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The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations. For accurate reporting, materials may be referred to by the name of the commercial product. No endorsement is intended of products mentioned, or criticism of those not mentioned.

AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Lyndon Mason
Director
Cut Flower Centre Ltd

Signature Date

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GROWER SUMMARY

Headlines

- Extensive trials on 'German Asters' suggest particular promise from Krallen types, greater uniformity for UK block raised 'German Asters' compared with conventional plug propagation, and better stem quality from earlier rather than later plantings.
- New varieties of *Aster ericoides* performed well for flowering in September and growers are recommended to trial this species on a small scale.
- Several other crops, notably tunnel grown lisianthis, 'Karma' dahlias and trumpet antirrhinums offer commercial potential and will be further developed.

Background and expected deliverables

The past 20 years have seen a marked increase in *per capita* purchases of cut-flowers in the UK. Consumption has moved up from what was once a very low level by European standards, and there has been a spectacular, continuing increase in the imports of cut-flowers to the UK. Despite this, the UK's own production of cut-flowers is still limited. The production of more cut-flowers in the UK would benefit from closeness to markets, delivering freshness without air-miles, but a lack of know-how may be critical in holding back expansion and enterprise. In 2007 the Cut Flower Centre was established at Kirton, Lincolnshire, to supply this practical knowledge, moving in 2009 to Rookery Farm, Holbeach St Johns, Lincolnshire, where it is now run as a discreet unit under the control of the Centre Management Group.

The Centre delivers:

- Demonstrations, trials and problem-solving experiments relevant to UK cut-flower production, covering current crops and, especially, potential new crops for the UK
- Evaluations of promising, newer cut-flower crops on a commercial scale
- Technology transfer of the results, helping establish 'Best Practice' for the crops and cultivars promoted
- A forum to identify and facilitate further R&D projects relevant to UK cut-flower production.

The Centre also aims to assist in the commercialisation of newer crops and cultivars through providing a 'shop window' and by providing samples of cut-flowers for the wider industry.

Summary of the project and main conclusions

Trumpet antirrhinum

These striking snapdragons were new to the UK and attracted real interest from the industry. They yielded heavy stems, on the first cut (around 315 g for a bunch of six 66cm-long stems) as well as a second flush of shorter, lighter marketable stems. Initial tests indicated a vase life of up to 15 days, but the flowering stems would need to be displayed at a somewhat later stage of development than usual for the trumpet flower form to be appreciated.

Aster ericoides

The mainly double cultivars demonstrated in 2010 were new to the UK market. The industry recognised considerable potential for these autumn flowers, and three supermarkets plan to test market these cultivars in 2011. The Centre proved valuable as a resource, with numerous sample bunches being supplied as demonstrations. They grew best as a pinched crop in tunnels, although there may be potential for growing it as a single-stem crop with black-outs to restrain excessive stem extension.

'German asters'

These novel, colourful cultivars of China aster have attracted much attention in trials at the Centre, and in 2010 considerable efforts were put into a trials programme to optimise their production. The main findings are listed here.

- Trials of both the 'Krallen' and 'Gala' series confirmed earlier experience that efforts should concentrate on the 'Krallen' cultivars which produce sturdier stems than the 'Gala' series and a much more attractive flower which is very different to the commonly grown Matsumoto types. The greater weight of 'Krallen' stems appears to be a result of the substantially larger flowers rather than thicker stems or a greater growth of side-shoots. These results were obtained using conventional, Dutch-raised plug plants.
- The consistency in stem lengths, weights, flower size, etc was notable for a week 23 planted UK block raised 'Krallen' and 'Gala' crop planted in week 23. This contrasted with the greater variability resulting from the conventional Dutch plug raised crop planted earlier in the season (week 16).
- In direct comparisons of UK block-raised plants and Dutch plugs, block raised plants gave heavier plants with larger flowers from the early (week 16-17) and middle plantings (week 18-19), while the plug plants gave heavier stems and larger flowers only from the early (week 16) planting. Block-propagated plants were more robust than plugs.

- Blocks established equally well when 'planted' by placing on the soil surface, rather than by digging in.
- A range of planting dates (week 17 to 23) was tested to establish the earliest practical planting date for block and plug plants in tunnels. For plug-raised plants later planting produced lighter stems with smaller flowers, while stem length was greatest from the middle (week 18-20) planting dates. In contrast, in block-raised plants later planting led to thinner, lighter stems with fewer side-shoots and smaller flowers. In most cases late planting (say in weeks 20 to 22) led to poorer quality stems, whereas early or middle plantings (weeks 17 to 19) were satisfactory. Both block and plug plants performed well in many plantings, though the former will have the advantage of reducing transport costs and making delayed deliveries less likely.
- Early plantings can produce vigorous growth and excessively long stems, so a growth retardant treatment was tested. Plug-raised cultivars were planted in week 16, 18 and 20 and were treated with 3 or 6g/L of 'B-Nine SG'. The higher rate of retardant resulted in only a small reduction in stem length (not more than 10%) in all cultivars but only following planting in week 16, treatments of later plantings being ineffective. Growth retardants will be further investigated in 2011 with a view to using earlier and more frequent applications.
- Demonstration plantings of cultivars from the 'Standby', 'Benary Princess' and 'Matador' series showed that, while a limited market might exist for this wider range of shades, none matched the flower quality of the 'Krallen' series.

'Karma' dahlia cultivars

Following interest in supplying dahlia as a cut-flower, a demonstration of 18 'Karma' dahlia cultivars (bred for improved vase life) was undertaken at the Centre. Although the cultivars grew vigorously, especially under protection, and the blooms were striking, vase life tests were disappointing, failing to make the minimum of 11 days shelf-/vase-life necessary for a commercial proposition. Further research is planned.

Lisianthus (*Eustoma*)

Cut-flowers of lisianthus have now achieved considerable popularity in the UK, and the possibility of growing a short summer spot crop in Spanish tunnels was tested. Plug plants were planted in weeks 18, 19 and 20, and cropping started in week 30, with high-quality blooms, good stem strength and no pest and disease problems. Since the weather in 2010 had been ideal for growing lisianthus, the trial should be repeated in 2011 before any definite conclusions are drawn. The 2011 trials will also look at the effect of spacing because at 64 plants/m² the 2010 CFC crop was spaced wider than the industry norm for glasshouse crops.

Phlox

Plots established in a tunnel 2009 were grown-on and provided a useful resource to flower packers for demonstration to supermarket buyers.

Sunflowers

Sunflowers were included in the Centre's trials for the first time in 2010. Although already a well-established crop in the UK, their size means that harvesting and handling require significant resources. To facilitate handling, and perhaps mechanical harvesting, it was planned to investigate new dwarf cultivars as well as the use of plant growth regulators on standard cultivars. Unfortunately extremely dry weather followed sowing, resulting in poor germination and establishment, followed by wet, windy weather that adversely affected establishment and growth. The trial will be repeated in 2011.

Ornamental brassicas

For economic success ornamental brassicas need to be grown on as low-cost a basis as practical, which is likely to involve direct-drilling. Direct-drilling and traditional plug planting were carried out on a commercial nursery with a more appropriate soil type than at the CFC. The direct-drilled crop performed well, and as a result management at the nursery intends to direct-drill all its ornamental brassicas in future. A range of 15 new lines was also evaluated; some had potential as novelties or as alternatives to 'Crane' cultivars, and will be tested again in 2011.

Hardy foliage plants

A wide range of hardy foliage plants was planted outside in 2010 and their performance will be reported in the 2011 report.

Financial benefits

The project identified a number of crops having definite potential for further exploitation and commercialisation in the UK. It is estimated that two or three new products would help to maintain a significant number of larger or medium-sized businesses.

Action points for growers

- The trials on 'German asters' have provided a deal of know-how and growers might consider trial plantings using the basic information supplied from trials detailed in the main report as a starting point.
- Of the other promising lines tested, new cultivars of *Aster ericoides* for flowering in September attracted considerable interest, and are recommended for testing by growers on a small scale.
- Some other crops were promising, but as further work is required it is recommended that growers look for developments with these products in future trials at the Cut Flower Centre. These crops include, lisianthus (which performed well in Spanish tunnels but needs to be confirmed in another year), 'Karma' dahlias (which are superb producers but have post-harvest quality issues that need resolving), and 'Trumpet' antirrhinums (which need market testing to establish acceptance by buyers).
- Work on phlox, ornamental brassicas and sunflowers is continuing and growers should look for updates on these products as work progresses in 2011.

SCIENCE SECTION

Introduction

Despite consumer trends that have led to a huge increase in the sales of cut-flowers in the UK over the past 20 years, most are imported. It is evident that many types of cut-flowers cannot be grown in the UK because of climatic factors or economic considerations, and this does include many of the most popular and most traded sorts such as roses and carnations, for which large-scale glasshouse production in the UK is uneconomic. Figure 1 contrasts the recent value of the UK's cut-flower imports with home-grown production: the two charts have been intentionally drawn on the same vertical scale, giving a clear message. For clarity, home production is shown split to crop types in Figure 2.¹ UK-produced cut-flowers consist very largely of field-grown and glasshouse-forced bulbous crops and glasshouse crops such as chrysanthemum and alstroemeria: the outdoor and tunnel-grown cut-flowers, with which this report is mainly concerned, make up but a small proportion of the 'other bulbs and flowers grown in the open' category.

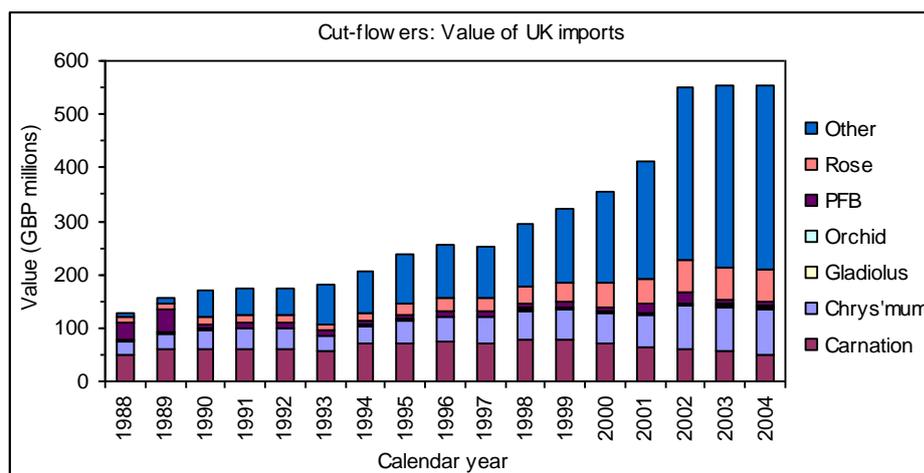
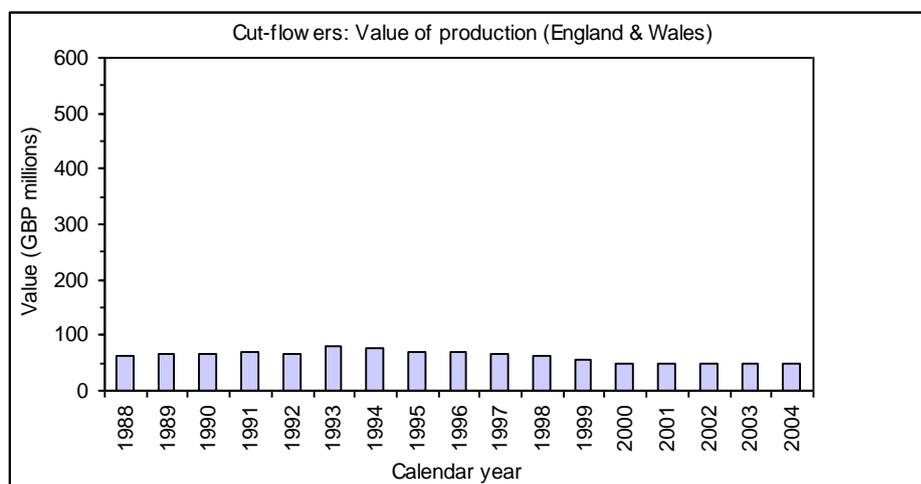


Figure 1.

Top: The value of the UK's cut-flower imports in £millions (excluding Channel Islands). The latest year's figures are provisional. The category PFB means 'prepared flowers and buds'. 'Other' is likely to include large quantities of bulb flowers such as lily, tulip and narcissus.



Bottom: Estimated farm-gate value of England & Wales' total cut-flower production in £millions, deliberately drawn to the same scale as the upper chart. For further explanation see Figure 2.

¹ Data for Figures 1 and 2 from Defra's *Basic Horticultural Statistics*, accessed 22 February 2011 at <http://defra.gov.uk/evidence/statistics/foodfarm/landuslivestock/bhs/index.htm>

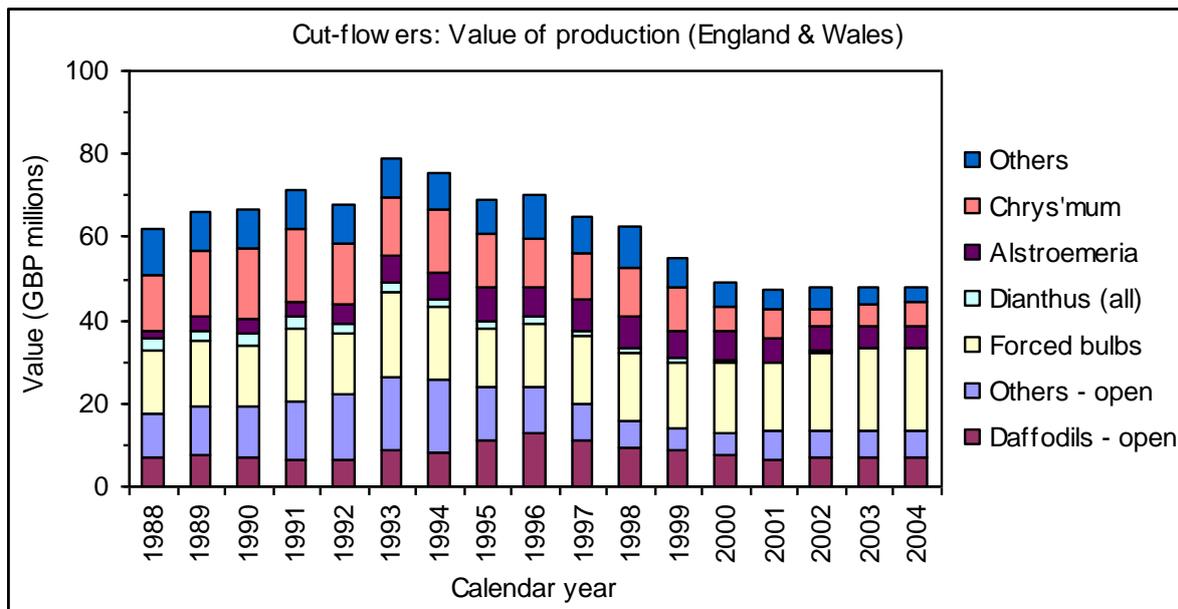


Figure 2. Estimated farm-gate value of England & Wales' total cut-flower production in £millions. The latest year's figures are provisional. The category 'Daffodils - open' means narcissus grown in the open, and 'Others - open' means other bulbs and flowers grown in the open, and in each case the figure has been reduced by half to approximate to the value of cut-flowers (the other half representing the value of dry-bulbs); the remaining categories all represent protected crops.

In defiance of these statistics, many popular cut-flower crops can be grown successfully in the UK, either in the field or under protection, the more so since the availability of Spanish tunnels and similar structures. UK growers have maintained only relatively small areas of natural-season chrysanthmums, sweet Williams, peony and pinks outdoors, though sunflowers are grown on a reasonably large scale. Many more sorts could be grown in the UK, either outdoors, or in tunnels covered for at least part of the growing season. Why has the UK industry not responded more positively to consumer trends? Why does it seem the industry's knee-jerk reaction is to import, import? After all, many of the 'minor' cut-flowers now more popular are relatively delicate, traditional British favourites and UK growers have the advantage of being close to their natural markets.

Discussions in various 'cut-flower growers' groups' in the late-1990s and early-2000s suggested that a lack of know-how, compounded by the wide array of candidate crops, may have been largely responsible. Perhaps there was also a need for practical demonstrations and trials to show growers, packers and buyers what could - and could not - be done. In 2006 all this stimulated the idea of an industry-led, yet independent, UK cut-flowers trial centre in South Lincolnshire, a major flower-growing region which already had the infrastructure for fresh produce logistics.

Cut Flower Centre Ltd was set up as the means for managing the project. In 2007 and 2008 trials were carried out under contract by Warwick HRI at its Kirton Research Centre (KRC), Kirton, Lincolnshire, funded jointly by the HDC (as project PC/BOF 268) and the Lincolnshire

Fenlands LEADER+ Programme. After the closure of KRC in February 2009, the trials were moved to Rookery Farm, Holbeach St John, Lincolnshire (made possible by a generous one-off contribution from Waitrose Ltd). It operates as a discrete unit, the *National Cut-Flower Trials Centre* ('the Centre'), under the direction of a Management Group (MG) comprising representatives of cut-flower growers, packers and marketing companies, supermarkets and consultants. After experiencing difficulties with the regional EU funding bodies succeeding LEADER+, largely over the interpretation of the HDC-levy as private or public funds, starting in 2009 the project has been funded solely by the HDC jointly through its BOF and PC Panels (as project PC BOF 002). The present contract runs to 2012.

The technical aims of the Centre are:

- To carry out demonstrations, trials and problem-solving experiments relevant to UK cut-flower production, covering current crops and, especially, potential new crops for the UK.
- To evaluate promising, newer cut-flower crops on a commercial scale.
- To publish the results of these findings and help establish 'Best Practice' for the crops and cultivars promoted.
- To act as a forum to identify and facilitate further R&D projects relevant to UK cut-flower production.
- To provide a source of samples to enable growers, packers and supermarkets to test consumer reaction to 'new' cut-flower lines. This role was especially strong in 2010, with some samples even being sent to packers in Holland.

These technical aims are linked to the practical aim of assisting UK businesses by promoting UK cut-flower production - by helping the commercialisation of newer crops and cultivars through demonstrations, by providing samples of cut-flowers for market testing, and by providing related back-up information.

This Annual Report presents the full results of the 2010 trials carried out in the field and under Spanish tunnels. In 2010 much effort was concentrated on understanding the production of the newer strains of China aster ('German asters') that had previously attracted intense interest when growing at the Centre. The other trials and demonstrations featured 'trumpet' cultivars of antirrhinum, *Aster ericoides* for September flowering, 'Karma' dahlia cultivars, ornamental brassicas, lisianthus, phlox and sunflower. A range of hardy foliage species was planted for use, once established, in demonstrations.

Materials and methods

Trials and demonstrations at the Centre

The Centre facility at Rookery Farm, Joys Bank, Holbeach St Johns, Spalding, Lincolnshire was set up in early-2009 and consists of a single-span 'Haygrove' tunnel (7.9m wide x 38.1m long), a triple-span 'Pro Tech' tunnel (overall 22.7m wide x 38.0m long) and an area of outside beds of about 600m². The whole area is irrigated using zoned, fully computer-controlled lay-flat tubes. It is an exposed site, and wind-breaks of 2.5m-high polypropylene netting are provided at each end of the 'Pro Tech' tunnels. The soil is a heavy silt typical of the area.

The soil in the tunnels was steam-sterilised in March 2010. Prior to trialling, the usual ploughing, agricultural soil analysis, fertilizing according to needs, and cultivation were carried out. Beds, 1m-wide, were marked out, three beds per tunnel, and further beds were made outside adjacent to the tunnels as required. For weed control, all transplanting was done through 1.2m-wide, 120 gauge, micro-perforated black polythene film. Each bed was irrigated with three lay-flat tubes, and each bed was divided half-way along the tunnel to provide two irrigation zones per bed.

Crop husbandry protocols were agreed between key staff at Rookery Farm and the Centre's MG with the aim of achieving good commercial practice, adapted as necessary to suit small trial plots. A standard liquid feed was applied to all plots at weekly intervals, and was increased to every other irrigation once deemed necessary. Pesticide advice was given by a BASIS-qualified agronomist who visited regularly throughout the growing season. During 2010 pesticides were applied as needed and according to recommendations against the following target organisms:

- For aphid, pymetrozine + lambda-cyhalothrin (as 'Chess WG' + 'Hallmark with Zeon Technology') on 23 June and 01 July, and thiacloprid + cypermethrin (as 'Calypso' + 'Toppel 100 EC') on 29 June and 19 July
- For thrips, spinosad (as 'Conserve') on 06 July
- For aphids and thrips, spirotetramat + lambda-cyhalothrin (as 'Novento' and 'Hallmark with Zeon Technology') on 23 July
- For mildew and caterpillar, sulphur + indoxacarb (as 'Thiovit Jet' + 'Steward') on 25 June and 21 September
- For mildew, mancozeb + metalaxyl-M + azoxystrobin (as 'Fubol Gold WG' + 'Amistar') on 28 September.

Note: Since approvals for pesticide applications change rapidly, it will be necessary to verify the current status of all treatments listed above via a BASIS qualified advisor or via the LTAEU Liaison tab on the HDC website or directly from the CRD website.

The species and cultivars trialled and demonstrated at the Centre in 2010 are listed in Table 1, along with the name of the supplier, dates of transplanting or direct-drilling, whether grown outside or in tunnels, planting density, any special treatments and whether transplanted crops were obtained as plug-plants, seed, rooted cuttings or were raised in peat-blocks.

The plots for demonstrations and trials were typically 3m-long, with 1m-long unplanted guard areas between plots. Appropriate to the more 'practical' nature of the project, treatment plots were not generally replicated. Where appropriate, factorial analysis of variance without replication was used to assess the significance of 'main effects' (e.g. planting density or planting date), though this did not allow interactions between main effects to be assessed formally.²

The crops and results for the project, along with plans for further work, were assessed at regular meetings by the MG and others as appropriate. Stems were picked at the appropriate stage for each crop. Typically, the number of stems picked was recorded, along with the picking dates and lengths and weights of individual stems; additional measurements were taken in specific cases. Under 'Results', stem lengths and weights always refer to the total weights and lengths of the whole stem, i.e. from the bottom of stem to the tip of the flower. In the case of the more 'observational' plots, photographs and notes were taken, but no formal records.

Evaluation at commercial nurseries

From observations of previous trials of ornamental brassicas at the Centre and elsewhere, it is known that this crop is very sensitive to soil conditions. As the soil at the Rookery Farm site was thought to be unsuitable, in 2010 evaluations of direct-drilled and plug-planted ornamental brassicas, and of a range of new lines of ornamental brassicas, were grown on a commercial nurseries (Winchester Growers Ltd, Herdgate Lane, Pinchbeck, Lincolnshire) using commercial protocols. The new lines were planted on 10 July and harvested on 28 October. Further details are given under 'Results and conclusions'

² Using the data analysis tool within Microsoft Excel.

Vase-life trials

Freshly harvested stems of marketable quality were cropped from selected trials and subjected to vase life testing under standard conditions carried out by Winchester Growers Ltd. In the case of the novel ornamental brassica lines, stems were cold-stored for one day and then for three days at 21°C (to simulate the storage, transport and retail stages of handling) before vase life testing with 'Chrysal Clear Universal Flower Food' added to the vase water.

Table 1. Cut-flowers grown at the Centre in 2010

Species and purpose of trial	Cultivars, series, (producer/supplier)	Transplanting or drilling dates	Site and planting density	Other notes
1. Antirrhinum ('trumpet' cultivars) (<i>Antirrhinum majus</i>) Demonstration plots	'Peloric' series 'Ivory White', 'Red' and 'Yellow' (Florensis)	Plugs transplanted week 14	Haygrove tunnel 64 plants/m ²	Support netting
2. Aster ericoides Pinching trial and cultivar demonstration	'Chicago Moergo', 'Coldwater', 'Flameback', 'Flamingo', 'Milka Dark', 'Parrot', 'Blue Tail', 'Cape Town', 'Moertown', 'Cassy Moercas' and 'Dubblefun White' (Armada)	Plugs transplanted Week 18 in tunnel, week 20 outside	ProTech tunnel 3 and outside 16 plants/m ²	Grown both as pinched and un-pinched plants Side wire support
3. China aster ('German asters') (<i>Callistephus chinensis</i>) Planting date trial UK block and Dutch plug trial Growth regularor trial Cultivar comparisons	'Krallen' series 'Chinchilla', 'Golden', 'Kameo', 'Kartthausen', 'Lux', 'Orient' and 'Perser' (Ball Holland) 'Gala' series 'Lavender' and 'Purple' (Combinations) 'Standby' series* 'Pink', 'Deep Blue', 'Carmine Red', 'Creamy White', 'Salmon Pink', 'Light Pink', 'Carmine White', 'Red', 'Light Blue' and 'Dark Red' 'Benary Princess' series* 'Bright Red', 'Blue', 'Bright Rose', 'White', 'Deep Red', 'Light Blue', 'Crimson' and 'Yellow'	Plugs transplanted weeks 16, 18, 20 and 22 UK-raised block plants transplanted weeks 16, 17, 18, 19, 20, 21, 22 and 23 Plugs transplanted weeks 20	ProTech tunnels 1 and 2 64 plants/m ²	Some plug-raised plants received growth regulator treatments (see text)

Species and purpose of trial	Cultivars, series, (producer/supplier)	Transplanting or drilling dates	Site and planting density	Other notes
3. continued...	'Matador' series* 'Deep Blue', 'White', 'Soft Blue', 'Crimson', 'Yellow', 'Salmon Rose', 'Fiery Red' and 'Bright Carmine'		Haygrove tunnel 64 plants/m ²	-
	*Cultivar comparisons only			
4. Dahlia ('Karma' series) (<i>Dahlia</i> hybrids) Demonstration plots	'Karma' series 'Lagoon', 'Choc', 'Prospero', 'Amanda', 'Bon Bini', 'Thalia', 'Ying Yang', 'Sangria', 'Maarten de Zwaan', 'Ventura', 'Royal', 'Serena', 'Fiesta', 'Red Corona', 'Corona', 'Pink Corona', 'Irene' and 'Naomi' (Keep Smiling BV)	Cuttings transplanted week 28	Outside 9 plants/m ²	-
5. Lisianthus (<i>Eustoma</i>) Demonstration	'Arena Blue', 'Pink Picotee', 'Paloma Yellow', 'Piccolo Apricot', 'Mariache Yellow', 'Kyoto Purple', 'Dream White', 'Mariache White Pure', 'Mariache Misty Pink', 'Mariache Lime Green' and 'ABC 2-3 Rose' (Florensis)	Plugs transplanted weeks 18, 19 and 20	Haygrove tunnel 64 plants/m ²	Support netting
6. Phlox (<i>Phlox paniculata</i>) Demonstration	'Icecap', 'Miss Marple', 'Miss Fiona' and 'Sugar Missy' (Bartels Stek) 'Magical Dream', 'Magical Fragrance' and 'Magical Surprise' (Kolster BV)	Plants established in 2009	ProTech tunnel 3 16 plants/m ²	-
7. Sunflower (<i>Helianthus annuus</i>) Dwarf cultivars and growth regulators trial	'Premium Light Yellow', 'Premium Lemon', 'Galilee Adami', 'Sunrich Orange' and 'Zohar Yellow' (via Simon Crawford)	Direct-drilled week 24, 25 and 26	Outside 35cm between rows and 8 seeds per running metre.	-

Results and discussion

1. ANTIRRHINUM ('TRUMPET' CULTIVARS)

In 2009 the Centre planted demonstration plots of two lines (AHC 129 and 130) from a new range of antirrhinums marketed by Florensis. Instead of the traditional shape, the new cultivars have striking, trumpet-shaped flowers. Growers, packers and supermarket representatives visiting the trials were impressed by the performance and appearance of this new material: in response, three cultivars from Florensis's 'Peloric' series (red, white and yellow lines) were included as a further demonstration in 2010.

Following transplanting in week 14 the plants flowered around week 22. Not only was the unusual form of the flowers again appreciated by visitors, but the stems were of an impressive quality with bunches of six stems with a length of 66cm weighing 310 to 320g. Standard VL tests were carried out and a VL of up to 15 days was achieved.

Unexpectedly, there was a second flush of flowers around week 28. While the stems from the second flush were shorter and lighter, they were nevertheless of a marketable quality. Bunches of six stems with a length of 55cm weighed 285 to 305g.

Because of the amount of interest in these flowers, throughout the flowering season significant numbers of bunches were supplied by the management group to interested parties for monitoring by their buyers and account managers. This involved at least six major packers and assessments in the UK and Holland.

The definite response from the industry means that trumpet antirrhinums will be grown at the centre again in 2011. One limitation of the trial in 2010 was the restricted range of colours available, and it is hoped that in 2011 a wider selection of colours, especially of those associated with a spring and summer mix, will be available for testing. As there is currently no information available on the effect of planting date on cropping, this should also be investigated.

In future it will be important to emphasise to company technologists that these cultivars should be displayed at a later stage of development than would be the case with standard snapdragons, in order to better display their attractive form. A confirmation of realistic vase life expectations will also be needed.



Three cultivars of 'trumpet' antirrhinums flowering in week 23, 2010



The second flush of 'trumpet' antirrhinums in week 29, 2010

2. ASTER ERICOIDES

The aim of the trial was to demonstrate a range of cultivars, mostly doubles and new to the UK market, that are useful for September flowering. At the Centre they were grown in Spanish tunnels and outside, both as single stems and as a pinched crop.

Under tunnels, the pinched plants yielded numerous strong stems that were ready for cropping from around week 36 (the images below were taken in week 34). The outdoor crop, in marked contrast, gave a poor product. The single-stem crop grew excessively tall.

The response of the industry was that these lines showed real potential. As with the trumpet antirrhinums, the aster trial proved to be a useful resource, with numerous sample bunches being provided by the management group to interested packers and buyers. As one consequence of this, three supermarkets plan to test market these cultivars in stores in 2011.

There are clearly substantial differences between cultivars, and so more cultivar demonstrations are needed in 2011, when new plants will be sourced and grown alongside the earlier plantings. As the asters are long-day plants their cropping period can be manipulated by blackouts and this will be tested in 2011. However, the high cost of planting material means that other production costs must be kept to a minimum.



Vigorous plots of Aster ericoides growing at the Centre



'Coldwater'



'Flamingo'



'Parrot'



'Milka Dark'

A selection of Armada's A. ericoides cultivars³

³ From: <http://www.armadayoungplants.nl/catalogue/ArmadaCatalogus2010.pdf>

3. CHINA ASTERS ('GERMAN ASTERS')

With continued interest in these striking cultivars of China aster, further trials on a number of cultural aspects were carried out at the Centre in 2010. Several cultivars from the 'Krallen' and 'Gala' series were grown, mainly from Dutch plug plants, though some were instead seeded into blocks in the UK. Transplanting dates ranged from week 16 to week 23. Some plug-raised plants were treated with the growth retardant daminozide to reduce excessive growth. Selected treatment combinations are set out below under the headings of cultivar comparisons, which evaluated plug- and block-raised plants, effects of planting date, and the effects of growth retardant.

As a further cultivar evaluation, demonstration plots of 26 cultivars from the 'Standby', 'Benary Princess' and 'Matador' series were also grown.

1. *Cultivar comparison: plug-raised 'Krallen' and 'Gala'*

Figure 3 is a comparison of six 'Krallen' and two 'Gala' cultivars raised as plugs in the Netherlands and transplanted to tunnels in week 16. Mean stem lengths for the different cultivars ranged from around 90cm to 110cm, with the 'Gala' cultivars notably taller than the shorter but more variable 'Krallen' cultivars (Figure 3a). In contrast, the tall 'Gala' cultivars were conspicuously light in weight, about 20g/stem, confirming earlier observations that 'Gala' produced tall, but very thin, weak stems. In contrast the 'Krallen' cultivars were heavier, especially 'Kameo' and 'Kartthausen' whose stems weighed nearly 80g each (Figure 3b). Among this selection of cultivars at least, stems appeared either short and sturdy or tall and thin, but this was not borne out by measurements of stem diameter (all cultivars having stem diameters between 1.0 and 1.5cm), or the numbers of side-shoots per plant (which were almost as variable between 'Gala' cultivars as between 'Krallen' cultivars) (Figure 3c and d). However, with the exception of 'Golden', a cultivar atypical in several respects (see below), 'Krallen' cultivars had larger, more impressive flowers which must largely be responsible for the greater stem weights (Figure 3e). Picking dates were the same in all cultivars, except for 'Golden' which was a few days later to picking (Figure 3f).

These results confirmed the findings of 2010 trials that 'Krallen' was the superior series on account of its larger, 'unusual' flowers and heavier stems. The trials in 2009 also showed that 'Krallen' cultivars showed better tolerance to pests and disease.

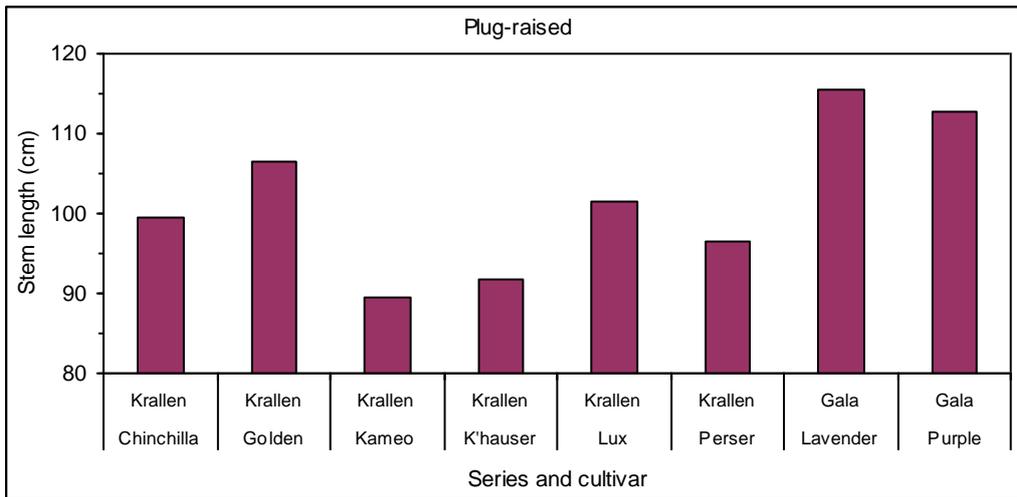


Figure 3a. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from plugs transplanted in week 16, 2010. Stem length

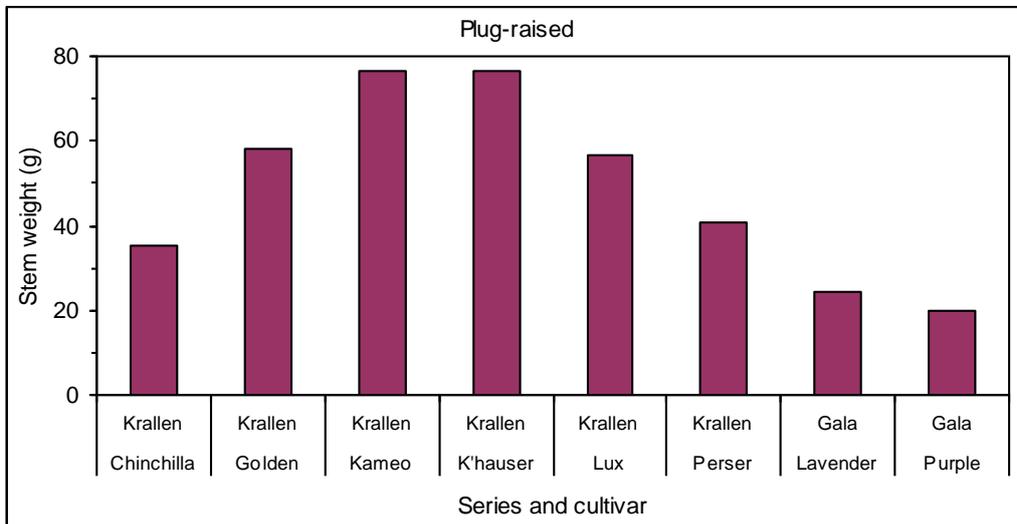


Figure 3b. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from plugs transplanted in week 16, 2010. Stem weight.



Figure 3c. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from plugs transplanted in week 16, 2010. Stem diameter.

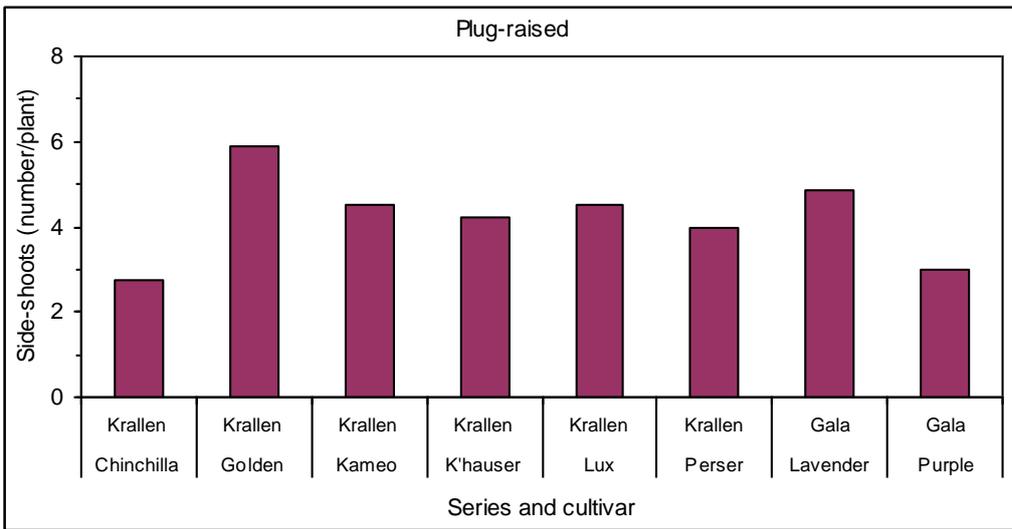


Figure 3d. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from plugs transplanted in week 16, 2010. Number of side-shoots

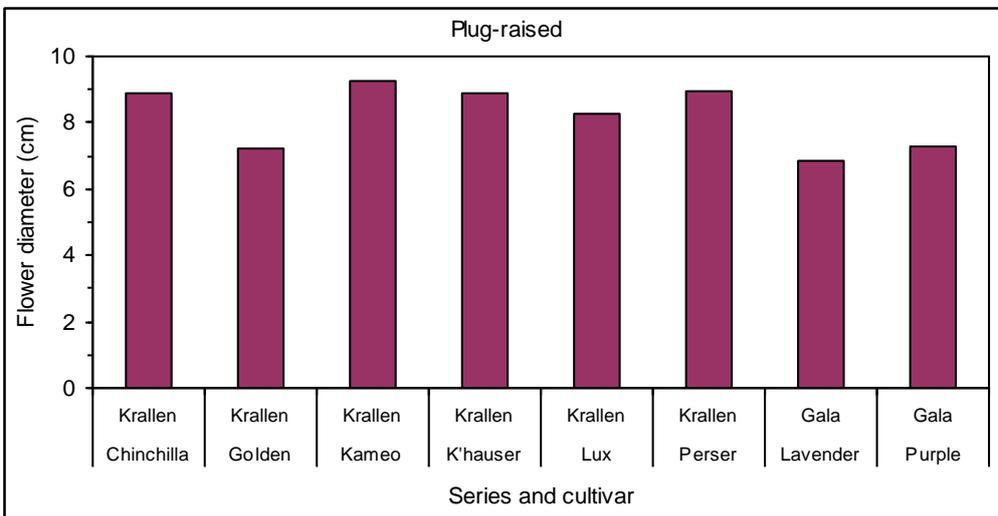


Figure 3e. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from plugs transplanted in week 16, 2010. Flower diameter.

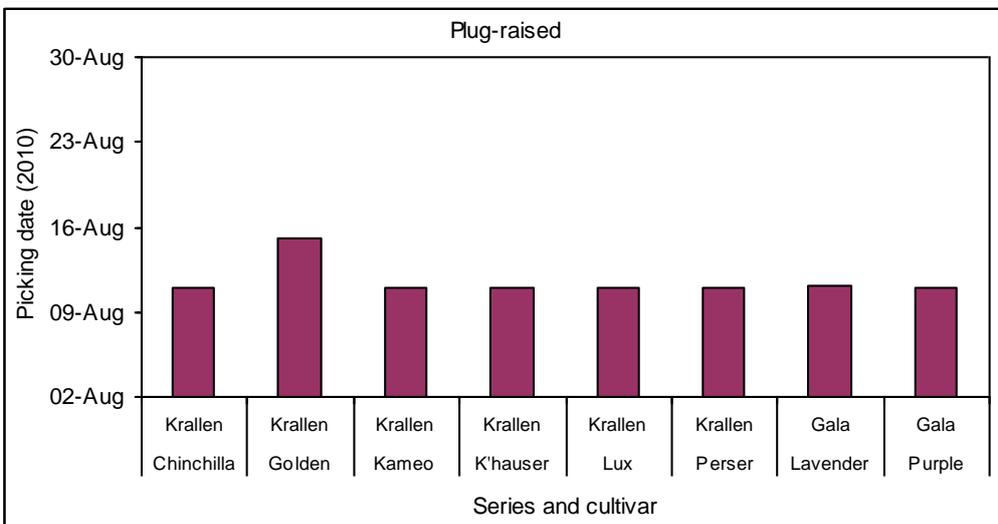


Figure 3f. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from plugs transplanted in week 16, 2010. Picking date.

2. Cultivar comparison: block-raised 'Krallen' and 'Gala'

Figure 4 is a comparison of six 'Krallen' and two 'Gala' cultivars that had been raised as blocks in the UK and transplanted into tunnels in week 23. Mean stem lengths were reasonably consistent, at around 105cm, across all cultivars (Figure 4a), as were stem weights (Figure 4b). In contrast to plug-raised plants (section 1 above) there were no consistent differences between the cultivars of the 'Krallen' and 'Gala' series tested. Stem diameters (Figure 4c) were equally consistent. There were small, but probably commercially non-significant, differences in the numbers of side-shoots per plant (Figure 4d). Flower sizes too were consistent across the cultivars (Figure 4e) and they all reached the picking stage together (average date, 1 September).

These late-planted, block-raised plants were quite consistent in quality aspects across all cultivars, for both 'Krallen' and 'Gala' series, in marked contrast to the early-planted, plug-raised plants (see above) where between-cultivar differences were marked.

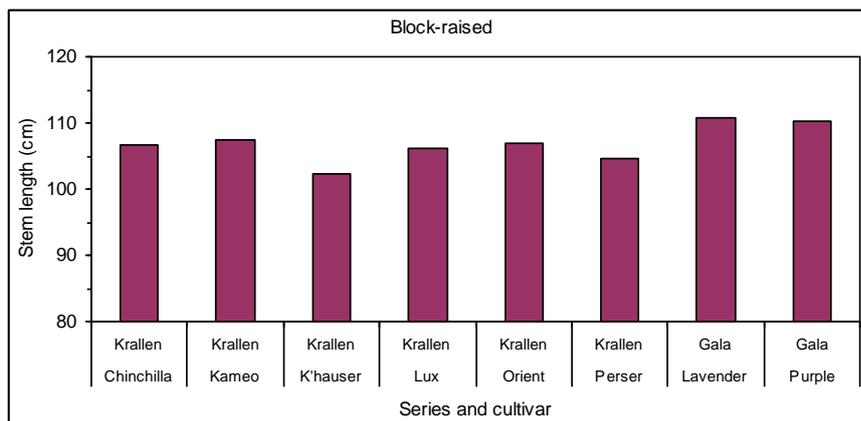


Figure 4a. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from blocks transplanted in week 23, 2010. To assist comparisons, the vertical scales of histograms are the same as in Figure 3. Stem length

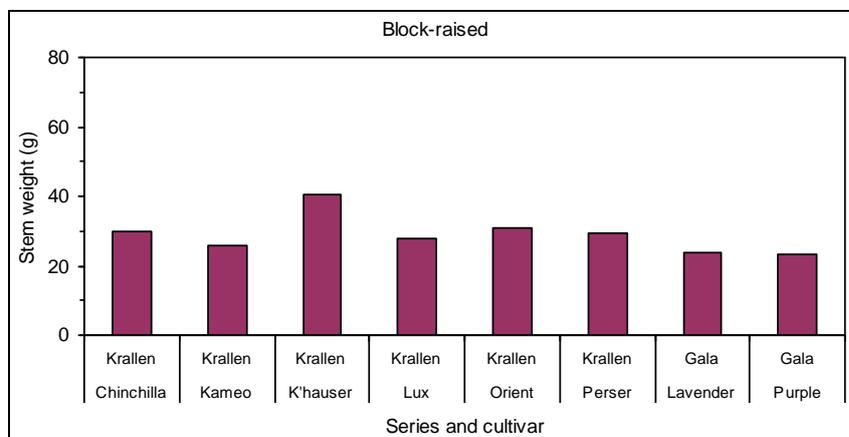


Figure 4b. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from blocks transplanted in week 23, 2010. To assist comparisons, the vertical scales of histograms are the same as in Figure 3. Stem weight.

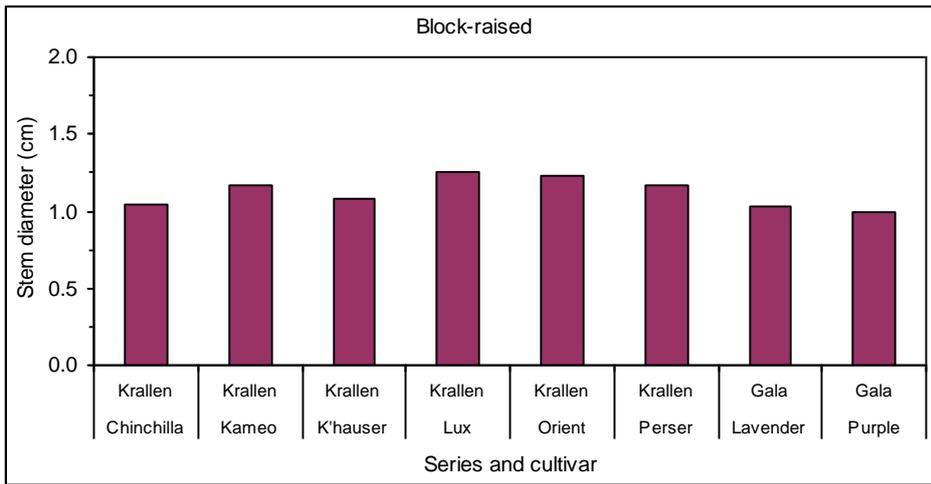


Figure 4c. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from blocks transplanted in week 23, 2010. To assist comparisons, the vertical scales of histograms are the same as in Figure 3. Stem diameter.

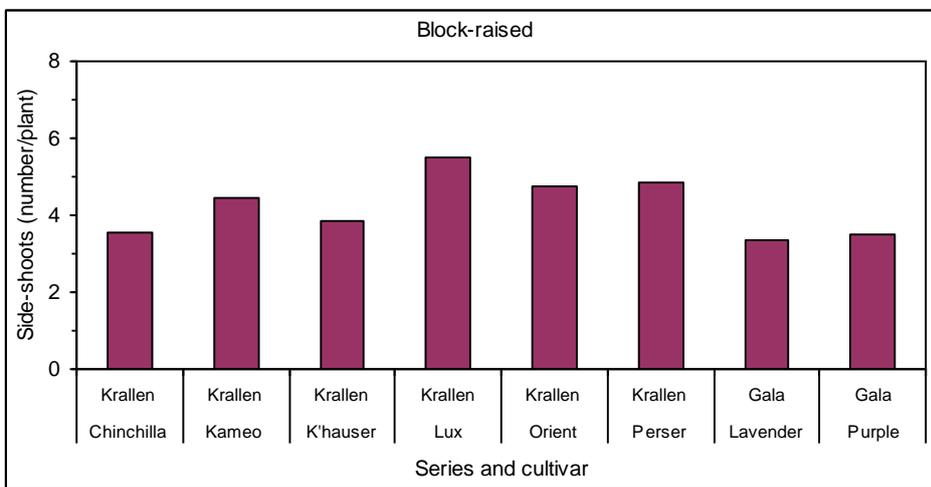


Figure 4d. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from blocks transplanted in week 23, 2010. To assist comparisons, the vertical scales of histograms are the same as in Figure 3. Number of side-shoots.

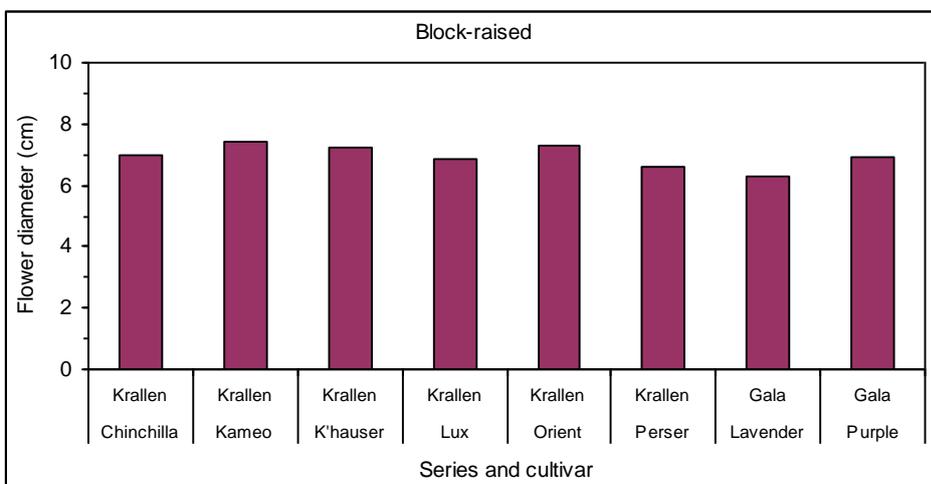


Figure 4e. Comparison of eight cultivars of 'German aster' 'Krallen' and 'Gala' series, grown from blocks transplanted in week 23, 2010. To assist comparisons, the vertical scales of histograms are the same as in Figure 3. Flower diameter.

3. Comparison of UK block-propagated plants and Dutch plug-plants

Figure 5 is a comparison of block- and plug-raised plants of five 'Krallen' cultivars planted at weeks 16, 18 and 20 (plugs) and weeks 17, 19 and 21 (blocks).

For stem lengths, no consistent differences between cultivars, propagation method or planting date could be seen, though 'Chinchilla', 'Golden' and 'Lux' gave consistently long stems (Figure 5a). Stem weight showed more distinct results: plug-raised plants gave heavy stems from the earliest planting, decreasing later, while block-raised plants gave heavy stems from both the early and middle plantings, with lighter stems later (Figure 5b). Despite their long stems, plants of 'Chinchilla', 'Golden' and 'Lux' produced light-weight stems.

Stem diameter (Figure 5c) and the number of side-shoots (Figure 5d) were reasonably consistent across the cultivar-treatment combinations, with the exception that 'Golden' in the three heavier plantings (plugs at week 16, and blocks at weeks 17 and 19) had thicker stems and more side-shoots.

Flower size varied between cultivars, but, overall, the same three heavier plantings (see above) also produced larger flowers (Figure 5e). Within plantings, picking dates were generally similar, except that cultivar 'Golden' was slightly later to crop (Figure 5f).

The UK block-propagated plants performed as well or better than conventional Dutch plugs. The former gave heavier plants with larger flowers from the early and middle plantings, while the latter gave heavier stems and larger flowers only from the early planting. Block-propagated plants may be more robust than plugs, and appeared to make more consistent stems (sections 1 and 2 above). Cultivar 'Golden' again behaved somewhat differently from the others in some respects.

A subsidiary trial showed that block-raised plants could simply be laid on the ground, as in AYR chrysanthemum growing; the blocks did not need to be buried in the soil, provided they were kept well watered.

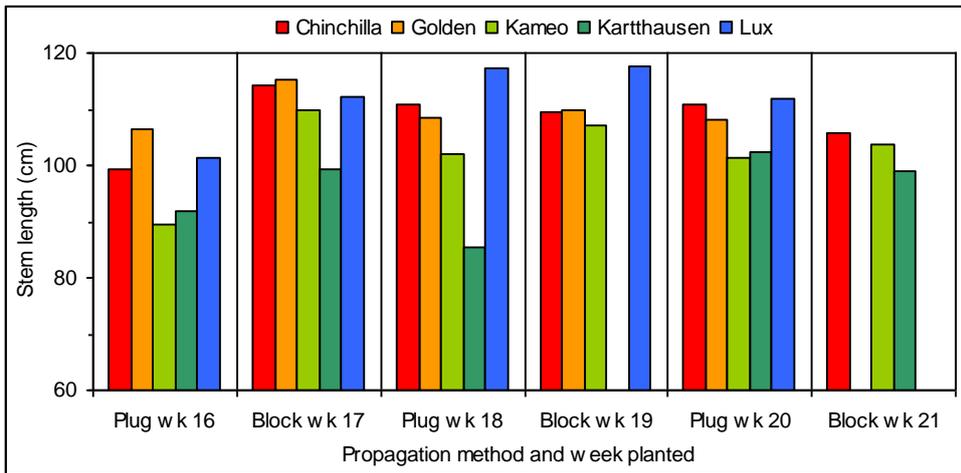


Figure 5a. Comparison of five 'Krallen' cultivars of 'German aster' grown from plugs or blocks and transplanted from week 16 to week 21, 2010. Due to missing or failed plants three cultivar-treatment combinations are missing. Stem length.

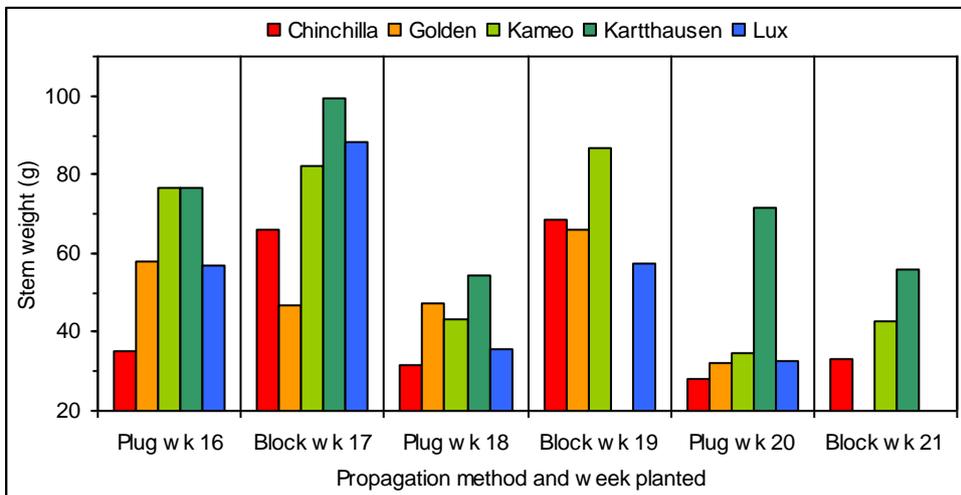


Figure 5b. Comparison of five 'Krallen' cultivars of 'German aster' grown from plugs or blocks and transplanted from week 16 to week 21, 2010. Due to missing or failed plants three cultivar-treatment combinations are missing. Stem weight.

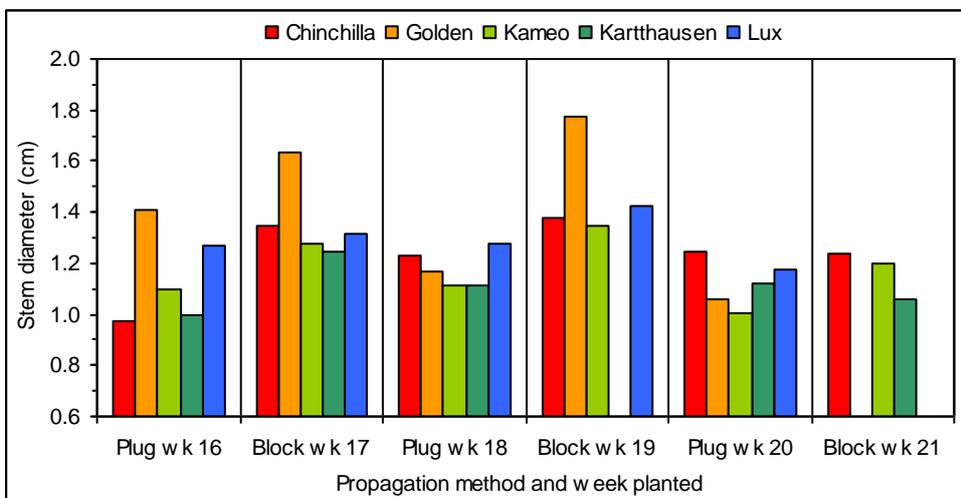


Figure 5c. Comparison of five 'Krallen' cultivars of 'German aster' grown from plugs or blocks and transplanted from week 16 to week 21, 2010. Due to missing or failed plants three cultivar-treatment combinations are missing. Stem diameter.

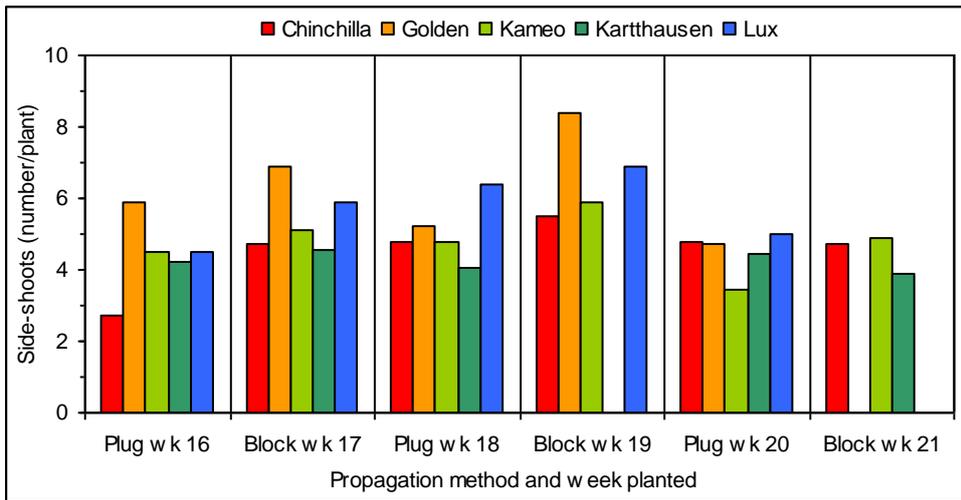


Figure 5d. Comparison of five 'Krallen' cultivars of 'German aster' grown from plugs or blocks and transplanted from week 16 to week 21, 2010. Due to missing or failed plants three cultivar-treatment combinations are missing. Number of side-shoots.

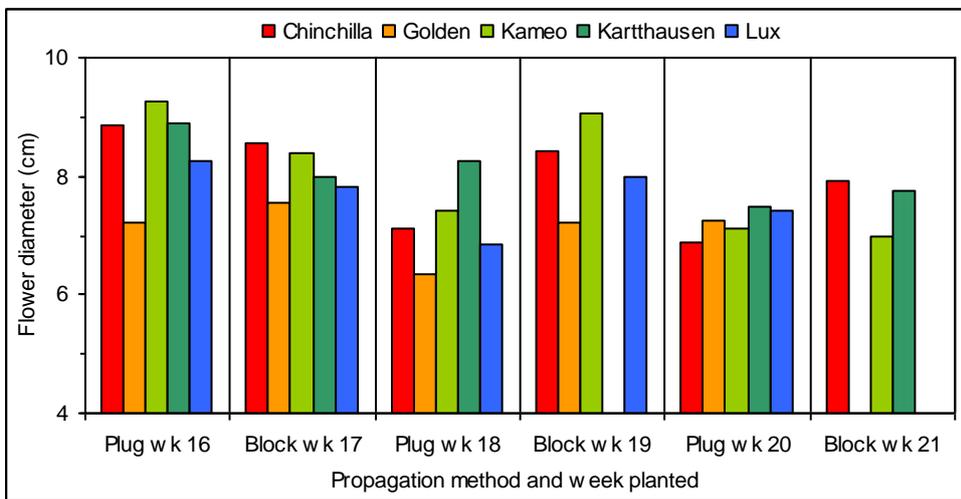


Figure 5e. Comparison of five 'Krallen' cultivars of 'German aster' grown from plugs or blocks and transplanted from week 16 to week 21, 2010. Due to missing or failed plants three cultivar-treatment combinations are missing. Flower diameter.

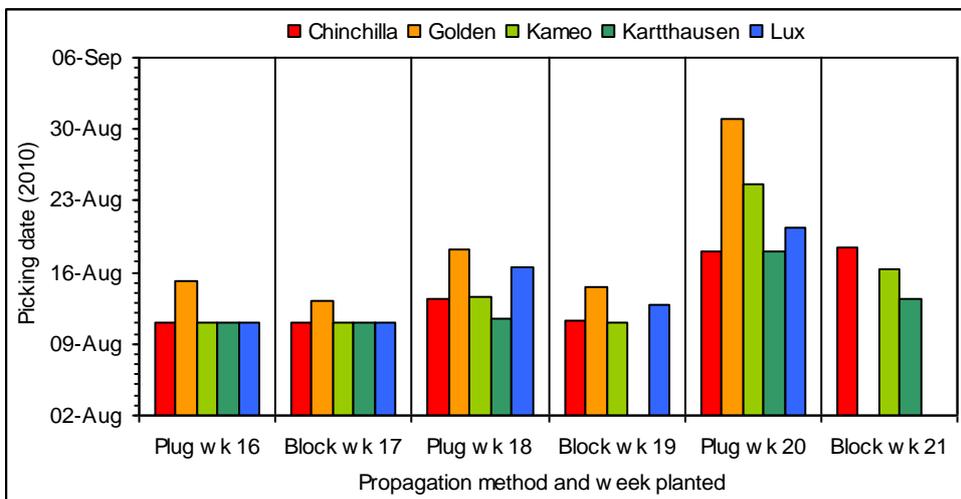


Figure 5f. Comparison of five 'Krallen' cultivars of 'German aster' grown from plugs or blocks and transplanted from week 16 to week 21, 2010. Due to missing or failed plants three cultivar-treatment combinations are missing. Picking date.

4. The effect of planting date on UK block and Dutch plug -propagated plants

The objective of using a range of planting dates was to determine the earliest practical planting date for block and plug plants in Spanish tunnels. Figure 6 is a comparison of block-raised plants of seven 'Krallen' cultivars planted mainly between weeks 17 and 23.

Except in the case of 'Kartthausen', which had shorter stems than the other cultivars included, average stems lengths for the cultivars did not vary greatly and were largely in the range of 105 to 115cm (Figure 6a). For each cultivar, there was no clear trend for stems to be longer or shorter following progressively later planting. Generally, stem length was satisfactory at the earliest planting date (week 16 or 17). Stem weight was much more variable than stem length (Figure 6b). With the exception of 'Golden', stems were markedly heavier from the earlier plantings and fell with later plantings: in several cases the weights of stems from plantings in weeks 17 to 19 were double those of plantings in week 21 or later. A balanced sub-set of the data (four cultivars x three planting dates) was subjected to two-factor analysis of variance (AOV). This showed that the effects of cultivar on stem length and weight were not statistically significant, and that the noted effect of planting date on stem weight was significant ($p < 0.05$).

Stem diameter was notably greater for earlier plantings of 'Chinchilla' and 'Golden' than for later plantings, but this trend was not seen in the other cultivars tested (Figure 6c). The number of side-shoots per plant varied in a very similar way (Figure 6d). For flower size, too, with the exception of 'Golden' there was a very clear trend for smaller flower diameter following progressively later planting (Figure 6e). Figure 6f shows the expected later cropping from later plantings, but also confirms that differences between cultivars from the same planting dates were minor. AOV showed there were statistically significant effects of cultivar on flower diameter and on the number of side-shoots (both at $p < 0.05$), but not on stem diameter or picking date. Flower diameter ($p < 0.001$) and side-shoot number and stem diameter (both $p < 0.05$) were all significantly reduced by later planting.

Essentially, these findings demonstrate that the early plantings of all tested cultivars produced heavier stems and larger flowers; performance lessened with later plantings.

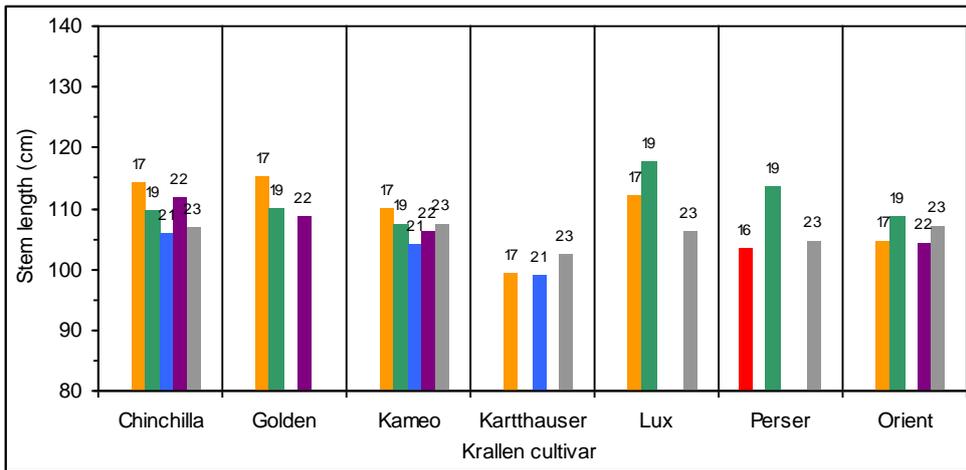


Figure 6a. Comparison of seven 'Krallen' cultivars of 'German aster' grown from blocks and transplanted between weeks 16 to 23 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. Stem length.

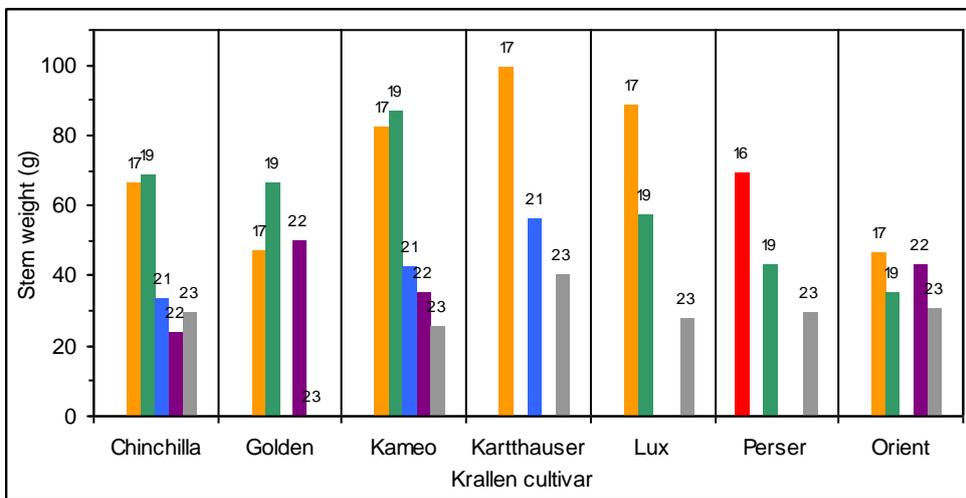


Figure 6b. Comparison of seven 'Krallen' cultivars of 'German aster' grown from blocks and transplanted between weeks 16 to 23 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. Stem weight.

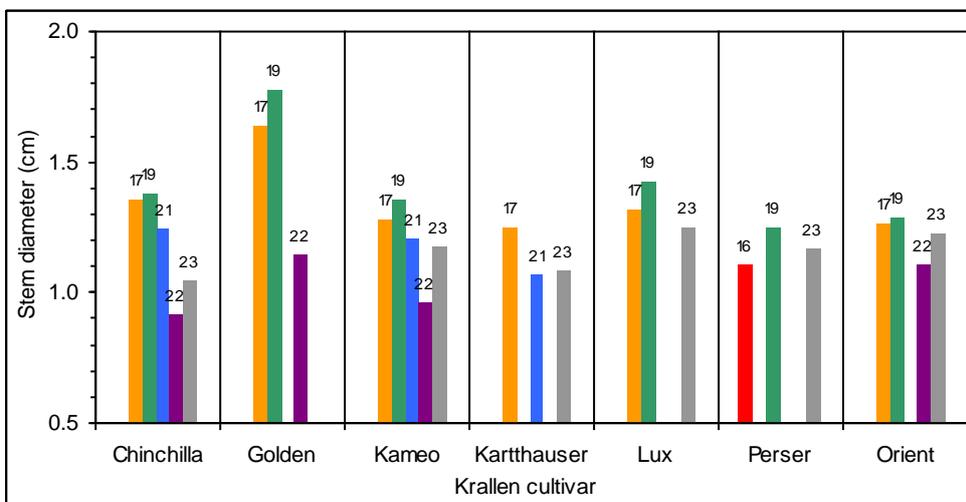


Figure 6c. Comparison of seven 'Krallen' cultivars of 'German aster' grown from blocks and transplanted between weeks 16 to 23 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. Stem diameter.

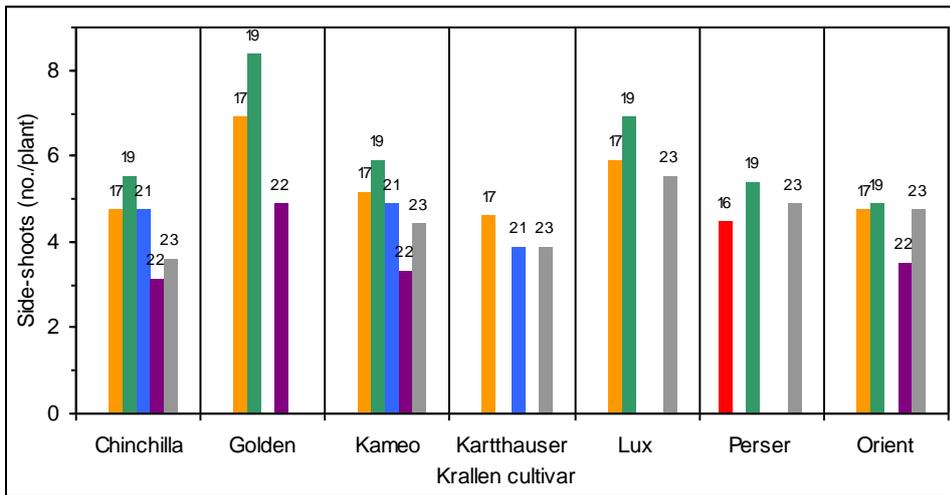


Figure 6d. Comparison of seven 'Krallen' cultivars of 'German aster' grown from blocks and transplanted between weeks 16 to 23 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. Number of side-shoots.

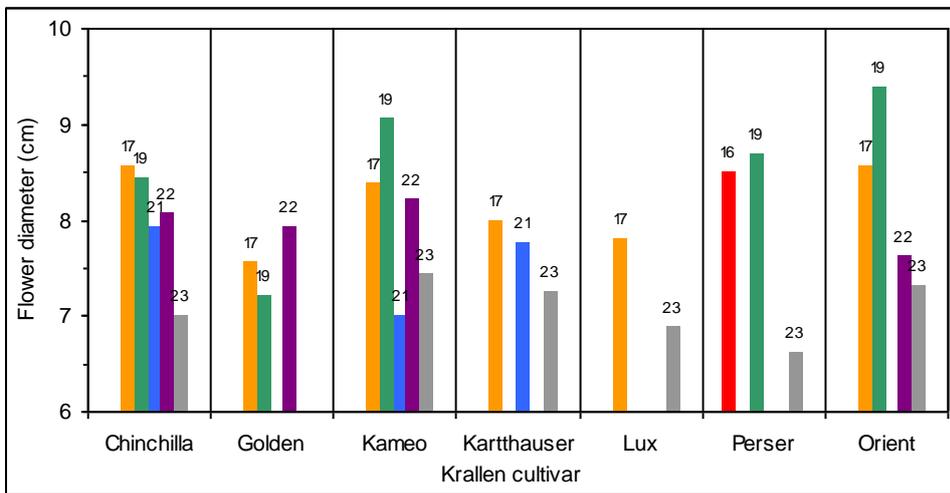


Figure 6e. Comparison of seven 'Krallen' cultivars of 'German aster' grown from blocks and transplanted between weeks 16 to 23 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. Flower diameter.

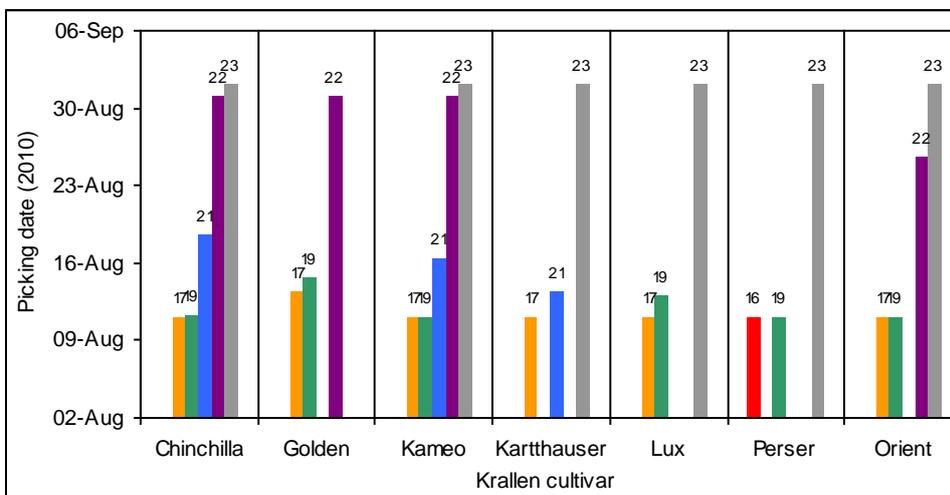


Figure 6f. Comparison of seven 'Krallen' cultivars of 'German aster' grown from blocks and transplanted between weeks 16 to 23 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. Picking date.

5. The effect of planting date on Dutch plug-propagated plants

Figure 7 is a comparison of plug-raised plants of seven 'Krallen' and 'Gala' cultivars planted between weeks 16 and 22.

Stem length in plug-raised 'Kameo' and 'Kartthausen' was shorter than average, while that of the two 'Gala' cultivars was longer than average (Figure 7a). There was a clear trend for the middle plantings (weeks 18 or 20) to produce longer stems. Except for the 'Gala' cultivars, there was a clear trend for stem weight to decrease following progressively later plantings, and this effect was conspicuous in the case of cultivars 'Golden', 'Kameo', 'Kartthausen' and 'Lux' (Figure 7b). There was also the suggestion of a tendency for thicker stems and more side-shoots to be had with the middle plantings (Figures 7c,d). A balanced sub-set of the data (seven cultivars x three planting dates) was subjected to two-factor AOV. This confirmed the statistical significance of the effect of cultivar on stem length ($p < 0.001$) and weight ($p < 0.01$) and of planting date on stem length and weight (both $p < 0.05$); there was no statistically significant effect of planting date on numbers of side-shoots or on stem diameter.

For flower size, the striking result was the much greater diameter of flowers from the first (week 16) plantings of the four cultivars that also produced much heavier stems from this early planting - 'Golden', 'Kameo', 'Kartthausen' and 'Lux' (Figure 7e). However, AOV showed the effect of planting date on flower size was weak ($p < 0.1$).

As with the block-raised plants (see above) there was the expected later cropping from later plantings (e.g. week 20 or 22), with only minor difference between cultivars from the same planting dates (Figure 7f). However, the two 'Gala' cultivars were exceptional in that flower cropping was considerably delayed even following planting at week 18. AOV confirmed the cultivar effect on picking date as statistically significant ($p < 0.01$).

The effects of planting date found in the 2010 trials reported here, confirm and extend the findings from trials at the Centre in 2009. For these plug-raised plants, and generalising somewhat across cultivars, later planting led to the production of lighter stems with smaller flowers, while stem length, stem diameter and the number of side-shoots were less from either the early or the late plantings and maximal from middle plantings. This was in contrast to block-raised plants (see above) where later planting led to thinner, lighter stems with fewer side-shoots and smaller flowers. In most cases late planting (in weeks 20 to 22) led to poorer quality stems, whereas early or middle plantings were satisfactory. While earlier findings had suggested that these cultivars should not be planted later than week 26, the issues of light-weight stems and smaller flowers in the present 'late' plantings – no later than week 22 - needs to be addressed: from the present results, producing marketable stems

from a planting at week 26 seems unlikely. It may however be useful to investigate plantings earlier than week 18 in more detail. Both block- and plug-plants performed well in many plantings, but the former would have the advantage of reducing transport costs (since blocks can be seeded in the UK) and making delayed deliveries less likely.

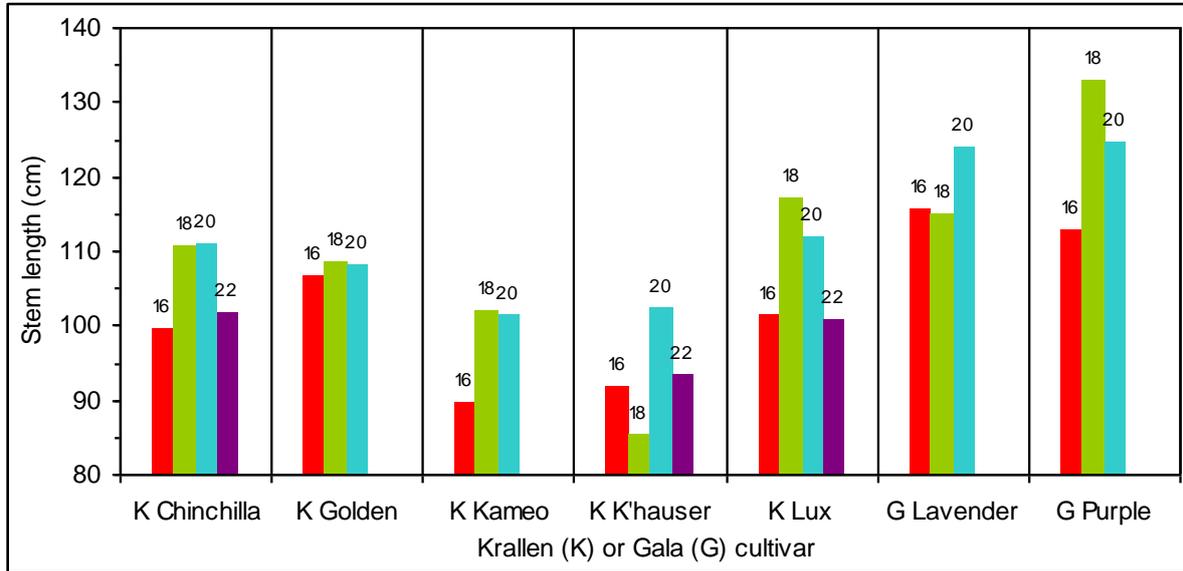


Figure 7a. Comparison of seven 'Krallen' and 'Gala' cultivars of 'German aster' grown from plugs and transplanted between weeks 16 to 22 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. To assist comparisons, the vertical scales of histograms are the same as in Figure 6. Stem length.

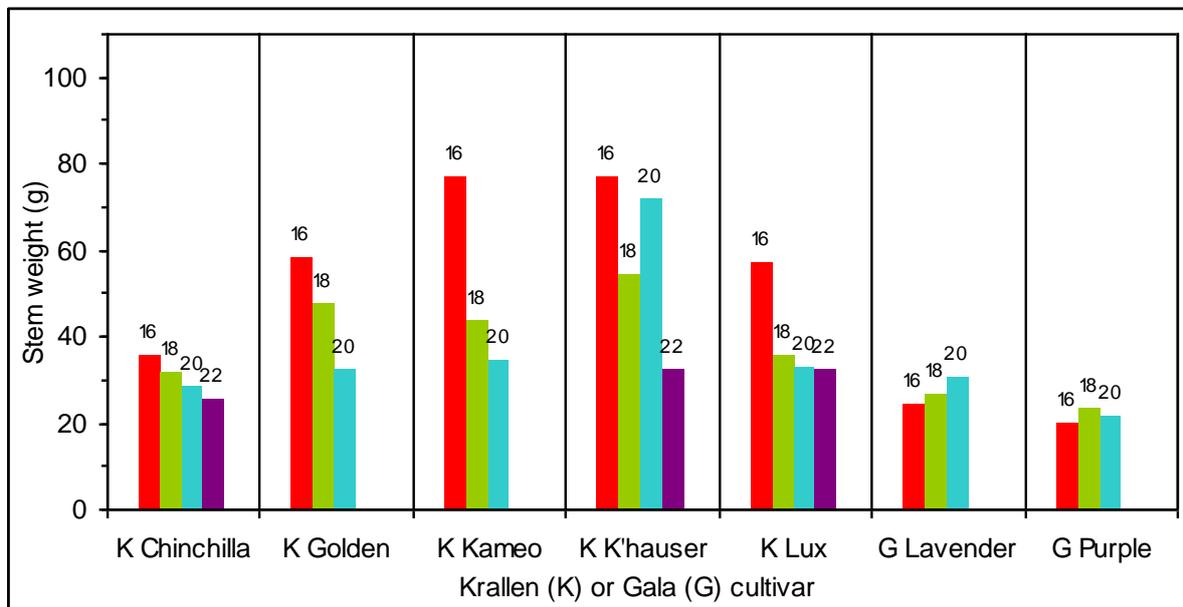


Figure 7b. Comparison of seven 'Krallen' and 'Gala' cultivars of 'German aster' grown from plugs and transplanted between weeks 16 to 22 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. To assist comparisons, the vertical scales of histograms are the same as in Figure 6. Stem weight.

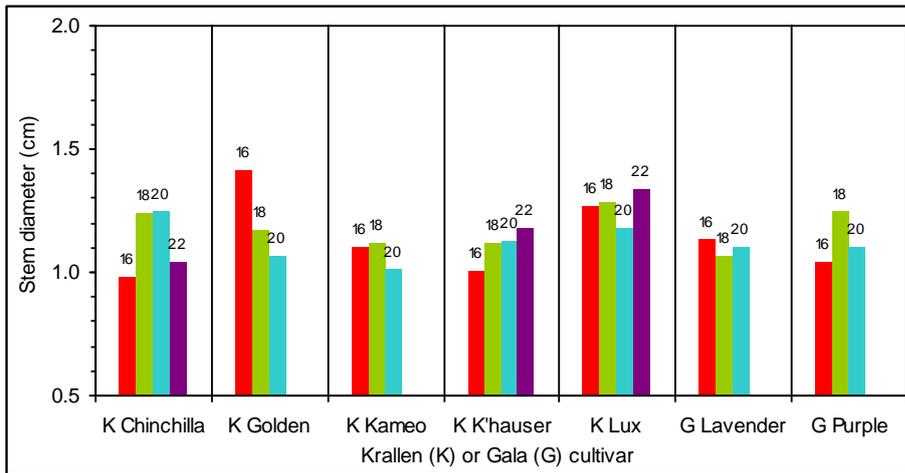


Figure 7c. Comparison of seven 'Krallen' and 'Gala' cultivars of 'German aster' grown from plugs and transplanted between weeks 16 to 22 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. To assist comparisons, the vertical scales of histograms are the same as in Figure 6. Stem diameter.

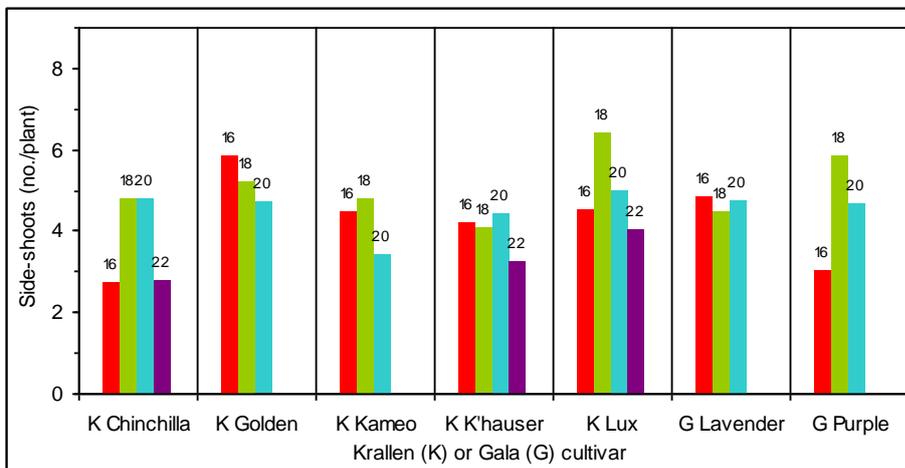


Figure 7d. Comparison of seven 'Krallen' and 'Gala' cultivars of 'German aster' grown from plugs and transplanted between weeks 16 to 22 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. To assist comparisons, the vertical scales of histograms are the same as in Figure 6. Number of side-shoots.

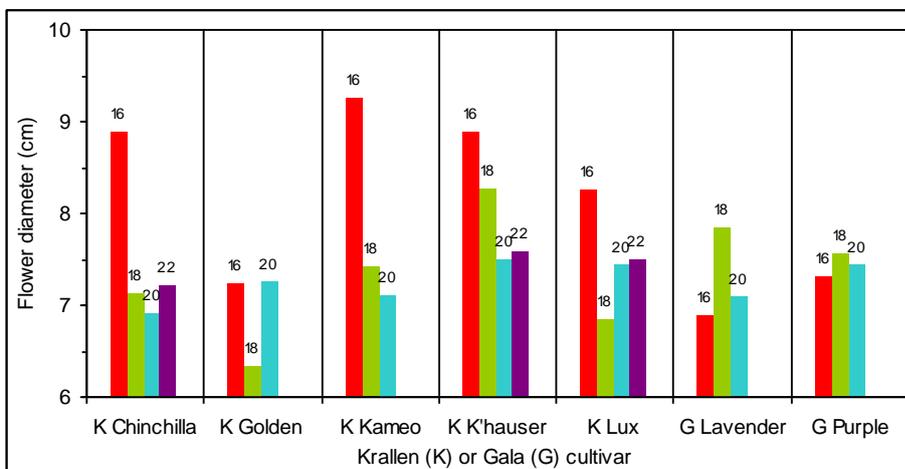


Figure 7e. Comparison of seven 'Krallen' and 'Gala' cultivars of 'German aster' grown from plugs and transplanted between weeks 16 to 22 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. To assist comparisons, the vertical scales of histograms are the same as in Figure 6. Flower diameter.

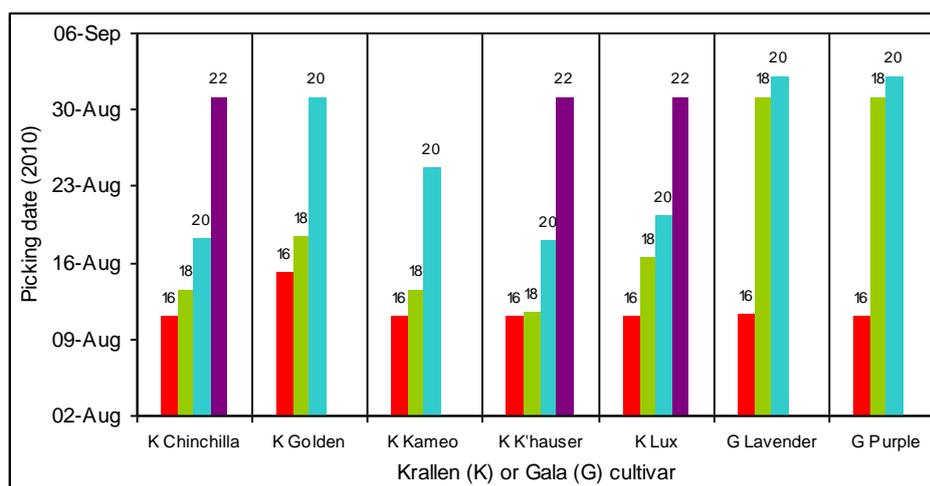


Figure 7f. Comparison of seven 'Krallen' and 'Gala' cultivars of 'German aster' grown from plugs and transplanted between weeks 16 to 22 (the planting date is indicated above each coloured block). Not all cultivars were available for all planting dates. To assist comparisons, the vertical scales of histograms are the same as in Figure 6. Picking date.

6. The effect of plant growth regulator on stem length

As confirmed above, early plantings of these cultivars can produce vigorous growth and excessively long stems, so treatment with a growth retardant may be useful. Plots of plug-raised 'Krallen' 'Kameo' and 'Kartthouser', and of 'Gala' 'Lavender' and 'Purple', were planted in week 16, 18 and 20, and were treated with two rates of daminozide (as 'B-Nine SG') or were left un-treated as controls. The 'B-Nine' rates were 3 and 6g/L, with split-dose applications made as foliar drenches to run-off on 02 June and 03 July 2010.

Stem length at picking is shown in Figure 8. The higher rate of retardant resulted in only a small reduction in stem length – by not more than about 10%, compared with un-treated controls – in all cultivars but only following the early planting date (week 16). Treatments of the later plantings were ineffective. There were no or only minimal effects of retardant treatment on the other variables measured – stem weight, stem diameter, number of side-shoots, flower diameter or picking date (data not presented).

Four balanced sub-sets of the data (two or three 'B-Nine' treatments x three planting dates for each of four cultivars) were subjected to two-factor AOV. This confirmed that the effects of growth regulator treatment were effective and statistically significant (at $p < 0.05$) for plantings of week 16, but were not significant for plantings of weeks 18 or 20.

The weak and inconsistent effect of 'B-Nine' applications shown in Figure 8 confirmed the observed impressions. The small retardant effect was noticeable only close to cropping time. This trial needs to be repeated in 2011 using earlier and perhaps repeated applications at a higher dose.

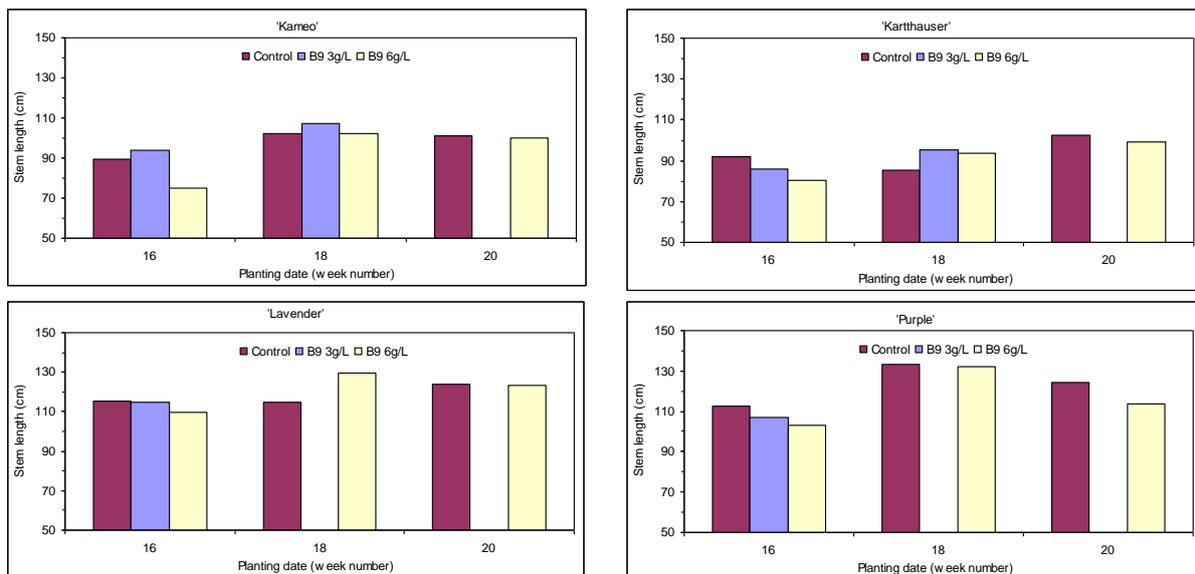


Figure 8. The effect of 'B-Nine' growth regulator treatments on stem length of 'German aster' 'Krallen' 'Kameo' and 'Karthaus' and on 'Gala' 'Lavender' and 'Purple' grown from plugs and transplanted in weeks 16, 18 and 20. Not all plantings received the lower rate of 'B-Nine'.

7. Cultivar demonstration – 'Standby', 'Benary Princess' and 'Matador' series

A selection of these cultivars is shown in the picture below. While these supplied an additional range of shades, the general view of the growers and buyers who examined them was that none were of the quality of the 'Krallen' series. However, some of them might find a limited market.

General discussion

A series of trials with 'German asters' at the Centre has shown there is potential for exploiting these vibrant cultivars in the UK. The 'Krallen' series produces a stem of superior quality, compared with the 'Gala', 'Standby', 'Benary Princess' and 'Matador' series, but there is still scope for further cultivars trials to eliminate poor or inconsistent cultivars (e.g. 'Golden' often behaves in an atypical manner and has been reported as exhibiting premature leaf-tipping).

It was interesting to note that blocks could be seeded in the UK and go on to produce stems at least as good (if not better) and more consistent than conventional plugs, also saving on transport charges. Block-raising might be exploited more. There appears to be some uncertainty about the suitable planting period, and in 2011 this should be examined further using the best cultivars. Grower observations suggest that late plantings are very sensitive to poor light levels in autumn. Once optimal growth retardant treatments have been defined in the 2011 trials, these should be used to bolster stem weight in cultivars and planting dates that need it.

Some 'German asters' of the 'Standby', 'Benary Princess' and 'Matador' series



'Standby Pink'



'Standby Deep Blue'



'Standby Carmine Red'



'Standby Creamy White'



'Standby Salmon Pink'



'Standby Light Pink'



'Standby Carmine White'



'Standby Red'



'Standby Light Blue'



'Standby Bright Red'



'Benary Princess Bright Rose'



'Benary Princess White'



'Benary Princess Deep Red'



'Benary Princess Light Blue'



'Benary Princess Crimson'



'Benary Princess Yellow'



'Matador Deep Blue'



'Matador Soft Blue'



'Matador Bright Crimson'



'Matador White'



'Matador Salmon Rose'



'Matador Fiery Red'



'Matador Bright Carmine'



'Matador Yellow'

4. DAHLIA ('KARMA' SERIES)

More than one member of the management group has confirmed the supermarkets' interest in sourcing dahlias as a cut-flower, but this is currently being resisted since vase life issues are unresolved. In 2009 a demonstration of 18 'Karma' dahlia cultivars was grown at the Centre to assess their potential and vase life. Dahlias are generally considered to have a poor vase life, and this series was developed to deal with this shortcoming. However, although the crops grew vigorously, especially under protection, and the blooms were eye-catchingly striking, the results of vase life tests were disappointing. The flowers failed to reach the minimum of 11 days shelf-/vase-life considered necessary to be a commercial proposition. The vase-water become highly contaminated during vase life assessment.

Despite these disappointing results, productivity and flower quality were so impressive that further demonstration and vase life testing were planned for 2010, and it is proposed to develop an HDC funded project to examine the post-harvest qualities of dahlia blooms at a more strategic level.



'Karma' dahlias; satisfactory establishment following late planting

5. LISIANTHUS (*EUSTOMA*)

Cut-flowers of lisianthus have now achieved considerable popularity in the UK. Although regarded as a fairly exotic crop, the possibility of growing a short summer 'spot' crop in Spanish tunnels in the UK was raised.

Plug plants were planted in beds in the Haygrove tunnel (fitted with side skirts and doors) in weeks 18, 19 and 20. Stems were broken in windy weather if the doors were not kept shut. Cropping started in week 30 and continued past the 2010 Centre Open Day in week 34, when the images below were taken. The results were impressive, with high-quality blooms, good stem strength and no pest and disease problems. But it was also noted that in 2010 the trial had coincided with weather very favourable for growing lisianthus (ie warm and dry), so the trial needs to be repeated in 2011 before any definite conclusions are drawn. It is planned to extend the range of cultivars grown and to test planting density, since densities above 64 plants/m² are used in Holland for commercial viability of the crop. The growing season of lisianthus is longer than for many other flower crops, restricting the number of rounds that can be accommodated each year. Nevertheless, as with the the antirrhinums and 'German asters', large numbers of sample bunches were provided in 2010 by management group members to packers and buyers for assessment.



Lisianthus growing at the Centre, week 34, 2010

6. PHLOX



Plots of seven phlox cultivars established in 2009 in a tunnel at Rookery Farm were grown-on mainly to provide a resource to flower packers for demonstration to supermarket buyers. The crop continued to produce a quality of blooms far superior to an outdoor crop. Stems were picked over the period week 27 to 31; the images here were recorded in week 29.

In 2009, tests suggested phlox had a variable but generally acceptable vase life. However, grower observations indicate that, by the time of marketing, there may be a natural petal drop from the first opened florets that detracts from the appeal of the stems: this may be an area where further cultivar selection and post-harvest studies are needed.



7. SUNFLOWERS

In 2010 sunflowers were included in the Centre's trials for the first time. Although sunflowers are already a well-established crop in the UK, their size means that harvesting and handling require significant resources. To facilitate handling, and perhaps mechanical harvesting, it was planned to investigate new dwarf cultivars as well as the use of plant growth regulators on standard cultivars.

The standard cultivar 'Sunrich Orange' and a number of dwarf varieties including 'Galilee Adami', 'Zohar Yellow', 'Premier Light Yellow' and 'Premier Lemon', were direct-drilled to outside beds in weeks 24, 25 and 26. It was planned to treat the standard cultivar with growth regulators, but the extremely dry weather that followed resulted in poor germination and establishment, especially for the last two sowings. This was followed by wet, windy weather that adversely affected establishment and growth.

Stem lengths were recorded at picking stage for 30 stems of each cultivar from the first sowing. The average stem lengths of the standard cultivars were 151, 129 and 109cm (for 'Galilee Adami', 'Sunrich Orange' and 'Zohar Yellow', respectively, and 48 and 45cm for 'Premier Light Yellow' and 'Premier Lemon'. The later sowings, and the Premier Light Yellow and Lemon, failed to produce stems of marketable quality.

This trial will be repeated in 2011, with some sowings being under tunnels as an insurance against adverse weather conditions.

OTHER CROPS

The plantings of three **sedum** cultivars established in 2009 grew poorly and it was decided that they should be grubbed. The good weight and quality of sedums as cut-flowers suggest that they will need to be re-visited at a later date.

A wide range of **hardy foliage plants**, sourced from Kolster BV, was planted outside in 2010, and once these have become established they will be included in the Annual Report.

The plants were:

- *Calicarpa bodiniera* 'Profusion'
- *Hedera helix arborescens*
- *Symphoricarpus* 'Magical Pride'
- S. 'Charm Fantasy'
- S. 'Bright Fantasy'
- *Photinia* 'Purple Peter'
- P. 'Red Robin'
- *Philadelphus* 'Snowbelle'
- *Cornus alba* 'Kesselringil'
- C. *alba* 'Flaviramea'
- C. *alba* 'Sibirica'
- *Viburnum tinus*
- V. *tinus* 'Red Spirit'
- V. *opulus* 'Roseum'
- V. *opulus* 'Compactum'
- *Quercus palustris*
- Q. *rubra*
- *Salix udensis* 'Sekka'
- S. 'Caradoc'
- S. *alba* 'Darts Snake'
- *Corylus avellana contorta*
- *Cotinus* 'Royal Purple'
- C. 'Magical Green Fountain'

COMMERCIAL TRIALS: ORNAMENTAL BRASSICAS

For economic success ornamental brassicas need to be grown on as low-cost a basis as practical, and this is likely to involve direct-drilling, as is increasingly practiced in the Netherlands. In 2009 a small trial was set-up to compare the production of ornamental brassicas by direct-drilling with traditional plug planting, but, owing to extreme dry weather, germination was erratic and it was not possible to obtain any meaningful results.

Ornamental brassicas appear to be very sensitive to poor soil conditions, so, when the trial was repeated in 2010 it was located on a commercial nursery with a more appropriate soil type. The direct-drilled crop performed very well, and as a result management at this nursery intends to direct-drill all its ornamental brassicas in future.

In addition a trial of about 15 new, coded lines of ornamental brassicas was grown at a 'look-see' at the same nursery. A summary of the findings is given in Table 2. These proved very promising, some having potential as novelties, and others as alternatives to 'Crane' cultivars. A further trial will be carried out in 2011. Plots of ornamental brassicas showed a distinct 'edge effect', with the outside plants developing a 'true cabbage' appearance rather than producing a typical ornamental head, a finding which could be followed up.

Table 2. Observations on 15 new ornamental brassica lines



A
Green outer leaves and purple centre. Nice oak-shaped leaves and good colour. Has potential as a novelty cultivar.
Length in field: 32cm
Total vase-life: 15 days



B
Green outer leaves with white and pink centre. Nice oak-shaped leaves and good colour. Has potential as a novelty cultivar.
Length in field: 48cm
Total vase-life: 13 days



C
Green with white centre, but short like a standard cabbage. Has an interesting crinkly edge but a very wide head. Too like an edible cabbage to be of much interest as an ornamental.
Length in field: 33cm
Total vase-life: 16 days



D
Green lower leaves with a white head and pink centre. Much of the crop bolted. Maturity variable, so little potential for ornamental use.
Length in field: 46cm
Total vase-life: 16 days



E
Green outer leaves leading to white with a purple centre. Leaves have interesting frizzy edges. Has potential as a novelty cultivar.
Length in field: 40cm
Total vase-life: 15 days



F
Green lower leaves leading to crisp white in the centre. Looks like 'White Crane', to which it has potential as an alternative.
Length in field: 45cm
Total vase-life: 10 days



G
Green outer leaves leading to white with a purple centre. Colour is a little 'dirty'; inferior to 'Crane' varieties.
Length in field: 46cm
Total vase-life: 13 days



H
Green outer leaves leading to a purple centre. Good length, a possible alternative to 'Red Crane'.
Length in field: 50cm
Total vase-life: 13 days



I
Green outer leaves, leading to white with a purple centre. Frizzy leaf edge, but a little short. Has potential as a novelty cultivar.
Length in field: 35cm
Total vase-life: 15 days



J
Green leaves with a white centre.
Good white, possible alternative to
'White Crane'.
Length in field: 53cm
Total vase-life: 13 days



K
Shiny green outer leaves, leading to
white then purple centre. Base green
leaves are shiny, but would be
removed. Too short and white colour a
little 'dirty', hence no potential as an
ornamental cultivar.
Length in field: 30cm
Total vase-life: 16 days



L
Green edge with white centre, but too
short and flat. Lovely form, but the
frizzy leaves hold the water and the
crop started to rot in the field. Although
the form is interesting this variety is too
short for cut-flower use.
Length in field: 20cm
Total vase-life: 13 days



M
Outer leaves green, inner leaves
purple. Much browning on the outer
leaves. Too short. For these reasons,
no potential for ornamental use.
Length in field: 26cm
Total vase-life: 16 days



N
Green outer leaves turning to white
then pink in the centre. A very variable
crop; much of the crop branched,
throwing out lots of smaller side
shoots.
Length in field: 37cm (but very
variable)
Total vase-life: 15 days



O
Green edge with white centre. A very
variable crop, much of which has
branched, throwing many smaller side
shoots. Too short, giving it little
potential as an ornamental.
Length in field: 30cm (but very
variable)
Total vase-life: 16 days

Conclusions

Trumpet antirrhinum

New lines of these striking snapdragons were demonstrated at the Centre in 2009 and 2010, attracting real interest from the industry. The plots yielded suitably heavy stems – a bunch of six 66cm-long stems weighing around 315g – and a second flush of shorter, lighter stems that were still of a marketable quality. Initial tests indicated a VL of up to 15 days. Trumpet antirrhinums are an obvious subject for further trialling, and in 2011 it is planned to investigate a wider selection of lines planted at a range of dates. Additional VL testing needs to take place, bearing in mind that, for optimum display and consumer appeal, these cultivars would need to be displayed at a somewhat later stage of development than would usually be expected for snapdragons.

Aster ericoides

As with the trumpet antirrhinums, the mainly double cultivars demonstrated at the Centre in 2010 were new to the UK market, and, again, the industry recognised considerable potential for their autumn flowers – such that three supermarkets plan to test market these cultivars in 2011. The Centre proved valuable as a resource, with numerous sample bunches being supplied as demonstrations. These aster cultivars grew best as a pinched crop grown in tunnels, though there may be potential for growing it as a single-stem crop with black-outs to manipulate flowering time, which will be evaluated in 2011. Investigation of VL is also needed.

'German asters'

These novel, colourful and vigorous cultivars of China aster attracted much attention when demonstrated in tunnels at the Centre in 2009, and considerable efforts were put into a trials programme to optimise their production. The main findings in 2010 were:

- Trials of examples of both the 'Krallen' and 'Gala' series confirmed earlier experience that efforts should concentrate the 'Krallen' cultivars which produce sturdier stems against the relatively weak, tall stems of the 'Gala' series. The greater weight of the 'Krallen' stems appears to be a result of substantially larger and attractive flowers rather than thicker stems or a greater growth of side-shoots. There is still scope for further cultivar trials with the 'Krallen' series, as they can show considerable differences. 'Kameo' and 'Kartthausen' reliably produce heavy stems. Compared with the other

cultivars tested, 'Golden' appears to respond atypically. As reported earlier, these results were obtained using conventional, Dutch-raised plug plants.

- As an alternative, 'Krallen' and 'Gala' cultivars were also raised in blocks in the UK and compared as a late-planted (week 23) crop. Stem lengths and weights, flower size, etc were found to be much more consistent between cultivars when grown by this method.
- Demonstration plantings of cultivars from the 'Standby', 'Benary Princess' and 'Matador' series showed that, while a limited market might exist for this wider range of shades, none matched the flower quality of the 'Krallen' series.
- In further comparisons of UK block-raised plants with conventional Dutch plugs, it was found that the block plants gave heavier plants with larger flowers from the early and middle plantings, while the plug plants gave heavier stems and larger flowers only from the early planting. Block-propagated plants may be more robust than plugs, and appeared to make more consistent stems. Cultivar 'Golden' behaved somewhat differently from the others in some respects.
- It was also found that blocks established equally well when 'planted' by placing on the soil surface, rather than by digging in, providing adequate irrigation was supplied.
- A range of planting dates was tested with the aim of establishing the earliest practical planting date for block and plug plants in tunnels. For plug-raised plants later planting led to the production of lighter stems with smaller flowers, while stem length, stem diameter and the number of side-shoots were less from either the early or the late plantings and maximal from middle plantings. In contrast, in block-raised plants later planting led to thinner, lighter stems with fewer side-shoots and smaller flowers. In most cases late planting (say in weeks 20 to 22) led to poorer quality stems, whereas early or middle plantings were satisfactory. The issues of light-weight stems and smaller flowers in the later plantings needs to be addressed, and possibly it might be useful to investigate earlier plantings also. Both block and plug plants performed well in many plantings, though the former will have the advantage of reducing transport costs (since blocks can be seeded in the UK) and making delayed deliveries less likely.
- Early plantings can produce vigorous growth and excessively long stems, so a growth retardant treatment was tested. Plug-raised cultivars were planted in week 16, 18 and 20 and were treated with 3 or 6g/L of 'B-Nine SG'. The higher rate of retardant resulted in only a small reduction in stem length (not more than 10%) in all cultivars but only following planting in week 16, treatments of later plantings being ineffective. This trial needs to be repeated in 2011 using earlier and perhaps repeated applications of growth regulator at a higher dose.

'Karma' dahlia cultivars

Following interest in supplying dahlia as a cut-flower, a demonstration of 18 'Karma' dahlia cultivars (bred for improved VL) was grown at the Centre in 2009. Although the cultivars grew vigorously, especially under protection, and the blooms were striking, VL tests were disappointing, failing to make the minimum of 11 days shelf-/vase-life necessary for a commercial proposition. Despite disappointing VL results, productivity and flower quality were so impressive that further demonstration and VL testing were planned for 2010. It was proposed to develop an HDC research project to examine the post-harvest qualities of dahlia blooms on a more strategic level, making use of plant material grown at the Centre. However at the time of writing this report, this project has not yet been submitted.

Lisianthus (Eustoma)

Cut-flowers of lisianthus have now achieved considerable popularity in the UK, and in 2009 the possibility of growing a short summer 'spot' crop in tunnels in the UK was suggested. Plug plants were planted in weeks 18, 19 and 20, and cropping started in week 30, with high-quality blooms, good stem strength and no pest and disease problems. Since the weather in 2010 had been ideal for growing lisianthus, the trial should be repeated in 2011 before any definite conclusions are drawn. It is also planned to extend the range of cultivars grown and test planting density.

Phlox

Plots established in a tunnel 2009 were grown-on to provide a resource to flower packers for demonstration to supermarket buyers.

Sunflowers

Sunflowers were included in the Centre's trials for the first time in 2010. Although already a well-established crop in the UK, their size means that harvesting and handling require significant resources. To facilitate handling, and perhaps mechanical harvesting, it was planned to investigate new dwarf cultivars as well as the use of plant growth regulators on standard cultivars. Unfortunately extremely dry weather followed sowing, resulting in poor germination and establishment, and this was followed by wet, windy weather which adversely affected establishment and growth. This trial will be repeated in 2011. New cultivars will be added if available.

Ornamental brassicas

For economic success ornamental brassicas need to be grown on as low-cost a basis as practical, which is likely to involve direct-drilling. In a small trial set-up in 2009 to compare direct-drilling and traditional plug planting, germination was erratic due to extreme weather. Since ornamental brassicas are sensitive to poor soil conditions, the trial was repeated in 2011 located on a commercial nursery with more appropriate soil type. The direct-drilled crop performed very well, and as a result management at this nursery intends to direct-drill all its ornamental brassicas in future. In addition a trial of 15 new, coded lines of ornamental brassicas was grown at the same nursery, some showing potential as novelties, and others as alternatives to the 'Crane' series; a further trial is planned for 2011.

Hardy foliage plants

A wide range of hardy foliage plants was planted outside in 2010 and their performance will be reported in the 2011 report.

Sedum

Plantings of three sedum cultivars were established in 2009 but grew poorly and were grubbed. The good weight and quality of sedums as cut-flowers suggest that they will need to be re-visited at a later date and new cultivars will be planted in 2011.

Other trials and demonstrations planned for 2011

The Centre encourages suggestions and ideas from the industry for further trials, and in 2010 candidates suggested, initially for small-scale demonstration plots, included new cultivars of *Eryngium* and of autumn stocks, as well as *Amaranthus*, *Rudbeckia* and (subject to availability) *Pericalis*. The continued interest in sweet peas as cut-flowers has prompted a decision to investigate low-cost production systems at the Centre. As an adjunct to further proposals for research on column stocks, a comparison of loose-fill and glue plugs is being considered as is a demonstration plot of new varieties of 'autum' stocks.

Some views have been expressed that the gladiolus crop warrants inclusion in the Centre's programme. The inclusion of further trials on larkspur and delphinium has been much debated, with a general view that these crops are too dependent on suitable weather to achieve reliably consistent results.

Growers who would like to know about other novel cut-flowers are encouraged to contact the project leader or the HDC with suggestions for the Centre's programme in 2011 and beyond.

Technology transfer

During 2010 the MG met on five occasions (25 February, 12 May, 12 July, 14 October and 8 December). A successful Open Day was held on 26 August 2010. Many more visitors were shown round the trials on more informal basis. Reports on the work of the Centre appeared in *HDC News* issues for June 2010 (p. 29), October 2010 (p. 5) and November 2010 (pp. 16-17).

Discussions at the Centre also highlighted the industry's need for specific projects on the following, which have been addressed by new research proposals:

- Improving the VL of dahlia
- Defining the basis of problems affecting the reliability of column stock production
- Testing the feasibility of using hydroponic systems for UK cut-flower production.

As well as providing data on the performance of potential new cut-flower crops for UK growers, the Centre aims to be a source of sample bunches of promising material for supply by MG members to interested growers, packers and retailers. During 2010 large numbers of, especially, trumpet antirrhinums, lisianthus, *Aster ericoides* and 'German asters' were provided to stakeholders and brought to the attention of the major multiple retailers. The MG is aware of test runs of new product by supermarkets, of the uptake of new crops by growers, and major decisions on production methods being used by growers, as a direct result of the trial and demonstration plots grown at the Centre.

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