Part II: A model peat free crop

Requirements of growing media

- Provide anchorage
- Create environment that promotes crop health
- Facilitate gas exchange in rootzone
- Facilitate water uptake
- Facilitate nutrition delivery to the plant

Must be tailored to the specific needs of specific crops

Differences between peat and peat free

- Structure
  - Increased Air-Filled Porosity (AFP)
  - Generally lower Water Holding Capacity (WHC) and Available Water (AW)
- Nutrition
  - Higher pH and pH reduced buffering capacity
  - Lower Cation Exchange Capacity (CEC) and increased risk of leaching
  - Lower Ca availability
- Pest and Disease pressures
- Cost

Peat free costs and opportunities

- Ingredients are significantly more expensive than peat
- Fluctuations in price do occur
- Savings must be found elsewhere

This programme can provide a model that can be followed to make a more environmentally and financially sustainable crop

Crop overview

- Cyclamen crop in Greenhouse on raised bench
- 6000 plants (0.5L pots) in 49.5m² area
- Sown as plugs in June
- Aim to be sold in September and October
- Ferring Nurseries in West Sussex

Cyclamen is a short-term crop and so we want a fine mix, which holds water but enables root development and has a slightly acidic pH

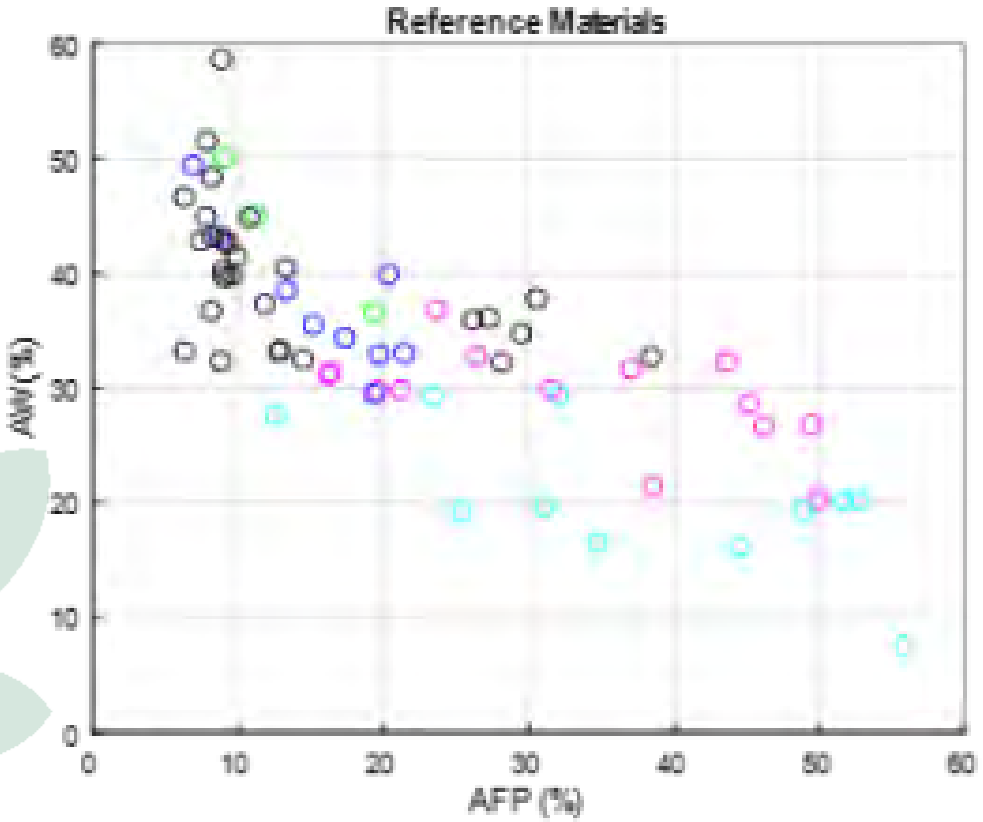
Growing Media Selection

- pH: **5.8**; EC: **1.5** mS/cm, Wetting agent: **0.32kg/m³**

Ingredient	Composition (%)
Woodfibre	35
Coir	30
Green Compost	12
Pine Bark	10
Perlite	10
Granulated Clay	3

Fertiliser	Volume (kg/m³)
DCM Ecor 5	4
DCM Vivifos	1
Base Fertiliser (17-10-14)	0.7
N fertiliser (31-0-0)	0.3
Calcium Nitrate	0.3
DCM Micromix	0.2

Growing media structure



Parameters: Available water (AW), Air filled porosity (AFP)

Point colours:

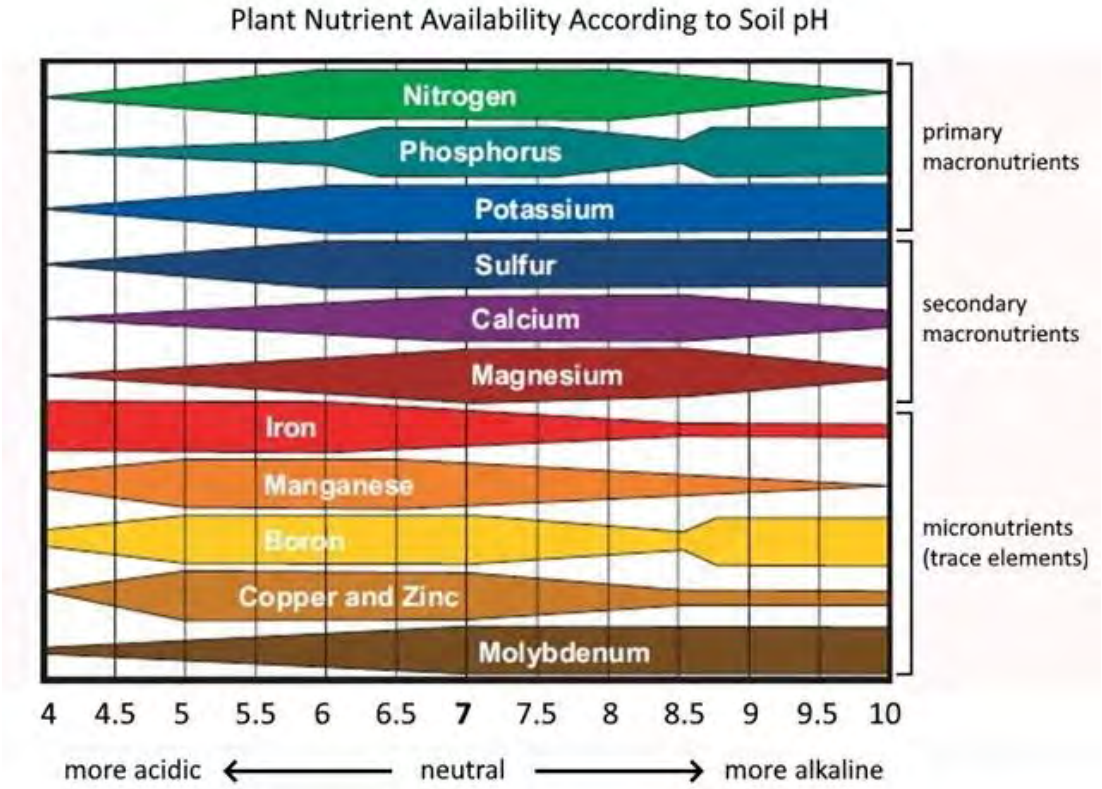
- **Peat (black)**
- **coir (blue)**
- **wood fibre (cyan)**
- **bark (pink)**
- **green compost (green)**

Source: ADAS

Growing media chemical profile

Raw material type	pH	EC (µS cm^{-1})	CEC (meq 100 cm^{-3})	AFP (%)	Available water (%) at 5kPa	Dry bulk density (g cm^{-3})
Coarse peat (10-25 mm)	4.2 - 4.7	15.0 – 49.0	15.1 - 42.8	13.3 - 38.4	32.5 – 44.6	0.12 - 0.19
Fine peat (0-5 mm)	4.1 - 4.7	24.2 - 49.8	10.5 - 20.9	8.2 - 9.1	35.0 – 43.0	0.09 - 0.17
Bark (0-8 mm)	5.7 - 6.4	98.0 - 246.1	13.9 - 22.0	16.3 – 26.3	30.1 - 34.2	0.16 - 0.23
Potting bark (5-16 mm)	5.3 - 5.8	20.2 - 46.3	7.3 - 11.9	38.6 - 49.4	35.0 - 43.0	0.15 - 0.17
Buffered coir (0-12 mm)	6.9 - 7.3	38.3 - 96.2	5.3 - 6.8	17.3 - 20.3	36.6 - 40.4	0.06 - 0.11
Green compost (0-10 mm)	7.5 - 8.2	456.6 - 1739.1	15.8 - 20.9	5.0 - 15.1	35.8 - 46.7	0.23 - 0.52
Wood fibre (all tested types [a])	5.4 – 8.3	5.3 – 441.1	9.0 - 14.9	25.4 - 51.7	13.2 – 24.7	0.06 - 0.11
Vermiculite (superfine - medium)	8.0 - 9.8	18.7 - 36.7	3.0 - 9.7	11.9 - 40.2	34.4 - 41.6	0.10 - 0.13
Perlite (fine - coarse)	8.0 - 9.2	5.2 - 9.7	0.8 - 2.1	21.3 - 36.2	21.4 - 24.2	0.05 - 0.12

Source: ADAS



We are seeing improved nutrient availability at higher pH in peat free compared to peat

Ingredients: Wood fibre (35% of mix)

- **AFP: High (25% - 50%)**
- WHC: Low
- AW: Low (37% - 40%)
- pH: 4.4 – 6.0
- Buffering capacity: Low
- Cation Exchange Capacity: Low
- Electrical Conductivity: Low
- Microbial life: Low
- **Considerations: locks up N in first 8-10 weeks**

Ingredients: Coir (30% of mix)

- AFP: Medium (17% - 20%)
- WHC: High
- **AW: High (37% - 40%)**
- pH: 6.0 – 7.3
- Buffering capacity: Low
- Cation Exchange Capacity: Low
- Electrical Conductivity: Low
- Microbial life: Low
- **Considerations: high in K**

Ingredients: Green compost (12% of mix)

- AFP: Low (5% - 15%)
- WHC: High
- **AW: High (36% - 47%)**
- pH: 7.5 – 8.2
- Buffering capacity: Low
- **Cation Exchange Capacity: Medium**
- Electrical Conductivity: Very high
- **Microbial life: High**
- **Considerations: Quality and properties can vary widely**

Ingredients: Fine Pine Bark (10% of mix)

- AFP: Medium (16% - 26%)
- WHC: High
- AW: Medium (30% - 34%)
- **pH: 5.7 – 6.4**
- **Buffering capacity: Medium**
- **Cation Exchange Capacity: Medium**
- Electrical Conductivity: Medium
- Microbial life: Low
- **Considerations: locks up N in first 8-10 weeks**

Ingredients: Perlite (10% of mix)

- **AFP: High (21% - 36%)**
- WHC: High
- AW: Medium (21% - 24%)
- pH: 8.0 – 9.2
- Buffering capacity: Very low
- Cation Exchange Capacity: Very low
- Electrical Conductivity: Very low
- Microbial life: Low
- **Considerations: Concern over environmental impact of production**

Ingredients: Clay (3% of mix)

- **Buffering capacity: High**
- **Cation Exchange Capacity: High**
- Electrical Conductivity: Low
- Microbial life: Low

Mix design

- **Wood fibre**: Aeration
- **Coir**: Water availability
- **Green compost**: water availability, nutrient adsorption, soil biology
- **Fine pine bark**: good pH, aeration, some buffering capacity
- **Perlite**: aeration and soil structure
- **Clay**: Nutrient adsorption and pH buffering
- **Wetting agent**: improved water uptake and retention

Growing media has good aeration of small pores and good water holding capacity with sufficient acidity and CEC

Media and rooting

Nutrition: Growing Media Chemical Profile

- pH: 5.8; EC: 1.5 mS/cm
- Lower CEC and pH buffering than peat-based mixes
- Higher nutrient availability (mostly K, with other macro and micronutrients)
- Increased microbial activity compared to peat-based mixes

Nutrition: Fertilisation requirements

- Crop demands
  - 12 to 15 week crop
  - Steady availability of macro and micronutrients
  - EC around 1
  - Ca not available with lime so must be added
- Growing media demands
  - Nitrogen is immobilised by soil microbes in mixes containing bark and wood fibre

Nutrition: Fertilisation regime

Fertiliser	Volume (kg/m³)	Type	Nutrition
Base Fertiliser	0.7	mineral	NPK 17-10-14
N fertiliser	0.3	mineral	NPK 31-0-0
Calcium Nitrate	0.3	mineral	Ca^{2+}, NO_3^-
DCM Ecor 5	4	organic	NPK 8-5-6
DCM Vivifos	1	organic	NP 4-30
DCM Micromix	0.2	organic	B, Cu, Fe, Mn, Mo, Zn

Nutrition: Mineral Fertiliser

- Integrated mineral fertilisers
  - Base fertiliser (0.7kg/m^3)
    - Formulation: granular
    - NPK 17-10-14
  - Nitrogen (0.3kg/m^3)
    - Formulation: granular
    - NPK 31-0-0
    - Release profile: 12-15 weeks
  - Calcium nitrate (0.3kg/m^3)
    - Formulation: granular
    - Release profile: up to 2 weeks

Nutrition: Mineral Fertiliser

- Liquid mineral fertiliser
  - Mixed with H2Gro (5ml/10L dosed at 1%)
  - First 8 weeks
    - Calcium Nitrate – rate: 1kg/10L dosed at 1%
    - No. applications: Average every 3-4 days (approx. 18 feeds)
  - After 8 weeks (following soil analysis)
    - Calcium Nitrate – rate: 0.5kg/10L dosed at 0.5% (50/50)
    - Potassium Nitrate – rate: 0.5kg/10L dosed at 0.5% (50/50)
    - No. applications: Average every 3-4 days (approx. 9 feeds*)

Nutrition: Mineral Fertiliser

Benefits of mineral fertilisers

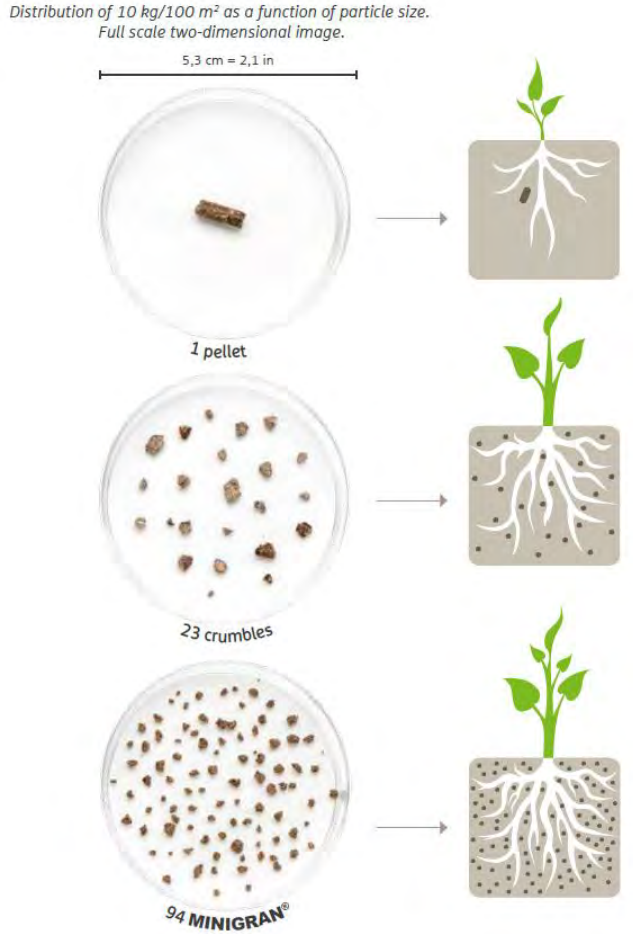
- Integrated feed
  - Base fertiliser (17-10-14)
    - Immediately available nutrition to crop for establishment
  - Nitrogen (31-0-0)
    - Stops competition between plant and growing media for N
  - Calcium nitrate
    - Easily accessible Ca and N source in place of lime for establishment
- Liquid Feed
  - Calcium Nitrate, Potassium Nitrate: provides tailored nutrition throughout crop

Nutrition: Mineral Fertiliser

- Considerations with mineral fertilisers
  - Nitrogen (31-0-0)
    - Release pattern of N may not be in line with lock up by growing media and can lead to short periods of fast growth
  - Calcium Nitrate
    - Calcium uptake isn't only dictated by availability – humidity must be managed to ensure sufficient water flow throughout the plant
- Liquid feed
  - Peat free media has higher propensity for leaching due to reduced CEC and so applications should be well targeted

Nutrition: Organic fertiliser

- Integrated fertiliser
  - DCM Ecor 5 (4kg/m³)
    - NPK 8-5-6
    - Release pattern: 100-to-150-day
  - DCM Micromix (0.7kg/m³)
    - B, Cu, Fe, Mn, Mo, Zn
    - Release pattern: 75-100 days
  - DCM Vivifos (1kg/m³)
    - NP 4-30
    - Release pattern: approx. 75-100 days

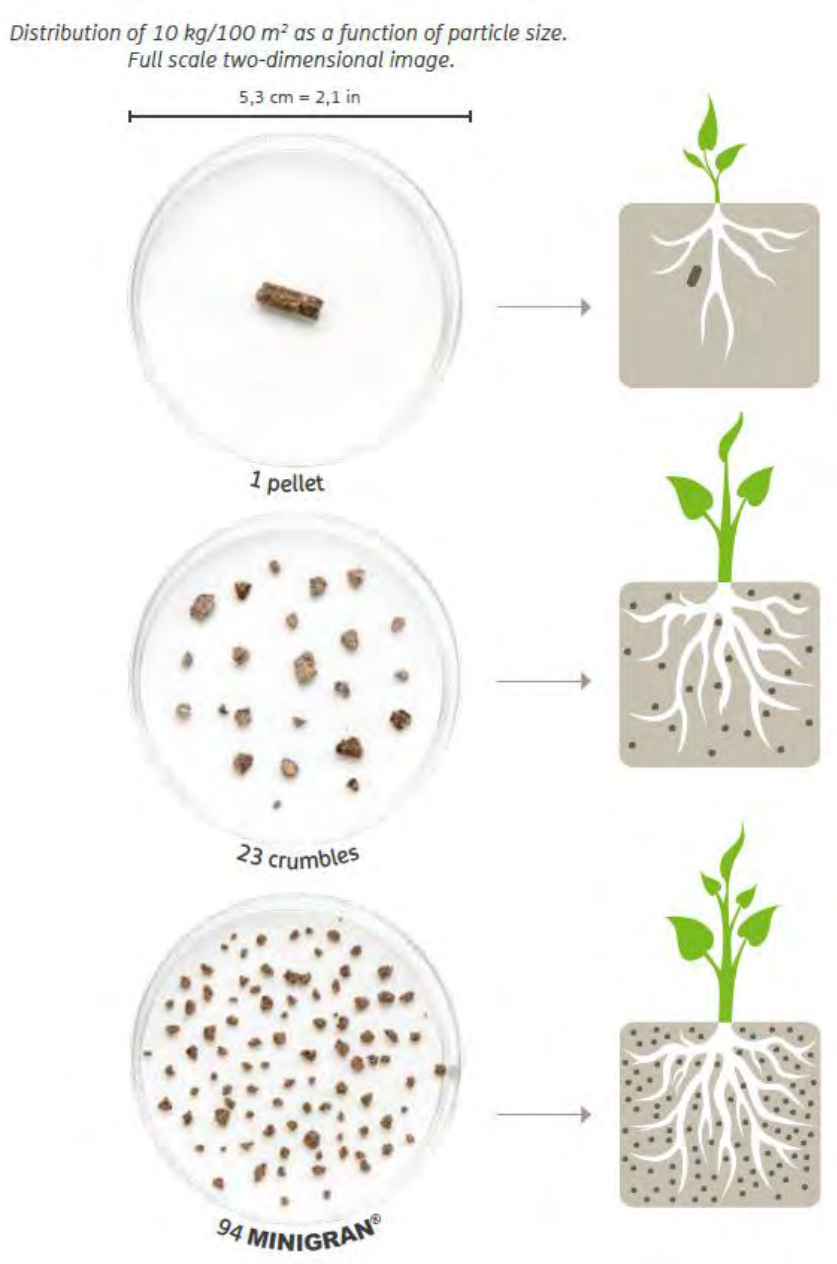


Nutrition: Organic fertiliser

- Release mechanism
  - Organic nutrients must be mineralised to be taken up by plant
  - Mineralisation dependents on biology (helped by presence of compost in growing media)
  - Microbe metabolic speed aligns with plant metabolic speed
  - Release is well suited to plant growth

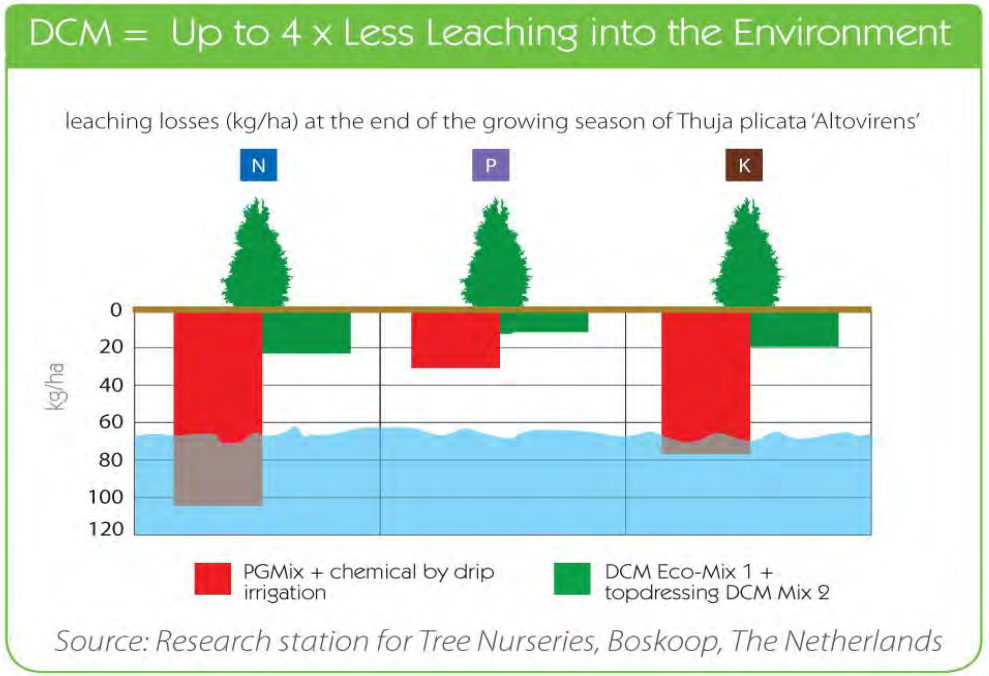
Nutrition: Organic fertiliser

- Benefits of organic fertilisers
  - Uniformity
    - Small granule size provides uniform nutrition throughout the growing media
    - Release pattern delivers consistent EC to avoid shocking plant or burning the roots
  - Improved rooting
    - Distribution in growing media encourages plant to develop dense roots throughout the pot
    - This facilitates better uptake of added mineral fertiliser
  - Soil biology
    - Improves soil biology to delivers plethora of benefits



Nutrition: Organic fertiliser

- Benefits of organic fertilisers
  - Reduced water requirements
    - Uptake requires less water than mineral feeds and so crop can be grown in a drier manner
    - Controls pest and disease pressure
  - Reduced leaching
    - Peat free mixes hold nutrition less tightly
    - But the strongly bound nutrients in organics are harder to leach as well as having a lower NPK
    - Mineral nutrients are released in line with plant demands so majority is used – reducing waste and costs



Nutrition: Organic fertiliser

- Considerations with organic fertilisers
  - Release mechanism means that nutrition is not available immediately
  - Increased microbial activity interacting with nutrition can lead to changes in pH and soil chemistry
  - Length of release is limited due to organic nature and so for longer term crops they're best combined with a longer releasing CRF or top dressing

Nutrition: Soil sample tests

- Peat-free media is more dynamic
- Materials and nutrition can cause changes
- Testing is important for understanding behaviour

Original

Sample

Research-/ordernumber: 317752/006114437
Date sampling: 25-07-2023
Date report: 08-08-2023
Test code: 310
Receiving date: 08-08-2023
Sample was taken by: Third party
FERRING NURSERY

Results

		analysis	at EC 0,67	target	low	normal	high	basi sch
	pH	6,7	6,7	5,9				
mS/cm 25°C	EC	0,9	0,9	< 1,8				
Cations mmol/l	NH_4	< 0,1	< 0,1	< 0,1				
	K	3,2	3,1	1,6				
	Na	1,9	1,9	< 3,5				
	Ca	0,8	0,8	1,2				
	Mg	0,4	0,4	0,5				
Anions mmol/l	NO_3	2,6	2,5	4,0				
	Cl	2,0	2,0	< 3,5				
	S	1,2	1,1	0,8				
	HCO_3	< 0,1	< 0,1					
	P	0,33	0,32	0,50				
Micro-nutrients µmol/l	Fe	10	10	10				
	Mn	1,0	1,0	2,0				
	Zn	2,9	2,9	2,0				
	B	12	12	10				
	Cu	0,5	0,5	0,7				
	Mo	0,1	0,1					
mmol/l	Si	0,14	0,14					
	K/Ca	4,0		1,3				

Original

Sample

Research-/ordernumber: 318749/006125053
Date sampling: 08-08-2023
Date report: 21-08-2023
Test code: 310
Receiving date: 21-08-2023
Sample was taken by: Third party
FERRING NURSERY

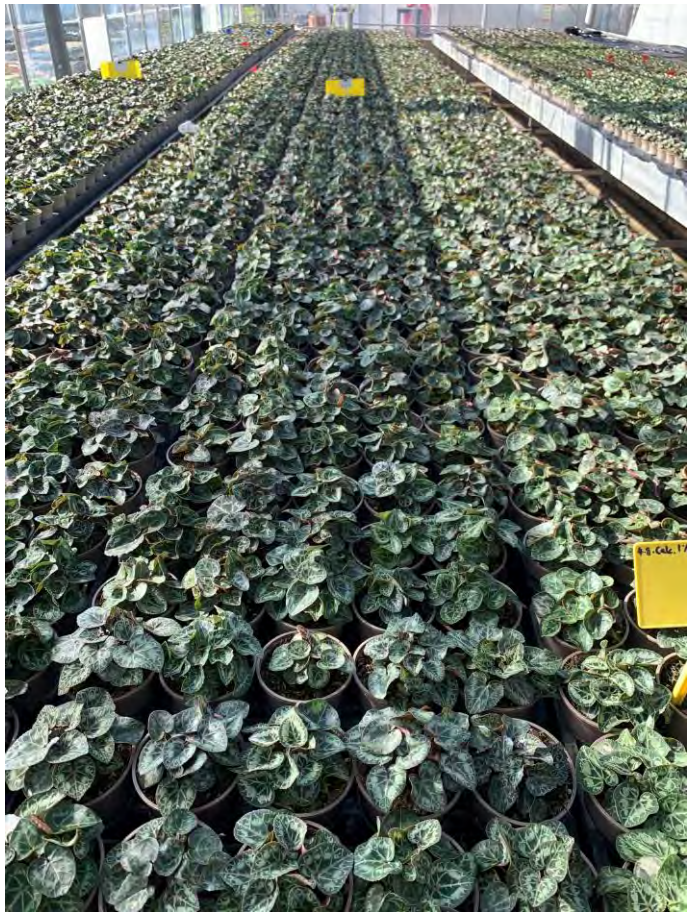
Results

		analysis	at EC 0,67	target	low	normal	high
	pH	6,7	6,7	5,9			
mS/cm 25°C	EC	0,9	0,9	< 1,8			
Cations mmol/l	NH_4	0,1	0,1	< 0,1			
	K	3,0	2,8	1,6			
	Na	1,8	1,8	< 3,5			
	Ca	0,9	0,8	1,2			
	Mg	0,4	0,4	0,5			
Anions mmol/l	NO_3	1,9	1,8	4,0			
	Cl	1,8	1,8	< 3,5			
	S	1,4	1,3	0,8			
	HCO_3	< 0,1	< 0,1				
	P	0,40	0,37	0,50			
Micro-nutrients µmol/l	Fe	11	11	10			
	Mn	0,6	0,6	2,0			
	Zn	2,5	2,5	2,0			
	B	13	13	10			
	Cu	0,6	0,6	0,7			
	Mo	0,2	0,2				
mmol/l	Si	0,18	0,18				
	K/Ca	3,3		1,3			

Crop progress: strong and uniform growth

4 weeks

6 weeks



8 weeks

Growing media and nutrition

- Approx. cost per plant: £0.05 (£50 per 1,000 plants)

Irrigation

Irrigation: Every 3 days with H2Gro and liquid fertiliser

- Water delivery
  - Mix is more open than peat and so dries out quicker
  - However, drying profile is different and so a dry top doesn't always mean the pot is dry
  - Increased AFP means more scope for compaction – important to water gently
- Nutrition delivery
  - Organic fertiliser can deliver nutrition in drier environment than mineral
  - Consider growing drier (which also helps with pest and disease)

Pest Management

Key pest from peat free bedding is sciarid fly due to decomposition of ingredients in media

- Cultural controls
- Biological/physical controls
  - *Atheta coriaria* beetle breeder bucket
    - Rate: 1 per crop
  - Nematode drench (*Steinernema feltiae*)
    - Applications: 3
    - Rate: 5m nematodes in 49.5m² area
  - Yellow sticky traps
    - Applications: 2 (6 total)
    - Rate: 3 traps in 49.5m² area

Approx. cost per pot: £0.014 per plant (£14 per 1,000 plants)

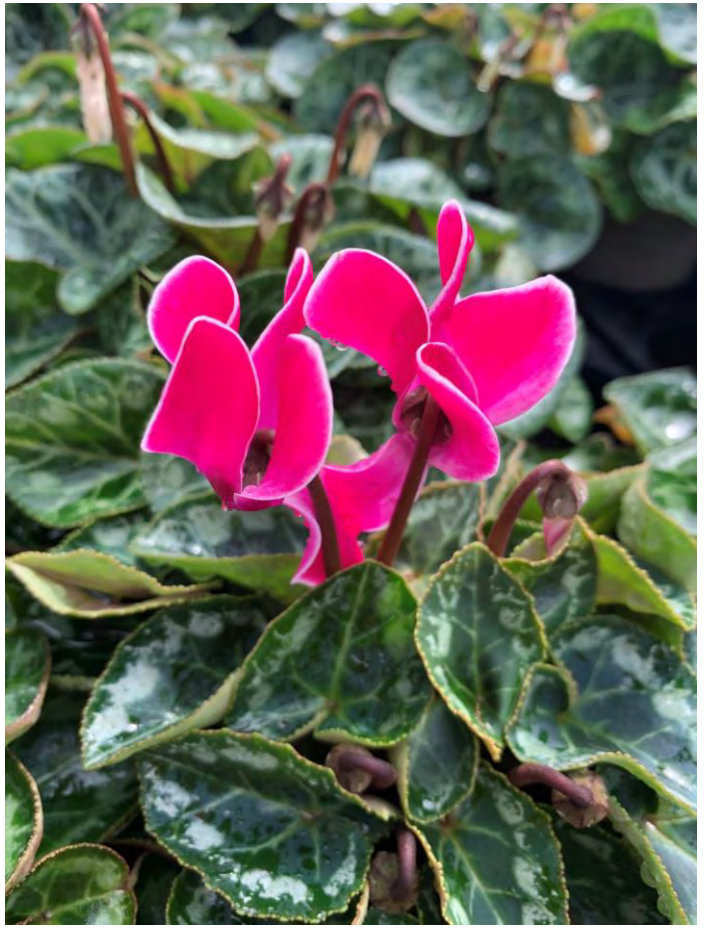
Disease Management

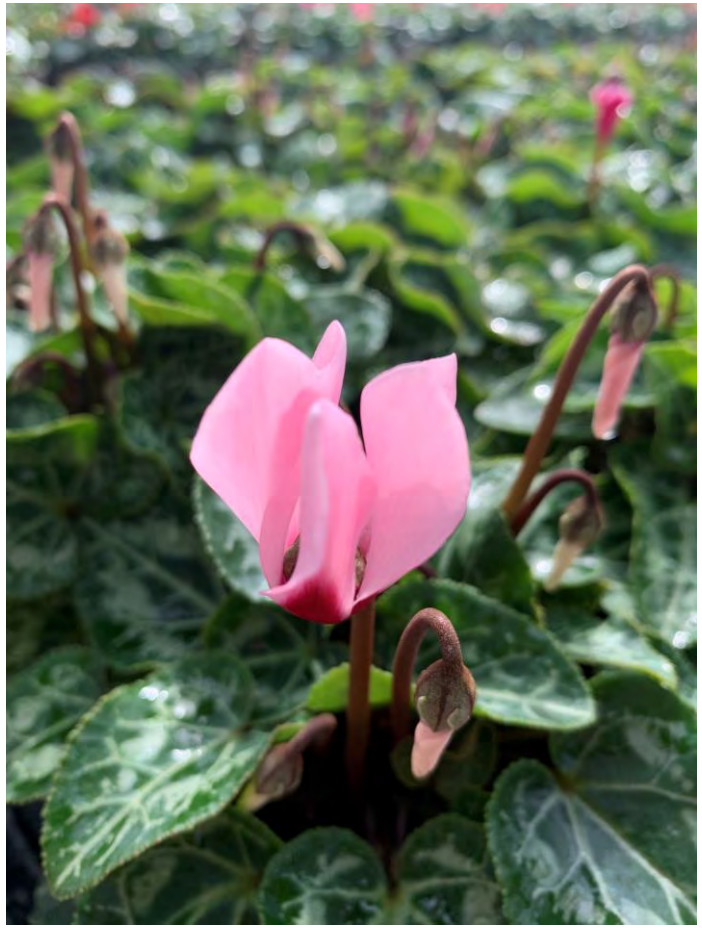
- Botrytis is primary concern
- Cultural controls important – with nutrition key
- This enables use of lower cost and more ecologically friendly pesticides

Approx. cost per pot: £0.0006 per plant (£0.60 per 1000 plants)

Week (crop)	Week (year)	Romeo (cerevisane)	Taegro (*Bacillus a.*)	SB Plant Inv.
1	27			
2	28			
3	29			
4	30			
5	31		•	•
6	32	•		
7	33		•	•
8	34	•		
9	35		•	•
10	36	•		
11	37		•	•
12	38	•		
Sale	39	-	-	-

Disease management





Environmental control

- Temperature
  - Reduce scope for pest development
- Humidity
  - Reduce humidity to limit disease pressure – can be done with less irrigation
  - Ca uptake is dependent on flow of water through crop so venting is key

Crop Overview

- Crop: 0.5L Cyclamen
- Sow: week 26
- Sale: week 34 - 38
- Estimated crop loss/waste: less than 1%

<u>Approx. costings</u>

Media & fertiliser: £0.05 per plant

Pest Management Programme: £0.014 per plant

Disease Management Programme: £0.0006 per plant

TOTAL COST: £0.0646 per plant (£64.60 per 1,000 plants)

Benefits of programme

- Benefits
  - Healthy crop
    - Reduced crop loss to quality issues and pest and disease (less than 1%)
    - Consumer more likely to buy and will receive better product
    - Ecologically and financially sustainable pest and disease management programme – safer for staff and the environment
  - Reduced input costs compared to conventional programme
    - Lower NPK and release profile of organic fertiliser ensures good uptake and limits waste – reducing fertiliser cost
    - Reduced leaching will limit damage to environment
  - Reduced labour inputs
    - Integrated fertiliser limits time spent mixing liquid feeds and limits watering requirements
    - Uniform, high-quality crop reduces time spent rogueing or cleaning low-quality plants