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Chemical weed control in outdoor cut flower crops

This factsheet provides a summary of the herbicide options for weed control in outdoor cut flower crops. It takes into account more than 20 years of trials work funded by MAFF/Defra and AHDB Horticulture to evaluate new herbicide products and programmes together with relevant information from global research.



Figure 1. Drilled cut flower trials at the former HRI Kirton research station

Action points

- Review weed control programmes in light of recent AHDB Horticulture-funded research and herbicide availability outlined in this factsheet (Figure 1).
- Use the tables of weed susceptibility to herbicides to plan treatment programmes, bearing in mind any anticipated weed populations.
- Be prepared to amend programmes to avoid over-reliance on specific herbicides.
- If there are any doubts about particular plant varietal sensitivities, test a small area of crop first before widespread commercial use with any new herbicide product.
- Use the Health and Safety Executive website ([pesticides.gov.uk](https://www.pesticides.gov.uk)) to keep abreast of changes in the approval status of herbicide products.

Background

Cut flowers are a high value horticultural product, however, there are virtually no specific label approvals for the use of herbicides in cut flower production and a wide range of different plant genera are grown within the sector, each with differing herbicide sensitivities. From a commercial perspective, the market for herbicides is too small and the risks too great for new product development. Furthermore, changes in the crop protection legislation have had an impact on the availability of herbicides for use in cut flowers, with a number of traditional herbicides, such as Ronstar Liquid (oxadiazon), being withdrawn.

Weed growth reduces the yield and quality of any flowers produced, and can impede flower stem picking. Excessive weed growth may also delay crop maturity and introduce pests (such as stem nematode) and diseases. Many cut flower crops have considerably less tolerance to the range of herbicides used in woody ornamental plant production, however, some are similar in sensitivity to herbaceous perennials, indeed some common perennial crops, such as delphinium, are grown both as herbaceous perennial and cut flower crops. For these perennial cut flower crops, a similar range of herbicides to that used in herbaceous perennial production can be used. In the case of annual cut flower crops, some are drilled and some transplanted from modules, inevitably these crops are shallow rooting and particularly vulnerable to herbicide damage.

AHDB Horticulture has continued funding research to find alternative herbicides to fill the gaps left by those withdrawn, and has also obtained Extension of Authorisation for Minor Use (EAMU) approvals for promising new products, on behalf of the industry, to maintain the range of available herbicides to cut flower growers. This factsheet draws on this and other research, describing the range of herbicides currently available and the best way to make use of them.

Weed control in drilled and transplanted cut flower crops

As with many other horticultural crops, perennial weeds need to be dealt with in the seasons prior to drilling or planting, as there are fewer control options available when the crop is present. The choice of herbicide will depend upon the weed species present and the time available between herbicide application and planting. In most cases, glyphosate formulations will control the range of weeds present, but for more tolerant weeds, such as perennial nettle and willowherb, mixtures with other alternative active ingredients such as carfentrazone-ethyl (for example the product Shark, via EAMU 0552/08) will be more effective. For drilled crops in particular, a stale seedbed technique can be useful. To achieve this, a fine soil tilth is prepared in advance of drilling to allow annual weeds to germinate. These are then cultivated out or sprayed off with diquat or glyphosate prior to drilling the crop.

Drilled cut flowers – crop specific recommendations

For drilled crops, a range of residual herbicides is listed in Tables 1, 4 and 7 (located in the wallet at the back of the factsheet) for use immediately after drilling, before weed and crop emergence. Application should not be delayed as crop safety can be compromised by application to germinating crop seedlings, and weed control may be reduced if weeds have already emerged at the time of application.

Once the crop has emerged, there are relatively few options for controlling weed seedlings that have germinated within the crop (Table 2, located in the wallet at the back of the factsheet). Selective contact herbicides such as Betasana SC tend to be effective only on small weed seedlings and carry the risk of some check to the crop.

Some crops, such as bupleurum and cornflower, compete well with weeds once initially established, reducing the need for follow up treatments. For other less competitive crops, further treatments of residual herbicides may be applied to extend weed control once the crop has emerged and developed to a sufficient size.

The herbicide options for specific drilled cut flower crops are discussed in more detail in the following sections.

Allium, ornamental (*Allium* species)

Ornamental alliums are normally grown as a direct drilled outdoor crop. There is no specific information available on herbicide safety in ornamental alliums. It might be anticipated that herbicides used in the production of edible onion and leek crops would be safe, but there could be unexpected varietal differences. A typical herbicide programme for edible onions would start with Wing-P as a residual herbicide applied at drilling. Growers wishing to test treatments for ornamental alliums may wish to try this treatment on a small scale first.

Ammi (*Ammi majus*)

Ammi is grown as an annual, direct drilled outdoor crop. In trials, ammi was generally tolerant of the equivalent of Intruder used at 2.0L/ha + Afalon at 1.35L/ha or Stomp Aqua at 1.5L/ha, applied post-drilling. The former combination provided good weed control, but higher rates were used than are authorised now. There is a risk of crop damage on light soils where heavy rain falls after application. For light soils, Stomp Aqua is safer but may not provide adequate control of mayweed and groundsel. If a follow up treatment is required to remove small weed seedlings, Betasana SC can be used.

Aster, China (*Callistephus chinensis*)

China asters are normally grown as a transplanted, annual crop but direct drilling is also possible. Trials have shown that a tank mix of Stomp Aqua at 2.0L/ha + Gamit 36 CS at 0.125L/ha can be safely applied at drilling without significantly affecting emergence or crop vigour. If a follow up treatment is required to remove small weed seedlings, Betasana SC at 2.5L/ha can be used. China asters were found to be fully tolerant of Betanal Expert applied at 1.5L/ha. This product is not currently available, but it is hoped that an EAMU can be obtained to enable similar products to be used. China aster also have some tolerance to Shark applied at 0.4L/ha, however the plants take some time to recover from the resulting leaf scorch.

Brassica, ornamental (*Brassica oleracea* Capitata group)

The ornamental brassicas, including ornamental cabbage and kale, are normally grown as an annual, direct drilled crop. Edible cabbages by contrast are grown from transplants so herbicide recommendations cannot be directly translated from the edible to the ornamental crop. The closest comparable direct drilled cruciferous crops are swedes and wallflowers. Following recent



Figure 2. The equivalent of Stomp Aqua + Flexidor 500 proved the best weed control treatment with bupleurum, however, some groundsel (centre) was left uncontrolled

trials at the Cut Flower Centre, a half rate of Wing-P (applied at 1.75L/ha) was found to be effective and safe on direct drilled wallflower. Wing-P is also commonly used on direct drilled swedes. There could however be varietal differences in susceptibility to herbicides, so growers wishing to try this treatment for ornamental brassicas should test it on a small scale first.

Bupleurum (*Bupleurum griffithii*)

Bupleurum is grown as an annual, direct drilled outdoor crop. Safe treatments from trials work included Stomp Aqua at 2.9L/ha + Flexidor 500 at 0.25L/ha (Figure 2) or Intruder at 2.0L/ha + Afalon at 1.35L/ha applied post-drilling. Betasana SC applied at 1.8L/ha can be used as a follow up for the control of small seedling weeds. Bupleurum is a vigorous plant, and once established will suppress weeds via its dense crop canopy. Follow up herbicides are therefore not always necessary.

Cornflower (*Centaurea cyanus*)

Cornflower is grown as an annual, direct drilled outdoor crop. In trials, the crop was tolerant of a range of herbicide combinations including the equivalent of Stomp Aqua + Flexidor 500. In most situations Stomp Aqua used at 2.9L/ha + Flexidor 500 at 0.25L/ha (Figure 3) will provide adequate weed control. Cornflower is a vigorous plant, and once established will suppress weeds via its dense crop canopy. Follow up herbicides are therefore not necessary.



Figure 3. The best weed control treatment in cornflower was the equivalent of Stomp Aqua + Flexidor 500

Godetia (*Godetia amoena*)

Godetia is normally grown as an annual, direct drilled outdoor crop. There is relatively little information about herbicide tolerance. A MAFF-funded trial (see the 'Other publications' section) indicated godetia to be tolerant of a programme of two applications of low rate (1.5L/ha) Venzar Flowable. An initial application was made after drilling with a further application made four weeks later, following crop establishment. There is little commercial experience with this treatment and Venzar Flowable is now limited to 0.4L/ha per application. If a follow up treatment is required to remove small weed seedlings, Betasana SC applied at 1.8L/ha can be used.

Lagurus (*Lagurus ovatus*)

Lagurus is a grass (known as 'Bunny Tails') grown as an annual, direct drilled outdoor crop. Like most grasses, it is tolerant of Flexidor 500 used at 0.25L/ha. There is little known of its tolerance to other herbicides.

Larkspur (*Consolida ajacis*)

Larkspur is grown as an annual, direct drilled crop. It tends to germinate and grow slowly to the young plant stage and is therefore very vulnerable to weed competition because of its slow growth rate and light crop canopy.

Several trials have shown the equivalent of Stomp Aqua at 2.0L/ha + Gamit 36 CS at 0.25L/ha to be relatively safe when applied immediately after drilling, pre-emergence (Figure 4). Weed control from this combination is quite good, but occasionally groundsel or mayweed is not controlled.

A lower dose of Gamit 36 (0.2L/ha) may be equally effective where cleavers are not anticipated. A number of early post-emergence treatments, such as Betasana SC at 1.8L/ha, were investigated, none were entirely safe, but may be worth considering if weed problems are severe.

Love-lies-bleeding (*Amaranthus paniculatus*)

Love-lies-bleeding is grown as an annual, direct drilled outdoor crop. It is tolerant of Flexidor 500. It is also tolerant of the equivalents of Betasana SC at 1.3L/ha applied as a post-emergence treatment for the control of small seedling weeds. There is little known of its tolerance to other herbicides.

Nigella (*Nigella damascena*)

Nigella is highly susceptible to herbicides as an annual, direct drilled crop. Following the loss of herbicide approvals, no safe replacement herbicide treatments have yet been found in the trials so far undertaken.



Figure 4. Larkspur crop; untreated and hand weeded (left), treated with the equivalent of Stomp Aqua + Gamit 36 CS after drilling (right), followed by Betasana SC; note the slight delay to cropping caused by Betasana SC

Sunflower (*Helianthus annuus*)

Sunflowers are widely grown as an annual, direct drilled crop. Stomp Aqua at 2.9L/ha is normally used as a pre-emergence herbicide applied after drilling. Although Stomp Aqua does not control groundsel or mayweed effectively, sunflowers grow quickly and generally out-compete weeds once established. Alternative herbicides with different weed control spectra that can be used pre-emergence of the crop include Dual Gold applied at 0.78L/ha, Flexidor 500 at 0.5L/ha and Wing-P at 3.5L/ha. There is not normally a requirement for any post-emergence treatment.

Sweet william (*Dianthus barbatus*)

Sweet william is normally grown outdoors as a biennial crop, direct drilled in the summer months. Ronstar Liquid was the standard treatment applied to drilled sweet william until its withdrawal. Unfortunately, sweet william has proved to be quite sensitive to the alternative herbicides tested, with many treatments reducing crop emergence. The safest treatment was Goltix 70 SC applied at 1.5L/ha. Many growers have also successfully used a tank mix of Goltix 70 SC at 1.0L/ha + Stomp Aqua at 0.75L/ha (Figure 5). Sweet william is sensitive to higher rates of Stomp Aqua and some growers have experienced poor emergence even with the low (0.75L/ha) rate.

As only low rates of herbicide can be used at drilling, a follow up treatment at the crop four true leaf stage is necessary to maintain weed control. Residual herbicide treatments that have proved relatively safe at this stage include Butisan S at 1.5L/ha, or Springbok at 1.6L/ha. A low rate tank mix of Venzar Flowable at 0.75L/ha + Flexidor 500 at 0.125L/ha caused some stunting in trials, but the plants recovered by the winter. Venzar Flowable is now limited to 0.4L/ha per application, but a follow up treatment could be made.



Figure 5. Satisfactory emergence and growth of sweet william following the use of low rate Goltix 70 SC + Stomp Aqua at drilling

In addition, sweet william has tolerance of the desiccant herbicide Shark, which is normally used for non-selective weed control or potato desiccation. Shark can be mixed with the follow up residual herbicide treatments to provide control of emerged weeds. Rates of 0.4L/ha have been widely used and although some temporary scorch occurs to the crop it recovers rapidly (Figure 6).

If required, a further residual herbicide application can be made to the dormant crop prior to the onset of spring growth. Devrinol at 7.0L/ha, or Butisan S at 1.5L/ha were both safe when applied in a tank mix with Flexidor 500 at 0.25L/ha. The choice of herbicide will depend on previous treatments as all of these are subject to application limits per crop or year (Table 1).



Figure 6. Initial damage 11 days after Shark application to sweet william (top) and recovery after five weeks (bottom)

Zinnia (*Zinnia elegans*)

Zinnia is grown as an annual, direct drilled outdoor crop. Although zinnia plants are tall at flowering, they do not produce a dense leaf canopy and so are poor competitors with weeds. In trials, zinnias were tolerant of a range of herbicide combinations including the equivalent of Stomp Aqua at 2.9L/ha + Flexidor 500 at 0.25L/ha and Stomp Aqua at 2.9L/ha + Gamit 36 CS at 0.25L/ha. In most situations, Stomp Aqua + Gamit 36 CS will provide adequate weed control (Figure 7). For follow up post-emergence weed control, Betasana SC at 1.0L/ha is considered safe.



Figure 7. Zinnia crop treated with the equivalent of Stomp Aqua + Gamit 36 SC at drilling

Transplanted cut flowers – crop specific recommendations

For transplanted crops, a range of residual herbicides is listed in Tables 1, 4 and 8 (located in the wallet at the back of the factsheet) for use before or after planting, prior to weed emergence. Application before planting avoids the risk of foliar damage to the transplants but can result in poorer weed control as the soil is disturbed during the process of planting.

As with the drilled crop, there are relatively few options for controlling weed seedlings that have germinated within the crop after planting (Table 2, located in the wallet at the back of the factsheet). Products such as Betasana SC tend to be only effective on small weed seedlings. Specific selective grass herbicides such as Fusilade Max or Centurion Max may be used over crop foliage to remove grass weeds (Table 5, located in the wallet at the back of the factsheet). For longer term crops, residual herbicides can be re-applied to maintain weed control over a longer time period.

For some perennial flower crops, such as peony, it is possible to use non-selective contact herbicides such as Quit or Shark (Tables 3 and 6) once the plants have died back. Further residual herbicides can then be applied over winter providing a clean start to the season and residual weed control.

The herbicide options for specific transplanted flower crops are discussed in more detail in the following sections.

Agapanthus (*Agapanthus umbellatus* and *A. intermedius*)

Agapanthus is a perennial cut flower crop grown from bulbs. There is both protected and outdoor production within the UK, however the following recommendations are for outdoor production only. There is limited information on herbicide safety in agapanthus, much of it has been developed through trials on container-grown plants, carried out at the former HRI Kirton in 2006, and commercial experience from plant production where a mix of Flexidor 500 + Venzar Flowable is widely used.

Results of the HRI Kirton trials indicated that agapanthus should be tolerant of Flexidor 500 at 0.25L/ha + Butisan S at 1.5L/ha, used as a residual herbicide even when applied to plants in full leaf. In practice, earlier applications would normally be made to provide weed control in spring up to flowering. Applications of Venzar Flowable were also tolerated over the crop foliage and could be used as a top-up treatment in a programme following Flexidor 500 + Butisan S. Venzar Flowable applications rates are now limited to 0.4L/ha, so a further follow up treatment may be needed. For post-emergence selective weed control in the crop, Basagran SG at 1.65kg/ha or Boxer at 100ml/ha were found to be safe and could be used to control weed seedlings up to the two true leaf stage.

Aster, China (*Callistephus chinensis*)

China asters are generally grown as a transplanted annual crop. Following earlier trials, Ronstar Liquid was the standard treatment applied to the bare soil before planting. Since the withdrawal of Ronstar Liquid, herbicide trials have focused on finding alternative treatments. Treatments were tested both before and after planting. Although post-planting application is possible, the herbicides can cause a slight check, so a pre-planting treatment is preferred. The standard treatment now is to apply Stomp Aqua used at 2.0L/ha + Gamit 36 CS at 0.25L/ha to the soil before planting (Figure 8).

In order to maintain weed control, a follow up application of the residual herbicide Butisan S at 1.0L/ha can be made three weeks after planting. This can cause a slight check (Figure 9) but the plants recover. An alternative tank mix treatment of low rate Venzar Flowable applied at 0.75L/ha + Flexidor 500 at 0.125L/ha was fully tolerated in trials (Figure 8) but has no



Figure 8. Transplanted China aster; hand weeded control in front plot, Stomp Aqua + Gamit 36 CS pre-planting, followed by low rate Venzar Flowable + Flexidor 500 three weeks after planting in plot behind the orange label



Figure 9. Slight leaf scorch to China aster from Butisan S application three weeks after planting

contact action against emerging weeds and Venzar Flowable is now limited to use at 0.4L/ha. The latter tank mix can be repeated after a further four to six weeks.

A number of selective contact treatments were also evaluated in earlier trials and China asters were found to be fully tolerant of Betasana SC used at 1.8L/ha or Betanal Expert at 1.5L/ha. Both treatments are effective against seedling weeds and could be used to take out any seedlings not controlled by the residual herbicide treatment. China asters also have some tolerance to Shark at 0.4L/ha, however the plants take some time to recover from the resulting scorch (Figure 10). Once established, China asters compete well with weeds, so later follow up treatments are not required.



Figure 10. Leaf scorch from Shark application to China aster, one week after treatment at the four true leaf stage

Bells of Ireland (*Moluccella laevis*)

Bells of Ireland is an annual crop, normally grown from transplanted module-raised plants, occasionally direct drilled. In trials, Bells of Ireland was found to be susceptible to Flexidor 500, Butisan S and Venzar Flowable applied after planting. Further trials are needed to determine safe treatments for this particular crop.

Chrysanthemum (*Chrysanthemum* species)

A high proportion of this crop is grown in sterilised soil and will therefore not require herbicide treatment. For those outdoor crops grown in unsterilised soil, a range of herbicide treatments was investigated in trials work culminating in the use of Ronstar Liquid pre-planting. As this treatment is no longer available, alternative safe treatments identified from the trials work should now be considered. Stomp Aqua at 2.9L/ha and Flexidor 500 at 0.3L/ha could be applied individually as post-planting treatments. In addition, Venzar Flowable is commonly used in herbaceous plant production and could be applied as a follow up treatment at 0.4L/ha.

Dahlia (*Dahlia* species)

Dahlias are an annual crop grown from tubers. Tank mix combinations of Afalon with either Venzar Flowable or Intruder gave good results for weed control and crop safety when applied after planting before foliage emergence (Figure 11). The maximum authorised rate for these products has been reduced since the trial was carried out. For Afalon it is now 1.35L/ha and for Intruder 2.0L/ha. Venzar Flowable was used at 2.0L/ha but rates are now limited to 0.4L/ha, although a follow up treatment can be made.



Figure 11. Dahlia treated with the equivalent of Afalon + Venzar Flowable gave good results

Delphinium (*Delphinium* hybrids)

Delphiniums are a long-term perennial crop. Results from trials indicate that Stomp Aqua applied at 2.9L/ha + Gamit 36 CS at 0.25L/ha, can be used after planting (Figure 12). In addition, Venzar Flowable at 0.4L/ha and Betasana SC at 1.8L/ha are commonly used in herbaceous plant production and could be applied as a follow up treatment. The choice of herbicide should be made according to the weed spectrum anticipated. Neither herbicide combination will give weed control for a full season, so follow up cultivations may be required as the crop does not compete strongly with weeds.

Delphiniums will die down during the winter months giving the opportunity to apply an overall non-selective, contact herbicide such as Quit or Shark (rates can be found in Table 3) to remove any overwintering weed. Residual herbicides can then be applied to a weed-free surface prior to crop emergence in the spring.



Figure 12. Delphinium treated with the equivalent of Stomp Aqua + Gamit 36 CS was safe but left some mayweed uncontrolled

Gladiolus (*Gladiolus x hortulanus*)

Gladioli are a perennial crop grown from corms that may be left down for several years. The indoor crop would normally be grown in sterilised soil. Outdoor crops are usually treated with herbicides selected from the range used on bulb crops. Recent trials have shown that the equivalent of Stomp Aqua used at 2.9L/ha + Sencorex Flow at 0.58L/ha gave good results and was safe on a light silt loam. Stomp Aqua however, can cause damage when the growing point is less than 13mm below the soil surface and on very light or sandy soils, Sencorex Flow has the potential to be damaging to gladioli as a result of leaching.

Other herbicide treatments used traditionally on gladioli after planting include Intruder + Afalon. This combination is particularly effective against common chickweed and knotgrass, however the authorised rates of use of these products have been reduced so they will now have reduced efficacy and persistence.

Gladioli will die down during the winter months giving the opportunity to apply an overall non-selective, contact herbicide such as Quit or Shark to remove any overwintering weed. Residual herbicides can then be applied to a weed-free surface prior to crop emergence in the spring.

Lily (*Lilium* species)

Lilies are a perennial crop grown from bulbs that may be left down for two years. The indoor crop would normally be grown in sterilised soil or in trays of substrate. Recent trials have shown that the equivalent of Stomp Aqua applied at 2.9L/ha + Sencorex Flow at 0.58L/ha gave good results and was safe. However, on very light or sandy soils, Sencorex Flow has the potential to be damaging to lilies as a result of leaching. Other treatments used traditionally on lilies include Venzar Flowable, now limited to 0.4L/ha + Afalon at 1.35L/ha.

Lilies will die down during the winter months giving the opportunity to apply an overall non-selective, contact herbicide such as Quit or Shark to remove any overwintering weed. Residual herbicides can then be applied to a weed-free surface prior to crop emergence in the spring.

Peony (*Paeonia* hybrids)

Peonies are a long-term perennial crop. They have good tolerance of residual herbicides when applied prior to leaf emergence. Typical programmes are based on Stomp Aqua at 2.9L/ha, Afalon at 1.2L/ha and low rates (0.5L/ha) of Sencorex Flow. However, on very light or sandy soils, Sencorex Flow has the potential to be damaging as a result of leaching. Venzar Flowable and Flexidor 500 are also tolerated when the crop is dormant and top-up treatments

of these may be applied as directed sprays to the interrow during the growing season. Trials have shown that for the control of thistles, directed sprays of Dow Shield 400 at 0.5L/ha were tolerated during the growing season (Figure 13).

Peonies will die down during the winter months giving the opportunity to apply an overall non-selective, contact herbicide such as Quit at 2.0L/ha, Shark at 0.8L/ha, or Roundup Pro Biactive at 5.0L/ha to remove any overwintering weed. Residual herbicides can then be applied to a weed-free surface prior to crop emergence in the spring.

Phlox (*Phlox drummondii*)

Phlox is an annual crop, normally grown from transplanted, module-raised plants. They were found to be susceptible to virtually all post-planting herbicides tested in trials. Further work is needed on this subject to ascertain safe herbicides.

Pinks, hybrid (*Dianthus x allwoodii*)

Pinks are members of the Caryophyllaceae family and respond similarly to herbicides as established sweet william. Butisan S at 1.5L/ha + Flexidor 500 at 0.25L/ha or Venzar Flowable at 0.4L/ha + Flexidor 500 at 0.25L/ha may be used after planting. The Venzar Flowable application can be repeated. Devrinol at 9.0L/ha can be used as a winter treatment.



Figure 13. Dow Shield can be applied in peony crops to control creeping thistle

Snapdragon (*Antirrhinum majus*)

Snapdragons are an annual crop, normally grown from transplanted, module-raised plants. They were found to be susceptible to a number of post-planting herbicides in trials, but show good tolerance to Venzar Flowable (Figure 14).

Statice (*Limonium sinuatum*)

Annual statice is normally grown from transplanted, module-raised plants. There have been relatively few trials on weed control involving this crop, but statice is known to have tolerance of Venzar Flowable. An application of Venzar Flowable at 0.4L/ha can be made soon after transplanting and a further follow up treatment can also be undertaken. Only limited weed control can be expected from Venzar Flowable, due to the low rate and the fact that speedwells and cleavers are resistant. Where the latter weeds emerge, it may be necessary to resort to cultivations.

Stocks, column (*Matthiola incana*)

Column stocks are an annual crop, normally grown from transplanted, module-raised plants. Although a significant proportion of the crop is grown under protection in sterilised soil, some of the outdoor or Spanish tunnel-grown crops will not be grown in sterilised soil and will therefore require herbicide treatment.

Ronstar Liquid was effective and safe when used as a pre-planting soil treatment, but is no longer available. Although trials have shown tolerance to Butisan S, in commercial practice unacceptable stunting has been experienced from time to time. Dual Gold used at 0.78L/ha or Venzar Flowable at 2.0L/ha both caused some stunting when applied after planting, but the plants recovered well. Venzar Flowable applications are now limited to 0.4L/ha, but a follow up treatment can be made.



Figure 14. Snapdragon crop treated with Venzar Flowable after planting

Table 1. Herbicides – primarily soil-acting, residual (April 2017)

Example product	Active ingredient	Maximum rate/ha	Timing	Approval status	Notes
Afalon	Linuron (450g/L)	1.35L/ha	Pre-emergence of crop	EAMU (0877/2009). Use up date for active ingredient 3 June 2018	Must not be applied to emerged crop
Butisan S	Metazachlor (500g/L)	1.5L/ha maximum dose, but a total of no more than 1,000g a.i./ha (equivalent to Butisan S 2.0L/ha) to be applied over three years to the same site	No restriction	Label approval for ornamental plant production	Slight contact action when applied over foliage
Devrinol	Napropamide (450g/L)	9.0L/ha	May to October (EAMU)	Label approval for ornamental plant production and EAMU (2044/2016)	Do not use on sands or on soils with greater than 10% organic matter
Dual Gold	S-metolachlor (960g/L)	0.78L/ha	May only	EAMU (0501/2012)	
Flexidor 500	Isoxaben (500g/L)	0.5L/ha	No restriction	Label approval for ornamental plant production	Two applications permitted
Gamit 36 CS	Clomazone (360g/L)	0.25L/ha	Pre or early post-emergence of crop	EAMU (1108/2014)	Short-term residual, with some contact action on small weeds
Goltix 70 SC	Metamitron (700g/L)	2.0L/ha	Pre-emergence of crop	EAMU (1175/2015)	Short-term residual, with some contact action on small weeds
Intruder	Chlorpropham (400g/L)	2.0L/ha	Pre-emergence of crop	Label approval for ornamental plant production	Two applications of 2.0L/ha can be made
Sencorex Flow	Metribuzin (600g/L)	1.15L/ha	Pre-emergence of crop	EAMU (1867/2013)	

Table 1. Herbicides – primarily soil-acting, residual (April 2017) continued

Example product	Active ingredient	Maximum rate/ha	Timing	Approval status	Notes
Springbok	Dimethenamid-p (200g/L) + metazachlor (200g/L)	1.6L/ha	No restriction	EAMU (2108/2015)	No hand-held application. Post-treatment handling restriction
Stomp Aqua	Pendimethalin (455g/L)	2.9L/ha	No restriction	EAMU (2919/2009)	
Venzar Flowable	Lenacil (500g/L)	0.4L/ha, maximum total dose 1.0L/ha per year. Only use one year in three on the same site	No restriction	LTAEU	Not recommended on very light soils
Wing-P	Dimethenamid-p (212.5g/L) + pendimethalin (250g/L)	3.5L/ha	Pre-emergence of crop	EAMU (0253/2013)	

This table has been collated using information from the Health and Safety Executive (HSE) website ([pesticides.gov.uk](https://www.hse.gov.uk)) and from product labels and supplier technical leaflets. Important – regular changes occur in the approval status of plant protection products, arising from changes in the legislation or for other reasons. For the most up to date information, please check the HSE website or with a professional supplier or BASIS-qualified consultant, as information could have changed since the publication of this factsheet.

Some product labels state 'ornamental plant production' but unless the crop species is specified on the label this use is at grower's own risk.

EAMU Extension of Authorisation for Minor Use

LTAEU Long Term Arrangement for Extension of Use

Growers must hold a paper or electronic copy of an EAMU before using any product under the EAMU arrangements. Any use of a plant protection product via an EAMU or via a LTAEU is at grower's own risk.

Always follow approved label or EAMU recommendations, including rate of use, maximum number of applications per crop or year and where crop safety information is not available, test the product on a small number of plants to determine crop safety prior to widespread commercial use.

If in doubt about which products are permissible on ornamentals or how to use them correctly, seek advice from a BASIS-qualified consultant with expertise in ornamental plant production.

Table 2. Herbicides – primarily foliar-acting, selective (April 2017)

Example product	Active ingredient	Maximum rate/ha	Timing	Approval status	Notes
Basagran SG	Bentazone (87% w/w)	1.65kg/ha	No restriction	EAMU (2819/2008)	
Betanal Expert	Desmedipham (25g/L) + ethofumesate (151g/L) + phenmedipham (75g/L)	1.5L/ha	No restriction	EAMU (2351/2014)	Three applications may be made
Betasana SC	Phenmedipham (160g/L)	3.0L/ha	No restriction	EAMU (2050/2015)	Two applications may be made
Boxer	Florasulam (50g/L)	0.1L/ha	Early post-emergence of bulbs, post-harvest of flowers	EAMU (2826/2008)	
Centurion Max	Clethodim (120g/L)	2.0L/ha	No restriction	LTAEU	Some control of annual meadow grass. Not yet widely tested in flower crops
Fusilade Max	Fluazifop-P-butyl (125g/L)	1.5–3.0L/ha one application per crop	No restriction	EAMU (1321/2012)	Must not be applied with hand-held equipment. Use higher rates for couch grass control

This table has been collated using information from the Health and Safety Executive (HSE) website ([pesticides.gov.uk](https://www.hse.gov.uk)) and from product labels and supplier technical leaflets. Important – regular changes occur in the approval status of plant protection products, arising from changes in the legislation or for other reasons. For the most up to date information, please check the HSE website or with a professional supplier or BASIS-qualified consultant, as information could have changed since the publication of this factsheet.

Some product labels state 'ornamental plant production' but unless the crop species is specified on the label this use is at grower's own risk.

EAMU Extension of Authorisation for Minor Use

LTAEU Long Term Arrangement for Extension of Use

Growers must hold a paper or electronic copy of an EAMU before using any product under the EAMU arrangements. Any use of a plant protection product via an EAMU or via a LTAEU is at grower's own risk.

Always follow approved label or EAMU recommendations, including rate of use, maximum number of applications per crop or year and where crop safety information is not available, test the product on a small number of plants to determine crop safety prior to widespread commercial use.

If in doubt about which products are permissible on ornamentals or how to use them correctly, seek advice from a BASIS-qualified consultant with expertise in ornamental plant production.

Table 3. Herbicides – primarily foliar-acting, non-selective (April 2017)

Example product	Active ingredient	Maximum rate/ha	Timing	Approval status	Notes
Quit	Diquat (200g/L)	2.0L/ha	Pre-emergence of crop or around crops	Label approval	
Roundup Pro Blactive	Glyphosate (360g/L)	5.0L/ha	Pre-emergence of crop	EAMU (2877/2008)	
Shark	Carfentrazone-ethyl (60g/L)	0.8L/ha	Pre-emergence of crop	EAMU (0552/2008)	Selective in sweet william

This table has been collated using information from the Health and Safety Executive (HSE) website ([pesticides.gov.uk](https://www.hse.gov.uk)) and from product labels and supplier technical leaflets. Important – regular changes occur in the approval status of plant protection products, arising from changes in the legislation or for other reasons. For the most up to date information, please check the HSE website or with a professional supplier or BASIS-qualified consultant, as information could have changed since the publication of this factsheet.

Some product labels state 'ornamental plant production' but unless the crop species is specified on the label this use is at grower's own risk.

EAMU Extension of Authorisation for Minor Use

LTAEU Long Term Arrangement for Extension of Use

Growers must hold a paper or electronic copy of an EAMU before using any product under the EAMU arrangements. Any use of a plant protection product via an EAMU or via a LTAEU is at grower's own risk.

Always follow approved label or EAMU recommendations, including rate of use, maximum number of applications per crop or year and where crop safety information is not available, test the product on a small number of plants to determine crop safety prior to widespread commercial use.

If in doubt about which products are permissible on ornamentals or how to use them correctly, seek advice from a BASIS-qualified consultant with expertise in ornamental plant production.

Table 4. Weed species' susceptibility to primarily soil-acting, residual herbicides authorised for use on outdoor cut flower crops

Herbicide product												
Afalon	Butisan S	Devrinol	Dual Gold	Flexidor 500	Gamit 36 CS	Goltix 70 SC	Intruder	Sencorex Flow	Springbok	Stomp Aqua	Venzar Flowable	Wing-P
Approval status												
Weed species	EAMU	Label	EAMU	Label	EAMU	EAMU	Label	LTAEU	EAMU	EAMU	LTAEU	EAMU
Annual meadow-grass	R	S	S	R	MS	S	S	S	S	S	S	S
Bindweed, black	MR	MS	R	S	MR	S	S	MS	MS	MS	S	S
Charlock		MR		S	R	S	MS	S	MR	R	S	S
Chickweed, common	S	S	S	S	S	S	S	S	S	S	S	S
Cleavers	R	MR	R	MR	S	R	R	R	S	MR	R	
Corn spurrey		MS	S	S		S	S	S			S	
Crane's-bill, dove's-foot		MR	S	MS	S		R		S	MS		
Dead-nettle, red	MR	S	S	S	S	S	R	S	S	S	MS	S
Fat-hen	S	MS	R	S	MS	S	MS	S	MS	S	S	S
Flabane, Canadian		S										
Fumitory, common		R	S	S	R	S	MS	MS	R	S	S	
Groundsel	MS	S	S	MR	S	S	R	S	S	R	MS	MS
Knotgrass	R	R	R	S	MR	S	S	S	R	S	S	S
Mayweeds	S	S	S	S	S	S	R	S	S	MS	MS	S
Nettle, small	S	MS	MS	S	MR	S	S		S	S	MS	S
Nightshade, black	MS		MR	R			R	R	MR	MR	R	S
Orache, common	S			S		S	MS	S	MS	S	S	S
Pansy, field		MR	MR	S	R	S		S	R	S	R	MS
Penny-cress, field	S	R		S		S	S	S			S	

Table 4. Weed species' susceptibility to primarily soil-acting, residual herbicides authorised for use on outdoor cut flower crops *continued*

Herbicide product													
	Afalon	Butisan S	Devrinol	Dual Gold	Flexidor 500	Gamit 36 CS	Goltix 70 SC	Intruder	Sencorex Flow	Springbok	Stomp Aqua	Venzar Flowable	Wing-P
Approval status													
Weed species	EAMU	Label	Label	EAMU	Label	EAMU	EAMU	Label	LTAEU	EAMU	EAMU	LTAEU	EAMU
Poppy, common	S	MS	S		S	R	S	S	S	S	S	S	MS
Redshank	MS	MS	MS	R	S		S	S	S	R	MS	S	S
Scarlet pimpernel	S		R						S		S	S	S
Shepherd's-purse	S	S	MS	S	S	S	S	MS	S	S	MS	S	S
Sow-thistle, smooth	MS		MS	S			S	R	S	S	S	S	MS
Speedwell, common field		S	S	S	S	S	S	S	S	S	S	MS	S
Speedwell, ivy-leaved		S			S		MS	S	S		S	R	S
Volunteer cereals			MS	S	R					MS	R	S	
Wild oats				S	R			MS		R	R	R	
Willowherbs	MS	S	S	S	R					S	R	R	S
Label	Label approval												
EAMU	Extension of Authorisation for Minor Use (grower's own risk use)												
LTAEU	Long Term Arrangements for Extension of Use (grower's own risk use)												
				<div></div>	Susceptible	<div></div>	Moderately susceptible	<div></div>	Moderately resistant	<div></div>	Resistant		

Table 5. Weed species’ susceptibility to primarily foliar-acting, selective herbicides authorised for use on outdoor cut flower crops

	Herbicide product					
	Basagran SG	Betanal Expert	Betasana SC	Boxer	Centurion Max	Fusilade Max
	Approval status					
Weed species	EAMU	EAMU	EAMU	EAMU	LTEAU	EAMU
Annual meadow-grass	R	S	R	S	S	R
Bindweed, black	MS	S	MS	S	R	R
Charlock	S	S	S	S	R	R
Chickweed, common	S	S	S	S	R	R
Cleavers	S	S	MR	S	R	R
Corn spurrey			MS		R	R
Crane’s-bill, dove’s-foot	S		R		R	R
Dead-nettle, red	MS	S	S		R	R
Fat-hen	MS	S	S	R	R	R
Fleabane, Canadian					R	R
Fumitory, common	MS	S	S		R	R
Groundsel	MS	S	S	S	R	R
Knotgrass	MR	S	MS	MS	R	R
Mayweeds	S	S	MR	S	R	R
Nettle, small	S	S	S	R	R	R
Nightshade, black	S	S	MR	S	R	R
Orache, common	MS	S	S		R	R
Pansy, field	R	S	S		R	R
Penny-cress, field	S	S	MS		R	R
Poppy, common	MS		S	MR	R	R
Redshank	S	S	MS		R	R
Scarlet pimpernel	S	S	S		R	R
Shepherd’s-purse	S		S	S	R	R
Sow-thistle, smooth	MS	S	S		R	R
Speedwell, common field	MS		S		R	R
Speedwell, ivy-leaved	MR				R	R
Volunteer cereals					S	S
Wild oats					S	S
Willowherbs				R	R	R

Label Label approval

EAMU Extension of Authorisation for Minor Use (grower’s own risk use)

LTAEU Long Term Arrangements for Extension of Use (grower’s own risk use)

Susceptible

Moderately susceptible

Moderately resistant

Resistant



Table 6. Weed species' susceptibility to primarily foliar-acting, non-selective herbicides authorised for use prior to planting or around outdoor cut flower crops

	Herbicide product		
	Quit	Roundup Pro Biactive	Shark
	Approval status		
Weed species	EAMU	EAMU	EAMU
Annual meadow-grass	MR	S	R
Bindweed, black	S	S	S
Charlock		S	S
Chickweed, common	S	S	MR
Cleavers	MR	S	S
Corn spurrey		S	
Crane's-bill, dove's-foot	MS	S	S
Dead-nettle, red		S	S
Fat-hen	S	S	S
Fleabane, Canadian		MR	
Fumitory, common		S	
Groundsel	S	S	MR
Knotgrass	MR	S	S
Mayweeds	S	S	MR
Nettle, small	MR	MR	S
Nightshade, black		S	S
Orache, common		S	
Pansy, field		S	S
Penny-cress, field		S	
Poppy, common	S	S	
Redshank	MR	S	S
Scarlet pimpernel		S	
Shepherd's-purse	S	S	S
Sow-thistle, smooth	S	S	S
Speedwell, common field	MS	S	S
Speedwell, ivy-leaved		S	
Volunteer cereals		S	R
Wild oats		S	R
Willowherbs		MS	S

Label *Label approval*

EAMU *Extension of Authorisation for Minor Use (grower's own risk use)*

LTAEU *Long Term Arrangements for Extension of Use (grower's own risk use)*

Susceptible

Moderately susceptible

Moderately resistant

Resistant

Table 7. Tolerance of outdoor, drilled cut flower species to authorised primarily soil-acting, residual herbicides applied at drilling

Herbicide product										
Afalon	Devrinol	Dual Gold	Flexidor 500	Gamit 36 CS	Goltix 70 SC	Intruder	Stomp Aqua	Venzar Flowable	Wing-P	
Approval status										
Crop	EAMU	Label	EAMU	Label	EAMU	Label	EAMU	LTAEU	EAMU	
Ammi	T					T	T		T	
Aster (China)			S		MS				T	
Bupleurum	T			T	MS	T	T		T	
Cornflower				T	MS		T		T	
Godetia	S					S		T		
Lagurus				T						
Larkspur			T	S	T		S	S	T	S
Love-lies-bleeding				T	S				S	
Nigella					S				S	
Sunflower			T	T					T	T
Sweet william		S	S		S	T			MS	S
Zinnia				T	T				T	

Due to lack of herbicide tolerance information, ornamental allium and ornamental brassica crops are not included in the above table.

Label Label approval

EAMU Extension of Authorisation for Minor Use (grower's own risk use)

LTAEU Long Term Arrangements for Extension of Use (grower's own risk use)

Tolerant
Moderately susceptible
Susceptible

Table 8. Tolerance of outdoor, transplanted cut flower species to authorised primarily soil-acting, residual herbicides applied at or before planting

Herbicide product												
Afalon	Butisan S	Devrinol	Dual Gold	Flexidor 500	Gamit 36 CS	Goltix 70 SC	Intruder	Sencorex Flow	Stomp Aqua	Venzar Flowable	Wing-P	
Approval status												
Crop	EAMU	Label	Label	EAMU	Label	EAMU	Label	EAMU	EAMU	LTAEU	EAMU	
Agapanthus		T	T		T					T		
Aster (China)				T	T				T		T	
Bells of Ireland		S			S					S		
Chrysanthemum		S			T				T	T		
Dahlia	T	S			T		T	MS	T	T		
Delphinium	S	S		T	MS	T	S	T	T	T		
Gladiolus	T	T	T	T		S	T	T	T		T	
Lily	T	T	T		T		T	T	T	T		
Peony	T	T			T	T	T	T	T	T	T	
Phlox	S	S			MS	S	S		S	S		
Pinks		T	T	T	T					T		
Snapdragon	S	S			S	S	S		S	T		
Statice										T		
Stocks		MS		T		S			S	T	S	

Label Label approval

EAMU Extension of Authorisation for Minor Use (grower's own risk use)

LTAEU Long Term Arrangements for Extension of Use (grower's own risk use)

Tolerant
Moderately susceptible
Susceptible

Further information

AHDB Horticulture factsheets and publications

Factsheet 11/13: 'Chemical weed control in narcissus crops'.

AHDB Grower summaries and reports

PO/BOF 002a: 'The National Cut Flower Centre trials programme for 2013–2017'.

BOF 065: 'Outdoor flowers: evaluation of a herbicide to replace Dosafo for volunteer potato control in gladiolus'.

BOF 058: 'Lily: herbicide trials'.

BOF 051a: 'Outdoor flowers: an evaluation of herbicides project extension'.

BOF 051: 'Outdoor flowers: an evaluation of herbicides'.

BOF 040: 'Larkspur: evaluation of weed control systems in *Delphinium ajacis* and *Delphinium consolida* grown for flower production outdoors'.

BOF 030: 'Evaluation of systems of weed control in chrysanthemum grown for flower production outdoors'.

BOF 029: 'Evaluation of systems of weed control in *Dianthus barbatus* (sweet william) grown for flower production outdoors'.

HNS/PO 192a: 'Herbicide screening for ornamental plant production (nursery stock, cut flowers and wallflowers)'.

HNS/PO 192: 'Herbicide screening for ornamental plant production (nursery stock, cut flowers and wallflowers)'.

CP 086 (2014): 'Weed control in ornamentals, fruit and vegetable crops – maintaining capability to devise sustainable weed control strategies'.

AHDB Grower guide – Practical weed control for nursery stock.

Other publications

Hanks, G.R., Meeks, R., Atwood, J., Briggs, J.B. and Meacham, M. (2001). Evaluation of herbicides for safe use on transplanted cut flower crops grown in Spanish tunnels. Tests of Agrochemicals and Cultivars, 22, p24–25.

Hanks, G.R., Meeks, R., Atwood, J., Briggs, J.B. and Meacham, M. (2001). Evaluation of herbicides for safe use on direct drilled cut flower crops grown in Spanish tunnels. Tests of Agrochemicals and Cultivars, 22, p26–27.

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If you want more information about AHDB Horticulture, or are interested in joining our associate scheme, you can contact us in the following ways...

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