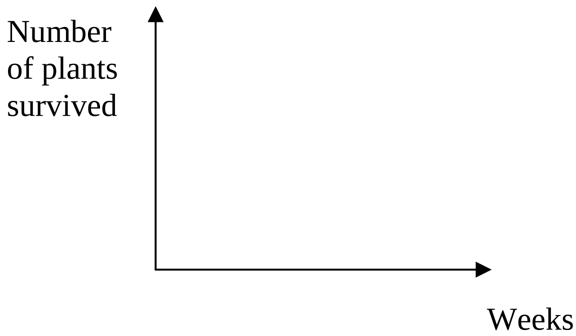
2. Yield and Relative yield overall



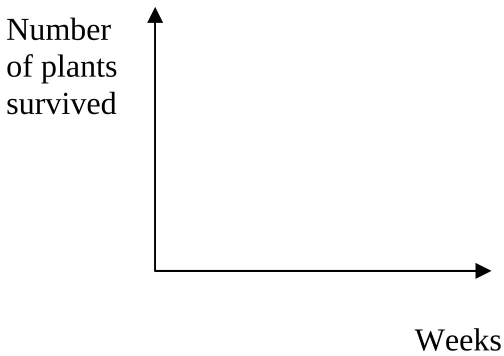
Tray 0



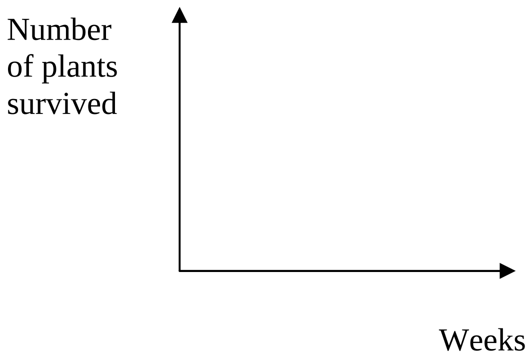
Tray 1



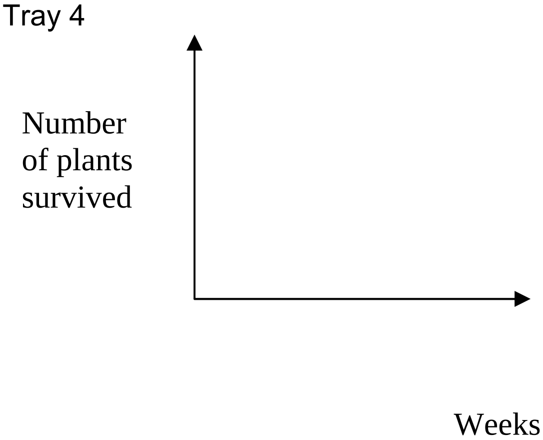
Tray 2



Tray 3



Tray 4



Tray 5