Including examiner comments

R2102

PLANT NUTRITION & THE ROOT ENVIRONMENT

Level 2

Monday 19 June 2023

11:20 – 12:10

Written Examination

Candidate Number: .....

Candidate Name: .....

Centre Name: .....

IMPORTANT – Please read carefully before commencing:

i) The duration of this paper is **50** minutes;
ii) **ALL** questions should be attempted;
iii) **EACH** question carries **10 marks**;
iv) Write your answers legibly in the spaces provided. It is **NOT** necessary that all lined space is used in answering the questions;
v) Use **METRIC** measurements only;
vi) Use black or blue ink only. Pencil can be used for drawing purposes only. Ensure that all diagrams are labelled accurately with the line touching the named object;
vii) Where plant names are required, they should include genus, species and where appropriate, cultivar;
viii) Where a question requires a specific number of answers; only the first answers given that meet the question requirement will be accepted, regardless of the number of answers offered;
ix) Please note, when the word **'distinct'** is used within a question, it means that the items have different characteristics or features.

Ofqual Unit Code R/505/2834

Please turn over/…..

ANSWER ALL QUESTIONS

MARKS

Q1 a) State **THREE** benefits of using organic matter in the soil. **3**

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b) Describe how to produce bulky organic matter in a garden for use as a soil improver. **7**

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Total Mark

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MARKS

Q2 a) State **FOUR** characteristics of soil that affect its fertility. **4**

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b) State the differences between the soil types shown in the table below:

	Top soil	**Subsoil**	
Organic matter content			**1**
Pore space/aeration			**1**
Water content			**1**
Colour of soil			**1**
Nutritional content			**1**
Presence of roots			**1**

Total Mark

Please turn over/…..

MARKS

Q3 a) State why a pH of 6.5 is suitable for the growth of a wide range of garden plants. **4**

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b) Identify **TWO** materials to lower soil pH, and **TWO** materials to increase soil pH from the 10 materials in the following list by completing the table below: **4**

ammonium sulphate	wood ash
ground limestone	ferrous sulphate
elemental sulphur	ground chalk
peat	magnesium limestone
pine needles	ground eggshells

Materials to lower soil pH	**Materials to raise soil pH**

c) Name **TWO** distinct plants suitable for a neutral soil pH. **2**

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Total Mark

Please see over/…..

MARKS

Q4 a) Name appropriate examples for each of the following types of plant nutrients:

THREE major plant nutrients: **3**

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2.....

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3.....

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ONE minor plant nutrient: **1**

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b) Identify a nutrient deficiency for the following plant symptoms by completing the table below: **4**

	Nutrient lacking
Stunted yellowing growth	
Flowering and fruit sparse	
Chlorosis/chlorophyll production affected	
Inhibited shoot growth, leaves dark	

c) Name **TWO** organic sources of plant nutrients. **2**

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Total Mark

Please turn over/…..

MARKS

Q5 Describe how **EACH** of the following can affect the root environment:

i) single digging **2**
ii) rotary cultivation **2**
iii) raking **2**
iv) no-dig method **2**
v) bed systems **2**

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Total Mark

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MARKS

Q6 a) Define 'field capacity'. **3**

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b) Describe how to maintain suitable water content in growing media for container plants. **5**

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c) List **TWO** methods of maintaining the nutrient levels of a container grown plant. **2**

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Total Mark

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The Royal Horticultural Society, Wisley, Woking, Surrey GU23 6QB.
Charity Registration Number: 222879/SC038262

R2102

PLANT NUTRITION & THE ROOT ENVIRONMENT

Level 2

Monday 19 June 2023

Candidates Registered	**283**		**Total Candidates Passed**	218	84%
Candidates Entered	259	91%	Passed with Commendation	75	29%
Candidates Absent/Withdrawn	22	8%	Passed	143	55%
Candidates Deferred	2	1%	Failed	41	16%

Senior Examiner's Comments:

1 Candidates should be able to demonstrate a good range of plant knowledge and be able to give accurately named plant examples where appropriate. Common names and generic names are often too vague and cannot be rewarded in the positive manner that genus, species and where appropriate, variety/cultivar can. This is particularly important when answering questions relating to particular (named) plant(s). Marks can only be awarded for these narratives where the example(s) are correctly and fully identified.

2 Candidates must be able to display accurate knowledge of the technical terms and concepts detailed in the syllabus, in the context of horticulture and also be aware that wider interpretation will not be rewarded. The examination should be regarded as a possible introduction to higher level studies, which will only be open to those who are in possession of a clear understanding of the horticultural terms and concepts which are current.

3 The introductory rubric given on the first page of each question paper should be read carefully by candidates. At each examination there are a significant number of candidates who ignore or misread the instructions given and consequently may not perform as well as they could have done.

4 Candidates should pace themselves during each paper. The most successful candidates allow sufficient time to read the question thoroughly before answering it and also take time to read through their answers. They should take care to write as legibly as possible, so that the examiner is in no doubt about what is intended.

5 Candidates need to interpret key words within questions, particularly those such as 'state', 'list' and 'describe'. Questions requiring descriptions or explanations obviously require a more detailed answer than those requiring a list.

6 It is important to ensure that responses to questions are to the point. Candidates should bear in mind that small sketches might be used to convey information more succinctly than words.

7 Successful candidates ensure that their answers are focused and to the point. It is disappointing when they cannot be rewarded for their efforts because the answer is irrelevant to the particular question. Candidates should take note of the mark allocation for specific sections and allocate their time and efforts accordingly.

8 Diagrams can enhance an answer and where appropriate can replace detailed descriptions. They should be large, clear and well annotated, ensuring that labels are properly attached to the features they describe. Diagrams should preferably be in pencil. Colour may be used successfully but only where it is relevant to the answer.

9 In each examination it is clear that some candidates are ill prepared to answer papers of the type set. It is essential that candidates have the opportunity to practice questions. Ideally some papers should be answered in a time constrained situation. Appropriate feedback must, in any case be provided.

Q1 a) State **THREE** benefits of using organic matter in the soil.

b) Describe how to produce bulky organic matter in a garden for use as a soil improver.

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Q1 a) Candidates who provided qualified statements of the benefits of using organic matter in the soil gained full marks. Acceptable answers included:

- organic matter provides some nutrients at a rate that the plant can use
- organic matter aids water retention in sandy soils
- organic matter reduces evaporation if used as a mulch on the surface of the soil
- organic matter increases air filled porosity (AFP) in heavy soil
- organic matter will supress weeds if used as a mulch on the surface of the soil.

b) Good descriptions of how to produce bulky organic matter in a garden were provided by most candidates who achieved maximum marks. Suitable answers included:

A container/bin made from wooden slats or recycled plastic which has ventilation in the sides and a lid to keep excess rain out and heat in, is required. The bin should be sited in an area of the garden which is away from full sun. Materials used should be shredded to increase their surface area and placed in 15cm layers in the bin. These materials can include green kitchen waste, grass clippings, foliage, small twigs, cardboard etc. at a ratio of carbon:nitrogen of 15-30:1. The contents of the bin should be watered if they become dry and turned regularly to ensure that there is adequate oxygen present for the micro-organisms.
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Q2 a) State **FOUR** characteristics of soil that affect its fertility.

b) State the differences between the soil types shown in the table below:

	Top soil	**Subsoil**
Organic matter content		
Pore space/aeration		
Water content		
Colour of soil		
Nutritional content		
Presence of roots		

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Q2 a) A range of characteristics of soil that affect its fertility were provided by the best candidates who were awarded full marks. These included:

- soil structure
- soil texture
- organic matter content (living or dead)
- air/water content
- compaction/surface capping
- waterlogging/high water table
- mineral availability

b) The majority of candidates were able to provide the differences between specific soil types and gained full marks. Suitable answers included:

	Top soil	**Subsoil**
Organic matter content	**High**	**Low**
Pore space/aeration	**High**	**Low**
Water content	**High**	**Low**
Colour of soil	**Dark in colour**	**Lighter in colour**
Nutritional content	**Most nutrients in topsoil**	**Few nutrients in subsoil**
Presence of roots	**Main root zone**	**Only where deeply rooted plants are present**
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Q3 a) State why a pH of 6.5 is suitable for the growth of a wide range of garden plants.

b) Identify **TWO** materials to lower soil pH, and **TWO** materials to increase soil pH from the 10 materials in the following list by completing the table below:

ammonium sulphate	wood ash
ground limestone	ferrous sulphate
elemental sulphur	ground chalk
peat	magnesium limestone
pine needles	ground eggshells

Materials to lower soil pH	**Materials to raise soil pH**

c) Name **TWO** distinct plants suitable for a neutral soil pH.

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Q3 a) Maximum marks were achieved by candidates who were able to state why a pH of 6.5 is suitable for the growth of a wide range of garden plants. Acceptable answers included:

- soil pH affects the solubility of nutrients
- nutrients need to be dissolved in water before a plant can use them
- a pH of 6.5 is where most minerals are available
- soils with a pH of 4-5 can contain high levels of aluminium, iron and manganese which can be toxic to plants
- very alkaline soils lead to micro-nutrients not being available
- soil pH affects the presence of micro-organisms. There are less bacteria at low pH resulting in a reduction in the breakdown of organic matter.

b) Candidates who had a good understanding of soil pH were able to identify materials suitable to lower and increase soil pH and were awarded full marks. These included:

Lower soil pH – peat, ammonium sulphate, ferrous sulphate, elemental sulphur, pine needles.

Increase soil pH – ground limestone, ground eggshells, wood ash, ground chalk, magnesium limestone.

c) Most candidates were able to name a range of plants suitable for a neutral soil pH and achieved maximum marks. These included:
Bergenia cordifolia, Prunus avium, Hosta sieboldii.
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Q4 a) Name appropriate examples for each of the following types of plant nutrients:

THREE major plant nutrients:

ONE minor plant nutrient:

b) Identify a nutrient deficiency for the following plant symptoms by completing the table below:

	Nutrient lacking
Stunted yellowing growth	
Flowering and fruit sparse	
Chlorosis/chlorophyll production affected	
Inhibited shoot growth, leaves dark	

c) Name **TWO** organic sources of plant nutrients.

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Q4 a) A range of appropriate examples of specific types of plant nutrients were named by the majority of candidates who gained full marks. Suitable answers included:

THREE major plant nutrients:

1. Nitrogen
2. Phosphorus
3. Potassium

Magnesium and calcium were also accepted.

ONE minor plant nutrient:

1. Iron

Boron, manganese and copper were also accepted.
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b) The best candidates were able to identify a nutrient deficiency for specific plant symptoms and were awarded full marks. Suitable answers included:

	Nutrient lacking
Stunted yellowing growth	Nitrogen
Flowering and fruit sparse	Potassium
Chlorosis/chlorophyll production affected	Iron, magnesium, nitrogen
Inhibited shoot growth, leaves dark	Phosphorus

c) A range of organic sources of plant nutrients were provided by the majority of candidates who achieved maximum marks. These included:

- fertilisers of organic origin e.g. Blood Fish and Bone, Bonemeal, Comfrey, Seaweed Extract
- bulky organic sources e.g. garden compost, well-rotted farm yard manure, municipal compost.

Q5 Describe how **EACH** of the following can affect the root environment:

i) single digging
ii) rotary cultivation
iii) raking
iv) no-dig method
v) bed systems

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Q5 Good descriptions of specific soil management techniques were provided by many candidates who gained full marks. Acceptable answers included:

i) **single digging** – breaks up clods, relieves compaction and improves aeration of the soil. It also breaks up surface capping and enables weeds and other plant debris to be buried. Single digging makes the soil more friable and creates smaller particles for root penetration.

ii) **rotary cultivation** – tends to be carried out to the same depth all the time which can lead to soil compaction. It produces a fine/fluffy tilth which enables root penetration but can also damage the structure of the soil.

iii) **raking** – is carried out to remove stones/lumps of soil/dead plant material etc. to enable the roots of seedlings to penetrate more easily. Raking is also carried out to level the soil and to produce a fine tilth prior to seed sowing or planting.

iv) **no-dig method** – requires a depth of 10-30cm of organic matter which is broken down by soil macro and micro-organisms to create tunnels and pore space for root penetration and air. It is necessary to add 5cm of organic matter every year to maintain this environment for plant roots. Surface weeds must be removed by hand or shallow hoeing to avoid disturbance to plant roots.

v) **bed systems** – these include raised beds which provide improved drainage and aeration of the root environment. They can be used to introduce a new soil type to a garden, warm up more quickly and drain better. Bed systems are generally not walked on which ensures that the root zone is not compacted.
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Q6 a) Define 'field capacity'.

b) Describe how to maintain suitable water content in growing media for container plants.

c) List **TWO** methods of maintaining the nutrient levels of a container grown plant.

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Q6 a) Suitable definitions were provided by candidates who had a clear understanding of the term 'field capacity' and were awarded full marks. These included:

Field capacity is when drainage water has been lost over a 24-48 hour period from a saturated soil, but before it has evaporated. Water will be present in the micropores (which is unavailable to plants), and the mesopores and air fills the macropores.

b) Many candidates were able to describe how to maintain suitable water content in growing media for container plants and achieved maximum marks. These included:

A suitable water content can be maintained in growing media by ensuring that the growing media is water retentive but free draining. This can be achieved by ensuring that the correct growing media is selected for specific plants e.g. a gritty growing media for cacti or incorporating perlite, coarse sand/ fine grit or water retaining gel into the growing media. An organic or inorganic mulch can be applied to the surface of the growing media in containers which will retain moisture. Watering at the correct time i.e. at specific intervals depending on the climate is important and can be carried out using a watering can or trickle/drip irrigation which is controlled by an automatic timer.

c) A range of suitable methods to maintain the nutrient levels of a container grown plant were provided by the best candidates who gained full marks. These included:

- use of controlled release fertilisers at the beginning of the season
- periodic use of liquid fertilisers throughout the growing season
- top dress larger plants in spring by removing growing media from around the plant and replacing it with fresh growing media containing nutrients
- use of a specific growing media if a nutrient deficiency is identified.

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