Herbicides for container-grown hardy nursery stock masterclass

James Coles & Sons (Nurseries), 624 Uppingham Road, Leicester LE7 9QB

Tuesday 29th October 2024

Contents

Agenda

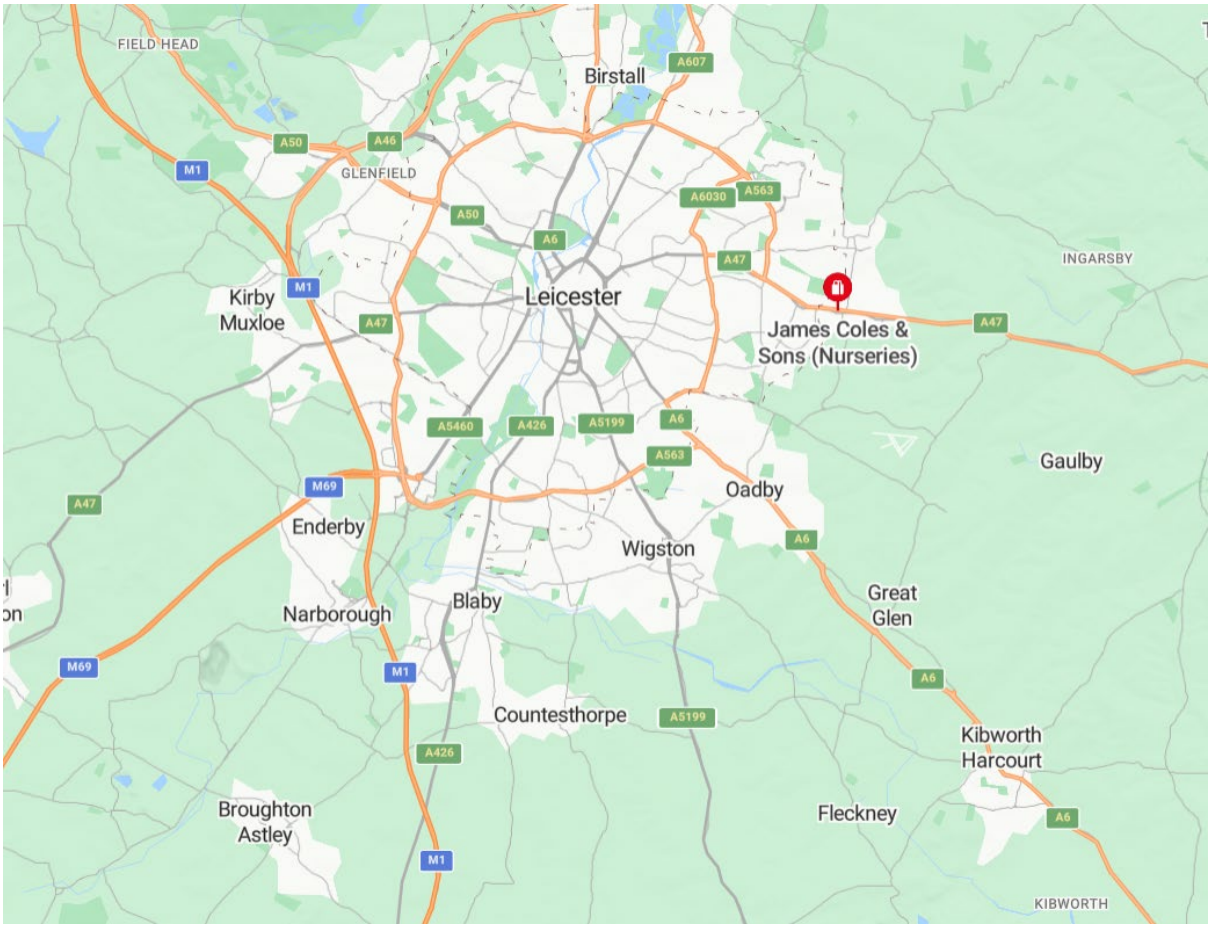
Time	Content	Speaker
James Coles & Sons (Nurseries), Leicester		
09:00 – 09.30	*Coffee, tea, and refreshments*	
Presentations		
09:30 – 10:30	**Common weeds associated with container-grown HNS crop production and their biology** **Weed identification – a practical session to hone identification skills**	Wayne Brough, **HTA**
10:30 – 11:15	**Herbicide products approved for container-grown HNS, modes of action and resistance management, approval specifics and restrictions**	Selchuk Kurtev, **Zest Sustainable ICM**
11:15 – 11:30	*Coffee, tea, and refreshments*	
11:30 – 12:30	**Pre-emergence, selective contact and total herbicide options for container-grown HNS crops** **Herbicide damage symptoms caused by various active substances**	Selchuk Kurtev and Wayne Brough, **Zest Sustainable ICM and HTA**
12:30 – 13:30	*Lunch buffet*	
Practical session		
13:30 – 15:00	**Desktop exercise – planning an herbicide programme for example crops –** programme creation to optimise weed control for example crops with discussion	**All delegates**
15:00 – 15:30	**Summary quiz to establish learnings from the day** – an engaging multiple-choice quiz to round off the masterclass	**All delegates**
15:30	*Wrap up and depart*	

BASIS and NRoSO continued professional development points will be available on the day of the workshop.

Location

Addresses and locations:

James Coles & Sons (Nurseries), 624 Uppingham Road, Leicester LE7 9QB
What3words: ///woof.blues.else



Common weeds associated with container-grown HNS crop production and their biology

Wayne Brough, HTA

Notes

zest Sustainable ICM

HTA

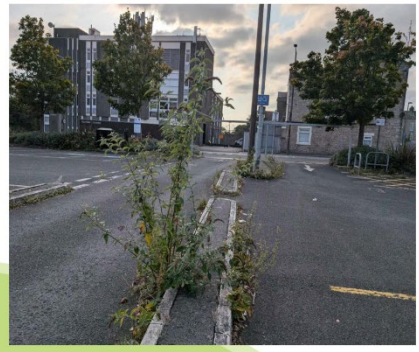
COMMON WEEDS ASSOCIATED WITH CONTAINER-GROWN HARDY ORNAMENTAL NURSERY STOCK CROP PRODUCTION AND THEIR BIOLOGY

WAYNE BROUGH, TECHNICAL HORTICULTURE MANAGER

What is a weed?

HTA

'A weed is a plant considered undesirable in a particular situation, growing where it conflicts with human preferences, needs, or goals'.



What makes a good weed?

HTA

- Is robust and vigorous.
- Can propagate itself freely.
- Can survive in many environments.
- Persistent?
- Short lifecycle?

Weed lifecycles

Annual

Completes its lifecycle in one year and sets seeds for the next year.

Perennial

Lives for many years as a single plant and sets seeds from the same plant every year.

Biennial

Completes its lifecycle in **TWO** years and sets seeds for next year (often with a different habit between years).

Weed distribution

Seed

- Wind-blown.
- Explosively thrown.
- Sticky, attached to pots, clothing, tools etc.

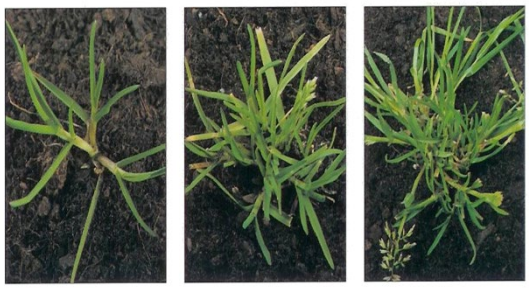
Spores

Roots

- Fragments in growing media and liners.

General – on matting and beds, young/old stock, bought-in stock, in irrigation water, background pressure around the nursery, adjacent fields etc.

Annual meadow-grass (*Poa annua* L.)



Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

- Main grass species of container-grown plants.
- Low growing, slightly creeping with flower spikelets.
- Perennial biotypes exist.
- Can be found overwintering following autumn germination.
- Found in propagation as well as production.
- Spread from old stock, on cutting material, re-used pots, on clothes etc.

Solid yellow – main period

Light yellow – when favourable conditions

https://archive.ahdb.org.uk/knowledge-library/practical-weed-control-for-nursery-stock

Notes

Bittercress, hairy (*Cardamine hirsuta* L.)

Flowering period

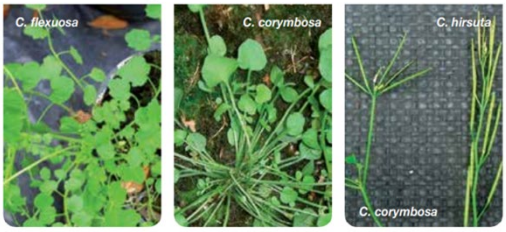
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	■	■	■	■	■	■	■	■	■	■	

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			■	■				■			

- Abundant weed of container-grown crops.
- Short annual, sometimes biennial with compact rosette of pinnate leaves.
- Flowers small and white.
- Found in propagation as well as production.
- Can flower and set seed rapidly.
- Exploding seed pods. Seed can be found on adjacent plants, re-used pots etc.

Bittercress, flexuous and New Zealand



Plant feature	Hairy bittercress *C. hirsuta*	Flexuous bittercress *C. flexuosa*	New Zealand bittercress *C. corymbosa*
Rosette	Tight and leafy	Open	Open, abundant prostrate stems
Stems	Hairy	Hairy	Few hairs
Stem leaves	1-4 per stem, hairy	5-11 per stem, hairy	0-4 per stem, few hairs
Leaflets per leaf	3-11, smooth outline	5-17, wavy outline	3-7, wavy outline
Flowers	4 stamens	6 stamens	6 stamens
Seed pods	Upright	Variable	Out-held

- Similar to hairy bittercress.
- Rosette shape and leaf number per stem used to identify each.
- Short annual, sometimes biennial.
- All three can be found on individual nurseries.
- Can be more difficult to control.

Chickweed, common (*Stellaria media*)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	■	■	■	■	■	■	■	■	■	■	

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	■	■	■	■	■	■	■	■	■	■	

- Common nursery weed.
- Vigorous, low growing, spreading annual.
- Oval leaves, small white flowers.
- Found in propagation as well as production.
- Long flowering and germination periods.
- Seeds slightly sticky, can spread on cutting material and re-used pots.

Notes

Chickweed, mouse-ear (*Cerastium fontanum*)

- Similar to common chickweed.
- Leaves hairy and downy in appearance.
- Often more rounded tip to leaf.
- Slightly reduced flowering and germination periods.

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			■	■	■	■	■	■	■	■	

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			■	■	■	■	■	■	■		

Groundsel (*Senecio vulgaris* L.)

- Widely distributed on nurseries.
- Short growing annual, with succulent leaves.
- Leaves pinnately lobed.
- Flowers yellow in loose clusters.
- Fluffy wind-blown seed.
- Can flower and set seed quickly through year.
- Can be problematic on old stock.

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
■	■	■	■	■	■	■	■	■	■	■	■

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	■	■	■	■	■	■	■	■	■		

Liverwort (*Marchantia polymorpha* L.)

- Lower plant (bryophyte), forming slimy green layer on the media surface.
- Spore producing bodies when mature.
- Problematic in propagation and under protection.
- Encouraged by over-watering.
- Spread by fragments and spores.

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■						

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			■	■	■	■	■	■	■		

Notes

Moss (*Funaria hygrometrica*)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■	■					

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			■	■	■			■	■		

- Another lower plant (bryophyte), forming a matted layer on the media surface.
- Brown stalked brown spore producing bodies when mature.
- Problematic in propagation and production.
- Spores are water and wind spread.

Oxalis (*Oxalis* spp.)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■	■	■	■	■		

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
			■	■							

- An occasional problem on nurseries.
- Low creeping annual/perennial.
- Leaves brown and three-lobed.
- Small yellow flowers.
- Seed ejected from exploding seed pods.
- But can be spread by root fragments in media and stock.
- Problematic in propagation and under protection.

Pearlwort, common (*Sagina procumbens* L.)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■	■	■	■			

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	■	■	■	■	■	■	■	■	■	■	

- Problematic on some nurseries.
- Vigorous low growing perennial, spreading from green star-like rosettes.
- Flowers tiny and greenish white.
- Can form a thick mat when abundant.
- Seed can stick to cutting material, re-used pots, clothing etc.

Notes

Sowthistle, common (*Sonchus oleraceus* L.)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■	■	■	■	■	■	

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						■	■	■	■		

- Occasional problem on nurseries.
- Medium greyish green annual, forming a tap rooted rosette.
- Flowers pale yellow and thistle-like.
- Fluffy seed heads when mature.
- Seed spread by wind.

Willow (*Salix spp.*)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		■	■								

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■						

- Can be problematic where seed is blown in from perimeter and beyond.
- Tree seedling, oval leaves, downy grey on underside.
- Fluffy seed are wind dispersed in quantities.
- Once established difficult to hand weed.

Willowherb (*Epilobium spp.*)

Flowering period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				■	■	■	■	■			

Germination period

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
■	■	■	■	■			■	■	■	■	■

- Widely distributed on nurseries.
- Number of different species, most common are medium sized perennials.
- Leaves lanceolate.
- Basal rosette can form.
- Small pink flowers give rise to fluffy seed.
- Wind-blown seed.
- Problem in final production.

Notes

Notes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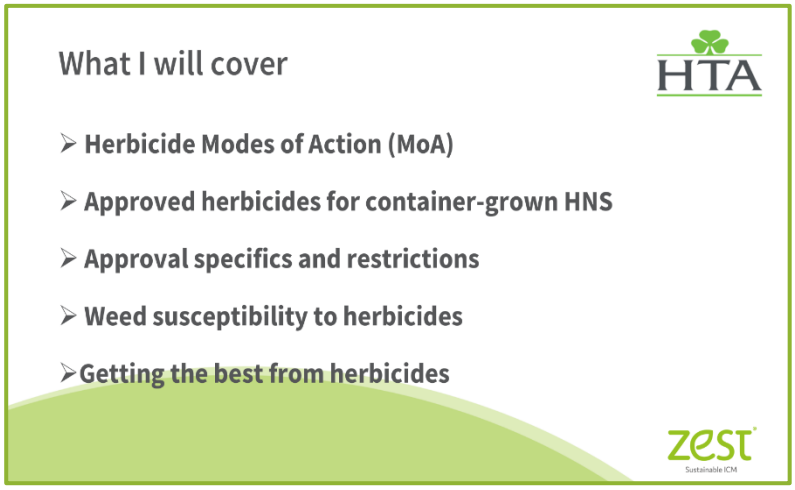
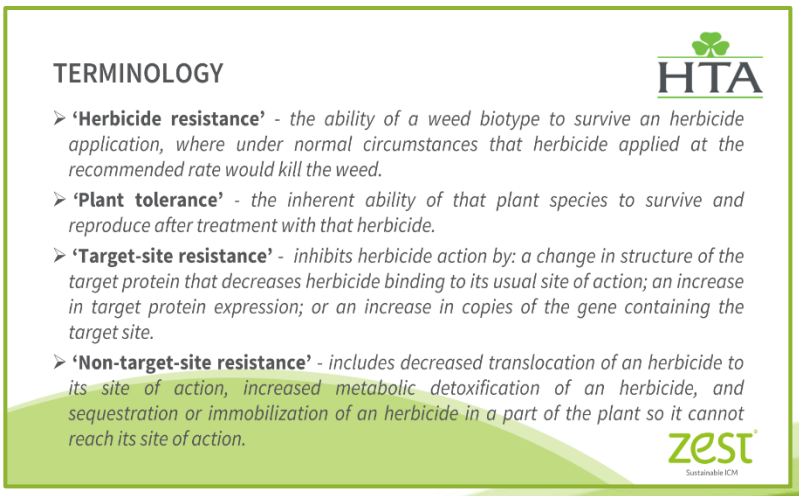
THANK YOU….
NEXT THE IDENTIFICATION PRACTICAL
ACKNOWLEDGEMENTS – 'HDC PRACTICAL WEED CONTROL FOR NURSERY STOCK, REVISED 2013'

Herbicide products approved for container-grown HNS, modes of action and resistance management, approval specifics and restrictions

Selchuk Kurtev, Zest – Sustainable ICM

Notes





Notes

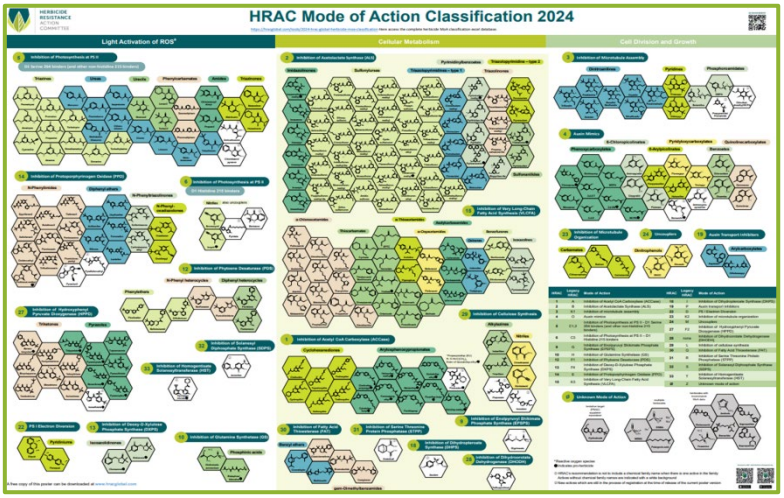
TERMINOLOGY

- **'Cross resistance'** - *occurs when a plant has one mechanism that enables plants to survive treatment with herbicides from different chemical classes or with differing modes or sites of action.*
- **'Multiple resistance'** - *refers to plants that have more than one mechanism that enables them to survive treatment with herbicides with differing modes or sites of action.*

Mode of Action (MoA)

- 3 plant processes, 24 groups, 78 chemical classes, 79 active substances
- *in HNS containers –* ***30 active substances or 27 products (O+P)***

HRAC	Legacy HRAC	Mode of Action	HRAC	Legacy HRAC	Mode of Action
1	A	Inhibition of Acetyl CoA Carboxylase (ACCase)	18	I	Inhibition of Dihydropteroate Synthase (DHPS)
2	B	Inhibition of Acetolactate Synthase (ALS)	19	P	Auxin transport inhibitors
3	K1	Inhibition of microtubule assembly	22	D	PS I Electron Diversion
4	O	Auxin mimics	23	K2	Inhibition of microtubule organization
5	C1,2	Inhibition of Photosynthesis at PS II - D1 Serine 264 binders (and other non-histidine 215 binders)	24	M	Uncouplers
			27	F2	Inhibition of Hydroxyphenyl Pyruvate Dioxygenase (HPPD)
6	C3	Inhibition of Photosynthesis at PS II – D1 Histidine 215 binders	28	none	Inhibition of Dihydroorotate Dehydrogenase (DHODH)
9	G	Inhibition of Enolpyruvyl Shikimate Phosphate Synthase (EPSPS)	29	L	Inhibition of cellulose synthesis
10	H	Inhibition of Glutamine Synthetase (GS)	30	Q	Inhibition of Fatty Acid Thioesterase (FAT)
12	F1	Inhibition of Phytoene Desaturase (PDS)	31	R	Inhibition of Serine Threonine Protein Phosphatase (STPP)
13	F4	Inhibition of Deoxy-D-Xylulose Phosphate Synthase (DXPS)	32	S	Inhibition of Solanesyl Diphosphate Synthase (SDPS)
14	E	Inhibition of Protoporphyrinogen Oxidase (PPO)	33	T	Inhibition of Homogentisate Solanesyltransferase (HST)
15	K3	Inhibition of Very Long-Chain Fatty Acid Synthesis (VLCFA)	Ø	Z	Unknown mode of action



Notes

Mode of Action (MoA) and regulations

- Key regulatory challenge
- Many active substances from same chemical class
- Perennial cropping a significant risk
- Short cycle crops medium risk
- Adoption of ICM
- Environmental impact
- Non-target organisms
- Water pollution
- Pollinators
- ED concerns
- Many others ….

Resistance risk management

Cropping System Evaluation - Risk of Resistance

MANAGEMENT OPTION	LOW RISK	MODERATE RISK	HIGH RISK
Herbicide mix or rotation in cropping system	> 2 modes of action	2 modes of action	1 mode of action
Weed control in cropping system	Cultural*, mechanical and chemical	Cultural and chemical	Chemical only
Use of same mode of action per season	Once	More than once	Many times
Cropping system	Full rotation	Limited rotation	No rotation
Resistance status to mode of action	Unknown	Limited	Common
Weed infestation	Low	Moderate	High
Control in last three years	Good	Declining	Poor

Approved herbicide actives

PROTECTED

	Active Substance
1	Bentazone
2	Carfentrazone-ethyl
3	Clethodim
4	Clopyralid
5	Cycloxydim
6	Ethofumesate
7	Fatty acids: pelargonic acid
8	Florasulam
9	Flufenacet
10	Fluroxypyr
11	Glyphosate
12	Isoxaben
13	Metamitron
14	Metazachlor
15	Metribuzin
16	Napropamide
17	Nicosulfuron
18	Picloram
19	Propyzamide
20	Prosulfocarb

OUTDOOR

	Active Substance
1	2,4-D
2	Amidosulfuron
3	Bentazone
4	Carfentrazone-ethyl
5	Clethodim
6	Clomazone
7	Clopyralid
8	Cycloxydim
9	Diflufenican
10	Dimethenamid-P
11	Ethofumesate
12	Fatty acids: pelargonic acid
13	Florasulam
14	Fluazifop-P-butyl
15	Flufenacet
16	Flumioxazine
17	Fluroxypyr
18	Glyphosate
19	Imazamox
20	Isoxaben
21	Lenacil
22	Metamitron
23	Metazachlor
24	Metobromuron
25	Metribuzin
26	Napropamide
27	Nicosulfuron
28	Pendimethalin
29	Phenmedipham
30	Picloram
31	Propyzamide
32	Prosulfocarb
33	Rimsulfuron
34	S-metolachlor
35	Triflusulfuron-methyl

Notes

Approved example products

PROTECTED
Shark – contact, total
Centurion Max – contact, selective
Shield Pro – contact, selective
Laser – contact, selective
Efeckt - contact
Finalsan – contact, total
Sunfire – pre-emergence
Glyphosate – contact, total
Flexidor – pre-emergence
Goltix – pre-emergence
Butisan – pre-emergence
Sencorex – pre-emergence
Devrinol – pre-emergence
Fornet – pre-emergence
Defy – pre-emergence
Laser – contact, selective

OUTDOOR	
Eagle – pre-emergence	**Nirvana** – pre-emergence
Shark – contact, total	**Stomp Aqua** – pre-emergence
Centurion Max – contact, selective	**Dual Gold** – pre-emergence
Shield Pro – contact, selective	**Debut** – pre-emergence
Laser – contact, selective	**Starane XL** – contact selective, pre-emergence
Effeckt - contact	**Centium** – pre-emergence
Finalsan – contact, total	
Sunfire – pre-emergence	
Glyphosate – contact, total	
Flexidor – pre-emergence	
Goltix – pre-emergence	
Butisan – pre-emergence	
Sencorex – pre-emergence	
Devrinol – pre-emergence	
Fornet – pre-emergence	
Defy – pre-emergence	
Titus – pre-emergence	
Hurricane – pre-emergence	
Springbok – pre-emergence	
Fusilade – contact, selective	
Paramount/Boxer – pre-emergence	

Approved example products

Example Product	Type of Herbicide	Approval situation	Notes
Butisan	pre-emergent	O/P	Extensive use
Centurion Max	contact, selective	O/P	Some use
Debut	pre-emergent	O	Not used
Defy	pre-emergent	O/P	Not used
Devrinol	pre-emergent	O/P	Extensive use
Dual Gold	pre-emergent	O	Extensive use
Eagle	pre-emergent	O	Not used, some non-cropped areas
Efeckt	contact	O/P	Not used
Finalsan	contact, total	O/P	Some use
Flexidor	pre-emergent	O/P	Extensive use
Fornet	pre-emergent	O/P	Not used
Fusilade	contact, selective	O	Not used
Glyphosate	contact, total	O/P	Extensive use on non cropped areas
Goltix	pre-emergent	O/P	Some use mainly non-cropped areas
Hurricane	pre-emergent	O	Some use in non-cropped areas
Laser	contact, selective	O/P	Some use
Nirvana	pre-emergent	O	Some use in non-cropped areas
Paramount/Boxer	pre-emergent	O	Not used
Sencorex	pre-emergent	O/P	Some use
Shark	contact, total	O/P	Extensive use on non-cropped areas
Shield Pro	contact, selective	O/P	Some use
Springbok	pre-emergent	O	Extensive use
Starane XL	contact selective, pre-emergent	O	Not used
Stomp Aqua	pre-emergent	O	Some use on non-cropped areas
Sunfire	pre-emergent	O/P	Some use
Titus	pre-emergent	O	Not used

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Herbicides approved for container-grown crops

Product	Active ingredient	HRAG	Solubility	Dose rate, L/ha	Water volume, L	On/off label	Nº of applications	Herbicide type	Protected use	Expiry date
Devrinol (MAPP19358)	Napropamide – 45%	Z	Mod	7.0L/ha	1,000-2,000	0168/20	1	R	✓	31/12/2025
Dual Gold (MAPP14649)	S-metolachlor – 96%	K3	Mod	0.78L/ha	200-400	0501/12	1	R	×	31/01/2031
Flexidor 500 (MAPP18902)	Isoxaben – 50%	L	Low	0.50L/ha	600	✓	1	R	✓	31/07/2029
Butisan S (MAPP16569)	Metazachlor – 50%	K3	Mod	1.5L/ha	400-600	✓	1	R	✓	30/04/2029
Sencorex Flow (MAPP20710)	Metribuzin 60%	C1	High	1.15 – 1.0L/ha	400-600	2113/2108/23	1	C,R	✓	15/08/2027
Venzar 500 (MAPP18799)	Lenacil – 50%	C1	Low	0.40L/ha	100-200	4263/19	2.5	R	×	15/02/2028
Sunfire (MAPP16745)	Flufenacet - 50%	K3	Mod	0.48L/ha	200-400	1065/17	1	R	✓	15/12/2027
Springbok (MAPP16786)	dimethenamid-P 20% and metazachlor 20%	K3+ K3	High + Mod	2.5/ 1.6L/ha	200-400	2108/15 3006/14	1	R	×	09/09/2099
Wing-P (MAPP15425)	dimethenamid-P and pendimethalin – 21.25% + 25%	K3+ K1	High + Low	3.5L/ha	400-600	0253/13	1	R	×	09/09/2099

Notes

Approval specifics

We will now look at the print outs!

Weed susceptibility to herbicides CONSIDERATIONS

- Type of weed and its growth stage
- Route of entry into crop
- Time of the year
- Dose rates, concentrations and weed coverage (which parts of weed?)
- Crop situation (indoor/outdoor)
- Irrigation management and growing media
- Presence or lack of mulch
- Weather conditions post-treatment – rain fastness

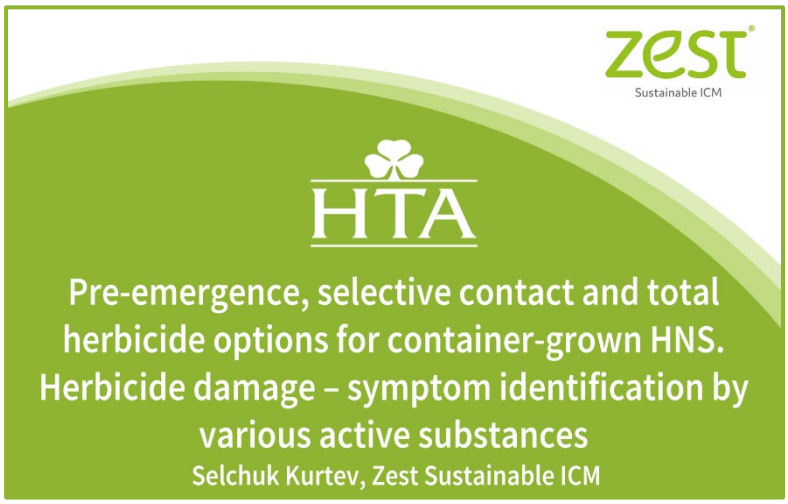
Herbicide failures

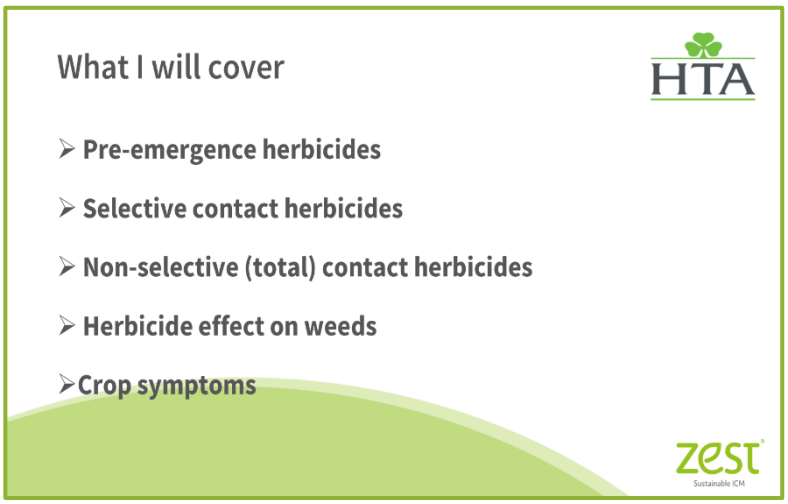
- Reading product label and EAMUs
- Disruption to herbicide layer
- Wrong choice of herbicides
- Incorporation of the herbicide where it's needed
- Overwatering or underwatering of the herbicide layer
- Use of lower rates
- Lack of crop husbandry
- Use of granular fertiliser at the wrong time
- Sprayer calibration issues
- Timing of herbicide applications

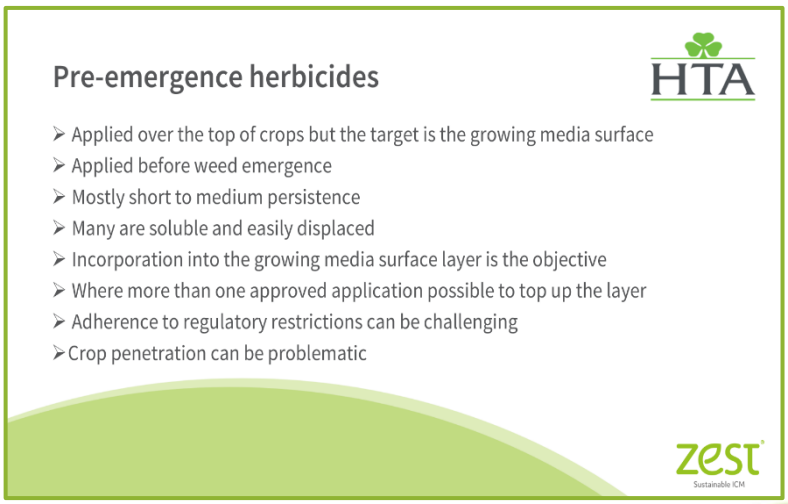
Pre-emergence, selective contact and total herbicide options for container-grown HNS crops

Selchuk Kurtev, Zest – Sustainable ICM

Notes







Root mitotic inhibitors

AIM: To block cell division

Pendimethalin, propyzamide

Effect on weeds

- ✓Root development inhibited resulting in stunted plant growth
- ✓Stems and leaves turn purple (similar to phosphorus deficiency)
- ✓High concentration of herbicide near soil surface can lead to formation of callus tissue
- ✓Stems become brittle
- ✓Damage from drift is uncommon
- ✓Low water solubility + volatile nature of product
- ✓Require soil incorporation

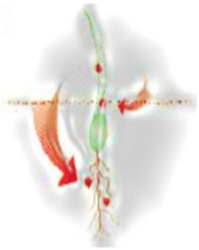
Shoot inhibitors

AIM: To affect cell growth and division

Flufenacet, metazachlor, napropamide, S-metolachlor

Effect on weeds

- ✓Stunted shoots; leaf crinkling
- ✓Seedlings may leaf up underground making emergence difficult
- ✓Grass seedling leaves may not unfurl correctly
- ✓Carry over or tank contamination injury is unlikely
- ✓Direct damage to crop only if under stress or if conditions encourage uptake (cool, wet spell followed by warm, windy weather)



Photosynthetic inhibitors

AIM: To interfere with photosynthesis by blocking electron transfer, resulting in cell damage and cell death

Lenacil, metamitron, metribuzin

Effect on weeds

- ✓Herbicides applied to soil penetrate root and translocate throughout plant
- ✓Oldest leaves turn chlorotic first
- ✓Plant becomes stunted and may die if enough leaf tissue is affected
- ✓Carry over damage is common especially in soils >pH 7.0

Notes

Dimethenamid-P and metazachlor

- HRAC K3 + K3 – α-chloroacetamide
- Two EAMUs – 1.6L field application and 2.5L pre-crop emergence
- 50 days handling restriction, this product must not be applied via handheld equipment
- Workers must not enter treated crops for a minimum of six days after an application is made
- Useful broadleaf weed spectrum, top up option for metazachlor for one year in three - 1,000g a.s/ha permitted per year per field
- Used at 1.25L/ha in late autumn, early winter

Isoxaben

- HRAC L - benzamide
- Inhibits cell wall formation in dividing cells
- Excellent broadleaf weed control particularly chickweed, **some** bittercress control
- Poor control of annual grass weeds, groundsel and willowherb
- Application immediately before standing down is OK
- Do not apply to very dry or extremely dry surfaces
- Can last up to 12 weeks
- One application per crop

Lenacil

- HRAC C1
- Residual activity, no contact
- Outdoors ONLY
- Good control of grasses, pearlwort, liverwort and willowherb
- Avoid application to soft spring growth, absorbed primarily by roots
- OK on most conifers except Cryptomeria and Taxus
- Use before end of July in year of application
- A maximum total dose of 500g/l lenacil per hectare may only be applied every third year on the same field
- 0.4L/ha in 200L of water, two applications at 0.4L/ha + one application at 0.2L/ha permitted

Notes

Notes

Metazachlor

- HRAC K3 - α-chloroacetamide
- Residual activity with a limited contact action on growing weeds
- Good control of grasses, groundsel, pearlwort and willowherb
- Avoid applications to soft spring growth
- Very good safety profile, lots of tolerance information available, absorbed by the hypocotyls and roots
- If damage occurs, crops often recover by the end of the season
- Less damage from applications made in the autumn/winter period
- Maximum total dose 1,000g metazachlor active substance per ha may only be applied every third year to same field

Metribuzin

- HRAC C1 - triazinone
- Good on wide range of annual and perennial broadleaved weeds including grasses
- Pre- and post-emergence control
- Contact and residual
- Root and shoot uptake
- Damage visible much later in season
- Two EAMUs available – post-emergence dormant season and pre-emergence of crop
- Deciduous and some evergreens
- Risk to crops
- 1.15L/ha – lower rate down to 0.75L/ha still OK

Napropamide

- HRAC K3 - acetamide
- Broken down by light in the soil/growing media
- Works best if followed by rainfall or a sprinkler irrigation of 10-15mm within 7 days
- Safe on many woody plants but is weak at controlling some broadleaf weeds such as oxalis
- Good grass, willowherb and groundsel control and can also suppress small nettle
- Useful on herbaceous subjects, and deciduous crops
- Absorbed by roots with systemic activity
- Not for use on alpines and succulents – stunted growth
- Do not use on variegated evergreens and pots less than 1L
- Apply in December – February – FULL RATE at 7L/ha use in 1,000L
- 13 weeks handling period!

Notes

Pendimethalin

- HRAC K1 - dinitroaniline
- Good grass control and many broadleaved weeds
- Controls oxalis
- Absorbed by roots and leaves, residual
- Broken down by light in tank
- Bright orange colour
- Good for sand beds and gravel beds
- Very useful on sand and MyPex as it prevents rooting through
- Application immediately before standing down
- One per crop

S-metolachlor

- HRAC K3 – α-chloroacetamide
- Controls annual and perennial grasses and wide range of broadleaved weeds
- Particularly useful for chickweeds, groundsel, willowherb
- Absorbed by hypocotyls
- Outdoor ONLY
- AHDB HNS 166 report for fern, herbaceous and ornamental grass tolerances
- Application may only be made between 1 May - 31 May
- One application at 0.78L/ha use 400-600L/ha

Other products

- Dimethenamid-P + pendimethalin – **Wing-P (MAPP15424)**
- Metamitron – **Goltix 70SC (MAPP16638)**
- Prosulfocarb – **Defy (MAPP16202)**

Notes

Selective contact herbicides

- Require dry weather conditions before and after treatment
- Wet foliage canopy reduces efficacy
- Timing of application is crucial as it depends on weed growth stage
- Concentrations of product more important than dose rate
- 'Selective' means specific weed species
- Damage does occur frequently, and it can be permanent, especially with herbaceous
- Presence of leaf wax on the crop provides the best tolerance
- Do not use with adjuvants

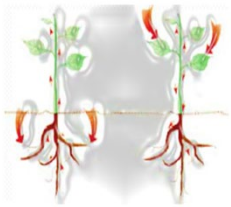
Hormone (auxin)-type herbicides (soil + foliar applied)

AIM: To affect growth in the newest stems and leaves

2,4-D, clopyralid, fluroxypyr, MCPA

Effect on weeds

- ✓Stunted, malformed seedlings
- ✓New growth twisted and distorted
- ✓Calluses form on stem; plant may lean and become brittle
- ✓Grasses exhibit leaf rolling
- ✓Symptoms likely from drift, tank contamination or direct injury



Meristematic (lipid) inhibitors (foliar applied)

AIM: To block formation of lipids in shoot (meristem) and roots of grass weeds

Clethodim, cycloxydim

Symptoms of injury

- ✓Symptoms slow to develop
- ✓Plants become stunted when new growth is stopped
- ✓Growing point disintegrates and dies first
- ✓Carry over unlikely at normal application rates; tank contamination and drift can affect crops
- ✓Direct damage usually caused by adjuvants used with products

Notes

Clethodim

- HRAC: A
- Controls perennial and annual grass weeds
- Can be used over deciduous nursery stock and certain bulb species from 5-10 cm tall
- Best control when weeds are small
- Do not cultivate for 14 days after application
- Death of foliage takes three to four weeks after application
- No rain for four hours after application
- Drought and cool conditions reduce effectiveness
- Can be used with a knapsack sprayer
- Compatible with Butisan S, Dow Shield
- Application March to September
- Six weeks handling restriction with protective workwear

Clopyralid

- HRAC: O
- Controls creeping thistle, spear thistle, corn marigold, mayweeds, groundsel, clover and dandelion
- Treat creeping thistle at rosette stage
- Avoid rain for six hours, absorbed **by roots** and leaves
- Not on Brachyglottis, Cytisus, Eryngium, Genista or Laburnum
- On-label approval for ornamentals for a range of products
- EAMU available for ornamentals
- Good for weed wiping
- Avoid drift at all costs!
- DO NOT use in protected structures on production beds
- Slow to work but it's very effective
- Needs actively growing weeds
- Effects reduced by low temperature

Fluroxypyr

- HRAC: O
- Good on a range of annual and perennial broad-leaved weeds but won't control grasses
- Low volatility so no vapour drift
- Requires high temperatures of 10°C+
- Fantastic bind weed, chickweed, cleaver, groundsel, red dead nettle control
- Poor on bittercress, fat hen, and other brassica weeds
- EAMU available for outdoor ornamentals
- 0.6L/ha (18ml/10L or 15ml/10L)
- Outdoors only, good in mixes with Nirvana in summer or autumn
- Serious problems if mixed with sulfonylureas

Starane® Hi-Load HL
HERBICIDE

Non-selective contact herbicides

- Particularly sensitive to weather conditions before and after treatment
- Wet foliage canopy reduces efficacy
- Weed coverage and dose is very important – speed and efficacy
- Adjuvants and water conditioners enhance performance
- Some can be used over top of dormant crops successfully
- Persistence in growing media and soils is noticeable

Protein biosynthesis inhibitors

AIM: To inhibit a key enzyme in the amino acid synthesis pathway

Glyphosate

Effect on weeds

- ✓Slow chlorosis of tissue (10-14 days)
- ✓Stunting
- ✓Change in flower colour
- ✓Systemic, non-selective action on tissue
- ✓Inactivated on contact with soil

Photosynthetic inhibitors

AIM: To block photosynthetic reaction; disrupt cellular membranes so light can't be converted into chemical energy

Carfentrazone-ethyl, pelargonic acid

Effects on weeds

- ✓Spray penetrates leaves and produces localised tissue discoloration and death
- ✓Plants become stunted and die if enough tissue is affected
- ✓Carry over unlikely and drift injury limited to droplets from nearby applications
- ✓Control increased with addition of spray additives

Notes

Notes

Carfentrazone-ethyl

- HRAC: E
- Can be used around the perimeter of the nursery
- Controls young annual weeds but not grasses, absorbed by leaves
- OK to use over fully dormant crops
- On-label approval for all non-edible crops
- EAMU available for protected and outdoor ornamentals (21 days PHI)
- Volatile and requires adjuvant 'Silwet L77'
- Best applied on dry sunny days
- Good in tank mix with glyphosate if you looking for speed of kill and grass control
- Use with some residuals in dormant season
- Some formulation challenges when mixing with residuals
- DOES HAVE RESIDUAL ACTIVITY ON SEED GERMINATION

Glyphosate

- HRAC: G
- Systemic herbicide, translocated to roots and shoots; kills the entire plant
- Effective on both annual and perennial weeds
- Contact with leaves of the ornamentals results in injury or total plant death
- Glyphosate activity is increased in low water volumes
- Often takes seven or more days after application for control
- Avoid drift
- pH and alkalinity sensitive
- Water conditioners and adjuvant may be required
- EAMUs available on Clinic Up, Roundup ProActive

Pelargonic acid

- HRAC: Z
- Two products available both unique
- Both require specific environmental conditions and coverage
- Good on broadleaf weeds, grasses require adjuvant and early-stage application
- Poor on a range of perennial weeds
- Avoid rain or high humidity after application
- Good for herbaceous perennial crops indoors in dormant season (Katoun Gold only)
- Some formulation difficulties, can become like a gel

Notes


Crop symptoms
HTA
zest
Sustainable ICM


HTA
zest
Sustainable ICM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Notes


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Appendix

1. Practical weed control for nursery stock fully revised 2013 - https://projectblue.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/AHDB%20Horticulture%20/Nursery%20weed%20control%20guide%20web%20version.pdf
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3. Weed ID guide - https://projectbluearchive.blob.core.windows.net/media/Default/Imported%20Publication%20Docs/Weed%20identification%20pocket%20guide.pdf
4. Non-chemical weed control for container-grown hardy nursery stock - https://projectbluearchive.blob.core.windows.net/media/Default/Horticulture/Publications/Non-chemical%20weed%20control%20for%20container-grown%20nursery%20stock.pdf

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