Including Examiners comments

R2102

PLANT NUTRITION & THE ROOT ENVIRONMENT

Level 2

Monday 10 February 2020

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) Name **TWO** distinct types of organic matter that can be used as a garden mulch. **2**

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b) Describe **THREE** ways in which organic matter can benefit the soil. **6**

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c) State **TWO** reasons why organic matter should be well rotted before use. **2**

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Total Mark

Please see over/…..

		MARKS
Q2	Describe the process of composting under **EACH** of the following headings:	
	i) choice of material	**2**
	ii) aeration	**2**
	iii) moisture content	**2**
	iv) accelerators	**2**
	v) temperature	**2**

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v).....

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Total Mark

Please turn over/…..

MARKS

Q3 a) State **FOUR** situations where excess water can occur in a domestic garden. **4**

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b) Describe **THREE** methods of dealing with excess water in a domestic garden. **6**

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Total Mark

Please see over/…..

MARKS

Q4 a) State what is meant by the following terms relating to soil pH: **2**

i) acidic pH
ii) alkaline pH

i)……

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ii)……

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b) State why a pH of 6.5 is the most suitable for the growth of a wide range of plants. **2**

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c) Describe **ONE** benefit and **ONE** limitation of **TWO** distinct **NAMED** materials that can be used to lower soil pH, by completing the table below:

NAMED material to lower pH	**Benefit**	**Limitation**
1.		
2.		

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Total Mark

Please turn over/…..

MARKS

Q5 a) Describe the natural process of soil formation under **EACH** of the following headings:

i) physical **2**

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ii) chemical **2**

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iii) biological **2**

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b) List **FOUR** soil horizons for a typical mineral soil. **4**

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Total Mark

Please see over/…..

MARKS

Q6 a) State **ONE** symptom of deficiency for **EACH** of the following plant nutrients by completing the table below:

Nutrient	**Symptom of deficiency**	
nitrogen		**1**
phosphorus		**1**
potassium		**1**
magnesium		**1**

b) State **TWO** characteristics of inorganic and organic fertilisers, for **NAMED** fertiliser examples by completing the table below:

	Inorganic fertiliser	**Organic fertiliser**	
NAMED example			**2**
Characteristic 1.			**2**
Characteristic 2.			**2**

Total Mark

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RHS
Inspiring everyone to grow

R2102

PLANT NUTRITION & THE ROOT ENVIRONMENT

Level 2

Monday 10 February 2020

Candidates Registered	**1006**		**Total Candidates Passed**	**666**	**80%**
Candidates Entered	837	83%	Passed with Commendation	276	33%
Candidates Absent/Withdrawn	142	14%	Passed	390	47%
Candidates Deferred	27	3%	Failed	171	20%

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.

		MARKS
Q1 *a)*	*Name **TWO** distinct types of organic matter that can be used as a garden mulch.*	***2***
b)	*Describe **THREE** ways in which organic matter can benefit the soil.*	***6***
c)	*State **TWO** reasons why organic matter should be well rotted before use.*	***2***

Q1a) A range of specific types of organic matter were provided by most candidates who achieved maximum marks. These included:

- Well-rotted farmyard manure
- Composted leaf mould
- Well-rotted garden compost
- Composted bark
- Spent mushroom compost

Q1b) Candidates who described distinct ways in which organic matter can benefit the soil were awarded full marks. Suitable answers included:

- Organic matter feeds soil organisms and allows their populations to thrive. The soil organisms incorporate the organic matter into the soil and recycle nutrients for plant growth

- With the incorporation of organic matter into the soil the soil organisms create tunnels which allows for greater porosity. This also creates more space for gaseous exchange and water

- Organic matter has an effect on soil structure as the soil organisms produce gums to hold the soil crumbs together. This helps to break up solid clay soils

- Organic matter can make a sandy soil more fertile and improve its water holding capacity

Q1c) Full marks were achieved by candidates who were able to state reasons why organic matter should be well-rotted before use. Acceptable answers included:

- Plants can be scorched by the high levels of nitrogen/ammonia that can still be present if organic matter is not well-rotted

- If organic matter is not well-rotted valuable nitrogen can be robbed from the soil as the decomposition process continues

- There is a risk of passing on diseases to existing plants if the organic matter is not well-rotted

MARKS

Q2 *Describe the process of composting under **EACH** of the following headings:*

i)	*choice of material*	***2***
ii)	*aeration*	***2***
iii)	*moisture content*	***2***
iv)	*accelerators*	***2***
v)	*temperature*	***2***

Q2) Good descriptions of composting were provided by many candidates who achieved maximum marks. These included:

i) **Choice of material** – Anything that is organic consisting of carbon (browns) e.g. shredded newspaper, cardboard, stable waste, shredded thin stems and nitrogen (greens) e.g. grass clippings, annual weeds, kitchen waste, green prunings and leaves at a ratio of 15-30:1 carbon to nitrogen.

Materials that should not be composted include; cooked food, meat, diseased plant material and perennial weeds.

ii) **Aeration** – It is important to have sufficient air when composting to encourage aerobic respiration which will encourage the soil organisms to break down the materials to be composted. Aeration can be increased by turning the compost regularly e.g. once a month which will also prevent the material from compacting. A lack of air will lead to anaerobic respiration which will slow down the rate at which the materials decompose.

iii) **Moisture content** – Moisture is required for the soil organisms to survive. If the compost becomes too dry the composting process will slow down and water needs to be added. If the compost becomes too wet it becomes slimy and the composting process will also slow down. This can be overcome by turning the compost and incorporating more air and by adding more carbon rich materials e.g. straw and shredded woody prunings to open up the compost.

iv) **Accelerators** – If the composting process has been set up correctly with the appropriate ratio of carbon to nitrogen there is no need for accelerators. If an accelerator is required materials e.g. grass clippings, seaweed, urine, urea (those that provide nitrogen) can be added or the product Garotta.

v) **Temperature** – An increase in temperature will speed up the composting process. An ideal temperature is between 60°C and 80°C to enable the soil organisms to be most active. The temperature can be maintained by turning the compost and by covering or placing a lid on the composter.

		MARKS
Q3 *a)*	*State **FOUR** situations where excess water can occur in a domestic garden.*	***4***
b)	*Describe **THREE** methods of dealing with excess water in a domestic garden.*	***6***

Q3a) The majority of candidates were able to provide suitable situations where excess water can occur in a domestic garden and were awarded full marks. Acceptable answers included:

- Run off from hard landscaping e.g. patios
- A sloping site which will be wet at the bottom
- A high water table
- Soil texture e.g. problems if there is a high clay content where water does not drain quickly
- Soil structure where the presence of compaction or a soil surface pan impedes drainage
- Leaking pipes

Q3b) Suitable descriptions of how to deal with excess water in a domestic garden were provided by many candidates who gained full marks. These included:

i) If compaction is a problem cultivation by double digging can be carried out to break up the compacted area and to incorporate bulky organic matter to maintain the structure of the soil and to improve aeration.

ii) If the soil has a high proportion of small particles e.g. clay the soil texture can be improved by cultivating to incorporate coarse sand/grit and bulky organic matter.

iii) A raised bed can be built which is high enough to keep the root zone out of the wet soil. The soil will need to be well structured to enable it to drain adequately.

iv) The installation of a drain will remove excess water. A soakaway needs to be constructed in the lowest area of the garden and French or tile drainage systems require an outflow.

MARKS

Q4 *a) State what is meant by the following terms relating to soil pH:* ***2***

i) acidic pH
ii) alkaline pH

b) State why a pH of 6.5 is the most suitable for the growth of a wide range of plants. ***2***

*c) Describe **ONE** benefit and **ONE** limitation of **TWO** distinct **NAMED** materials that can be used to lower soil pH, by completing the table below:*

NAMED material to lower pH	***Benefit***	***Limitation***	
1.			***3***
2.			***3***

Q4a) Candidates who were able to state the meaning of the specific terms relating to soil pH gained maximum marks. Acceptable answers included:

i) Acidic pH is a pH below 7.0
ii) Alkaline pH is a pH above 7.0

Q4b) Most candidates correctly stated that the reason why a pH of 6.5 is the most suitable for the growth of a wide range of plants is due to:

- Most plant nutrients are available at a pH of 6.5 whereas some become locked up and unavailable to plants at a higher pH e.g. Iron
- Soil organism and worm activity is optimal at a pH of 6.5. As the pH becomes more acidic this activity diminishes
- The soil is more fertile at a pH of 6.5

Q4c) The best candidates were able to describe the benefit and limitation of specific materials that can be used to lower soil pH and achieved full marks. Suitable answers included:

- Sulphur is safe to use but slow acting
- Acidifying fertilisers e.g. ammonium nitrate and aluminium sulphate will also act as a fertiliser as well as reduce the pH level but care must be taken to avoid too much being applied which could have an adverse effect on plants
- Sphagnum peat and pine needs are natural materials which may be available locally but large quantities are needed if the soil has a high pH and could be slow to lower the pH level.

MARKS

Q5 *a) Describe the natural process of soil formation under **EACH** of the following headings:*

i) physical ***2***

ii) chemical ***2***

iii) biological ***2***

*b) List **FOUR** soil horizons for a typical mineral soil.* ***4***

Q5a) Suitable descriptions of how soil is formed were provided by many candidates who were awarded full marks. These included:

i) **Physical** – Through the freeze/thaw cycles where water gets into cracks in rocks and freezes causing expansion. The cracks widen and this leads to the breakdown of rock particles into smaller pieces. Heat also causes the expansion and contraction of rock and causes it to break apart. Abrasion is caused by rocks brushing against each other down a mountainside or in rivers where the rock is gradually worn away.

ii) **Chemical** – Carbon dioxide in the air reacts with water to form a weak carbonic acid which has an eroding effect on rock. 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** - Plant roots and seeds can grow deep within the cracks in rocks and cause them to widen. The growth of moss and lichen on the surface of rocks can also cause cracks etc. The action of animals trampling/burrowing can cause rocks to break into smaller pieces.

Q5b) The majority of candidates were able to name the four soil horizons correctly and gained maximum marks. These are:

- Horizon O – Organic matter/leaf litter
- Horizon A – Topsoil
- Horizon B – Subsoil
- Horizon C – Parent Bedrock

MARKS

Q6 *a) State **ONE** symptom of deficiency for **EACH** of the following plant nutrients by completing the table below:*

Nutrient	***Symptom of deficiency***	
nitrogen		***1***
phosphorus		***1***
potassium		***1***
magnesium		***1***

*b) State **TWO** characteristics of inorganic and organic fertilisers, for **NAMED** fertiliser examples by completing the table below:*

	Inorganic fertiliser	***Organic fertiliser***	
NAMED example			***2***
Characteristic 1.			***2***
Characteristic 2.			***2***

Q6a) Full marks were achieved by candidates who were able to give the correct symptom of deficiency for each of the nutrients. These were:

Nitrogen – Chlorosis (yellowing) on the oldest leaves first and stunted growth.

Phosphorus – Stunted, slow growth and poor root development.

Potassium – Blue/green leaves with leaf margin browning and poor fruiting or flowering.

Magnesium – Interveinal chlorosis (yellowing between leaf veins).

Q6b) Candidates who were able to provide the characteristics of specific named types of fertiliser gained maximum marks. Suitable answers included:

Inorganic Fertiliser – e.g. Growmore, Phostrogen, Ammonium sulphate are synthetic and come from mined minerals. They contain specific amounts of nutrients, are usually concentrated which require dilution and are fast acting.

Organic Fertiliser – e.g. seaweed, hoof and horn, blood fish and bone, poultry manure pellets and comfrey or nettle tea are formed from plant and animal remains. The fertiliser needs to be broken down before the nutrients are released. This is carried out by bacteria and organisms in the soil. Organic fertilisers are slower to act compared to inorganic fertilisers and the amount of nutrients is variable

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