



**R2102**

**PLANT NUTRITION & THE ROOT ENVIRONMENT**

**Level 2**

**Monday 20 June 2022**

**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

**Q1 a)** State **FOUR** limitations of the use of organic matter to provide nutrients.

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**MARKS**  
**4**

**b)** Name **THREE** distinct types of organic matter and their application for the situations given, by completing the table below:

Situation	Type of organic matter	Application
<b>Ornamental perennial border</b>		
<b>Vegetable patch</b>		
<b>Woodland/shrubbery</b>		

**2**

**2**

**2**

Total Mark

**Please see over/.....**





**MARKS**

**Q4** Describe composting under **EACH** of the following headings:

- i) suitable container
- ii) location of container
- iii) materials to be composted
- iv) maintenance of compost heap

**3**  
**2**  
**3**  
**2**

i) .....

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ii) .....

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iii) .....

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iv) .....

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Total Mark
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**Please turn over/.....**





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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 20 June 2022

<b>Candidates Registered</b>	<b>816</b>		<b>Total Candidates Passed</b>	<b>495</b>	<b>74%</b>
Candidates Entered	669	82%	Passed with Commendation	154	23%
Candidates Absent/Withdrawn	114	14%	Passed	341	51%
Candidates Deferred	33	4%	Failed	174	26%

#### 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 **FOUR** limitations of the use of organic matter to provide nutrients.

**4**

b) Name **THREE** distinct types of organic matter and their application for the situations given, by completing the table below:

<b>Situation</b>	<b>Type of organic matter</b>	<b>Application</b>
<b>Ornamental perennial border</b>		
<b>Vegetable patch</b>		
<b>Woodland/shrubbery</b>		

**2**

**2**

**2**



**Q1a)** Most candidates were able to state appropriate limitations of the use of organic matter to provide nutrients and were awarded full marks. Suitable answers included:

- the nutrient content of organic matter is variable
- organic matter can be bulky and therefore a large quantity would be required
- it takes time for nutrients to become available after organic matter has been applied
- organic matter needs to be broken down to release nutrients which is dependant on temperature and moisture
- the use of organic matter can result in the loss of nitrogen from the soil due to bacteria thriving
- organic matter can contain pests and diseases if not well rotted
- organic matter may contain weed seeds.

**Q1b)** A suitable range of types of organic matter and their application were given by the majority of candidates for specific situations and achieved maximum marks. These included:

<b>Situation</b>	<b>Type of organic matter</b>	<b>Application</b>
<b>Ornamental perennial border</b>	Finely shredded garden compost/municipal compost/wood chip.	Carefully mulch around base of each plant in spring/ avoiding the crowns/incorporate into soil prior to planting new plants.
<b>Vegetable patch</b>	Farm yard manure/animal manures/garden compost/municipal compost/green manure.	Incorporate into soil and allow to overwinter/apply as a mulch to overwinter/incorporated

		prior to any planting or sowing.
<b>Woodland/shrubbery</b>	Leaf mould/bark chips.	Mulch around the base of plants/not touching the stems or trunks of trees to a depth of 5-10cm.

**Q2 a)** List **FOUR** characteristics of top soil compared to subsoil that contribute to healthy plant growth.

**4**

b) Describe how soil cultivation can improve soil structure.

**6**

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**Q2a)** Full marks were awarded to candidates who were able to list specific characteristics of top soil that contribute to healthy plant growth. Acceptable answers included:

- a lot of roots are present in top soil
- microorganisms/soil life is present to break down organic matter and aerate the soil
- pore space provides for aeration and the retention of moisture
- top soil is not compacted
- top soil is friable for root penetration
- more organic matter is found in top soil which is moisture retentive.

**Q2b)** Candidates who provided good descriptions of how soil cultivation can improve soil structure gained maximum marks. These included:

Cultivation either by single or double digging is best carried out in the autumn to allow the winter frosts to break down the clods of soil. It provides the opportunity for organic matter to be incorporated to open up heavy soils e.g. clay or to improve water retention in a sandy soil. Alternatively grit or coarse sand can be incorporated into a heavy soil to improve drainage. Subsoiling can also be carried out if required to break up compacted layers in a soil. Soil cultivation increases aeration providing oxygen for respiration of both plants and microorganisms and will break a soil surface cap which impedes drainage.

- Q3 a)** Name **TWO** materials that can be used to lower soil pH. **2**
- b) State the effects of soil pH on **EACH** of the following:
- i) soil structure **3**
  - ii) nutrient availability **3**
- c) Name **ONE** plant suitable for **EACH** of the following soil types:
- i) acidic (*calcifuge*) **1**
  - ii) alkaline (*calcicole*) **1**

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**Q3a)** The majority of candidates were able to name suitable materials that can be used to lower soil pH. These included:

Sulphur, aluminium sulphate, sphagnum moss peat, acetic acid, composted pine needles, ericaceous compost.

**Q3b)** Candidates who had a clear understanding of the effects of soil pH on soil structure and nutrient availability were awarded full marks. Acceptable answers included:

i) **Soil structure**

Extremes of pH i.e. low or high causes the reduction of microorganisms in the soil. In a soil with a low pH the breakdown of organic matter is much slower due to the lack of soil microorganisms. There is also a reduction in the formation of tunnels made by earthworms etc. due to them not being present in a soil with a low pH.

ii) **Nutrient availability**

Most nutrients are available between pH 6.0 and 7.5 with the best being pH 6.5. A low pH reduces the availability of macronutrients e.g. magnesium and a high pH reduces the availability of micronutrients e.g. iron.

**Q3c)** A range of plants suitable for specific soil types were provided by the best candidates who achieved full marks. These included:

i) **Acidic**

*Pieris japonica, Calluna vulgaris*

ii) **Alkaline**

*Euonymus europaeus, Lavandula angustifolia*

**Q4** Describe composting under **EACH** of the following headings:

- |                                 |          |
|---------------------------------|----------|
| i) suitable container           | <b>3</b> |
| ii) location of container       | <b>2</b> |
| iii) materials to be composted  | <b>3</b> |
| iv) maintenance of compost heap | <b>2</b> |

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**Q4)** Candidates who had a good knowledge of specific aspects of composting gained full marks. Suitable answers included:

**i) Suitable container**

A container with a minimum volume of 1m<sup>3</sup> is required for successful composting. If it is constructed from wood, slatted sides are preferable to provide ventilation. A lid will enable heat to be retained and prevent excess rain from over wetting the compost. A range of plastic bins are available but must have ventilation in the sides, a front opening and a lid.

**ii) Location of the container**

The container must be located on bare soil to enable microorganisms to enter, orientated away from direct sunlight and in a sheltered position to avoid the compost from cooling down too quickly. The container should ideally be located away from the house and be accessible for use of a wheelbarrow.

**iii) Materials to be composted**

The ratio of materials to be composted should be 30:1 Carbon (browns) : Nitrogen (greens) for successful composting. Woody materials should be shredded for quicker decomposition and placed in layers approximately 150mm deep. Nitrogen rich materials include; grass clippings, annual weeds, kitchen waste, leaves etc. Carbon rich materials include; shredded newspaper, cardboard, shredded woody prunings etc.



iv) **Maintenance of compost heap**

The compost will require turning approximately every two to four weeks to ensure that composting is taking place. If the compost becomes dry it will need watering or more soft green material could be added to the compost. The compost must be well rotted before use and the heap must be monitored for the presence of rodents.

|                                                                                                        | <b>MARKS</b> |
|--------------------------------------------------------------------------------------------------------|--------------|
| <b>Q5 a)</b> Name the term that describes soil with the optimum water content needed for plant growth. | <b>1</b>     |
| b) Explain why pore space is needed for plant growth.                                                  | <b>4</b>     |
| c) State <b>THREE</b> cases of excess water in soil.                                                   | <b>3</b>     |
| d) State <b>TWO</b> methods of managing excess water in soil.<br>(EXCLUDING DRAINAGE SYSTEMS)          | <b>2</b>     |

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**Q5a)** The majority of candidates correctly named Field Capacity as the term to describe soil with the optimum water content needed for plant growth and were awarded maximum marks.

**Q5b)** The best candidates understood that pore space is needed for plant growth. The macropores hold air which is required for aerobic respiration to take place. The mesopores hold moisture which is available to the plant and required to avoid wilting, to maintain the turgidity of the plant and for photosynthesis. A balance of macro and mesopores is required in the soil to provide suitable conditions for soil microorganisms which are beneficial for plant growth. Water held by the micropores is unavailable to plants and their subsequent growth and should therefore be minimised.

**Q5c)** Suitable causes of excess water in soil were provided by many candidates who achieved full marks. Acceptable answers included:

- heavy rain can cause excess water
- a high water table
- a layer of compaction which prevents water from draining
- excess irrigation
- the type of soil i.e. one which contains a high proportion of small particles e.g. clay or silt which will impede drainage
- run off from hard landscaping.

**Q5d)** A range of methods of managing excess water in soil were provided by candidates who gained full marks. These included:

- incorporation of coarse sand/grit into the soil to increase pore space and hence drainage
- break up compaction layer in the soil by cultivation, i.e. double digging or subsoiling
- create raised beds with stone/grit in the bottom to aid drainage.

Candidates who stated that excess water in soil could be managed by the creation of a bog garden could not be awarded any marks.

**Q6 a)** Name **TWO** major plant nutrients and their role by completing the table below:

<b>Major plant nutrient</b>	<b>Role in plant</b>

**2**

**2**

**b)** Describe how nutrients can be made available to plants in containers.

**6**



**Q6a)** Many candidates were able to name major plant nutrients and their role and achieved maximum marks. Suitable answers included:

<b>Major plant nutrient</b>	<b>Role in plant</b>
Nitrogen	Leafy growth/yield/nucleic acid
Phosphorus	Root growth

Potassium, calcium, magnesium and their role were also accepted.

**Q6b)** Candidates who were awarded full marks had a good understanding of how nutrients can be made available to plants in containers. Suitable answers included:

The growing media in a container contains the base level of nutrients required by plants which is limited and will run out over time. These can be replaced in a number of ways. Fertilisers in the form of granules or plugs can be incorporated into the top of the growing media during the growing season from spring through the summer. An appropriate fertiliser either containing nitrogen for leafy growth or potassium for flowers and fruit can be used. These may be controlled release compound fertilisers e.g. Osmocote which will release the nutrients over a set period of time. Alternatively, a liquid feed may be used by diluting the concentrate and applying it using a watering can on a weekly basis. Foliar feeds can be used to correct nutrient imbalances e.g. iron sequestrene to correct lime-induced chlorosis on *Camellias*.

Permanent plantings in containers can be top dressed every year in spring by scraping off the surface growing media and replacing it with new growing media containing nutrients. It is important for growing media to be moist to enable nutrients to be taken up by the plant in containers.

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