Weed control in container-grown hardy nursery stock workshops

James Coles and Sons Nurseries
The Potters Heron Hotel/Hillier Nurseries
29 and 30 June 2016
## Event Programme

<table>
<thead>
<tr>
<th>Time</th>
<th>Subject</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>11.00</td>
<td>Registration and tea and coffee.</td>
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<tr>
<td>11.20</td>
<td>Common nursery weeds - biology and identification.</td>
<td>David Talbot, ADAS</td>
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<tr>
<td></td>
<td>Weed sources.</td>
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<td></td>
<td>Nursery hygiene measures.</td>
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<td></td>
<td>Cultural and non-chemical weed control measures.</td>
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<td></td>
<td>Container mulch investigations <em>(29 June workshop)</em>.</td>
<td>David Kerr, DARDNI</td>
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<td></td>
<td>Herbicide approvals for ornamental crops <em>(30 June workshop)</em>.</td>
<td>Bolette Palle Neve, AHDB</td>
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<tr>
<td>12.15</td>
<td>Lunch – buffet refreshments.</td>
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<tr>
<td>13.15</td>
<td>Available herbicide products.</td>
<td>John Atwood, ADAS</td>
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<td>Herbicide programmes for:</td>
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<tr>
<td></td>
<td>- General nursery stock – designing a 12 month programme.</td>
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<td></td>
<td>- Herbaceous and alpine crops.</td>
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<td>- Moss and liverwort control.</td>
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<td>- Beds and paths.</td>
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<td>Including results from recent herbicide screening trials.</td>
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<td>14.05</td>
<td>Break.</td>
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<td>14.15</td>
<td>Current weed control research at NCSU, USA including:</td>
<td>Joe Neal, North Carolina State</td>
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<tr>
<td></td>
<td>- Techniques to avoid herbicide damage on sensitive crops.</td>
<td>University</td>
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<td></td>
<td>- New chemical treatments and mulches.</td>
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<td></td>
<td>- The economics of frequent vs less frequent hand weeding regimes.</td>
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<tr>
<td>15.15</td>
<td>Transfer to nursery (as relevant).</td>
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<tr>
<td>15.30</td>
<td>Weed identification on the nursery. Problems, products and solutions on</td>
<td>John Atwood, David Talbot ADAS</td>
</tr>
<tr>
<td></td>
<td>the nursery.</td>
<td>and nursery staff</td>
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<tr>
<td></td>
<td>Weed control in:</td>
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<tr>
<td></td>
<td>- A range of hardy nursery stock crops.</td>
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<td>- Standing beds.</td>
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<td></td>
<td>- Liners and plugs.</td>
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<td>- Crops under protection.</td>
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<td></td>
<td>Dealing with established weeds.</td>
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<tr>
<td>16.15</td>
<td>Technical discussion and Q&amp;A.</td>
<td>All</td>
</tr>
<tr>
<td>16.30</td>
<td>Refreshments and depart.</td>
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</tbody>
</table>
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<td>8</td>
</tr>
<tr>
<td>Herbicide approvals for ornamental crops – Bolette Palle Neve, AHDB Horticulture (30 June)</td>
<td>13</td>
</tr>
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<td>Weed control in container-grown hardy nursery stock – Available herbicide products and programmes – John Atwood, ADAS</td>
<td>15</td>
</tr>
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<td>Weed management in container nurseries: Principles and recent research findings – Joe Neal, NCSU</td>
<td>26</td>
</tr>
<tr>
<td>Notes</td>
<td>35</td>
</tr>
</tbody>
</table>
Weed control in container-grown hardy nursery stock

David Talbot ADAS UK Ltd

Weeds, nursery hygiene and non-chemical control measures

• Common nursery weeds
• Weed sources
• Nursery hygiene measures
• Culture and non-chemical controls

Introduction - devising a weed control strategy

Assess and consider:

• Weed sources
• Weed pressure
• Weed spectrum
• Nursery hygiene
• Crop types and growth stage
• Situation (outdoor / under protection) and timing (summer / winter)
• Cultural / non chemical control
• Review

Common weed problems

• Annual weeds (mainly)
• Wind or explosive distribution mechanism
• Prime germination sites - growing media surface
• Moss, liverwort and algae

Common weed problems

• Annual wind blown seed
  Groundsel
  Willowherb
  Sowthistle
  Goat willow

• Explosive seed distribution
  Bittercress
  Oxalis

• Seeds adhering to pots, trays, cuttings etc.
  Chickweed
  Annual meadow-grass
  Pearlwort

Common weed problems

• Water / wind dispersal
  Moss
  Liverwort

• Root fragments in growing media
  Sorrel
  Creeping yellow cress
Groundsel (Senecio vulgaris)

American willowherb (Epilobium ciliatum)

Rosebay willowherb (Epilobium angustifolium)

Hairy bittercress (Cardamine hirsuta)

New Zealand bittercress (Cardamine corymbosa)

Hairy bittercress
Flexuous bittercress (*Cardamine flexuosa*)

Mouse-ear chickweed (*Cerastium fontanum*)

Mouse-ear chickweed

Pearlwort (*Sagina procumbens*)

Willow (*Salix caprea*)

Sorrel (*Rumex spp.*)
Creeping yellow cress (*Rorippa sylvestris*)

Liverwort (*Marchantia polymorpha*)

Weed sources

- Growing media
- Dirty pots and trays
- Irrigation water
- Container beds, paths and surrounding areas
- Cuttings and liners
- Old stock
- Waste heaps and skips

Ensure water tanks are covered to prevent contamination
Cover growing media to prevent contamination

Green waste should be covered, particularly if weeds are included

Recycle or sterilise if re using pots / trays
Nursery hygiene measures

They are about reducing weed pressure by:

- Covering growing media storage areas
- Covering irrigation water tanks
- Controlling background weed pressure (e.g. paths, beds, old stock)
- Distancing waste heaps from the production area (10 metres)
- Keeping reservoir banks clean (incl. near abstraction points)
- Using clean pots and trays (e.g. biodegradable pots)
- Crop monitoring and hand weeding (before weed flowering)

Cultural and non-chemical weed control measures

They are about:

- Maintaining nursery hygiene to reduce weed pressure
- Growing not ‘anchoring’
- A measured approach to irrigation
- Using capillary / drip point irrigation
- Being prepared to hand weed
- Using non-chemical weed control measures as an alternative to herbicide programmes where appropriate
Mulch applicator

Coir pot topper
Container mulch investigations

David Kerr, Ornamental Crops Adviser, Greenmount Campus
College of Agriculture Food & Rural Enterprise
david.kerr@dardni.gov.uk

Question

• If you were going to invent a system to control weeds in container-grown crops what would you do?

Background

- Herbicides are mainly pre-emergence
- Loss of existing herbicides e.g. Ronstar (oxadiazon)
- Cost of hand weeding
- Cost of preparing plants for dispatch

Ornamental production in Northern Ireland

• 100 growers, value of production £16m
• Family businesses
• Small market
• Wide range of crops
• Small numbers

Cafre investigations

• Started in 2010 with a general evaluation of mulches available
• During 2013 a more specific evaluation of locally available mulch products e.g. Unique pot topper - blend of recycled fabrics, was undertaken

Criteria for container mulches

• Ease of application
• Durability
• Permeability
• Prevention of weed germination
• Cost effectiveness
Horticulture Technology
Evaluating container weed control mulches
2010

Chickweed seeds were introduced in the substrate and germinating weeds counted for the following toppers:
- Bark
- Rubber crumb
- Hemp
- Geo textile
- Coco disk
- No topper

After one season, container mulch materials reduce weeds, moss and liverwort growth on the surface of the pots.

Applying 40 weed seeds

Knowledge and Technology Transfer (KTT) Project 2013

- Under the Invest NI Support to business programme an Innovation Voucher was awarded to Unique Garden Products
- This allowed a detailed investigation at Greenmount Campus of the Unique pot topper container mulch, a local product made from a blend of recycled fabrics.

Average weed germination per container - 2010 project

Weed growth in pots with and without topper (pot top left was unseeded)

Topper prevented weeds germinating
Delta T meter – measures moisture and temperature

Moisture level with pot topper
- Allows normal wetting and drying cycle
- Retention of moisture for longer
- Absorbs and holds moisture
- Could reduce frequency of watering

This requires further investigation

Liverwort – after three months

Unique pot topper applied for three months prevented liverwort

Unique pot topper on left pulled back to show prevention of liverwort. No pot topper on right

Results - Unique pot topper
- This product was of a soft and flexible nature
- It was easy to apply on the containers
- If the topper was slightly larger than the pot it was still possible to apply due to it’s flexible nature
- Topper was durable and did not shrink over time
Unique pot topper after 12 months

Pot topper management

- The topper is placed on the pot after potting or it can be applied a few weeks after potting
- Pot topper placement should not allow any gaps around edge of the pot
- A small number of weeds can germinate at the edges of the pot or where there are gaps

Pot topper management

- Water management by observing dryness of top of container is not possible
- Lift a sample number of pots to assess watering need by weight

Nine growers in Northern Ireland using pot toppers

Growers more likely to adopt if:

- Producing a wide range of crops
- Growing small numbers of each variety
- Cost dispatch accurately
- Cost hand weeding accurately

Pot toppers on 9cm pots – early control of weeds is important
Liverwort grows on some materials

Record costs of weed control

By crop X batch Y.
• Labour hand weeding (hours)..........
• Herbicide material costs/crop.........
• Herbicide application (hours).........
• Weeding at dispatch (hours)..........

The future

• New mulches with lower price point
• Reduce price barrier
• Incorporate fertiliser, insect repellents etc.
Outline

1. Introduction – AHDB Crop Protection Team
2. The challenge
3. What’s approved in ornamental crops?
4. New herbicides/approvals?

AHDB Crop Health & Protection Team

Head of Crop Health & Protection – Jon Knight

Extension of Use Programme

Vivian Powell
vivian.powell@ahdb.org.uk

Bolette Palle Neve
bolette.palle-neve@ahdb.org.uk

What are we doing to get new approvals?

- Frequent liaison with AgChem companies
- European collaborations (Commodity Expert Group)
- Good links to the US (IR4 and others)

Extension of use programme (EAMUs)

- Product must be authorised on a UK crop
- Edible crops must be supported by residues data
- No crop safety or efficacy data
- Letter of Access from approval holder
- New uses but also re-registering current uses!

Agricultural weeds are a major constraint to sustainable agriculture

Herbicides account for 41% of global pesticide market

Herbicides account for 41% of global pesticide market

Pathogens
Viruses
Animal pests
Weeds
What’s approved in ornamental crops?

- Long Term Arrangements for Extension of Use
  https://secure.fera.defra.gov.uk/ltaeu/search.cfm

- CRD’s website
  http://www.hse.gov.uk/pesticides/topics/databases.htm

<table>
<thead>
<tr>
<th>Product</th>
<th>Proposed use</th>
<th>Progress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium bicarbonate (basic substance)</td>
<td>Control of liverwort in containers</td>
<td>Extension of current approval</td>
</tr>
<tr>
<td>Sencorex Flow (metribuzin)</td>
<td>Post-em outdoor, Pre-em/post-planting indoor</td>
<td>New EAMU in discussion</td>
</tr>
<tr>
<td>Successor (pethoxamid)</td>
<td>Outdoor and protected ornamentals</td>
<td>EAMU application to be submitted for new formulation</td>
</tr>
<tr>
<td>Logo (fonamsuluron + isodinefunguron-methyl-sodium)</td>
<td>Outdoor ornamentals</td>
<td>EAMU application submitted to CRD</td>
</tr>
<tr>
<td>HDC H25 (isoxaben + oryzalin)</td>
<td>New granular herbicide, known in other markets as 'Winshot'</td>
<td>Approval expected mid-2017</td>
</tr>
<tr>
<td>Gozai (pyraflufen-ethyl)</td>
<td>Directed spray, two applications</td>
<td>New EAMU in discussion</td>
</tr>
<tr>
<td>Centurion Max (clethodim)</td>
<td>Outdoor ornamentals</td>
<td>Covered by LTAEU but EAMU application in discussion</td>
</tr>
<tr>
<td>Metobromuron</td>
<td>Outdoor ornamentals</td>
<td>EAMU application to be submitted for new formulation</td>
</tr>
</tbody>
</table>

Thank you
bolette.palle-neve@ahdb.org.uk
Office: 02476 478884
Mobile: 07896 941874
Weed control in container-grown hardy nursery stock

Available herbicide products and programmes – John Atwood, ADAS

Herbicide products

- Available herbicide products
- Herbicide programmes for:
  - General nursery stock – designing a 12 month programme
  - Herbaceous and alpine crops
  - Moss and liverwort control
  - Beds and paths

Herbicides for container production

Flexidor 500 (isoxaben)

- New formulation is 4 x concentration of previous
- No recommendation for use under protection
- Popular and widely used
- Outstanding control of bittercress
- Lasts up to 18 weeks
- Use in programmes for best results
- Some HNS subjects are sensitive
- Poor control of willowherb and groundsel
- No control of grasses, moss and liverwort

Flexidor damage on Buddleja

Flexidor damage on Cornus
Flexidor damage on *Lavatera*

Butisan S (metazachlor)

- Butisan S authorised for use for ornamental plant production but no label for container HNS. Other products e.g. Sultan can be used.
- No more than 1000 gm /ha metazachlor in 3 years on same field.
- Can only be used at 1.5 L/ha one year in 3 (or 0.66 L/ha annually).
- Can damage soft growth, safer in autumn / winter period.
- Good weed control spectrum incl. liverwort, willowherb and groundsel.
- Use in programmes with Flexidor 500 or mix.
- Some HNS subjects are sensitive (e.g. herbaceous).

Delayed growth on *Cotoneaster* liners

Devrinol (napropamide)

- Wide range of recommendations on trees and shrubs.
- Not on label but can be used on herbaceous.
- Winter use, needs rain/irrigation to wash in.
- Summer use now permitted under EAMU.
- Long persistence.
- Good control of groundsel, chickweed and willowherb.
- Poor control of bittercress.
- Tank mix with Flexidor 500 for best results.

Devrinol – phytotoxicity from summer use

*Santolina Delphinium*
**Venzar (lenacil)**

- Long Term Arrangement for Extension of use in UK
- Excellent control of liverwort, bittercress and willowherb
- Moderate control of groundsel
- Conifers can be safely treated – not Cryptomeria, Taxus
- Useful option for conifers and some herbaceous crops
- Lasts < 18 weeks
- Very soluble (leaching): avoid spring/summer application
- Can persist in container beds

**Sumimax (flumioxazin)**

- EAMU outdoor ornamentals
- Winter use only due to contact action
- Used in USA but mainly granular product
- Some experience in UK (risky on evergreens, Cornus, herbaceous)
- Broad weed control spectrum up to 3-4 true leaf in winter

**Leaf scorch Pyracantha**
Leaf scorch *Ligustrum*

*Cornus ‘Hedgerow Gold’*

**Dual Gold (s-metolachlor)**

- EAMU outdoor ornamentals May 1 – 31 application window
- Mix with Flexidor 500
- Adds willowherb, grasses, some groundsel control
- Can cause slight damage to tips
- Potential use on herbaceous

**Buddleja ‘Lochinch’**

*Phytotoxicity - Dual Gold + Flexidor 500 2 WAT*

*Cotinus ‘Grace’*
HDC H25

- Granular herbicide to replace Ronstar 2G
- One application per crop
- Not authorised under protection
- Broad weed control spectrum
- Pre-emergence liverwort control
- Very safe, even on herbaceous

HDC H25 – percentage control

<table>
<thead>
<tr>
<th>Weed</th>
<th>% control</th>
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<tbody>
<tr>
<td>Annual meadow grass</td>
<td>90</td>
</tr>
<tr>
<td>Bittercress – hairy</td>
<td>100</td>
</tr>
<tr>
<td>Bittercress - NZ</td>
<td>82</td>
</tr>
<tr>
<td>Bittercress - flexuous</td>
<td>85</td>
</tr>
<tr>
<td>Chickweed</td>
<td>97</td>
</tr>
<tr>
<td>Groundsel</td>
<td>75</td>
</tr>
<tr>
<td>Mouse ear chickweed</td>
<td>91</td>
</tr>
<tr>
<td>Pearlwort</td>
<td>100</td>
</tr>
<tr>
<td>Willowherb</td>
<td>95</td>
</tr>
</tbody>
</table>

Springbok (dimethenamid-p + metazachlor)

- EAMU permits use over crop but not hand held equipment, six day no entry, 50 day gloves (EN374-2:2003, level 2) for handling
- Similar safety to Butisan S, some effect on soft growth,
- Not on herbaceous
- Only low (1.6 L/ha) rate approved in UK over HNS
- Moderate weed control due to low rate
- Can use annually without exceeding metazachlor limit

Springbok 1.6 L/ha - control

<table>
<thead>
<tr>
<th>Weed</th>
<th>Control</th>
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<tbody>
<tr>
<td>Annual meadow grass</td>
<td>Poor</td>
</tr>
<tr>
<td>Bittercress – hairy</td>
<td>Moderate</td>
</tr>
<tr>
<td>Bittercress - NZ</td>
<td>Moderate</td>
</tr>
<tr>
<td>Bittercress - flexuous</td>
<td>Poor</td>
</tr>
<tr>
<td>Chickweed</td>
<td>Poor</td>
</tr>
<tr>
<td>Groundsel</td>
<td>Moderate</td>
</tr>
<tr>
<td>Mouse ear chickweed</td>
<td>Poor</td>
</tr>
<tr>
<td>Pearlwort</td>
<td>Good</td>
</tr>
<tr>
<td>Willowherb</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
**Springbok - Hydrangea**

**Successor (pethoxamid)**

- Available in UK but yet not approved on HNS
- Slight effect on soft growth
- Good potential for use on herbaceous
- Weed control, good on pearlwort, moderate, groundsel, willowherb, some bittercress but poor on flexuous

**Successor - control**

<table>
<thead>
<tr>
<th>Weed</th>
<th>% control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual meadow grass</td>
<td>Poor</td>
</tr>
<tr>
<td>Bittercress - hairy</td>
<td>Moderate</td>
</tr>
<tr>
<td>Bittercress - NZ</td>
<td>Moderate</td>
</tr>
<tr>
<td>Bittercress - flexuous</td>
<td>None</td>
</tr>
<tr>
<td>Chickweed</td>
<td>Poor</td>
</tr>
<tr>
<td>Groundsel</td>
<td>Moderate</td>
</tr>
<tr>
<td>Mouse ear chickweed</td>
<td>Poor</td>
</tr>
<tr>
<td>Pearlwort</td>
<td>Good</td>
</tr>
<tr>
<td>Willowherb</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

**Successor – post-potting slight effects**

**Springbok + Successor mix**

**Container tree and shrub programme**

- After potting – Flexidor 500 (+ Dual Gold)
- Late summer - Springbok
- Late autumn / winter - Flexidor 500 + Devrinol (or Sumimax for selected crops)
- One year+ after potting - Flexidor 500 (+ Dual Gold)
Moss and liverwort control

Control measures:
- Cultural controls
- Biocides
- Herbicides

Cultural control HNS 93c HNS 126

- Reduce overhead irrigation
- Avoid excess liquid feeding
- Mulches
- Reduce percentage peat in growing media
- Growing media supplements

Effect of mulches on liverwort

C = Copper (Fungex)  F = FeSO₄  L = lenacil

Moss and liverwort control in liners HNS 93c

Available herbicide products and programmes – John Atwood, ADAS

Effect of growing media on liverwort

Control  Sylvafibre + herbicide
Cork granules

Liverwort

Tested 15 treatments for liverwort control, for contact and residual action when applied either in summer or winter

Liverwort - treatment list post-emergence

<table>
<thead>
<tr>
<th>Trt No.</th>
<th>Product</th>
<th>Rate kg L/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Untreated</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Chikara (flazasulfuron)</td>
<td>0.15</td>
</tr>
<tr>
<td>11</td>
<td>Acetic acid</td>
<td>250.0</td>
</tr>
<tr>
<td>12</td>
<td>Finalsan Plus (pelargonic acid + maleic hydrazide)</td>
<td>220.0</td>
</tr>
<tr>
<td>13</td>
<td>Quickdown (pyraflufen-ethyl)</td>
<td>0.8</td>
</tr>
<tr>
<td>14</td>
<td>Reglone (diquat)</td>
<td>2.0</td>
</tr>
<tr>
<td>15</td>
<td>HNS H22</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Springbok (metaachlor + dimethenamid-p)</td>
<td>1.66</td>
</tr>
</tbody>
</table>

Liverwort - treatment list post-emergence

<table>
<thead>
<tr>
<th>Trt No.</th>
<th>Product</th>
<th>Rate kg or L/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>HNS H25</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Sumimax (flumioxazine)</td>
<td>0.1</td>
</tr>
<tr>
<td>19</td>
<td>Venzar Flow (lenacil)</td>
<td>5.8</td>
</tr>
<tr>
<td>20</td>
<td>Wing-p (pendimethalin + dimethenamid-p)</td>
<td>3.5</td>
</tr>
<tr>
<td>21</td>
<td>MMC Pro Moss Killer (didecyl dimethyl ammonium chloride)</td>
<td>200</td>
</tr>
<tr>
<td>22</td>
<td>MMC Pro Moss Killer (ddac) + Reglone (diquat)</td>
<td>200 + 2.0</td>
</tr>
<tr>
<td>23</td>
<td>Mosskade (natural substances)</td>
<td>100</td>
</tr>
<tr>
<td>24</td>
<td>Sodium bicarbonate</td>
<td>122 as powder</td>
</tr>
</tbody>
</table>

Liverwort post-emergence (% green thallus) summer

Liverwort post-emergence (% green thallus) winter
Liverwort post-emergence

Liverwort - treatment list pre-emergence

<table>
<thead>
<tr>
<th>Trt No.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Untreated</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Chikara (flazasulfuron)</td>
<td>0.15</td>
</tr>
<tr>
<td>3</td>
<td>Finalsan Plus (pelargonic acid + maleic hydrazide)</td>
<td>166</td>
</tr>
<tr>
<td>4</td>
<td>Successor</td>
<td>2.0</td>
</tr>
<tr>
<td>5</td>
<td>Springbok (metazachlor + dimethenamid-p)</td>
<td>1.66</td>
</tr>
<tr>
<td>6</td>
<td>HNS H25</td>
<td>2.50</td>
</tr>
<tr>
<td>7</td>
<td>Sumimax</td>
<td>0.10</td>
</tr>
<tr>
<td>8</td>
<td>Venzar Flow</td>
<td>5.00</td>
</tr>
<tr>
<td>9</td>
<td>Wing-P</td>
<td>3.50</td>
</tr>
</tbody>
</table>

Herbicides with activity against moss and liverwort

- Venzar Flowable (pre and post)
- Metazachlor products (pre and post)
- Springbok (pre and post)
- HDC H25 (pre)
- Sumimax – (pre and post)
- Wing-P (pre)
- Chikara (pre)
- Reglone (post)

Fungicides and biocides with activity against moss or liverwort

- Mogeton (quinoclamine)
- MMC Pro Moss Killer
- Sodium bicarbonate

Container beds and paths

Container beds:

- Chikara (on beds before stocking with trees and shrubs)
- Sumimax (or Wing-P) + Flexidor 500 (on beds before stocking with herbaceous etc.)

Paths:

- Chikara (approved for “land not intended for cropping” and around “amenity plantings”)

Available herbicide products and programmes – John Atwood, ADAS
Chikara

- Non cropped land use only
- Replacement for Diuron, Casoron G
- 3-4 month persistence
- Good weed control spectrum but no control of speedwell, black nightshade, black bindweed
- Broad leaved weeds, grasses, moss and liverwort
- Tested also as sand bed treatment and dormant season treatment on shrubs

Prevention of rooting through on sand beds - HNS 167

- Most herbicides have minimal effect
- Stomp effective and safe for heathers
- Chikara gave good weed control
- Chikara an effective sand bed treatment for some shrubs, only approved for weed control
- Chikara not approved for use over crops

HNS under protection

- Devrinol – needs to be washed in
- Metazachlor products (low rate)
- Goltix 70 SC as pre-emergence on beds

Herbaceous perennials and alpines

Main residual herbicides used:
- Flexidor 500
- Venzar Flowable – only in winter
- Devrinol (not on alpines) – only in winter
- Dual Gold – May only
- HDC H25 - not yet approved
- Successor - not yet approved

Reference (HNS 35e, HNS 166, HNS PO 192)
Flexidor - typical damage to herbaceous

Dual Gold – Echinacea

Container herbaceous programme

- After potting – Flexidor 500 (+ Dual Gold)
- Late autumn / winter – Flexidor 500 + Devrinol (or Venzar Flowable for selected crops)

Any questions, thank you?
Weed management in container nurseries
Principles and recent research findings

Joseph C. Neal
Professor of Weed Science, NC State University

A typical container production system in the USA

- Many sizes of nurseries:
  - Small (~4 ha), medium (15 to 25 ha), large (80 to 120 ha). The majority – medium
  - Most produce a diversity of woody crops in 4 L and 10 L pots, but many larger containers
  - Purchase 20% to 40% of cuttings / seedlings; self-propagate the rest
  - Specialty nurseries – propagation, trees, ferns, “colour”

Even herbaceous production can be large numbers

Zelenka nursery, Sims NC. About 100 ha in colour production. Most crops in 3 L pots but some in 10 L containers

Weed management in container nurseries

- PRE herbicides
  - Broad spectrum GR products
  - Combinations of “broadleaf and grass” herbicides
  - 3 to 6 applications each year
  - Supplemented with hand weeding

PRE herbicides for container nurseries

- Broad spectrum
  - Oxyfluorfen + dinitroaniline (OH2, Rout, Biathlon G)
  - Isoxaben + dinitroaniline (Snapshot G, Gemini L)
  - Flumioxazin (Broadstar G, Sureguard DF)
  - Indaziflam (Marengo G & SC)
  - Dimethenamid-p (Tower EC) also + pendimethalin (Freehand G)

- Narrower spectrum
  - Pendimethalin (Pendulum G & EC)
  - Prodiamine (Barricade L, Regalkade G)
  - Oxadiazon (Ronstar G) also + oxyfluorfen (Regal O2)
  - S-metolachlor (Pennant Mag, EC)
  - Napropamide (Dewrinol)

How do I choose the best one(s)?

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Active ingredient</th>
<th>PPD (E – 14)*</th>
<th>Cell division (K1 – 3)</th>
<th>Cell wall synthesis (L – 21)</th>
<th>Long chain fatty acid synthesis (K3 – 15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barricade</td>
<td>Prodiamine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadstar</td>
<td>Flumioxazin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gallery</td>
<td>Isoxaben</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal</td>
<td>Oxyfluorfen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marengo</td>
<td>Indaziflam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tower</td>
<td>Dimethenamid-p</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pennant</td>
<td>S-metolachlor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surflan</td>
<td>Oryzalin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surflan</td>
<td>Oryzalin</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

26
MOA groups – combo products

<table>
<thead>
<tr>
<th>Trade name</th>
<th>Active ingredient(s)</th>
<th>PPO (E–14)*</th>
<th>Cell division (K1–3)</th>
<th>Cell wall synthesis (L–21)</th>
<th>Fatty acid synthesis (K3 –15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O'H2, Rout, Biathlon, Lejpa</td>
<td>oxyfluorfen + dinitroaniline</td>
<td>Green</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Blue</td>
</tr>
<tr>
<td>Snapshot</td>
<td>isoxaben + trifluralin</td>
<td>Green</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Blue</td>
</tr>
<tr>
<td>Freehand</td>
<td>dimethenamid-p + pendimethalin</td>
<td>Green</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Blue</td>
</tr>
<tr>
<td>Regal O0</td>
<td>oxyfluorfen + imadiazon</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
</tbody>
</table>

Fewer herbicides are available for use in UK nurseries

- Isoxaben – L
- Flumioxazin – E
- Metazachlor – K3 MOA
- Napropamide – K3
- Dimethenamid-p – K3 (with pendimethalin)
- S-metolachlor – K3

Weeds cost you in several ways

Crop competition

Weeds cost you in several ways

- Herbicides: ~ $0.05 per pot
- Nitrogen fertilizer lost (removed in weed biomass): ~ $0.04 per pot
- Hand weeding:
  - $0.40 to $0.70 per pot (hand weeding only)
  - $0.05 to $0.10 per pot (with herbicides)

How do you reduce costs?

With an effective weed management programme

- Hand weeded: 61 man-hours & 135 lb weeds
- Effective pre-H: 0.8 man-hour & 3 lb weeds

So, how do we get the most out of what you have?
Nursery weed management

- Weed identification
- Sanitation
- Pre-emergence herbicides
- Post-emergence herbicides
- Hand weeding
- Refining the system to save $$$

Sanitation - managing weed sources

- Prevent introduction of new weeds
- Identify sources
  - Liners
  - Pots / flats
  - Substrate

What can be done about it?

- Inspect liners when they arrive and after they are potted
- Produce your own liners?

Don’t introduce weeds into the system - clean liners before potting

Manage sources on the nursery!
Sanitising trays and pots

- Rinsing propagation trays with water reduced Cardamine seedlings 7-fold
- Steam sterilization
  - 70 to 80°C; ~4 hours killed most pathogens and weed seeds
- Dry heat was much less effective

Hand weed frequently to prevent spread

- Container weeds disperse their own seeds
  - Bittercress – 6 ft
  - Oxalis – up to 12 ft
  - Mulberryweed – 4 ft
  - Phyllanthus – 2 to 3 ft ??
  - Spurge – 2 to 3 ft ??
  - Groundsel – wind dispersed

Remove the weeds – don’t just pull them!

Pre-emergence herbicide use in container nurseries

- PRE herbicides
  - Broad spectrum GR products
  - Combinations of “broadleaf & grass” herbicides
- 3 to 6 applications each year
- Yet, weeds continue to emerge requiring hand removal

Research results from across the pond

- Longevity of herbicide residual in containers
- Reducing crop injury from spray applications
- Using mulches for weed control
- Cost comparisons of different approaches to hand-weeding
How long do our PRE herbicides last?

Weeds were surface seeded 0, 2, 4, 6 and 8 weeks after treatment (WAT)

4-litre pots filled day 0
Treated day 0
3 pots per species

Weed species used

Residual *Digitaria* control in containers

Bittercress
Weeks of > 80% control

<table>
<thead>
<tr>
<th>Species</th>
<th>Broadstar</th>
<th>OH2</th>
<th>Snapshot</th>
<th>Freehand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardamine</td>
<td>7.3</td>
<td>11.7</td>
<td>6.3</td>
<td>4</td>
</tr>
<tr>
<td>Eclipta</td>
<td>2.9</td>
<td>1.5</td>
<td>3.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Digitaria</td>
<td>6.1</td>
<td>9.2</td>
<td>5.1</td>
<td>5.5</td>
</tr>
<tr>
<td>Phyllanthus</td>
<td>9.8</td>
<td>9.3</td>
<td>2.5</td>
<td>2</td>
</tr>
</tbody>
</table>

Implications and questions

- Longevity of control depends on the weed species, the herbicide, dose, and climate (longer residual in cool climates)
- Longevity of control is less than typical re-application intervals
- But, we cannot apply herbicides any more frequently than we already do

Refining the system

- Product choice
  - Best product for the weeds and crops
  - Herbicide rotations
- Spray treatments are often more effective than granular herbicides

Spray applications

- Generally, liquid herbicides cost less than granules
- Efficacy is usually better with spray applications
- But, crop injury is greater from spray treatments

How can we reduce crop injury from spray-applied herbicides?

- Dormant applications – reduce injury to woody and herbaceous ornamentals
- Right product / right crop
  - Isoxaben injures hydrangea
  - Dimethenamid-p is less injurious to hydrangea
- Do not let the spray dry on the foliage
### Treatments

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Treatment to irrigation interval (minutes)</th>
<th>% necrotic tips 10 DAT</th>
<th>Plant quality 55 DAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-treated</td>
<td>-</td>
<td>0 c</td>
<td>76 a</td>
</tr>
<tr>
<td>Tower (dimethenamid-p)</td>
<td>120</td>
<td>18 b</td>
<td>72 a</td>
</tr>
<tr>
<td>Tower (dimethenamid-p)</td>
<td>15</td>
<td>0 c</td>
<td>70 a</td>
</tr>
<tr>
<td>Tower (dimethenamid-p)</td>
<td>During irrigation</td>
<td>0 c</td>
<td>74 a</td>
</tr>
<tr>
<td>Gallery (isoxaben) SC + Barricade (prodiamine) 4L</td>
<td>120</td>
<td>66 a</td>
<td>43 b</td>
</tr>
<tr>
<td>Gallery (isoxaben) SC + Barricade (prodiamine) 4L</td>
<td>15</td>
<td>68 a</td>
<td>49 b</td>
</tr>
<tr>
<td>Gallery (isoxaben) SC + Barricade (prodiamine) 4L</td>
<td>During irrigation</td>
<td>11 bc</td>
<td>69 a</td>
</tr>
</tbody>
</table>

**Something besides herbicides?**

**Mulches control weeds by excluding light**

Research suggests ½ inch layer of rice hull mulch controls bittercress

**½ inch layer of rice hull mulch controls weeds placed on top, not those germinating from below**

**Rice hull mulch**

Preen Mulch Plus = wood mulch impregnated with isoxaben + trifluralin

**But, there’s nothing that special about rice hulls**
Weeding frequency -

Weeded once before re-treatment vs weeded every 2 weeks

Cumulative time (man-hours) to hand weed pots
Hand weeded 250 pots on 2-week or 8-week intervals
NCSU 2014

Weeding frequently vs “when its weedy”
- 50% to 80% reduction in weeds
- 0 to 60% reduction in time spent weeding
- Average: 30% reduction in labor costs
- Challenge – labor management. If you miss a cycle, it is very hard to catch up

And yet, we still have weeds!
- Can we reduce weed reproduction and spread?

How quickly does spurge reproduce?
Hand weeded before re-treatment @ 8-week intervals vs weeded every 2 weeks

Weeding frequently vs “when its weedy”
- 50% to 80% reduction in weeds
- 0 to 60% reduction in time spent weeding
- Average: 30% reduction in labor costs
- Challenge – labor management. IF you miss a cycle, it is very hard to catch up

To be effective, frequent weeding must be part of an overall sanitation plan