



R2102

PLANT NUTRITION & THE ROOT ENVIRONMENT

Level 2

Monday 6 February 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.

ANSWER ALL QUESTIONS

MARKS

Q1 a) Describe **TWO** symptoms of deficiency for **EACH** of the following nutrients:

- i) nitrogen
- ii) calcium
- iii) iron

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b) Describe **TWO** different methods of maintaining suitable levels of plant nutrients in soil.

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MARKS

Q2 a) State **FOUR** limitations of the use of ordinary garden soil for use in containers.

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b) Describe the characteristics of **TWO NAMED** materials used in peat free growing media.

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Q3 a) Name **FOUR** soil horizons.

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b) Describe how rock is weathered in the process of soil formation under **EACH** of the following headings:

- i) physical
- ii) chemical
- iii) biological

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Q5 a) State the meaning of the term 'humus'.

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b) Describe **TWO** characteristics for **EACH** of the following organic materials:

- i) farm yard manure (FYM)
- ii) leaf mould
- iii) green manure
- iv) chipped bark

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MARKS

Q6 a) State the meaning of the term 'compaction' as applied to garden soils.

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b) List **THREE** indications of soil compaction.

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c) Describe **TWO** distinct methods to avoid soil compaction.

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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 6 February 2023

Candidates Registered

Candidates Entered	259
Candidates Absent/Withdrawn	TBA
Candidates Deferred	TBA

Total Candidates Passed

Passed with Commendation	75
Passed	143
Failed	41

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) Describe **TWO** symptoms of deficiency for **EACH** of the following nutrients:

- i) nitrogen
- ii) calcium
- ii) iron

b) Describe **TWO** different methods of maintaining suitable levels of plant nutrients in soil.

Q1a) Many candidates were able to describe symptoms of specific deficiencies and were awarded full marks. Suitable answers included:

i) **nitrogen**

The symptoms of nitrogen deficiency are yellowing of the foliage of plants which can occasionally have pink tints, spindly/stunted growth and reduced tiller development in lawn grasses.

ii) **calcium**

The symptoms of calcium deficiency are first seen in young leaves which is identified as interveinal chlorosis where the veins are dark green. Plants have a bushy appearance and the leaves can have necrotic spots on their margins. Other symptoms include; blossom end rot, bitter pit of apples, topple in tulips and curling of leaves.

iii) **iron**

The symptoms of iron deficiency include; strong yellowing on leaves with interveinal chlorosis identified on young foliage. Lime induced chlorosis occurs and leaf margins become necrotic due to the death of cells.

Q1b) Full marks were achieved by candidates who were able to describe specific methods of maintaining suitable levels of plant nutrients in soil. Acceptable answers included:

The use of organic matter e.g. farm yard manure that can be incorporated into the soil during the autumn to overwinter prior to planting. It can also be used as a mulch which is spread over the soil at a depth of 100mm. The soil macro and micro-organisms gradually incorporate the mulch into the soil which will release some nutrients. This takes a long time and the mulch will need replenishing every 1 to 2 years.

Fertilisers, either organic e.g. nettle or comfrey tea or inorganic e.g. Growmore can be incorporated into the soil or used as a top dressing or liquid feed. The nutrient levels of an organic fertiliser are not known whereas the levels in an inorganic fertiliser are precise.

Candidates who described specific green manures and how the nutrients are incorporated into the soil were also awarded marks.

Q2

- a) State **FOUR** limitations of the use of ordinary garden soil for use in containers
- b) Describe the characteristics of **TWO NAMED** materials used in peat free growing media

Q2a) A suitable range of limitations of the use of ordinary garden soil for use in containers was provided by the best candidates who gained maximum marks. These included:

- the structure of the soil may not be clear and there may be a predominance of a particular particle
- if the soil is heavy i.e. clay the container may be prone to waterlogging
- if the soil is light i.e. contains a high proportion of sand drought may become a problem and irrigation will be required
- the soil may not be sterile and contain pests, diseases or weeds
- the nutrient content of the soil is unknown and may not contain adequate nutrients
- loam is heavy and the containers may become difficult to move, especially when wet.

Q2b) Candidates who provided good descriptions of the characteristics of materials used in peat free growing media were awarded full marks. These included:

Coir is lightweight, has a high, water holding capacity with good porosity and air content. It contains N.P.K and trace elements and has a pH of 5.8 – 6.4

Composted bark is non-clumping with an open stable structure and good aeration.

Perlite is inert, durable, light and sterile. It only holds water on the surface.

Vermiculite is light and sterile. It has a good cation exchange capacity and it holds water well. It also allows light to pass through it.

Other materials which were acceptable included:

wood fibre, green compost, paper waste, sawdust, grit, sharp sand, rock wool.

Q3

- a) Name FOUR soil horizons.
- b) Describe how rock is weathered in the process of soil formation under EACH of the following headings:
- i) physical
 - ii) chemical
 - iii) biological

Q3a) The majority of candidates were able to name the soil horizons and gained maximum marks. These are:

O – organic or litter layer on the surface

A – topsoil

B – subsoil

C – parent material/bedrock

Q3b) Candidates who had a clear understanding of how rock is weathered in the process of soil formation achieved full marks. Acceptable answers included:

i) **physical**

Physical weathering is a result of the expansion and contraction of rocks due to temperature fluctuations and the freezing and thawing of ice in cracks and fissures. This causes the rock to shatter into smaller fragments.

ii) **chemical**

Chemical weathering occurs due to acids, e.g. carbonic acid which is found in rain and exuded from plant roots. Humic acid is released by decaying organic matter and sulphuric acid is formed by chemical pollutants e.g. sulphur dioxide. Oxygen in the air can also directly react with chemicals in the rock, e.g. iron to form oxides, which results in the mineral disintegrating or dissolving in water.

iii) **biological**

Biological weathering is the result of the roots of plants growing between cracks in the rocks and exerting great pressure, and of animals physically breaking up the parent material.

Q4

- a) A compost heap has been found to be dry, place a tick against **FOUR** materials that would improve this:

Materials	Tick
straw	
fallen fruit	
fresh manure	
finely shredded branches	
bark chips	
kitchen peelings	
fresh green prunings	

- b) Describe **TWO** distinct uses of garden compost in **NAMED** horticultural situations.

Q4a) Most candidates were able to identify materials that would improve the dryness of a compost heap and were awarded full marks. These were:

fallen fruit, fresh manure, kitchen peelings, fresh green prunings.

Q4b) Candidates who had a good knowledge of garden compost provided good descriptions of a suitable use for it in specific horticultural situations and achieved maximum marks. Suitable answers included:

Mulching shrubs or a tree in a border to reduce weed growth and evaporation of moisture from the soil surface.

Incorporation of garden compost into the soil on a vegetable plot or when preparing an herbaceous perennial border. This is carried out to improve the soil structure i.e. increase its water holding capacity in a sandy soil or to open up a heavy clay soil to aid drainage and avoid waterlogging.

Creation of growing media for use in a hanging basket or containers. This will enable the garden compost to be mixed with other media to formulate a growing media which is water retentive but light in weight which is important in this situation.

Q5

- a) State the meaning of the term 'humus'
- b) Describe **TWO** characteristics for **EACH** of the following organic materials:
- i) farm yard manure (FYM)
 - ii) leaf mould
 - iii) green manure
 - iv) chipped bark

Q5a) The best candidates who were awarded full marks stated that 'humus' forms the organic part of the soil and is the final decomposed vegetable and animal matter. It is dark, crumbly and water retentive, contains some nutrients and is brown and sticky.

Q5b) A range of characteristics for specific organic materials was provided by many candidates who achieved maximum marks. Suitable answers included:

i) **farm yard manure (FYM)**

FYM contains dung and urine from animals which contains straw and fodder that the animals have been fed. It is moisture retentive and contains some plant nutrients. FYM can also contain some weed seeds.

ii) **leaf mould**

Leaf mould contains fallen deciduous leaves and pine needles. It is not dense, is slightly acidic and low in macro nutrients but rich in trace elements. It takes a long time to decompose (1-2 years) although the leaves can be shredded. Once decomposition is complete the material has a fine texture.

iii) **green manure**

Fast growing plants e.g. clover, grazing rye, fenugreek, broad bean, rye grass mustard etc. are grown as green manure to cover the soil and suppress weeds in vegetable plots. The roots help to prevent soil erosion while the top growth is incorporated into the soil when it is still green to improve soil structure and return nutrients to the soil.

iv) **chipped bark**

Chipped bark can be used as a decorative mulch for shrub borders to help retain moisture and suppress weeds. It has little nutrient value and can lock up nitrogen. It drains well and is slow to rot down.

Q6

- a) State the meaning of the term 'compaction' as applied to garden soils
- b) List **THREE** indications of soil compaction.
- c) Describe **TWO** distinct methods to avoid soil compaction

Q6a) Full marks were awarded to candidates who were able to state that compaction is when the soil pores have collapsed and there is very little air remaining in the macropores and there is a reduced amount of water in the mesopores. Water can be found in the micropores but is unavailable to plants. The soil can therefore become anaerobic and there is less water infiltration.

Q6b) A range of indications of soil compaction were provided by the best candidates who gained maximum marks. These included:

- poor root penetration
- water run off/pooling/waterlogging of the soil
- stunted growth of plants
- reduced yield
- plants wilting
- lack of soil organisms due to a lack of oxygen
- minimal decomposition of organic matter by soil organisms due to a lack of oxygen

Q6c) Good descriptions of suitable methods to avoid soil compaction were provided by many candidates who achieved full marks. These included:

Soil compaction can be avoided by the incorporation of organic matter e.g. farm yard manure into the soil to improve the soil structure. By keeping the soil covered with vegetation i.e. a green manure e.g. mustard surface capping can be avoided.

By not walking/standing on the soil or using heavy machinery, especially when the soil is wet soil compaction can be avoided. It is important to consider the timing of cultivation. Rotary cultivation must not be carried out to the same depth consistently to avoid the creation of a soil pan. Drainage of heavy soil can be improved by the incorporation of grit into the soil or by installing soakaways. Paths can be installed to avoid walking on beds or raised beds can be constructed to avoid soil compaction.