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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

- Lisianthus grown in Spanish tunnels have been identified as producing a very high quality crop in terms of stem weight and vigour, and should be considered as a new production opportunity for UK flower growers.
- Further trials have confirmed opportunities for UK growers to exploit new 'trumpet' cultivars of antirrhinums and new German cultivars of China asters grown in Spanish tunnels, and of new ornamental brassicas and dwarf sunflowers as field crops.
- Modern cultivars of double flowering *Aster ericoides* have shown significant market potential, but further work is needed to look at scheduling and the control of excessive growth.
- As in previous years phlox have shown considerable potential as tunnel crops in the UK.

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. In 2009 the Centre moved to Rookery Farm, Holbeach St Johns, Lincolnshire, where it is now run as a discreet unit under the control of the Centre's 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 to assess.

Summary of the project and main conclusions

Amaranthus (*Amaranthus caudatus*)

Responding to a specific request from a grower, a small selection of amaranthus cultivars was grown in 2011 to assess their potential as a cut-flower crop in the UK. Plugs of five cultivars - 'Caudatus Red', 'Pygmy Torch', 'Oeschberg', 'Red Cathedral' and 'Green Thumb' - were transplanted in week 21 to a 'Pro-Tech' tunnel. Cropping started in week 30. The length and form of the inflorescences varied considerably. The smaller-flowered types were thought to have potential as cut-flowers for supermarket sales, whereas the larger types have scope for being grown by a specialist grower, for example, for architectural displays in larger settings, and so it is planned to continue with a variety demonstration in 2012. From comments received, it would be useful to look at an earlier cropping stage that might have more commercial potential. New cultivars will also be looked at in 2012.

Antirrhinum ('Trumpet' cultivars) (*Antirrhinum majus*)

These new varieties have consistently impressed growers, packers and supermarket technologists with their novel form and vigour and quality of the stems. In 2011 a variety demonstration was set up and a late crop was tested in both the 'Haygrove' and 'Pro-Tech' tunnels at the Centre.

Plugs of cultivars 'Yellow Peloric', 'Trumpet Pink' and 'Ivory White Peloric' were transplanted into 3m-long beds in the 'Haygrove' tunnel in week 17. Stem weights and spike lengths varied considerably between the three cultivars, though all were judged satisfactory. 'Yellow Peloric' gave the heaviest stems and long flower spikes. Consistent with the three weeks later transplanting than in 2010, the first flush was in week 25 (week 22 in 2010). Trimmed (60cm) stem weights in 'Yellow Peloric' and 'Ivory White Peloric' in 2011, about 50g, were similar to those obtained in 2010 (just over 50g for a 66cm-trimmed stem). Replicating the normal supermarket supply chain and carrying out vase-life testing, samples of all three cultivars had a vase-life of 10 days. The second flush produced many more stems, though these were much lighter (just under 30g for a 60cm-stem) than in 2010 (nearly 50g for a 55cm-stem).

Plugs of cultivar 'Tangerine' were transplanted into the 'Haygrove' and 'Pro-Tech' tunnels in week 27. Despite the late planting, stem length, trimmed weight and flower spike length were about the same as the best from the earlier planting, though there was insufficient time for a second flush.

Aster ericoides

A series of trials at the Centre has demonstrated the potential of *A. ericoides* cultivars as a pinched crop for September-flowering in Spanish tunnels. In 2011 further cultivars were trialled as early- and late-planted crops and further observations were made on the plants over-wintered in tunnels from 2010.

Rooted cuttings of ten cultivars were transplanted into plots in a 'Pro-Tech' tunnel in week 19. The crop was pinched. Most varieties produced strong plants which cropped around week 42, somewhat later than the equivalent plants in 2010. Among these cultivars, stem length varied from 77 to 159cm, stem weight from 35 to 62g, and the number of stems cropped per plot from about 100 to just over 200, so the importance of varietal differences was confirmed. Ranking the varieties by aspects of performance, 'Cassy' ('Moercas'), 'Linda' and 'Cirina Dark' produced above-average numbers of longer-than-average stems, but these were of low weight. 'Blue Tail', 'Cape Town' ('Moertown') and 'Cassandra' produced the heaviest stems, but these were relatively low in number as well as being relatively short.

The late-planted trial was conceived as a late-crop to follow a round of column stocks. Rooted cuttings of six cultivars were pinched and allowed to break before transplanting into beds in a 'Pro-Tech' tunnel in week 28. Three varieties, 'Cairo' ('Moerci'), 'Cape Town' ('Moertown') and 'Chicago' ('Moergo'), cropped in week 41, but with stem lengths and weights about half that of the better, early-planted crop. The other three cultivars, 'Blue Tail', 'Cassy' ('Moercas') and 'Dark Mark' either failed to flower or the stems were too short to crop.

Some varieties planted in 2010 and over-wintered in a 'Pro-Tech' tunnel survived the harsh 2010/2011 winter better than others. Part of the crop was pinched (in week 21) and part left intact. The over-wintered plots that were not pinched in the spring grew out of control: the first flush needs to be cut-back to yield a late flush.

Two separate vase-life tests were carried out, each involving about ten cultivars, mostly from the 2011 trials but including some from the over-wintered plants, either pinched or non-pinched. In one trial the vase-life of the different cultivars varied between 8 and 16 days, while in the second it varied from 7 to 21 days, a good measure of agreement. Vase-life was therefore largely more than sufficient for an expected guaranteed life of 5 or 7 days in mixed bouquets. A general comment was that the stems were too long (and often the branches too wide) and would require a significant amount of trimming before packing; this should be addressed by improving crop husbandry and varietal selection. The 'Double Fun' series were noted as the best performers overall.

China asters ('German' varieties) (*Callistephus chinensis*)

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. One trial involved using the growth retardant daminozide to reduce the excessive growth that can occur in early plantings of vigorous cultivars, but even the higher rate of retardant resulted in only a 10% reduction in stem length in early plantings, while application to the later plantings was ineffective. A further trial with 'B-Nine SG' was therefore carried out in 2011. Five varieties of the popular 'Krallen' series and six from the 'Gremlin' series were used in 2011. In week 25 each variety was transplanted into beds in a 'Pro-Tech' tunnel. Half of each bed was treated with 'B-Nine SG' at 6g of product per litre twice, in weeks 32 and 34. In the 'Krallen' varieties applying 'B-Nine SG' gave a fairly consistent, but only 3% overall, reduction in stem length compared with the controls. In contrast, in the 'Gremlin' varieties the result of using 'B-Nine SG' was unconvincing, inconsistent and resulted in an overall less than 2% reduction in length. The effect of retardant treatment on the weight of stems (trimmed to 65cm) was inconsistent, though some varieties produced heavier, sturdier stems when the retardant was used. However, differences due to cultivar and retardant treatment were not statistically significant. There was no significant effect of regulator treatment on the numbers of side-shoots produced. In vase-life testing of a sample of four cultivars, vase-life ranged from 4 to 9 days, meaning that, while some cultivars would be suitable for bouquet work, further selection for post-harvest quality is desirable.

Eryngium (*Eryngium* spp.)

Responding to a grower's request, in 2011 a small selection of *Eryngium* cultivars was grown to assess the varieties available and their potential as a crop in the UK. Plugs of cultivars 'Marbella', 'Blue Bell', 'Arabian Dawn', 'Deep Blue', 'Magical Purple Falls', 'Magical Blue Falls' and 'Magical Cloud' were transplanted into plots in a 'Pro-Tech' tunnel and outdoors in week 27 and 32. As expected, few flowers were produced in 2011; the further performance of this planting will be assessed in 2012.

Hardy foliage

A wide range of hardy foliage plants was planted in outside beds in spring 2010 and 2011, including varieties of *Callicarpa*, *Cornus*, *Corylus*, *Cotinus*, *Hedera*, *Hypericum*, *Philadelphus*, *Photinia*, *Quercus*, *Salix*, *Symphoricarpos* and *Viburnum*. Further information will be included in the next report, once the bushes have become established, though many species are showing promise and have generated interest from the industry

Lisianthus (*Eustoma grandiflorum*)

Cut-flowers of lisianthus are now popular in the UK and, although regarded as somewhat 'exotic', the possibility of growing a short summer spot crop in a tunnel was confirmed in trials at the Centre in 2010. Growing in the 'Haygrove' tunnel fitted with side skirts and end-doors that were kept shut in windy weather, the results were impressive, with high-quality blooms, a good stem strength and negligible pest and disease problems. But since the growing period in 2010 was particularly warm and dry – ideal for growing lisianthus – further trials were needed to test this result in a more 'normal' year.

In 2011 nearly thirty cultivars were trialled. Plugs of about ten cultivars were planted in a 'Haygrove' tunnel in each of weeks 18, 19 and 20. To test season extension, further plugs of the ten varieties already planted in week 20 were transplanted in week 21 to the 'Pro-Tech' tunnel (without end-doors). The plots growing in the 'closed' tunnel produced strong, high quality stems, and only inconsequential pest or disease problems were seen (there was no downy mildew and little evidence of root diseases). However, the late planting in the 'open' tunnel grew less strongly, with significant amounts of *Fusarium* and some *Pythium* seen, and the crop was abandoned after the cover was damaged in a gale. It is notable that a long established lisianthus grower visited the CFC site and commented that while the crop was not as strong and vigorous as the 'Haygrove' tunnel crop, it was still better than his equivalent glasshouse crop and is therefore well worth repeating in 2012, but using a slightly earlier planting date. The difference in pest and disease levels between the two tunnels may have been related to the different microclimates, or to the methods of soil sterilisation used in each: the 'Haygrove' tunnel was treated with dazomet (as 'Basamid') in autumn 2010 and left sheeted-down over winter, whereas the 'Pro-Tech' bays were sterilised with dazomet in spring 2011.

Cropping times and stem lengths and trimmed weights revealed considerable varietal differences, some cultivars evidently being more suited to cultivation in tunnels. Most cultivars planted in weeks 18 and 19 were cropping in weeks 32 to 33, respectively, with the odd cultivar later; the week-20 plantings cropped over weeks 32 to 36. Of the 28 plantings, eight failed to reach the average length of 70cm needed for trimming to specification, but only six had a trimmed stem weight of less than 80g. Untrimmed stem lengths and trimmed stem weights, averaged across the cultivars, showed no clear trend with later planting, although stems from the middle planting date were shorter and lighter (each by about 10%) than the earlier and later plantings. However, sometimes the standard deviation values indicated a large variation within plots, so supposed varietal differences should be treated with caution.

A selection of eight cultivars from the trial was used to test vase-life under standard conditions. Half of the cultivars reached or exceeded a 9-day vase-life, the criterion for use in straight bunches. However, all cultivars reached the 7-day vase-life that would be required for use in bouquets.

Ornamental brassicas (*Brassica oleracea*)

For economic success ornamental brassicas need to be grown on a low-cost basis, and this is likely to involve direct-drilling. In 2009 a small trial was set-up at the Centre showed just how sensitive brassica drilling is to poor soil conditions. In 2010 a further trial was located on a commercial nursery with a more appropriate soil type, where the direct-drilled crop performed particularly well. New lines of ornamental brassicas, still under code numbers, also formed part of the programme at the same nursery. Some proved very promising, had potential as novelties, or were potential alternatives to 'Crane' cultivars.

In 2011, ten further lines were evaluated at the same nursery. Seed was sown in plugs in week 22 and transplanted to field plots in week 27. None of the varieties presented any issues over their growing, though 'Sunny Bright' consisted of mixed seed, consequently resulting in a mix of head sizes. The overall selection produced a good range of head colour, from white to purple/pink, while many produced attractive heads, notably 'Snow Bright', with white veining in the pink/white/green leaves. Average stem length varied from 40cm (for 'Kohju No. 2', which was considered too short) to 62cm (for 'Dream White', possibly too tall). The percentage of stems cropped varied much between varieties – from only 5 or 10% in 'Sunny Bright' and 'Kohju No. 2', to 90% or more (in the tall varieties, 'Lake Swan', 'Suruga Hatshi' and 'Dream White'). The heads were harvested in week 40 and samples were subjected to standard vase-life testing following 2 days in a cold-store then 4 days representing the transport/retail period; 'Chrysal Clear Professional 2' was used as a conditioner and a universal flower food was used in the vases. Vase-life ranged from a satisfactory 12 days (in 'Sunny Bright', 'Dream Light', 'Suruga Hatshi' and 'Lake Swan') to 23 days (in 'Moon Light', 'Hakuju' and 'Dream White').

Phlox (*Phlox paniculata*)

Plots of phlox cultivars were planted in 2009 in the 'Pro-Tech' tunnel. They provided a further demonstration of the potential of the crop in the UK, and gave samples for flower packers to show to supermarket buyers. In 2011 the plots started to crop in early-July, again giving stems of far superior quality than an outdoor crop. Average trimmed stem weights varied from 32 to 38g. The number of stems cropped varied from a low 31/m² for 'Sugar Missy' to 104/m² for 'Miss Fiona'. The second flush was still developing when the polythene cover had to be removed from the tunnel due to deteriorating weather. Several cultivars were subjected

to vase-life testing, most having vase-lives of 9 to 11 days; although flower drop started between vase-days 4 and 6, other flowers continued to open to replace them. Exceptionally, cultivar 'Miniature Pink' had a vase-life of 14 days and did not drop flowers over this period.

Rudbeckia (*Rudbeckia hirta*)

Rudbeckia is another potential cut-flower crop, and its inclusion in the programme of the Centre was suggested by a supermarket representative. As an initial demonstration, cultivars 'Hirta My Joy' and 'Hirta Green Eye' were transplanted into plots in the 'Pro-Tech' tunnel in week 21. Although the flowers were attractive in themselves, the stems were too vigorous and unruly to be considered practical for commercial use. The cultivars tested were seed-raised annuals, but more robust perennial varieties of rudbeckia are also available, and the latter will be tested in 2012.

Sedum (*Sedum spectabile*)

The 2010 plantings of three sedum cultivars grew poorly in their establishment year but much more vigorously in year 2. The high weight and quality of sedums as cut-flowers suggested that further trial plantings should be made in 2011, and plants of 'Mr Goodbud', 'Magical Bon Bon', 'Magical Lizzy' and 'Magical Twist' were transplanted into outside beds in week 24 for further observations. The vase-life of sedums has not yet been tested and it is planned to do this in further trials.

Stocks (column) (*Matthiola incana*)

Column stocks for autumn-flowering were last included in the Centre's programme in 2009, when the suggested advantage of using block-raised plants was tested. This showed that there was no advantage due to using blocks over plugs.

Stocks are prone to failing or abnormal flower initiation when grown in summer temperatures. However, the 'Katz' series of column stocks was bred for resilience to higher temperatures, so work was planned to investigate summer cropping of 'Katz' varieties at the Centre in 2011. The plugs did not arrive at the Centre until late-August 2011, but nevertheless they were planted in the 'Pro-Tech' tunnel, which by then had had its cover removed when the weather deteriorated. The plants were in full flower in early-December, and, although battered, were of basically good quality and appeared to last well in the vase. This raised the question of whether, irrespective of its advantages as a crop in a warm summer, this series might be suitable as a late tunnel crop or, perhaps, a crop in poor quality cold glass. Subsequent discussions with the breeder have confirmed that this is worth investigating further. Unlike many stocks varieties, the 'Katz' series is selectable for double flowers "only with difficulty" and automated methods are not sufficiently sensitive, so it has

been suggested that selection in this case is not economic. However, in the right circumstances a profitable crop might still be obtained when growing in a Spanish tunnel or in minimally heated or unheated glass, provided the percentage of double flowers is consistently higher than 50%. For this reason records were kept of the numbers of double and single flowers obtained. The overall percentage of plants producing double flowers varied from 32 to 57% in different lines, or from 40 to 62% if plants with non-opening flowers were excluded (in which case about half of the eight lines yielded around 60% of doubles). Further tests would be needed to determine if the performance of the different 'Katz' lines are consistent year-on-year.

Sunflowers (*Helianthus annuus*)

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 this end it was planned in 2010 to investigate new dwarf cultivars and using a plant growth regulator on standard cultivars. However, adverse weather – dry weather limiting germination and establishment, followed by wet, windy weather adversely affecting growth – prevented any meaningful results being obtained. The work was therefore repeated in 2011.

Eight cultivars, some available only with code numbers, were seeded by hand into outdoor beds in weeks 19 and 22. Stem lengths and weights and flower diameters were recorded at about peak cropping for a sample of 30 stems of each plot. The percentage of seed germination varied from 38 to 100, but as some of these are trial varieties this shows that further work is needed by the breeder to ensure the germination rate is commercially viable. Cropping dates varied from 10 to 18 August across the cultivars sown in week 19, and from 18 August to 2 September for the sowing in week 22. In the earlier sowing 'Early Sunrise' (KB 114), 'Jua Maya' and 'Stellar Sun' (KB 105) were faster to crop than the other varieties, whereas cropping dates for the later sowing were more uniform – with the exception of 'Stellar Sun' (KB 105) which was again quick to crop. Flower diameters varied from about 15 to about 19cm for the various cultivars. The flowers of 'Jua Maya' were consistently relatively compact. For most, but not all, cultivars, stem lengths were greater from the later sowing, but this was not always accompanied by increased stem weight, there appearing to be no obvious relationship between the two. 'Happy Face' (KB 116) was the most dwarf cultivar trialled, from both sowings, while its stem weight remained high.

Seed of standard sunflower 'Sunrich Orange' were sown, using the same methods as above, in an outside bed in each of weeks 19, 22 and 26. The growth retardant 'B-Nine SG' was

applied to part of each bed. But it was visually obvious that the retardant application had had no effect on plant height, and no further observations were made.

Vase-life tests were carried out on a selection of sunflower cultivars. For most, it was 11 days, but 'Dafna' was exceptional with a vase-life of 15 days.

Sweet Peas (*Lathyrus odoratus*)

Recurrent expressions of interest in developing a low-input system of sweet pea production led to trials at the Centre in 2011. A metal 'A' frame with netting was erected along the length of the 'Pro-Tech' tunnel. Five varieties of sweet pea were transplanted from pots along either side of the framework in week 22. They were thinned to one plot at 30cm-spacings and one plot at 50cm-spacings for each variety, each plot being ca 5m-long. The 50cm-plants were pinched once, while the 30cm-plants were not pinched. The first stems were picked in mid-July, cropping continuing for an extended period. The initial results were very encouraging, with a large number of long, high-quality stems being produced from both growing formats. The average length of stems approached 30cm, with slightly longer stems from the 50cm, pinched plots. The yields obtained were very high, usually between 1000 and 2000 stems per 5m-long plot. However, floret numbers were consistently low throughout the cropping period, with 3.3 to 3.8 florets per stem, and vase-life was only 5 days in the samples tested.

General

A major part of the Centre's extension work was once again providing large numbers of samples, mainly of 'trumpet' antirrhinums, lisianthus, *Aster ericoides* and 'German' asters, and more limited numbers of other species, to major supermarkets and packers, and, in some cases, to local florists. The lisianthus were especially well received, and the MG considered that some supermarkets would pay a premium for it as a UK crop, though this would have to be balanced by the long time the crop is in the ground. The 'trumpet' antirrhinums also impressed, though with a concern that they might be more cheaply sourced from abroad. 'German' asters, *A. ericoides* and phlox were also promising, though more attention must be paid to the marketing stage of *A. ericoides* and phlox. While the sweet peas were considered a good quality product for a relatively low-cost production system, it was felt they would not compete with a more specialist F1 product raised under glass and giving a more florets and a much longer stem.

Financial benefits

The project has identified tunnel-grown lisianthus as potential new UK production system. Other novel crops have also been developed and are at a stage where they could be tested on a small commercial scale. Two or three new products would help to maintain a significant number of larger or medium-sized businesses. Now that the CFC is developing a clear market potential for “new” crops, it is proposed that the preparation of basic costings will be an integral part of its remit in the future. The basic costings will include as much information as possible including planting costs, yield, basic production costs etc but clearly it will be difficult to provide accurate labour figures owing to the issue of scaling up small scale trial plots to a realistic commercial situation.

Action points for growers

Growers looking for new opportunities might consider the case for growing new cultivars of ‘trumpet’ antirrhinums, lisianthus and ‘German’ asters as tunnel crops, and of dwarf sunflowers and ornamental brassicas as field crops.

SCIENCE SECTION

Introduction

The National Cut-Flower Centre (CFC) is a project funded by the Horticultural Development Company (HDC) for the benefit of the UK cut-flower industry. For its first two years the CFC was funded jointly by the EU Lincolnshire Fenlands LEADER+ programme and the HDC. HDC funding is through the HDC Bulbs & Outdoor Flowers (BOF)¹ and Protected Ornamentals (PO)² Panels.

Since 2009 the Centre has been located at Rookery Farm, Holbeach St Johns, having moved from the Kirton Research Centre where the project was successfully initiated in 2007 and 2008. Currently, its facilities consist of some 600m² of outdoor plots, a 7.9 x 38.1m single-span 'Haygrove' Spanish tunnel, and a 22.7 x 38.1m triple-span 'Pro-Tech' Spanish tunnel.

The CFC exists to help the UK cut-flower industry as a whole, and is run "by the industry, for the industry". Its strategic direction is driven by a Management Group (MG) made up of individuals representing a cross-section of the cut-flower business, from growers through packers to multiple and other retailers. Further information can be found on the Centre's web-site, <http://www.thecutflowercentre.co.uk/about-us/>

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 crops new to 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.

Or, expressed more generally:

- To provide information about cut-flower crops and growing formats that are new to UK

¹ see <http://www.hdc.org.uk/sectors/BOFindex.asp>

² see <http://www.hdc.org.uk/sectors/POindex.asp>

production, enabling UK growers to make informed choices about new marketing opportunities.

- To identify a small number of definite new opportunities for UK cut-flower growers.
- To enhance the perception of UK cut-flowers and flower growers.

The present report details the findings from the 2011 programme of demonstrations and trials. HDC members may obtain full reports of previous years' work on request to the HDC:

- Annual Report, HDC Project PC/BOF 268, 2007
- Final Report, HDC Project PC/BOF 268, 2008
- Final Report, HDC Project PC/BOF 268a, 2009
- Annual Report, HDC Project PO BOF 002, 2010.

An index to the crops trialled each year is given at the end of this report.

The Centre encourages suggestions and ideas from the industry for further trials. Growers who would like to know about other novel cut-flowers are encouraged to contact the project leader (Lyndon Mason), other MG members, or the HDC, with suggestions for the Centre's programme in 2012 and beyond.

Materials and methods

Trials and demonstrations at the Centre

The Centre facility at Rookery Farm, Joys Bank, Holbeach St Johns, Spalding, Lincolnshire includes 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' tunnel bays. The soil is heavy silt, typical of the area. Crop husbandry protocols were as agreed between management at Rookery Farm and the Centre's Management Group (MG) with the aim of achieving good commercial practice, adapted as necessary to suit small trial plots that required frequent and detailed observation and recording (e.g. there were only three beds along each bay of the tunnels).

The 'Haygrove' tunnel was sterilised with dazomet (as 'Basamid') in autumn 2010 and left sheeted-down over winter. The 'Pro-Tech' multi-span was also sterilised with dazomet, but in spring 2011. Fourteen soil samples were taken across the trials site for standard glasshouse soil analysis, the site was cultivated, and 1m-wide beds were marked out, three beds per bay with further beds outside adjacent to the tunnels as required. A compound fertiliser ('Root to Shoot', 20:10:10; J & H Bunn Ltd, Yarmouth, Norfolk, UK) or straights was top-dressed at 10g/m², according to the soil analyses, before planting *Aster ericoides* (week 25), column stocks (week 27), eryngium in 'Pro-Tech' bay 2 (week 32) and sunflowers (week 22). It is not possible to give a base fertiliser recommendation for all minor cut flower crops and in the aim was to bring the base levels up to those required for column stocks which are an index of 2 for N, 6 for P, 4 for K and 4 for Mg. The beds were covered with 1.2m-wide, 120-gauge, micro-perforated black polythene film, through which all planting was carried out. Each bed was irrigated with three lay-flat tubes and was divided half-way along the tunnel to provide two separate irrigation zones per bed.

Most crops were obtained as plug-plants and were transplanted into the beds at a density of 64 plants per m²; *Aster ericoides* was obtained as un-rooted cuttings, rooted in plugs, and transplanted at 16 plants per m². Sweet peas were germinated in small pots and transplanted into rows at the required spacing (30 or 50cm) along the base of support netting. Sunflowers were sown by hand 10cm apart in rows, with four rows 35cm apart across the bed (ca. 36seeds/m²). Hardy foliage plants were obtained as either pot-grown or bare-root plants, and were planted as per the supplier's recommendations which varied from 30 to 100cm apart. Beds were usually provided with support netting that was raised with the

growth of the crop, but in some cases, such as *A. ericoides*, side support wires were provided instead. In some cases plants were stopped (pinched) or a growth regulator was applied, in which case the details are given under 'Results'.

A 15:30:25 N:P:K liquid feed formulated for hard water (The Scotts Company) was applied to the plots weekly at 2% of the stock solution; application was increased to twice per week on vigorous crops (such as lisianthus) later in the growing season. Pesticide advice was given by a BASIS-qualified agronomist who visited regularly throughout the growing season. During 2011 pesticides were applied as needed and according to recommendations against the following target organisms:

- For thrips and powdery mildew, spinosad and bupirimate (as 'Conserve' and 'Nimrod') in 'Pro-Tech' bay 3 on 16 June
- For aphid, spirotetramat (as 'Movento') in 'Pro-Tech' bay 1 on 16 and 29 June and 28 July and in 'Pro-Tech' bay 2 on 28 July
- For mildew, mancozeb + metalaxyl-M (as 'Fubol Gold WG') in the 'Haygrove' tunnel on 29 June
- For mildew, sulphur (as 'Thiovit Jet') in 'Pro-Tech' bay 3 on 29 June
- For aphid and thrips, thiacloprid and spinosad (as 'Calypso' and 'Conserve') in all tunnels on 11 July
- For powdery mildew, mites and insects, bupirimate and abamectin (as 'Nimrod' and 'Dynamec') in 'Pro-Tech' bay 3 on 11 July
- For powdery mildew, kresoxim-methyl (as 'Stroby WG') in 'Pro-Tech' bay 3 on 28 July and 18 August.

The species and cultivars trialled and demonstrated at the Centre in 2011 are given in the text under 'Results', with the name of the supplier, dates of planting, transplanting or direct-drilling, and whether grown in the 'Haygrove' or 'Pro-Tech' tunnels or outside.

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, but, where appropriate, factorial analysis of variance without replication³ was used to assess the significance of the 'main effects' such as cultivar, planting density or planting date (this analysis does not allow interactions between the main effects to be assessed formally).

The crops and results for the project, along with plans for further work, were assessed at regular meetings of the MG and with others as appropriate. Stems were picked at the

appropriate commercial stage for each crop, with samples being taken close to the peak of cropping. Usually the number of stems picked was recorded, along with the picking dates and lengths and weights of individual stems (the weights after trimming to length, if necessary) and other measurements (such as spike length or head size) as appropriate. Under 'Results', 'stem' lengths and weights always refer to the total weights and lengths of the whole stem, including the buds, flower or inflorescence. In the case of preliminary trials, more emphasis was placed on photographs, notes and grower comments than on formal records.

Trial at commercial nurseries

From observations of previous trials of ornamental brassicas at the Centre and elsewhere, it was known that this crop is very sensitive to soil conditions. As the soil at the Rookery Farm site was thought to be too 'heavy', ornamental brassicas were instead grown and evaluated at a commercial nursery (Winchester Growers Ltd, Pinchbeck, Spalding, Lincolnshire). Typical commercial protocols were used.

Vase-life (VL) trials

Freshly harvested stems were cropped from selected trials and subjected to VL testing. Tests were carried out by Winchester Growers Ltd (Pinchbeck, Spalding, Lincolnshire; ornamental brassicas), JZ Flowers Ltd / Fast Track Flowers Ltd (Moulton, Spalding, Lincolnshire; *Aster ericoides* and sunflowers) and Intergreen (UK) Ltd (Holbeach, Spalding, Lincolnshire; antirrhinum, *Aster ericoides*, china aster, lisianthus, phlox and sweet peas), each using their standard conditions. Further details of the protocols used are given under 'Results'.

³ using the data analysis tool within Microsoft Excel

Results

1. AMARANTHUS (*AMARANTHUS CAUDATUS*)

After a specific request from a grower, a small selection of amaranthus cultivars was grown in 2011 to assess their potential as a cut-flower crop for the UK. Plugs of five cultivars - 'Caudatus Red', 'Pygmy Torch', 'Oeschberg', 'Red Cathedral' and 'Green Thumb' (Florensis Cut Flowers) - were transplanted in week 21 to 3m-long plots in 'Pro-Tech' bay 1.

Cropping started in week 30. As can be seen from the photographs below, the length and form of the inflorescences varied considerably. The smaller-flowered types were thought to have potential as cut-flowers for supermarket sales, whereas the larger types have scope for a specialist grower, for example, for architectural displays in larger settings, so it is planned to continue with a variety demonstration in 2012. From comments received, it would be useful to look at an earlier cropping stage than the photos below that might have more commercial potential.



***Amaranthus* cultivars, clockwise from top left: 'Green Thumb'; 'Red Cathedral'; 'Oeschberg'; 'Pygmy Torch'; 'Caudatus Red'; 'Oeschberg'**

2. ANTIRRHINUM ('TRUMPET' CULTIVARS) (*ANTIRRHINUM MAJUS*)

In 2009 and 2010 the Centre grew demonstration plots of new 'trumpet' cultivars of antirrhinum which are quite distinct in form from the typical 'snapdragon' flower. The new peloric⁴ varieties on trial consistently impressed growers, packers and supermarket technologists, not only on account of their novel form, but also because of their vigour and the quality of the stems. But adopting these varieties would require some changes in expectations and handling: for example, the novel form is not obvious unless they are displayed at a later stage of development than would be normal for antirrhinums. It was also felt that the range of colours available was too restricted,



and little was known of their likely vase-life. In 2011, before embarking on detailed trials (e.g. information is required on the effect of planting dates), a further variety demonstration was set up, a late crop was tested in both types of tunnels, and vase-life tests were carried out.

1. Variety demonstration

Plugs of cultivars 'Yellow Peloric', 'Trumpet Pink' and 'Ivory White Peloric' (Florensis Cut Flowers) were transplanted into 3m-long beds in the 'Haygrove' tunnel in week 17 (three weeks later than in 2010). The results are summarised in Table 1.

Stem weights and spike lengths varied considerably between the three cultivars, though all were judged satisfactory. 'Yellow Peloric' gave the heaviest stems and sufficiently long flower spikes for commercial expectations. Consistent with the three weeks later transplanting than in 2010, the first flush was in week 25 (week 22 in 2010). Trimmed (60cm) stem weights in 'Yellow Peloric' and 'Ivory White Peloric' in 2011, about 50g, were similar to those obtained in 2010 (just over 50g for a 66cm-trimmed stem). Samples of all three cultivars were taken in week 25 for vase-life testing. The second flush produced many more stems, though these were much lighter than in 2010 (just under 30g for a 60cm-stem, compared with nearly 50g for a 55cm-stem in 2010).

⁴ i.e. having a symmetrical flower form (in a genus which usually does not)

Table 1. Flowering performance of 'trumpet' antirrhinum cultivars following transplanting at week 17 into the 'Haygrove' tunnel. Cropped and recorded in weeks 25 (first flush) and 33 (second flush), the figures are means of 30 stems (or 20, for second flush) shown with standard deviations (SD); 'trimmed weight' refers to stems trimmed to 60cm length.

Cultivar	First flush										Second flush			
	Untrimmed stem length (cm)		Trimmed stem weight (g)		Flower spike length (cm)		Stem diameter (mm)		Number of side-shoots		Number of stems cropped	Trimmed stem weight (g)		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		Mean	SD	
'Yellow Peloric'	94.4	3.25	50.5	8.78	25.0	2.07	7.1	1.28	8.9	3.54	270	28.4	7.85	
'Trumpet Pink'	91.0	4.01	36.0	6.51	29.3	3.06	6.6	1.07	10.4	2.46	390	26.9	6.29	
'Ivory White Peloric'	82.6	5.35	48.8	11.61	19.9	3.61	7.0	1.38	8.3	3.97	470	28.0	4.82	



Antirrhinum cultivars, left to right: 'Yellow Peloric', 'Trumpet Pink' and 'Ivory White Peloric'



'Trumpet' antirrhinum cultivars:
flowers from the second flush

2. Late-planting in both types of tunnel

Plugs of cultivar 'Tangerine' (Florensis Cut Flowers) were transplanted into 4m-long beds in the 'Haygrove' tunnel and 'Pro-Tech' bay 1 in week 27. Table 2 shows that, despite the late planting, stem length, trimmed weight and flower spike length were about the same as the best from the earlier planting, but there was insufficient time for a second flush.

Table 2. Flowering performance of 'trumpet' antirrhinum 'Tangerine' following transplanting at week 27 into the 'Haygrove' tunnel or 'Pro-Tech' bay 1. Cropped and recorded in week 35, the figures are means of 20 stems shown with standard deviations (SD); 'trimmed weight' refers to stems trimmed to 60cm length.

Tunnel	Total no. stems cropped	Untrimmed stem length (cm)		Trimmed stem weight (g)		Flower spike length (cm)	
		Mean	SD	Mean	SD	Mean	SD
'Haygrove'	195	94.4	3.25	50.5	8.78	25.0	2.07
'Pro-Tech'	230	82.6	5.35	48.8	11.61	19.9	3.61

3. Vase-life testing

Samples of 'Yellow Peloric', 'Trumpet Pink' and 'Ivory White Peloric' were picked in week 25 and supplied to Intergreen (UK) Ltd for vase-life testing. There were two or five bunches of five stems for each cultivar. Replicating the normal supermarket supply chain, the stems

were harvested into buckets of water containing CVBN and transported to the test site. An initial assessment was made of the key specifications, stem weight, column length and bud count (for both open and un-opened buds). Still in their buckets with CVBN, the next day they were moved to a cold-store (5°C) for 2 days (despatch and depot phase) and then to a vase-life test room (20±1°C, 60±5% relative humidity) for 3 days (store phase). Finally, the stems were re-cut and placed in vases with fresh water containing a sachet of Chrysal Universal flower food (powder formulation). Stems were monitored daily and records taken, including date of first stem failure, foliage condition, opening stages, water clarity and date of bouquet failure (when 50% of the stems had failed). A summary of the assessments is given in Table 3. Perhaps the main point of note was the greater stem weights of 'Yellow Peloric' and 'Ivory White Peloric' compared with 'Trumpet Pink', confirming earlier results.

Table 3. Assessments of stems of three cultivars of 'trumpet' antirrhinum by the vase-life test provider.

Sample Number	Colour	Weight per Bunch (5 stems)	Weight per stem (avg)	Column length (avg)	Bud count per stem (avg)	Open buds (avg)	Buds to Come (avg)	Vase Life (Days)
Bunch 1	Yellow	316	63.2	26.5	29	15.8	13.2	10
Bunch 2	Yellow	231	46.2	25.5	27.8	14.3	13.5	10
Bunch 3	Yellow	237	47.4	27	28.6	14.8	13.8	10
Bunch 4	Yellow	249	49.8	28	28.9	15.2	13.7	10
Bunch 5	Yellow	245	49	27.5	28.6	15.5	13.1	10
Bunch 6	Pink	181	36.2	37	28.6	14.4	14.2	10
Bunch 7	Pink	167	33.4	29.5	28.8	14	14.8	10
Bunch 8	Pink	157	31.4	27	27.9	13.8	14.1	10
Bunch 9	Pink	162	32.4	32	27.3	14.1	13.2	10
Bunch 10	Pink	200	40	35	28.8	14.9	13.9	10
Bunch 11	White	205	41	22	19.4	9.6	9.8	10
Bunch 12	White	197	39.4	20	18.5	9.4	9.1	10

All bunches had a similar performance in the vase, with changes occurring within the same time-frame on all bunches. On vase-day 6 most of the lower buds were withering in all cultivars, and there was also a slight discolouration of stems (suggested as possibly being a reaction to the flower food used). Fifty per cent failure occurred in all bunches on vase-day 10, with all bunches being terminated for browning or withering of 50% of the flowers heads. Photographs of the stems at vase-day 6 and the end of vase-life are shown below.

'Yellow Peloric'

Vase-day 6



50% Failure/termination on vase-day 10



'Pink Trumpet'

Vase-day 6



50% Failure/termination on vase-day 10



'Ivory White Peloric'

Vase-day 6



50% Failure/termination on vase-day 10



3. ASTER ERICOIDES

A series of trials at the Centre demonstrated the potential of mainly double flowered *A. ericoides* cultivars as a pinched crop for September flowering under tunnels. It was shown that outdoor-grown *A. ericoides* were of poorer quality, though perhaps more manageable (owing to them being less vigorous and producing shorter stems), and that single-stem crops grew too tall. There were substantial differences in the performance of the varieties tested. In 2011 further cultivars were trialled in tunnels as early- and late-planted crops (weeks 19 and 28), and further observations were made on the plants over-wintered in tunnels from 2010. Vase-life testing was also carried out.

1. Early planting

Plugs of ten cultivars (Armada Young Plants, De Lier, The Netherlands) were transplanted into 3m-long plots in 'Pro-Tech' bay 3 in week 19. This crop was pinched. Most varieties produced strong plants which cropped around week 42, which was 4 to 6 weeks later than the equivalent plants in 2010. Clearly this has implications for crop programming and will need to be looked at again in 2012 to see if the 2010 results were unusually early owing to the hot weather experienced over the summer. Among these cultivars, stem length varied from 77 to 159cm, stem weight from 35 to 62g, and the number of stems cropped per plot from about 100 to just over 200, so the importance of varietal differences was certainly confirmed (Table 4).

Ranking the varieties by aspects of performance, 'Cassy' ('Moercas'), 'Linda' and 'Cirina Dark' produced above-average numbers of longer-than-average stems, but these were of low weight. 'Blue Tail', 'Cape Town' ('Moertown') and 'Cassandra' produced the heaviest stems, but these were relatively low in number. However the varieties that showed the most promise were the Double Fun series which produced a large number of good quality stems, which while shorter than most of the other varieties, still exceeded the industry spec of 65 to 70 cms.

Table 4. Flowering performance of ten *A. ericoides* cultivars following transplanting at week 19 into 'Pro-Tech' bay 3. Stem lengths and weights recorded in week 42, the figures are means of 30 stems shown with standard deviations (SD). Numbers of stems cropped from plots of about 80 plants each, in weeks 41 to 43, also shown.

Cultivar	Stem length (cm)		Stem weight (g)		Stems cropped per plot	
	Mean	SD	Mean	SD	Number	Weeks
'Chicago' 'Moergo'	110.9	18.53	41.3	23.45	120	41 - 42
'Linda'	149.1	9.13	34.7	11.96	200	42 - 43
'Cirina Dark'	127.7	10.56	35.3	11.96	173	41 - 43
'Blue Tail'	79.5	11.66	62.0	25.58	100	41
'Double Fun Pink'	91.8	9.29	39.0	17.29	215	41 - 43
'Double Fun Blue'	95.8	8.34	36.3	13.77	200	41 - 43
'Double Fun White'	77.0	5.32	48.0	20.91	160	41 - 42
'Cassy' ('Moercas')	159.0	9.21	38.3	11.77	180	42 - 43
'Cassandra'	108.4	13.42	48.7	18.33	142	41 - 42
'Cape Town' ('Moertown')	107.8	12.57	54.7	29.09	100	41

2. Late planting

This trial was conceived as a late-crop to follow a round of column stocks in Spanish tunnels. Plugs of six cultivars (Armada Young Plants, De Lier, The Netherlands) were pinched and allowed to break before transplanting into 3m-long beds in 'Pro-Tech' bay 2 in week 28.

Three varieties, 'Cairo' ('Moerci'), 'Cape Town' ('Moertown') and 'Chicago' ('Moergo'), cropped in week 41, but with stem lengths and weights about half that of the better, early-planted crop (Table 5). The other three cultivars, 'Blue Tail', 'Cassy' ('Moercas') and 'Dark Mark' either failed to flower or the stems were too short to crop.

Table 5. Flowering performance of six *A. ericoides* cultivars following transplanting at week 28 into 'Pro-Tech' bay 2. Stem lengths and weights recorded in week 41, the figures are means of 20 stems shown with standard deviations (SD).

Cultivar	Stem length (cm)		Stem weight (g)		Notes
	Mean	SD	Mean	SD	
'Blue Tail'	na ¹		na		Stems too short, not cropped
'Cairo' ('Moerci')	88.3	10.11	81.0	29.89	
'Cape Town' ('Moertown')	69.0	5.51	86.5	25.81	
'Cassy' ('Moercas')	na		na		No flowers produced
'Chicago' ('Moergo')	73.3	5.46	81.0	31.44	
'Dark Mark'	na		na		Stems too short, not cropped

¹na, not available or not applicable

3. Plants over-wintered from 2010

Some varieties (Armada Young Plants, De Lier, The Netherlands), planted in 2010 and left down in 'Pro-Tech' bay 3, survived the harsh 2010/2011 winter better than others. Part of the crop was pinched in week 21, and part left intact. The over-wintered plots that were not pinched in the spring grew out of control: the first flush needed to be cut-back to give a late flush. The pinched crop was much more manageable and more akin with the newly planted crop. All the overwintered crops will therefore be cut back in 2012 and the yields and flowering times recorded.

4. Cut-flower samples

Samples of these varieties were again supplied to technologists and managers of supermarkets and packers, some being sent to the Netherlands. Their general quality and stem weight were considered very satisfactory, though samples had often been picked at too late a stage because too many flowers were open at the time of harvest. As a consequence the harvesting stage will be adjusted in 2012 as per an agreed industry spec.

5. Vase-life testing (1) – Fast Track Flowers Ltd

Varieties 'Blue Tail', 'Cassandra', 'Chicago' ('Moergo'), 'Cape Town' ('Moertown'), 'Cirina Dark', 'Coldwater', 'Double Fun Blue', 'Double Fun Pink', 'Double Fun White', 'Flamingo' and 'Parrot', largely from the week 19 (although a few samples were from the overwintered pinched crop), 2011 planting, were subjected to standard vase-life testing by Fast Track Flowers Ltd after the stems were trimmed to 62cm long.

Vase-life varied between varieties, from 5 to 11 days (for the 20%-florets-dead stage), and much longer when assessed as the 50%-florets-dead stage (Table 6). However, the sample was considered relatively advanced for vase-life testing, so these figures should represent a conservative estimate for vase-life. A general comment was that the stems were too long (and often the branches too wide) and would require a significant amount of trimming before packing; this should be addressed by improving crop husbandry and varietal selection. The 'Double Fun' series were the best performers overall for weight and flower presentation and had a satisfactory vase-life.

Table 6. Vase-life performance of *A. ericoides* cultivars. See text for details.

Cultivar	Average trimmed weight (g)	Consumer vase-life (days)		Comments
		20%	50%	
'Blue Tail' 	21.6	8	13	Florets vibrant blue, double. Sample stems long and variable.
'Cape Town' ('Moertown') 	-	-	-	Florets double pink. Sample too far advanced, not tested therefore no photo.
'Cassandra' 	33.8	11	16	Florets light blue, single. Strong, heavy stems due partly to heavy foliage (which required stripping down, with loss of some lower florets). Good potential for core lines and bouquets.
'Chicago' ('Moergo') 	28.2	10	16	Florets vibrant blue, double.

Cultivar	Average trimmed weight (g)	Consumer vase-life (days)		Comments
		20%	50%	
'Cirina Dark'	17.5	7	10	Florets dark pink, single. Tall, thin stems with some wastage. Good distribution of florets through inflorescence.
'Coldwater'	21.2	8	14	Florets blue, single. Stems thin, little foliage. Inflorescence thin with only one floret per branch.
'Double Fun' series	31.6	10	16	Vibrant, double florets. Strong, heavy stems due partly to heavy foliage (which required stripping down and loss of some lower florets). Good potential for core lines and bouquets. Vase-life test done on 'Blue'; 'Pink' and 'White' shared these characteristics.

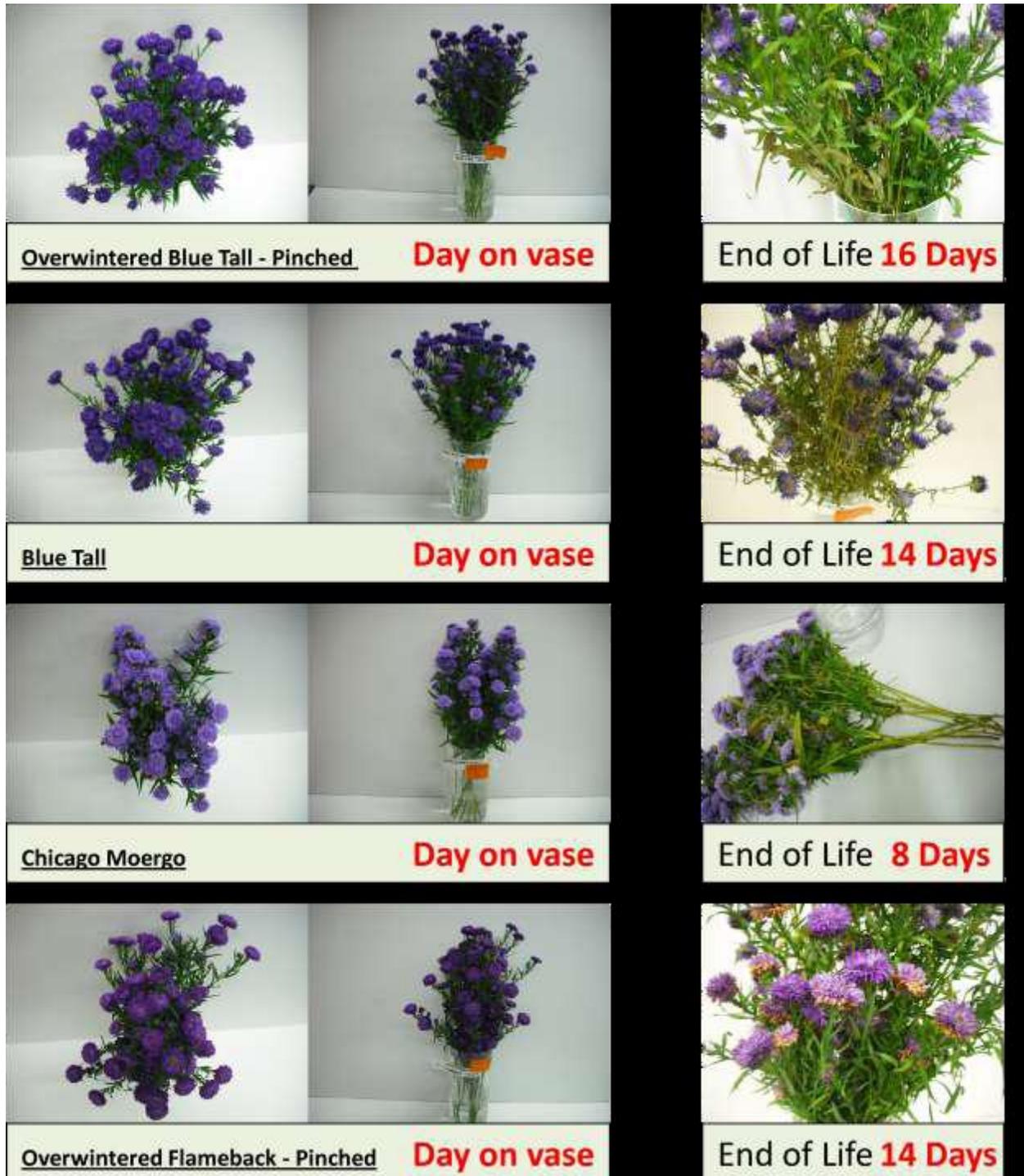


Cultivar	Average trimmed weight (g)	Consumer vase-life (days)		Comments
		20%	50%	
'Flamingo'	38.6	8	14	Good vivid pink, single florets. Relatively thick stems, but the form of the inflorescence is very broad and open with little foliage.
				
'Parrot'	29.4	5	8	Vivid blue, double florets. Inflorescence is very broad and open, requires trimming.
				

6. Vase-life testing (2) – Intergreen (UK) Ltd

Samples from ten plots, comprising seven cultivars from the 2011 trials and three from the over-wintered crop, were picked in week 39 and supplied to Intergreen (UK) Ltd for vase-life testing. There was one bunch for each of ten plots. The stems were harvested into buckets of water containing CVBN, transported to the test site, and, still in their buckets with CVBN, moved to a cold-store (5°C) for 2 days and then to a vase-life test room (20±1°C, 60±5% relative humidity) for 3 days. Finally, the stems were re-cut and placed in vases with fresh water containing a sachet of Chrysal Universal flower food (powder formulation). Stems were monitored daily and records taken, including date of first stem failure, foliage condition, opening stages, water clarity and date of bouquet failure (when 50% of the stems had failed).

Vase-life varied between 7 and 21 days (see photographs below), agreeing with the figure of 8 to 16 days seen in the first vase-life test. The main reasons for failure were yellowing or brown flower heads or leaves. In some varieties the colour faded towards the end of vase-life. All samples tested would therefore have reached or exceeded the current requirement for 5 or 7 days vase-life in mixed bouquets. Photographs of the stems as received and at the start and end of vase-life are shown below.



		
<u>Overwintered Flameback – Not Pinched</u>	Day on vase	End of Life
		
<u>Aster Doublefun – Pink Dark</u>	Day on vase	End of Life 14 Days
		
<u>Aster Doublefun – White</u>	Day on vase	End of Life 14 Days
		
<u>Aster Doublefun – Blue</u>	Day on vase	End of Life 21 Days
		
<u>Aster Cirina Dark</u>	Day on vase	End of Life 16 Days
		
<u>Aster Capetown Moer Town</u>	Day on vase	End of Life 10 Days

4. CHINA ASTERS ('GERMAN' VARIETIES) (*CALLISTEPHUS CHINENSIS*)

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. One trial involved using the growth retardant daminozide to reduce the excessive growth that can occur in early plantings of vigorous cultivars: plots were treated with two rates of daminozide (as 3 or 6g/L 'B-Nine SG'). However, even the higher rate of retardant resulted in only a small (10%), though statistically significant, reduction in stem length in early plantings, while treating the later plantings was ineffective. A further trial with 'B-Nine SG' was therefore carried out in 2011. Vase-life testing was also carried out.

1. Growth retardant trial

Five varieties of the popular 'Krallen' series (Florensis Cut Flowers) and six from the 'Gremlin' series (seed from Hem Zaden BV, Hem, the Netherlands, plugs from Florensis) were used in 2011. In week 25 (the earliest availability of plugs for the trial) each variety was transplanted into 3m-long beds in 'Pro-Tech' bay 2. Half of each bed was treated with 'B-Nine SG' at 6g of product per litre twice, sprayed to 'run-off', in weeks 32 and 34 when the crop was approximately 50cms tall.

The effects of 'B-Nine SG' treatment on total stem length are shown in Figure 1. These were harvested in week 38. In the 'Krallen' varieties applying 'B-Nine SG' gave a fairly consistent, but only 3% overall, reduction in stem length compared with the controls. In contrast, in the 'Gremlin' varieties the result of using 'B-Nine SG' was unconvincing, inconsistent and resulted in an overall less than 2% reduction in length. Analysis of variance (see Tables 7a and b) showed that, while varietal differences in stem length were significant at the 5% level of probability in both cultivar groups, the effect of 'B-Nine SG' was not (in the 'Krallen' series the effect of retardant only just failed to reach significance at this probability level).

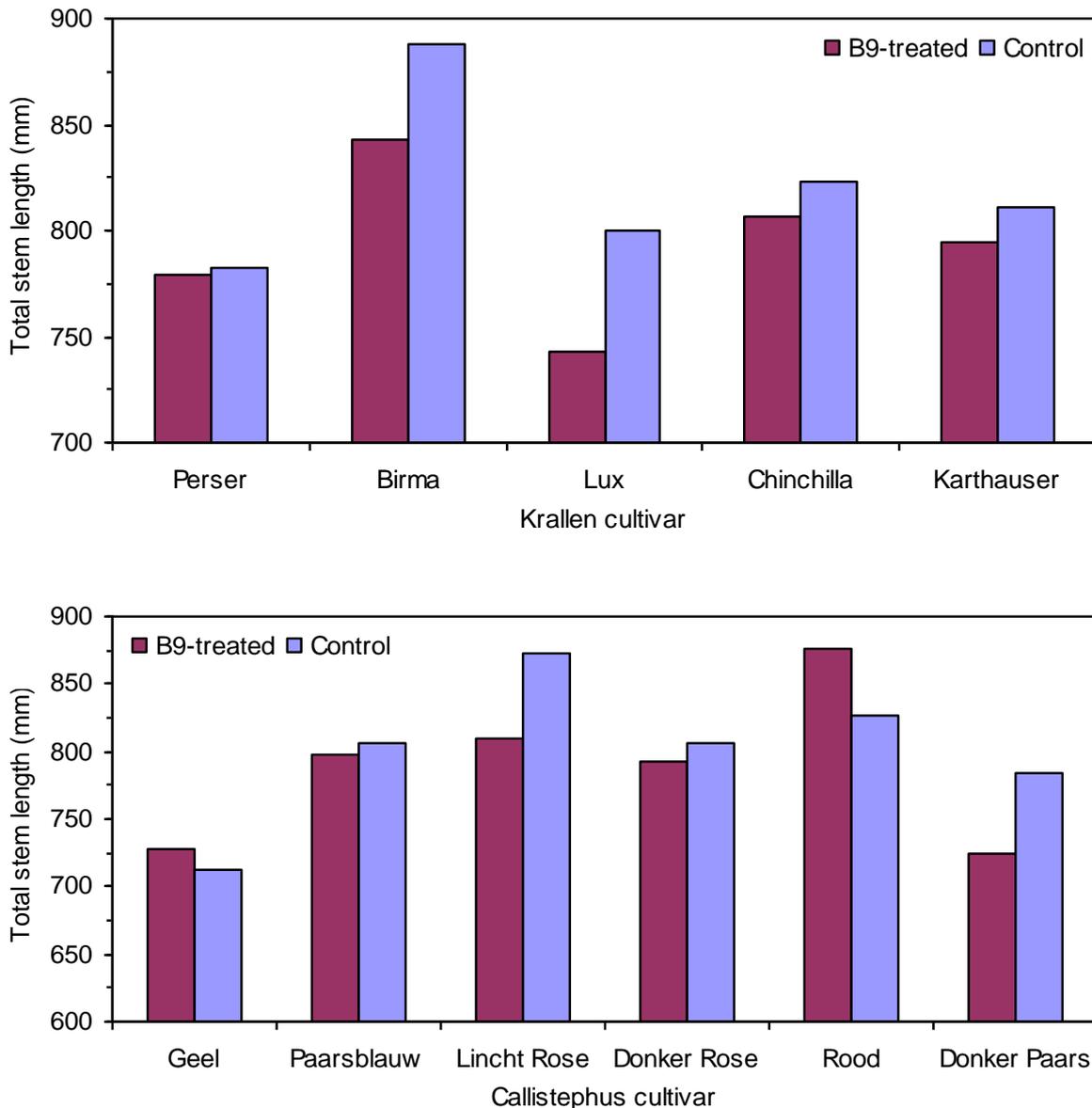


Figure 1. Total stem length of 'Kralen' (above) and 'Gremlin' series (below) of 'German asters' in plots treated with 'B-Nine SG' growth regulator or left untreated as controls.

The effect of retardant treatment on the weight of stems (trimmed to 65cm) was inconsistent, though some varieties produced heavier, sturdier stems when the retardant was used (Figure 2). However, differences due to cultivar and retardant treatment were not statistically significant (Tables 8a and b). There was no significant effect of regulator treatment on the numbers of side-shoots produced (Figure 3, Table 9a and b).

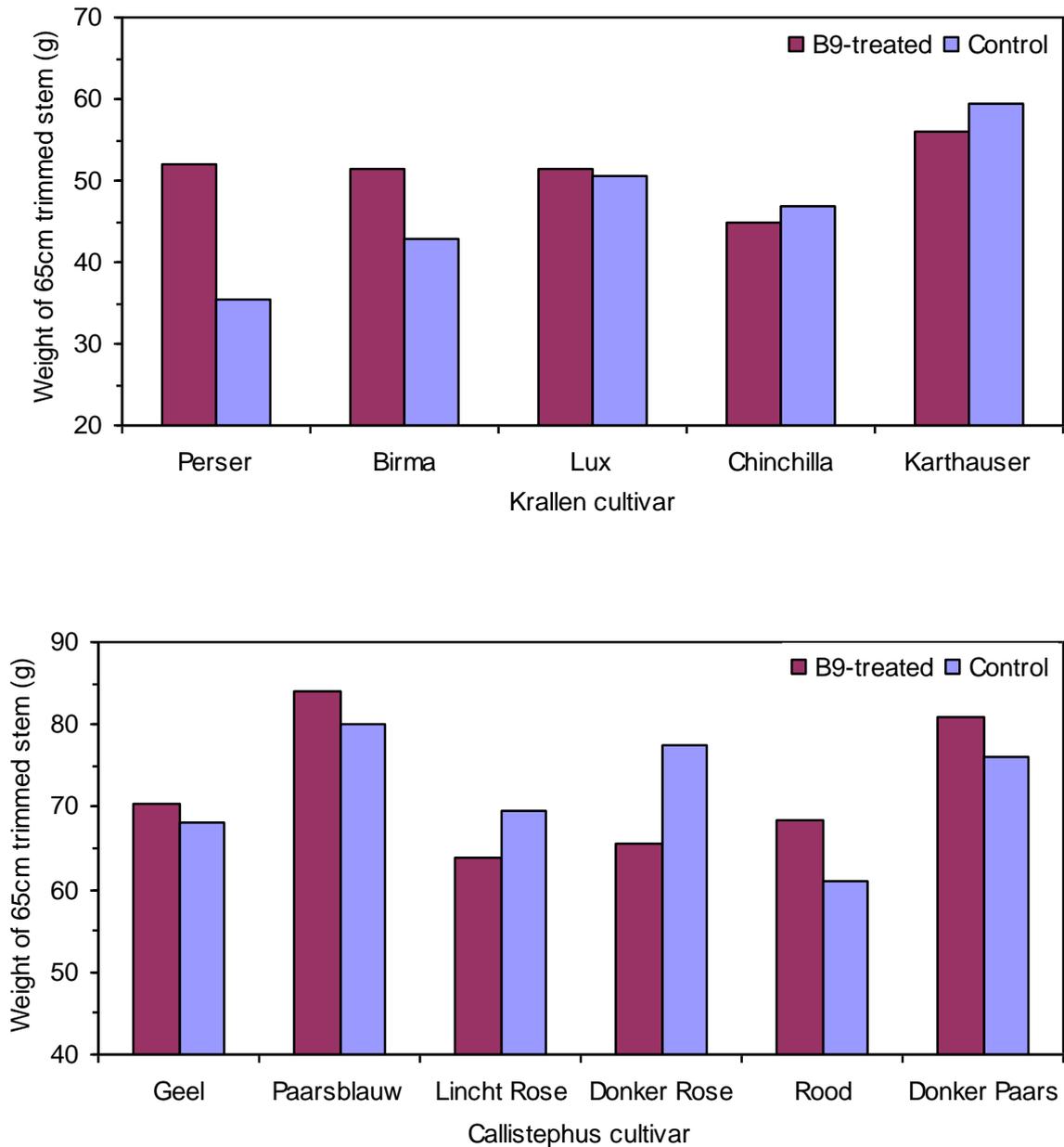


Figure 2. Trimmed stem weight of 'Krallen' (above) and 'Gremlin' series (below) of 'German asters' in plots treated with 'B-Nine SG' growth regulator or left untreated as controls.

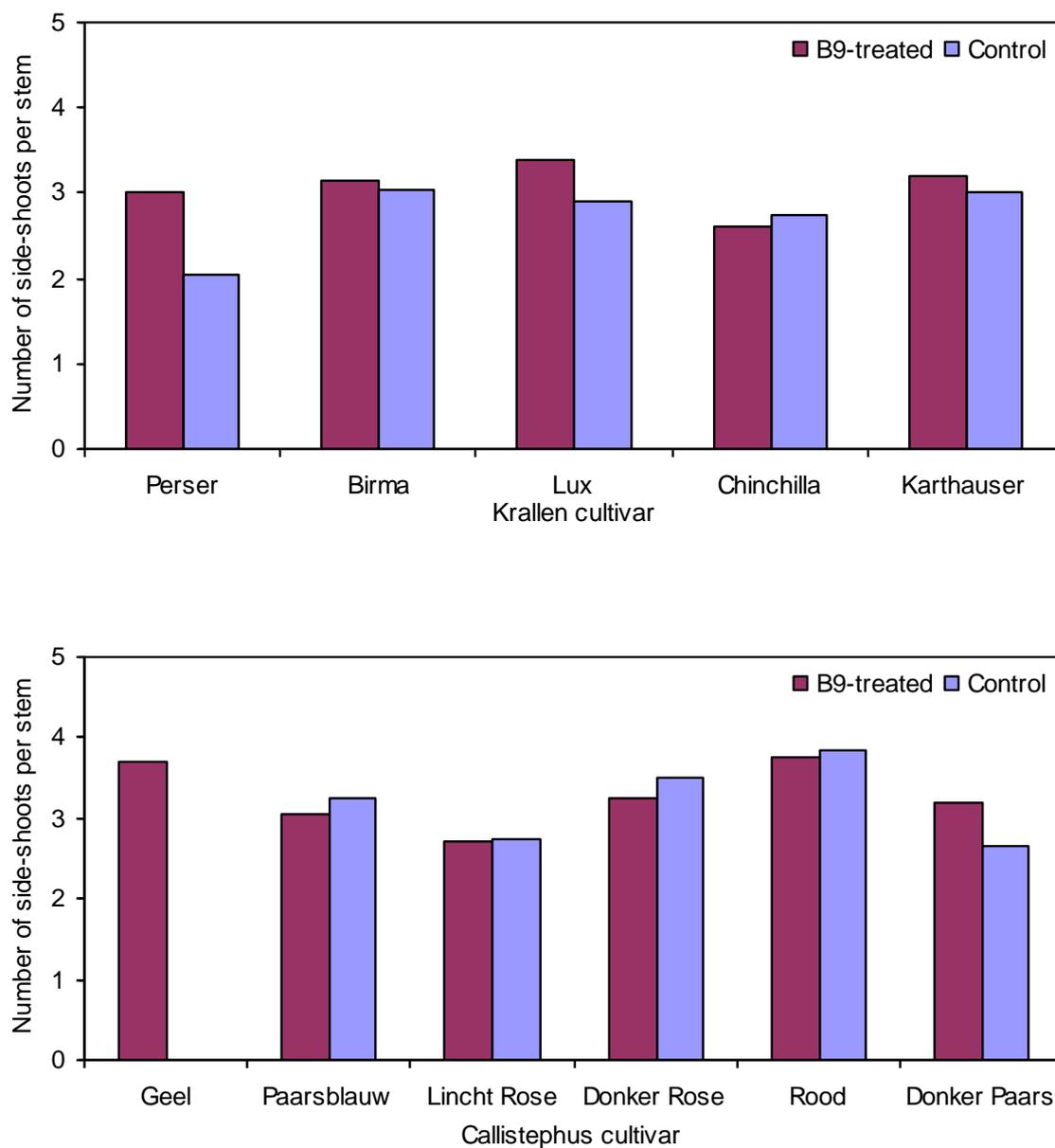


Figure 3. The numbers of side-shoots in 'Krallen' (above) and 'Gremlin' series (below) of 'German asters' in plots treated with 'B-Nine SG' growth regulator or left untreated as controls.

Table 7a. 'Krallen' varieties only - total stem length (mm)

Means and LSD values			
Cultivar	Retardant treatment		Cultivar means
	'B-Nine SG'	Control	
'Perser'	780	782	781
'Birna'	843	888	865
'Lux'	743	801	772
'Chinchilla'	807	823	815
'Karthäuser'	794	811	802
<i>Retardant means</i>	793	821	
	LSD (5%) = 44.8		LSD (5%) = 28.4

Analysis of variance						
Source of variation	SS	df	MS	F	P	Significance ¹
Cultivar	10849.9	4	2712.48	10.4016	0.0217	*
Retardant	1904.4	1	1904.40	7.3028	0.0540	(*)
Residual	1043.1	4	260.78			
Total	13797.4	9				

¹In this and the following tables the statistical significance of the cultivar and retardant factors are shown as NS, (*), *, ** and ***, meaning not significant or significant at the 10, 5, 1 and 0.1% levels of probability, respectively.

Table 7b. 'Gremlin' varieties only - total stem length (mm)

Means and LSD values			
Cultivar	Retardant treatment		Cultivar means
	'B-Nine SG'	Control	
'Geel'	728	713	720
'Paars Blauw'	798	806	802
'Licht Rose'	809	873	841
'Donkere Rose'	793	807	800
'Rood'	876	826	851
'Donkere Paars'	725	784	754
<i>Retardant means</i>	788	801	
	LSD (5%) = 78.7		

Analysis of variance						
Source of variation	SS	df	MS	F	P	Significance
Cultivar	25088.9	5	5017.79	5.3507	0.0447	*
Retardant	526.7	1	526.69	0.5616	0.4873	NS
Residual	4688.9	5	937.79			
Total	30304.6	11				

Table 8a. 'Krallen' varieties only - trimmed weight (g)

Means and LSD values				
Cultivar	Retardant treatment		Cultivar means	
	'B-Nine SG'	Control		
'Perser'	52	36	44	
'Birma'	52	43	47	
'Lux'	52	51	51	LSD (5%) = 10.3
'Chinchilla'	45	47	46	
'Karthouser'	56	60	58	
<i>Retardant means</i>	51	47		
	LSD (5%) = 16.4			

Analysis of variance						
Source of variation	SS	df	MS	F	P	Significance
Cultivar	240.2	4	60.04	1.7296	0.3043	NS
Retardant	42.0	1	42.03	1.2107	0.3330	NS
Residual	138.9	4	34.71			
Total	421.0	9				

Table 8b. 'Gremlin' varieties only - trimmed weight (g)

Means and LSD values				
Cultivar	Retardant treatment		Cultivar means	
	'B-Nine SG'	Control		
'Geel'	71	68	69	
'Paars Blauw'	84	80	82	
'Licht Rose'	64	70	67	LSD (5%) = 7.8
'Donkere Rose'	66	78	72	
'Rood'	69	61	65	
'Donkere Paars'	81	76	78	
<i>Retardant means</i>	72	72		
	LSD (5%) = 13.5			

Analysis of variance						
Source of variation	SS	df	MS	F	P	Significance
Cultivar	458.9	5	91.78	3.3203	0.1069	NS
Retardant	0.2	1	0.16	0.0059	0.9417	NS
Residual	138.2	5	27.64			
Total	597.3	11				

Table 9a. 'Krallen' varieties only - number of side-shoots

Means and LSD values			
Cultivar	Retardant treatment		Cultivar means
	'B-Nine SG'	Control	
'Perser'	3.0	2.1	2.5
'Birma'	3.2	3.1	3.1
'Lux'	3.4	2.9	3.2
'Chinchilla'	2.6	2.8	2.7
'Karthaus'	3.2	3.0	3.1
<i>Retardant means</i>	3.1	2.8	
LSD (5%) = 0.83			

Analysis of variance						
Source of variation	SS	df	MS	F	P	Significance
Cultivar	0.7	4	0.17	1.8696	0.2797	NS
Regulator	0.3	1	0.26	2.8724	0.1654	NS
Residual	0.4	4	0.09			
Total	1.3	9				

Table 9b. 'Gremlin' varieties (excluding 'Geel') - number of side-shoots

Means and LSD values			
Cultivar	Retardant treatment		Cultivar means
	'B-Nine SG'	Control	
'Paars Blauw'	3.1	3.3	3.2
'Licht Rose'	2.7	2.8	2.7
'Donkere Rose'	3.3	3.5	3.4
'Rood'	3.8	3.9	3.8
'Donkere Paars'	3.2	2.7	2.9
<i>Retardant means</i>	3.2	3.2	
LSD (5%) = 0.63			

Analysis of variance						
Source of variation	SS	df	MS	F	P	Significance
Cultivar	1.4	4	0.35	6.6595	0.0467	*
Regulator	0.0	1	0.00	0.0048	0.9481	NS
Residual	0.2	4	0.05			
Total	1.6	9				

2. Cut-flower samples

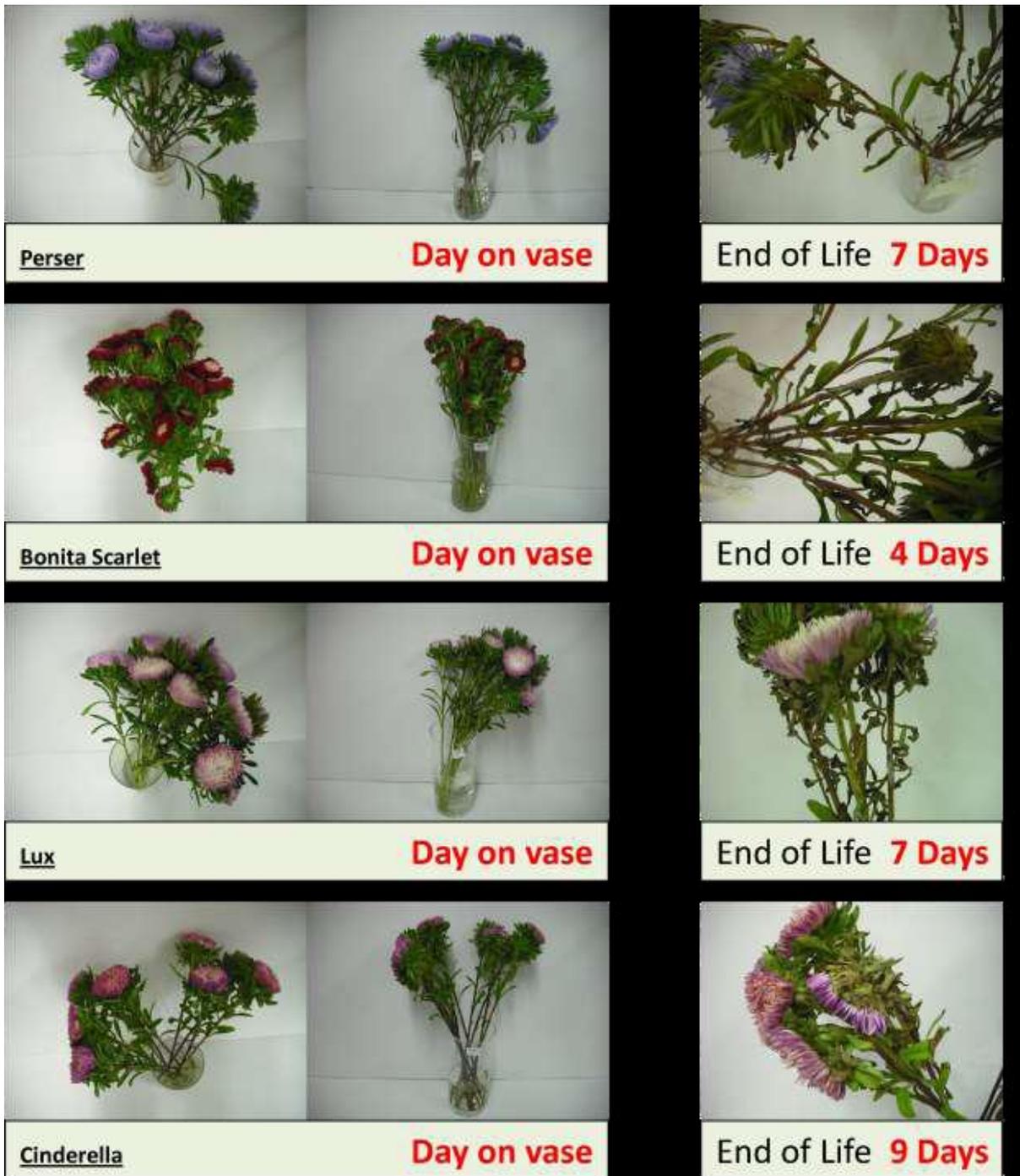
As in previous years many samples were supplied to supermarkets, packers and local florists, some being sent to the Netherlands. These samples (and the open day) have resulted in requests for further information in relation to season extension of trumpet antirrhinum, the development of premium quality lisianthus, season extension of aster

ericoides, new cultivars of ornamental brassica, perennial rather than annual Rudbeckia and various foliage options.

3. Vase-life testing

Samples of four cultivars – 'Bonita Scarlet', 'Chinchilla', 'Perser' and 'Lux' - were picked in week 39 and supplied to Intergreen (UK) Ltd for vase-life testing. There was one bunch for each cultivar. The stems were harvested into buckets of water containing CVBN, transported to the test site, and, still in their buckets with CVBN, moved to a cold-store (5°C) for 2 days and then to a vase-life test room (20±1°C, 60±5% relative humidity) for 3 days. Finally, the stems were re-cut and placed in vases with fresh water containing a sachet of Chrysal Universal flower food (powder formulation). Stems were monitored daily and records taken, including date of first stem failure, foliage condition, opening stages, water clarity and date of bouquet failure (when 50% of the stems had failed).

Vase-life varied from 4 to 9 days, the main reason for failure being yellowing or brown flower heads or leaves. The test provider pointed out that the samples were supplied towards the end of the season, when stems were relatively thin and weak compared with other products seen. Any promising varieties from the 2012 trials will be sampled during the main production season. Variety 'Bonita Scarlet' under-performed with a vase-life of only 4 days, while 'Chinchilla' out-performed the others with a vase-life of 9 days. 'Perser' and 'Lux' had intermediate vase-lives of 7 days. 'Chinchilla' would therefore exceed the likely guarantee of 5 to 7 days for bouquet work. Photographs of the stems as received and at the start and end of vase-life are shown below.



5. ERYNGIUM (*ERYNGIUM* SPP.)

Again responding to a grower's request, in 2011 a small selection of new *Eryngium* cultivars was grown to assess the varieties available and their potential as a crop in the UK. Plugs of cultivars 'Marbella', 'Blue Bell' and 'Arabian Dawn' (Armada Young Plants, De Lier, The Netherlands), 'Deep Blue' (seed from Hem Zaden BV, Hem, The Netherlands, plugs from Florensis Cut Flowers), and 'Magical Purple Falls', 'Magical Blue Falls' and 'Magical Cloud' (Kolster BV, Boskoop, The Netherlands) were transplanted into 4m-long plots both in 'Pro-Tech' bay 2 and outdoors in week 27 and 32. As expected, few flowers were produced in 2011; the further performance of this planting will be assessed in 2012.



***Eryngium*, left to right: 'Marbella', 'Blue Bell' and 'Arabian Dawn' (courtesy Armada Young Plants)**



***Eryngium*, left to right: 'Magical Purple Falls', 'Magical Cloud' and 'Magical Blue Falls' (courtesy Kolster BV)**

6. HARDY FOLIAGE

A wide range of hardy foliage plants (Kolster BV, Boskoop, The Netherlands) was planted in outside beds in spring 2010:

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

Some examples of *Hypericum* and further varieties of *Symphoricarpus* (also from Kolster BV) were added in spring 2011:

- *Hypericum inodorum* 'Magical Green Fall'
- *H. inodorum* 'Magical Tropical Fall'
- *H. inodorum* 'Magical White Fall'
- *Symphoricarpus* 'Magical Pride'
- *S.* 'Magical Avalanche'

Further information will be included in the next report, after the bushes have become established.



Photinia



Symphoricarpus



Hedera



Calicarpa



Viburnum



Philadelphus



Cornus



Corylus



Salix



Cotinus

7. LISIANTHUS (*EUSTOMA GRANDIFLORUM*)

Cut-flowers of lisianthus are now popular in the UK and, although regarded as somewhat 'exotic', the possibility of growing a short summer spot crop in tunnels was tested in 2010. Growing in the 'Haygrove' tunnel fitted with side skirts and end-doors that were kept shut in windy weather, the results were impressive, with high-quality blooms, good stem strength and negligible pest and disease problems. But since the growing period in 2010 was particularly warm and dry, ideal for lisianthus, further trials were needed in a 'normal' year.

1. Cultivar trial over three planting dates and two tunnels

In 2011 nearly thirty cultivars were trialled. Plugs of nine cultivars (Florensis Cut Flowers) were planted in the 'Haygrove' tunnel in each of weeks 18, 19 and ten varieties in week 20. Further plugs of the ten varieties planted in week 20 were transplanted in week 21 to 'Pro-Tech' bay 1 (without end-doors or skirted sides).

As in 2010, the plots growing in the 'closed' tunnel produced strong, high quality stems, with only inconsequential pest or disease problems seen (there was no downy mildew and little evidence of root diseases). However, the late planting in the 'open' tunnel grew weakly, with significant amounts of *Fusarium* and some *Pythium* seen, and the crop was abandoned after the cover was damaged in a gale. However, before the crop was abandoned, a long established lisianthus grower visited the CFC site and commented that, while the crop was not as strong and vigorous as the 'Haygrove' tunnel crop, it was still better than his equivalent glasshouse crop, and is therefore well worth repeating in 2012 but using a slightly earlier planting date. The difference in pest and disease levels between the two tunnels may have been related to the different microclimates or to the methods of soil sterilisation (the 'Haygrove' tunnel was treated with dazomet in autumn 2010 and left sheeted-down over winter, the 'Pro-Tech' bays were not sterilised with dazomet until spring 2011).



Cropping dates, stem lengths and trimmed weights are summarised for the main plots in the 'Haygrove' tunnel in Table 10. There were considerable varietal differences, some cultivars evidently being more suited to cultivation in tunnels. Most cultivars planted in weeks 18 and 19 were cropping in weeks 32 to 33, respectively, with the odd cultivar later, with the week-20 plantings cropped over weeks 32 to 36. Of the 28 plots planted (ie 9 in week 18 and 19 and 10 in week 20) eight failed to reach the average length of 70cm needed for trimming to specification, but only six had a trimmed stem weight of less than 80g. Untrimmed stem lengths and trimmed stem weights, averaged across the cultivars, showed no clear trend with

later planting, although stems from the middle planting date were shorter and lighter (each by about 10%) than the earlier and later plantings. In some cases the values of the standard deviation (also shown in Table 10) indicated a large variation within plots, so any apparent varietal differences should be treated with caution.



Lisianthus, from left to right: 'ABC 2-3 Blue Rim', 'Rosita Blue' and 'Dream White'

Table 10. Flowering performance of lisianthus cultivars following transplanting at weeks 18, 19 and 20 into the 'Haygrove' tunnel. Stem lengths and weights recorded on the dates shown, usually corresponding to peak cropping time. The figures are means of 20 stems shown with standard deviations (SD); trimmed stem weight refers to weight after trimming stems to 70cm.

Cultivar	Planting week	Recording date	Total stem length (cm)		Trimmed stem weight (g)	
			Mean	SD	Mean	SD
'ABC 2-3 Blue Rim'	18	08 Aug	86	18.7	93	21.0
'Arena Rose'	18	08 Sep	97	5.1	96	43.9
'Dream White'	18	08 Aug	62	2.1	52	19.9
'Excalibur Green'	18	08 Aug	84	3.4	101	30.6
'Kyoto Purple'	18	08 Aug	72	2.7	78	22.4
'Mariachi Lime Green'	18	08 Aug	73	3.7	77	19.6
'Minuet Dark Purple'	18	08 Aug	74	3.8	134	31.6
'Papillon Flash Pink'	18	17 Aug	80	5.4	164	56.4
'Rosita Blue'	18	08 Aug	82	17.9	88	22.8
'Arena III Red'	19	26 Aug	91	2.6	87	18.8
'Dream Lavender'	19	08 Aug	59	12.6	73	15.9
'Excalibur Pure White'	19	17 Aug	73	3.2	118	73.4
'Mariachi Lavender'	19	17 Aug	57	4.9	74	25.0
'Mariachi White Pure'	19	08 Aug	72	4.6	87	36.7
'Minuet Apricot'	19	17 Aug	61	13.4	95	27.4
'Piccolo 2 Rose Pink'	19	08 Aug	92	3.4	87	25.8
'Revolution Green'	19	17 Aug	60	3.2	85	21.1
'Revolution White'	19	17 Aug	64	6.6	96	38.6
'ABC 2-3 Blue Rim'	20	17 Aug	88	3.9	121	23.5
'Arena White'	20	31 Aug	89	2.8	88	19.7
'Ceremony Blue Flush'	20	31 Aug	90	3.5	94	18.5
'Dream Blue'	20	08 Aug	68	3.4	73	14.7
'Excalibur Yellow'	20	31 Aug	89	4.4	80	17.5
'Mariachi Blue'	20	17 Aug	70	4.5	97	22.7
'Minuet White'	20	31 Aug	76	3.6	94	17.8
'Papillon Rose Pink'	20	08 Sep	66	7.2	101	49.5
'Piccolo 2 Deep Blue'	20	31 Aug	79	4.2	110	29.5
'Rosita 3 Yellow'	20	17 Aug	79	4.5	142	36.6

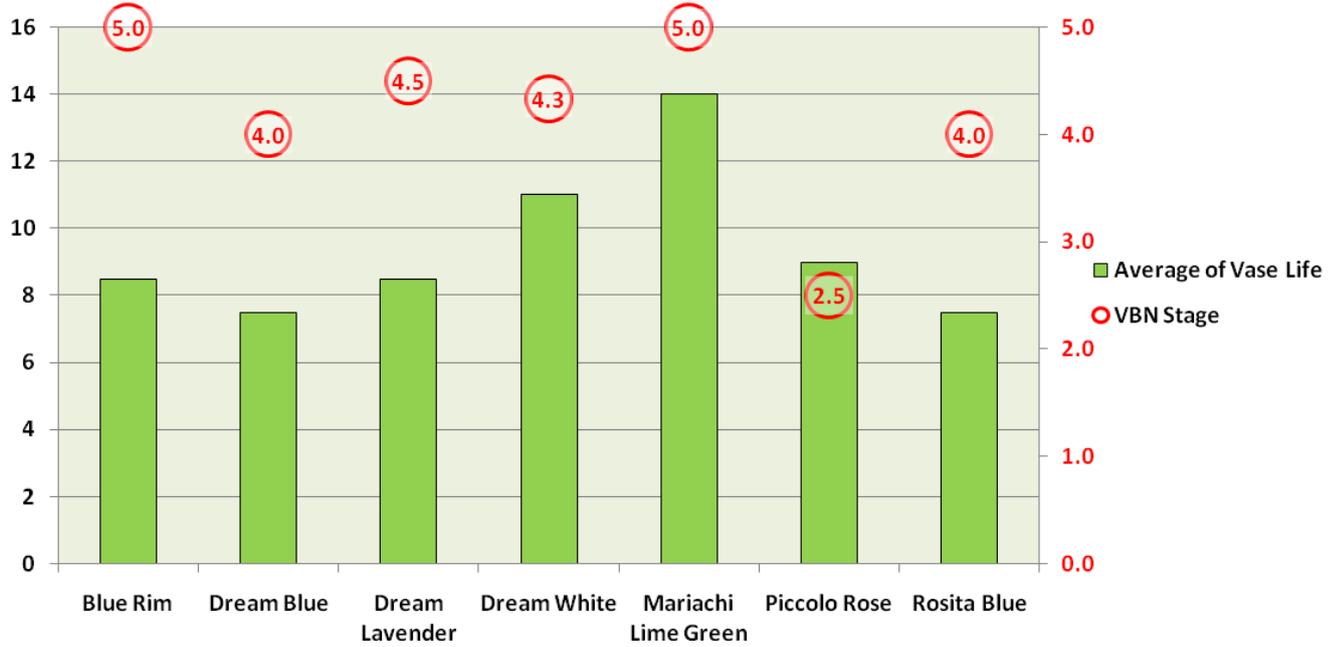
2. Vase-life trials

Samples of 'ABC 2-3 Blue Rim', 'Dream Blue', 'Dream Lavender', 'Dream White', 'Mariachi Lime Green', 'Piccolo 2 Rose Pink' and 'Rosita Blue', one bunch of five stems for each cultivar, were picked in week 32 and supplied to Intergreen (UK) Ltd for vase-life testing. A second batch – of cultivars 'ABC 2-3 Blue Rim', 'Dream Blue', 'Dream Lavender', 'Mariachi Lime Green', 'Piccolo 2 Rose Pink' and 'Piccolo 2 Deep Blue' – was picked in week 33 and treated in the same way as the first. The stems were harvested into buckets of water containing CVBN and transported to the test site. Still in their buckets with CVBN, the same day they were moved to a cold-store (5°C) for 2 days and then to a vase-life test room (20±1°C, 60±5% relative humidity) for 3 days. Finally, the stems were re-cut and placed in vases with fresh water containing a sachet of Chrysal Universal flower food (powder formulation). Stems were monitored daily and records taken, including date of first stem failure, foliage condition, opening stages, water clarity and date of bouquet failure (when 50% of the stems had failed).

Amongst the different cultivars, vase-life varied from 7.5 to 14.0 days in batch 1 and from 7.0 to 13.3 days in batch 2 (Figure 4). The main reasons for failure were flower-head damage due to *Botrytis* or drooping of the flowers and stems. The vase-life guarantee for straight lisianthus is usually 9 days. In batch one only 'Dream White', 'Mariachi Green' and 'Piccolo Rose' achieved this, while in batch 2 all cultivars except 'ABC 2-3 Blue Rim' and 'Dream Lavender' did, so about half the bunches picked met the 9-day requirement. Lisianthus is also commonly used in mixed bouquets that are generally guaranteed for 5 or 7 days. Following the latter criterion, all bunches tested would meet the required guarantee. Photographs of the stems at the start and end of vase-life are shown below.

The VBN stage refers to the Dutch Flower Auction Associations standard stage of development of lisianthus flowers. Day on vase refers to the first day of the vase life testing.

C.F.C. - Lisianthus 1st Replicate - Vase Life Overview



C.F.C. - Lisianthus 2nd Replicate - Vase Life Overview

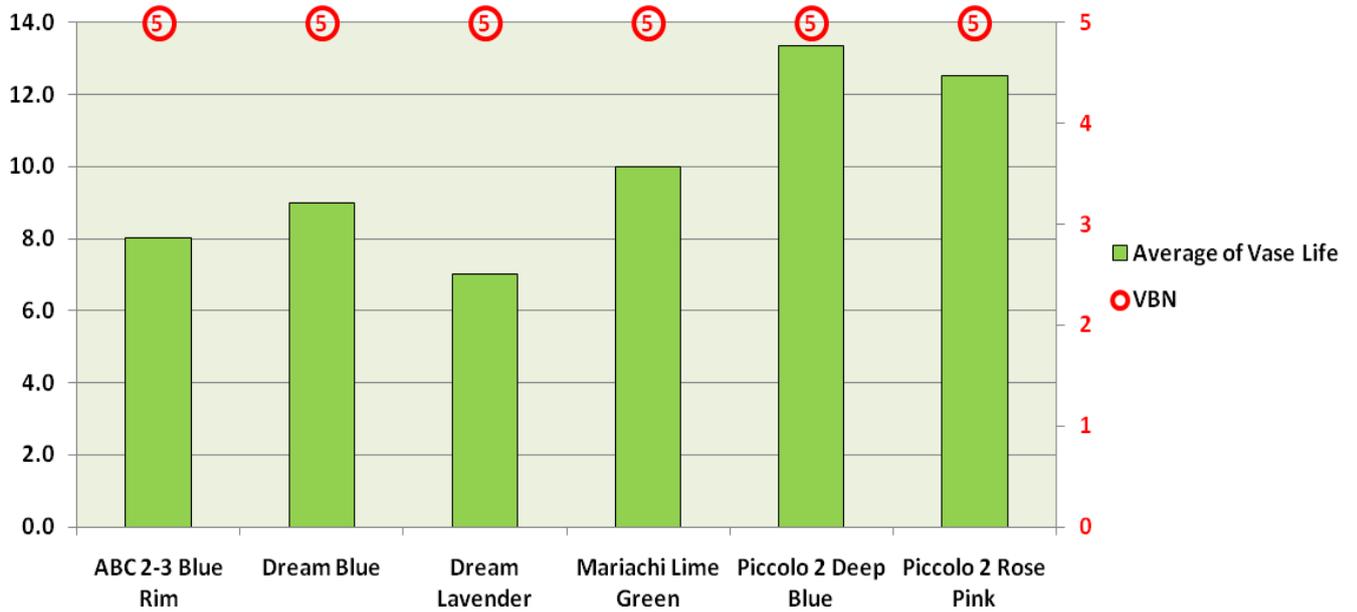


Figure 4. Vase-life (days, left-hand axis) and stage of development (VBN stage, right-hand axis and figures in circles) of two batches of lisianthus cultivars grown at the CFC.

Batch 1



Blue Rim

Day on vase



End of Life 8.5Days



Dream Blue

Day on vase



End of Life 7.5Days



Dream Lavender

Day on vase



End of Life 8.5Days



Dream White

Day on vase



End of Life 11 Days



Mariachi Lime Green

Day on vase



End of Life



Piccolo Rose

Day on vase



End of Life



Rosita Blue

Day on vase



End of Life **7.5 Days**

Batch 2



Piccolo 2 Deep Blue

Day on vase



End of Life **13.3 Days**



Piccolo 2 Rose Pink

Day on vase



End of Life **12.5 Days**



ABC 2-3 Blue Rim



Day on vase



End of Life



Dream Blue



Day on vase



End of Life



Dream Lavender



Day on vase



End of Life



Mariachi Lime Green



Day on vase



End of Life 10 Days

3. Cut-flower samples

Samples of lisianthus were again supplied very widely to technologists and managers of supermarkets and packers and were very enthusiastically received. With this quality and a home-grown product, it was considered the crop could generate a good return, the main obstacle being the long time the crop is in the ground. Viewing the trials, a representative of Florensis and one of the supermarkets said these were some of the strongest-stemmed lisianthus they had ever seen. However it was accepted that to be economically viable, this premium product will need to command a premium price. But the markets are reluctant to commit to this at the current time and this needs to be explored further in 2012.



Lisianthus

8. ORNAMENTAL BRASSICAS (*BRASSICA OLERACEA*)

For economic success ornamental brassicas need to be grown on a low-cost basis, and this is likely to involve direct-drilling. In 2009 a small trial was set-up at the Centre to compare production by direct-drilling with traditional plug planting, but showed only how sensitive brassica drilling is to poor soil conditions. In 2010 a further trial was located on a commercial nursery with a more appropriate soil type, where the direct-drilled crop performed particularly well.

New lines of ornamental brassicas, still under code numbers, also formed part of the trials at the same commercial nursery in 2010. Moon light, Snow Bright and Dream Red proved very promising and have potential as novelties, or were potential alternatives to 'Crane' cultivars. In 2011, ten further lines (Florensis Cut Flowers) were evaluated at the same nursery. For this trial, seed was sown in plugs in week 22 and transplanted to field plots in week 27. The characteristics of the cultivars are summarised in Table 11. They were harvested in week 40 and samples were subjected to standard vase-life testing, also by Winchester Growers Ltd, following 2 days in a cold-store then 4 days representing the transport/retail period; 'Chrysal Clear Professional 2' was used as a conditioner and a universal flower food was used in the vases.

None of the varieties presented any issues over their growing, though 'Sunny Bright' consisted of mixed seed, with some being white/pink and some rose, consequently resulting in a mix of head sizes. The overall selection produced a good range of head colour, from white to purple/pink and many produced attractive heads, notably 'Snow Bright' with white veining in the pink/white/green leaves. Average stem length varied from 40cm (for 'Kohju No. 2', which was considered too short) to 62cm (for 'Dream White', possibly too tall). The percentage of stems cropped varied much between varieties – from only 5 or 10% in 'Sunny Bright' and 'Kohju No. 2', to 90% or more (in the tall varieties, 'Lake Swan', 'Suruga Hatshi' and 'Dream White'). Vase-life ranged from a satisfactory 12 days (in 'Sunny Bright', 'Dream Light', 'Suruga Hatshi' and 'Lake Swan') to 23 days (in 'Moon Light', 'Hakuju' and 'Dream White'). All stems showed re-growth of the head while in the vase-life room.

Table 11. Field and vase-life performance of ten ornamental brassica cultivars grown on a commercial nursery in 2011. See text for further details.

Code and variety	Photo	Colour	Percentage cropped (%)	Comments	Field length (cm)	Vase-life (days)
A 'Kohju No. 2'		Purple/pink & green	10	Even heads but too short	40	16
I 'Moon Light'		White with green outer leaves	50	Nice head form	48	23
B 'Hakuju'		White, some have a very slight pink centre	20	Nice head form	45	23
C 'Snow Bright'		Pink centre, changing to white then green	80	Lovely white veining in the leaves and very good head form	54	16

Code and variety	Photo	Colour	Percentage cropped (%)	Comments	Field length (cm)	Vase-life (days)
F 'Sunny Bright'		Mixed seed, some white/pink, some rose.	5	Very mixed head size (due to mixed seed)	45	12
D 'Dream Red'		Deep-rose	70	Similar to 'Rose Crane' in colour, nice head	50	16
J 'Dream Light'		White with pink centre	50	Some small heads, all start to go mouldy early in the field	50	12
G 'Dream White'		White	95	Very tall	62	23

Code and variety	Photo	Colour	Percentage cropped (%)	Comments	Field length (cm)	Vase-life (days)
E 'Suruga Hatshi'		Purple middle, through to white, then green	90	Tall	55	12
H 'Lake Swan'		White	90	Tall	52	12

9. PHLOX (*PHLOX PANICULATA*)

Plots of several phlox cultivars (Bartels Stek, Aalsmeer, the Netherlands) were planted in 2009 in 'Pro-Tech' bay 3. They provided a further demonstration of the potential of this crop in the UK, and gave samples for flower packers to show to supermarket buyers.

1. Crop performance

In 2011 the plots started to crop in early July, again giving stems of far superior quality than an outdoor crop. Stem production is summarised in Table 12. Average trimmed stem weights varied from 32 to 38g. The number of stems cropped varied from a low 31/m² for 'Sugar Missy' to 104/m² for 'Miss Fiona'. The second flush was still developing when the polythene cover had to be removed from the tunnel due to deteriorating weather.

Table 12. Flowering performance in 2011 of four phlox cultivars planted in 2009 in 'Pro-Tech' bay 3. Stem weights recorded on the dates shown, usually corresponding to peak cropping time; the figures are means of 20 stems shown with standard deviations (SD) and stems were trimmed to 60cm before weighing.

Cultivar	Recording date	Plot size (m ²)	Stems cropped (no./plot)	Stems cropped (no./m ²)	Trimmed stem weight (g)	
					Mean	SD
'Miss Marple'	06 July	9.0	780	87	35	8.6
'Miss Fiona'	06 July	4.5	466	104	32	10.2
'Ice Cap'	11 July	4.5	185	41	38	9.1
'Sugar Missy'	11 July	9.0	283	31	34	9.8



2. Vase-life testing

Samples of several lines, ten bunches of five stems each, were picked in week 24 and supplied to Intergreen (UK) Ltd for vase-life testing. The stems were harvested into buckets of water containing CVBN and transported to the test site. Still in their buckets with CVBN, on the same day they were moved to a cold-store (5°C) for 2 days and then to a vase-life test room (20±1°C, 60±5% relative humidity) for 3 days. Finally, the stems were re-cut and placed in vases with fresh water containing a sachet of ASDA Universal flower food. Stems were monitored daily and records taken, including date of first stem failure, foliage condition, opening stages, water clarity and date of bouquet failure (when 50% of the stems had failed).

The vase-life results are shown in Figure 5. 'Pink Miniature' had an extremely good performance with a 14-day vase-life, and it was the only variety not to drop any flower heads during the trial. Between vase days 4 and 6 flower drop started on all bunches (except for 'Pink Miniature') and, although the amount of flowers dropping was significant, a substantial amount of flowers had the potential to open, giving the product continuous flowering. In these cultivars vase-life varied between 9 and 11 days. For all bunches the reason for failure was the development of withered stems, leaves and flower-heads. Photographs of the stems at the key stages of vase-life are shown below.

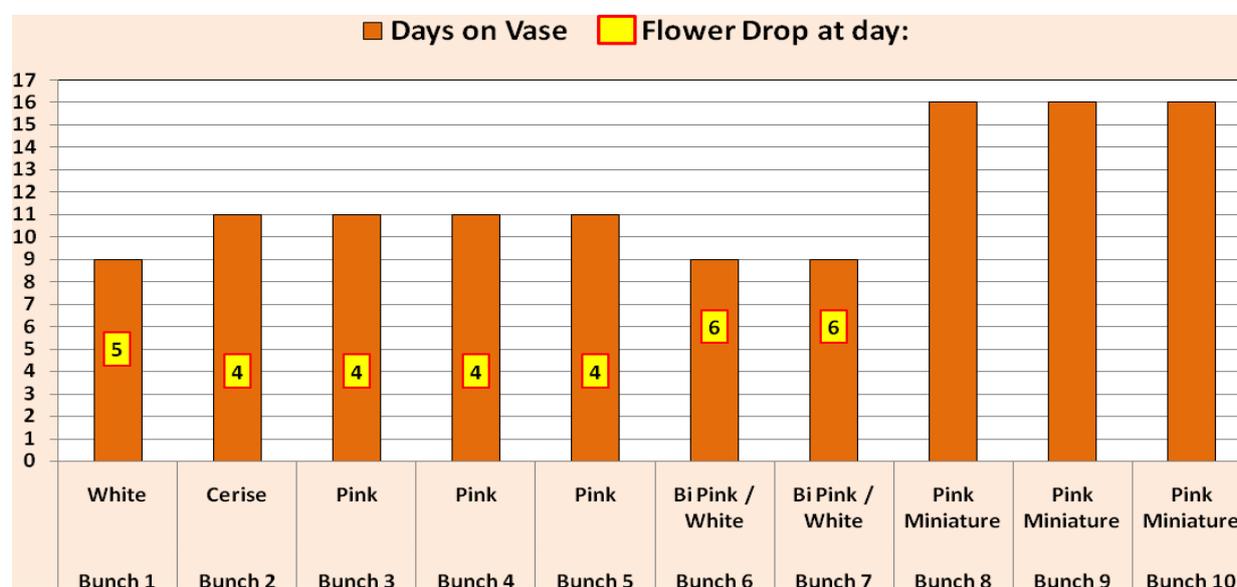
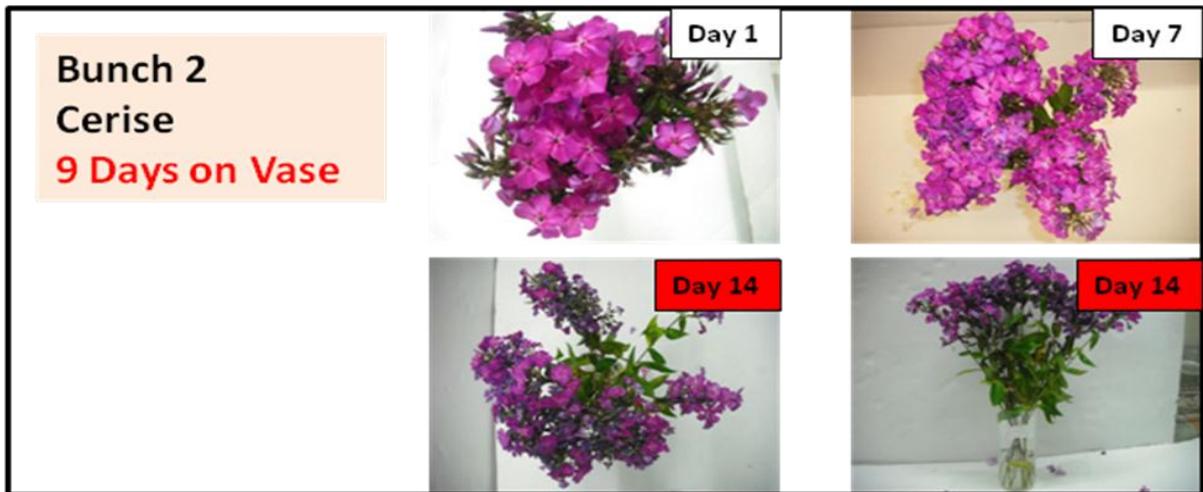
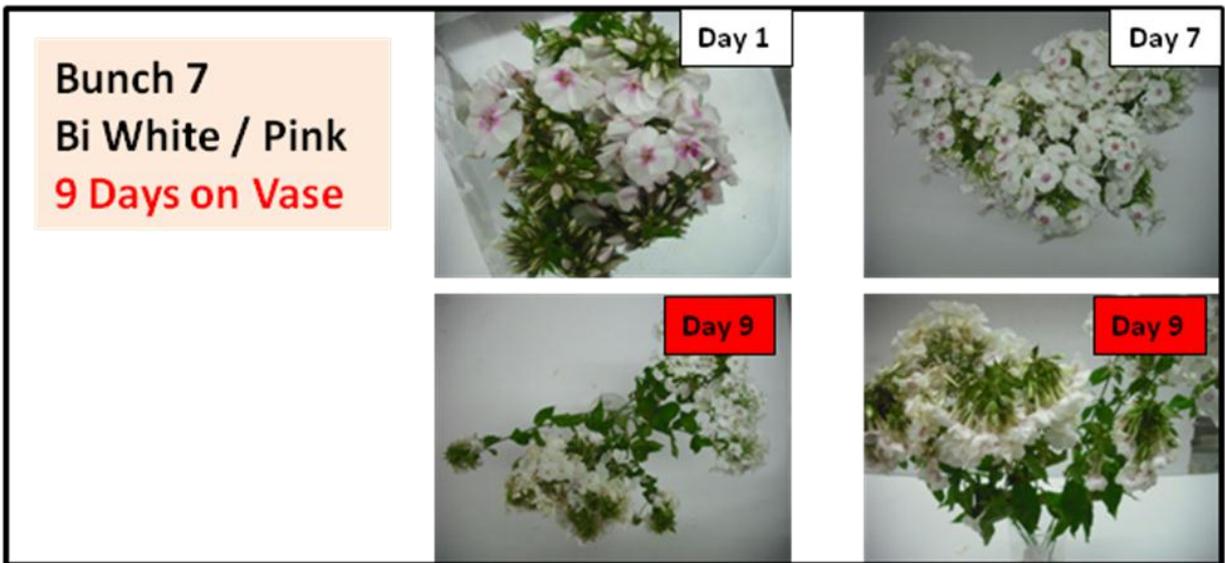
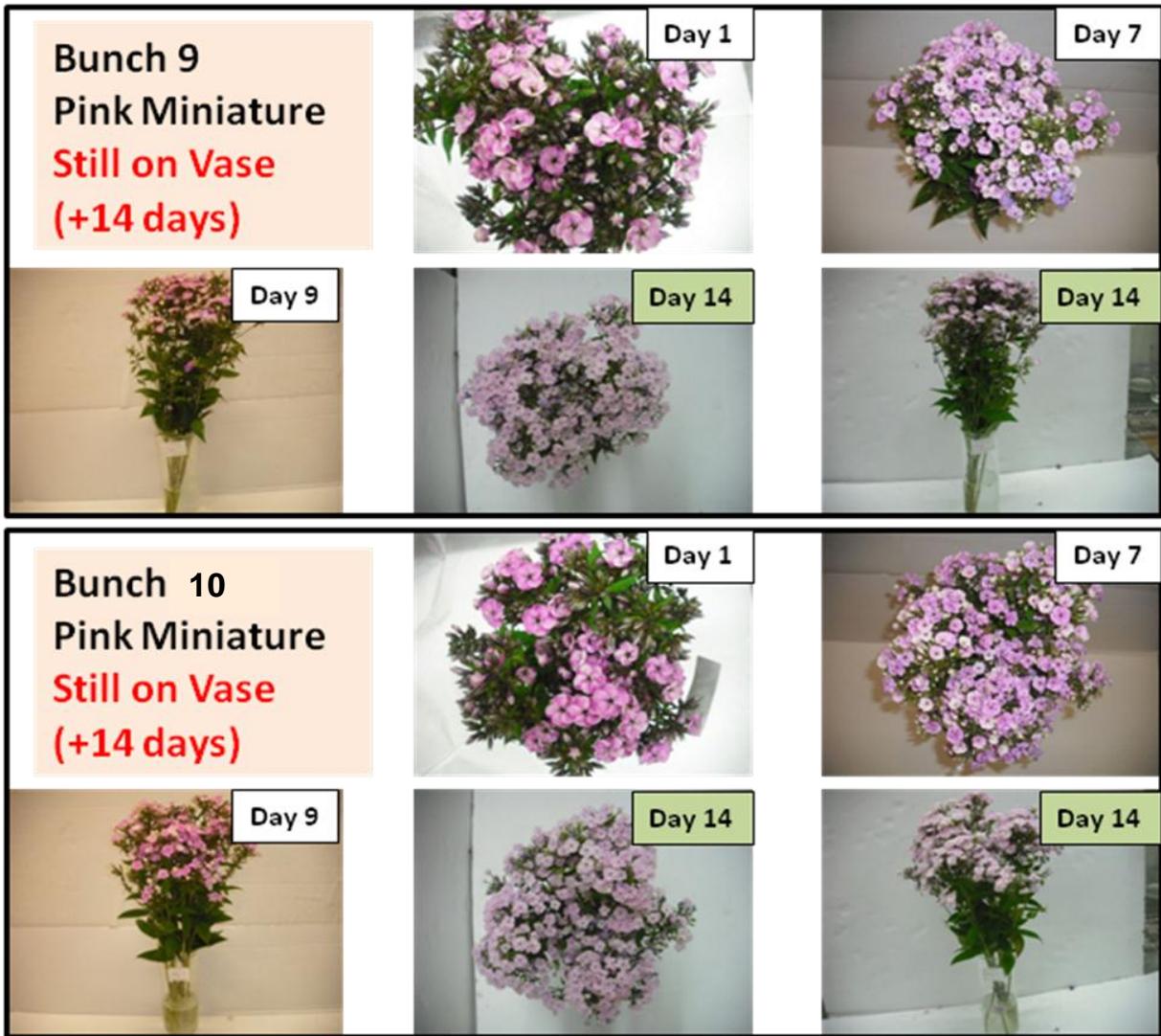


Figure 5. Vase-life (days, left-hand axis) and vase-day when flower drop started (figures on histograms – no flower drop on Pink Miniature) for phlox cultivars.







10. RUDBECKIA (*RUDBECKIA HIRTA*)

Rudbeckia is another potential cut-flower crop, and its inclusion in the programme of the Centre was suggested by a supermarket representative. As an initial demonstration, cultivars 'Hirta My Joy' and 'Hirta Green Eye' (Florensis Cut Flowers) were transplanted into two 4m-long plots in 'Pro-Tech' bay 1 in week 21. Although the flowers were attractive in themselves, the stems were too vigorous and unruly to be considered practical for commercial use.



The cultivars tested were seed-raised annuals, and more robust perennial varieties of rudbeckia are also available, and will be tested in 2012.

11. SEDUM (*SEDUM SPECTABILE*)

The 2010 plantings of three sedum cultivars grew poorly in their establishment year but much more vigorously in year 2.



Sedums, from left to right: *Sedum spectabile* 'Brilliant', *S. 'Matrona'* and *S. 'Herbstfreude'*

The high weight and quality of sedums as cut-flowers suggested that further trial plantings should be made in 2011, and plants of 'Mr Goodbud', 'Magical Bon Bon', 'Magical Lizzy' and 'Magical Twist' (Kolster BV, Boskoop, The Netherlands) were transplanted into outside beds in week 24 for further observations. The vase-life of sedums has not yet been tested but will be looked at in 2012.



Sedums, clockwise from top left: 'Magical Twist', 'Magical Lizzy', 'Magical Bon Bon', 'Mr Goodbud'

12. STOCKS (COLUMN) (*MATTHIOLA INCANA*)

Column stocks for autumn-flowering were last included in the Centre's programme in 2009, when the suggested advantage of using block-raised plants (i.e. a more robust plant, flowering earlier), rather than plugs, was tested, with transplanting in weeks 26, 28 and 33. This showed that there was no advantage from using blocks over plugs.

1. Effects of gapping-up

In producing selectable stocks, propagators may use automated gapping-up to replace single-flowered plants in the plug-tray by doubles, and this process has sometimes been seen to cause damage to the plants. To investigate, two plots were planted in week 27 in 'Pro-Tech' bay 2 with 'Centum Pink', one using selected plugs from a non-gapped up tray (hence less plants available to plant in the trial), the second from a tray previously gapped-up automatically. Flower quality was assessed and compared across the two plots, and showed minimal differences in stem length and weight and spike length (Table 13). Although this was only a small test, it may indicate there is no disadvantage in using automated gapping-up in this case.



Table 13. Flowering performance of gapped-up and non-gapped up column stock 'Centrum Pink' following transplanting at week 27 into 'Pro-Tech' bay 2. Cropped and recorded in week 35, the figures are the means of the indicated number of stems, with standard deviations (SD).

Treatment	No. of stems	Untrimmed stem length (cm)		Untrimmed stem weight (g)		Flower spike length (cm)	
		Mean	SD	Mean	SD	Mean	SD
Gapped-up	100	46.4	2.24	79.0	16.0	14.1	2.58
Not gapped-up	47	47.6	1.98	75.0	12.2	12.9	2.77

2. Variety demonstration

In 2011 samples of three column stocks cultivars (Florensis Cut Flowers) were transplanted to beds in 'Pro-Tech' tunnel bay 2 in week 27. The main aim was to assess a new line, 'Anytime Yellow'. Cut-stems were harvested in week 35 and the main features are summarised in Table 14. Overall stem and spike lengths were similar in the three cultivars, the main differences being in (untrimmed) stem weight which varied from just under 50g in 'Anytime Yellow' to over 75g in 'Centrum Pink'. On the basis of this small sample, 'Anytime Yellow' appeared to be of average stem length but with a long spike, and relatively light in weight but was the poorer of the three varieties.

Table 13. Flowering performance of column stock cultivars following transplanting at week 27 into 'Pro-Tech' bay 2. Cropped and recorded in week 35, the figures are means of 30 stems shown with standard deviations (SD).

Cultivar	Untrimmed stem length (cm)		Untrimmed stem weight (g)		Flower spike length (cm)	
	Mean	SD	Mean	SD	Mean	SD
'Figaro Lavender'	52.1	2.22	58.5	11.52	15.3	2.93
'Anytime Yellow'	47.8	2.98	47.5	8.19	18.5	3.13
'Centrum Pink'	46.4	2.14	76.3	16.4	13.6	3.01



Column stocks, from left to right: 'Figaro Lavender', 'Anytime Yellow' and 'Centrum Pink'

3. Summer flower failures in column stocks

Stocks are prone to failing or abnormal flower initiation when grown in summer temperatures. However, the 'Katz' series of column stocks was bred for resilience to higher temperatures, so work was planned to investigate summer cropping of 'Katz' varieties at the Centre in 2011.

The plugs (Florensis Cut Flowers) did not arrive at the Centre until late-August 2011, but nevertheless they were planted in the 'Pro-Tech' tunnel, which by then had had its cover removed. The plants were in full flower in early-December, and, although battered by the weather, were of basically good quality and appeared to last well in the vase. This raised the question of whether, irrespective of its advantages as a crop in a warm summer, this series might be suitable as a late tunnel crop. Unlike many stocks varieties, the 'Katz' series is selectable for double flowers "only with difficulty" and automated methods are not sufficiently sensitive, so it has been suggested that selection in this case is not economic.⁵ However, in the right circumstances a profitable crop might still be possible if a reasonable percentage of double flowers can be obtained growing in a Spanish tunnel or under minimally heated or unheated glass. For this reason records were kept of the numbers of double and single flowers obtained (Table 15). The overall percentage of plants producing double flowers varied from 32 to 57% in different lines, or from 40 to 62% if plants with non-opening flowers were excluded (in which case about half of the eight lines yielded around 60% of doubles). Further tests would be needed to determine if the performance of the different 'Katz' lines are consistent year-on-year, and this will be investigated further in 2012.

Table 15. The percentage of 'Katz' column stocks cultivars with double flowers assessed without selection in the 'Pro-Tech' tunnel in 2011, based on samples of about 100 plants each.

'Katz' cultivar	Number of sampled plants with different categories of flowers			Double plants as % of all plants	Double plants as % of all opening plants
	Double	Single	Non-opening		
001 Red	33	26	30	37.1	55.9
002 Pink	38	57	13	35.2	40.0
003 Soft Pink	60	41	9	54.5	59.4
006 Light Mauve	68	41	9	57.6	62.4
007 Light Pink	68	46	11	54.4	59.6
008 Dark Mauve	58	55	7	48.3	51.3
009 White	40	44	38	32.8	47.6
010 Cream	29	29	27	34.1	50.0

⁵ <http://www.panamseed.com/media/Culture/PAS/MatthiolaKatz.pdf>

13. SUNFLOWERS (*HELIANTHUS ANNUUS*)

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 this end it was planned in 2010 to investigate new dwarf cultivars and using a plant growth regulator on standard cultivars. However, adverse weather – dry weather limiting



germination and establishment, followed by wet, windy weather adversely affecting growth – prevented any meaningful results being obtained. The work was therefore repeated in 2011, and vase-life tests were also carried out.

1. Dwarf cultivars

Eight cultivars, some available only with code numbers (see Table 16), were sourced by Simon Crawford (Flowers by Design) from various seed-houses and were seeded by hand (ca. 36/m²) in outdoor beds in weeks 19 and 22. The percentage seed germination varied from 38 to 100, depending on the variety and sowing week (Table 16). While some were trial varieties, this showed that



further work is needed by the breeder to ensure germination rates are commercially viable. Stem lengths and weights and flower diameters were recorded at peak cropping.

Table 16. Seed germination and flowering performance of eight sunflower cultivars following sowing at the weeks shown into outdoor beds. The lengths and weights are means of 30 stems shown with standard deviations (SD).

Cultivar (and code number, if appropriate)	Sowing week	% germination	Date recorded	Total stem length (cm)		Total stem weight (g)		Flower diameter (cm)	
				Mean	SD	Mean	SD	Mean	SD
'Dafna'	19	100	01-Sep	112.9	6.70	366	91.5	16.5	1.01
'Early Sunrise' (KB 114)	19	67	10-Aug	127.3	10.09	398	89.9	14.9	1.17
'Galilee Orange'	19	81	17-Aug	149.5	8.36	574	121.5	17.9	1.50
'Happy Face' (KB 116)	19	38	17-Aug	87.2	5.62	688	177.9	19.0	1.77
'Jua Maya'	19	64	10-Aug	125.9	21.95	430	107.1	14.9	1.30
KB 105	19	69	18-Aug	118.4	7.95	347	123.1	14.3	1.29
KB 135	19	42	18-Aug	111.9	8.51	511	173.4	17.2	1.72
'Stellar Sun' (KB 105)	19	42	10-Aug	109.9	11.23	728	140.3	17.9	2.21
'Dafna'	22	86	01-Sep	112.4	6.04	367	90.9	16.4	1.00
'Early Sunrise' (KB 114)	22	72	02-Sep	152.8	13.64	482	208.6	19.2	1.66
'Galilee Orange'	22	100	02-Sep	164.8	7.82	526	109.0	19.3	1.37
'Happy Face' (KB 116)	22	88	30-Aug	91.8	5.80	392	72.6	16.2	1.77
'Jua Maya'	22	93	30-Aug	122.6	5.65	209	56.1	15.3	1.47
KB 105	22	81	02-Sep	152.6	8.49	653	150.7	19.2	1.42
KB 135	22	97	02-Sep	162.0	11.86	676	237.4	19.2	1.79
'Stellar Sun' (KB 105)	22	63	18-Aug	127.1	6.45	509	121.6	15.0	3.12

Cropping dates varied from 10 August to 1 September across the cultivars sown in week 19, and from 18 August to 2 September for the sowing in week 22 (Figure 6). In the earlier sowing 'Early Sunrise' (KB 114), 'Jua Maya' and 'Stellar Sun' (KB 105) were faster to crop than the other varieties, whereas cropping dates for the later sowing were more uniform – with the exception of 'Stellar Sun' (KB 105) which was again quick to crop. Flower diameters varied from 15 to 19cm for the various cultivars (Figure 6).

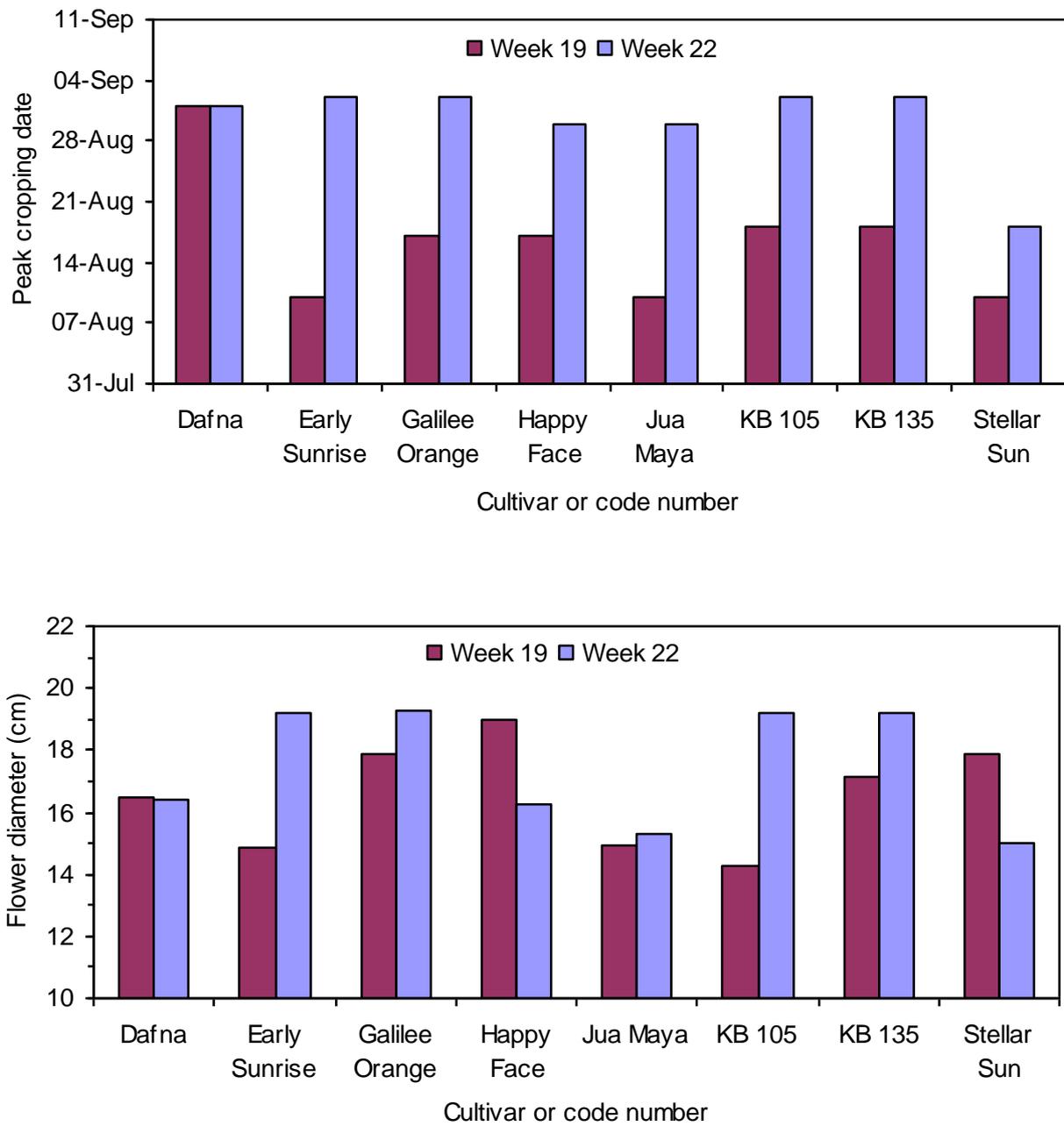


Figure 6. Main cropping periods (above) and flower diameter (below) for eight sunflower cultivars following sowing at week 19 or 22 in outdoor beds



Sunflowers, from left to right: ‘Stellar Sun’, ‘Early Sunrise’ and ‘Jua Maya’

Total stem lengths and weights are shown in Figure 7. For most, but not all, cultivars, stem lengths were greater from the later sowing, but this was not always accompanied by increased stem weight, there appearing to be no obvious relationship between the two. ‘Happy Face’ (KB 116) was the most dwarf cultivar trialled, from both sowings, and produced a high stem weight.

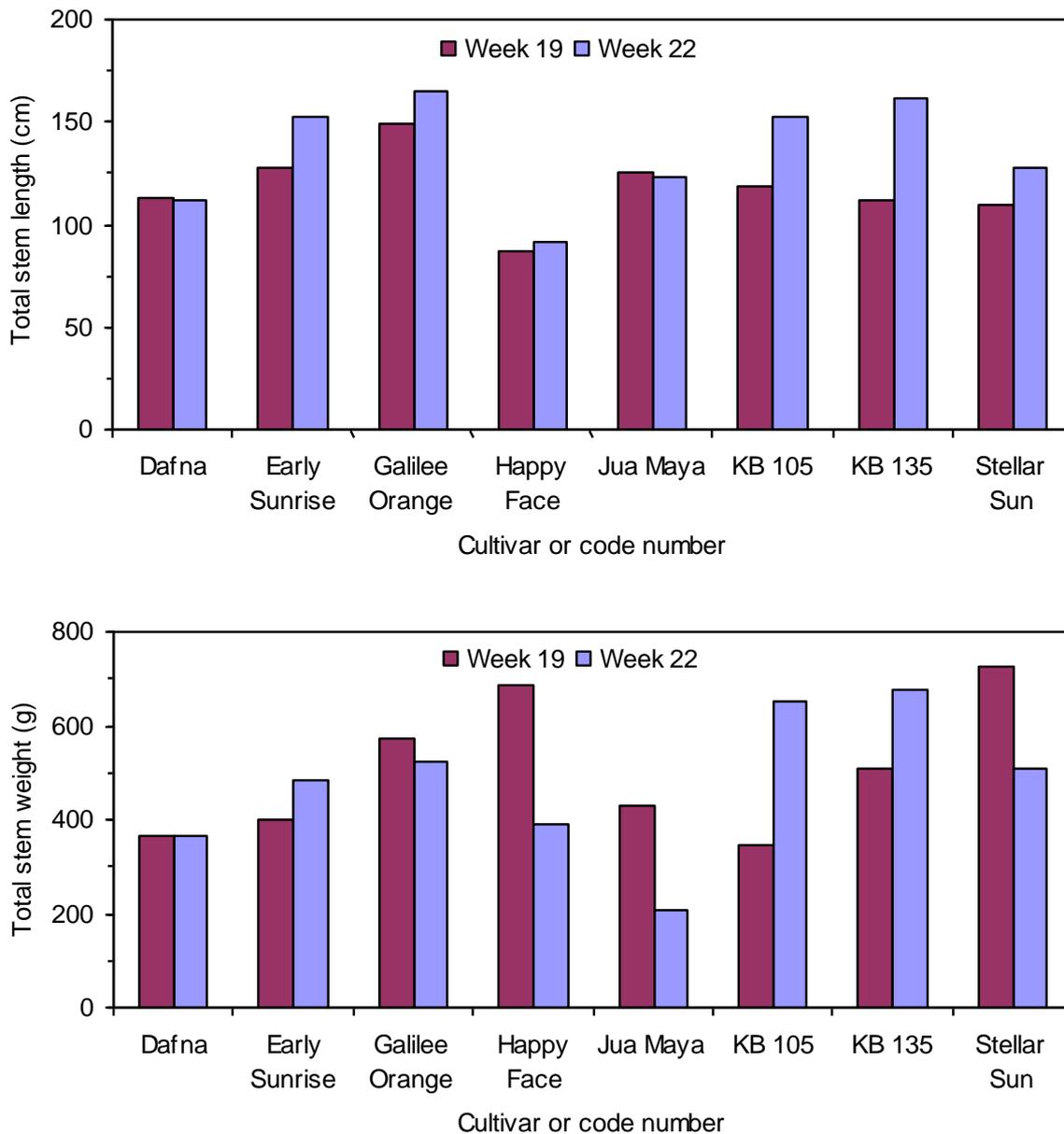


Figure 7. Total stem lengths (above) and weights (below) for eight sunflower cultivars following sowing at week 19 or 22 in outdoor beds.

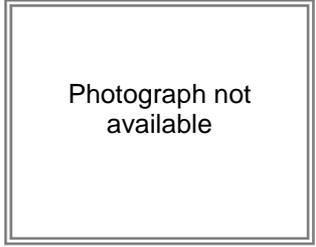
2. Growth regulator treatments

Seed of standard sunflower 'Sunrich Orange' were sown, using the same methods as above, in one outside bed in each of weeks 19, 22 and 26. The growth retardant 'B-Nine SG' was applied as a foliar spray to 'run-off' on part of each bed, using a rate of 6g product/L, in week 32 and again in week 33. This was applied when the plants were about half a metre tall. B9 was chosen because sunflower belong to the compositae family ie the same as chrysanthemums for which the use of B9 is the industry standard. As it was visually obvious that the retardant application had had no effect on plant height, no further observations were made.

3. Vase-life testing

Bunches of a selection of promising cultivars ie 'Galilee', 'Happy Face', 'KB105', 'Sunrich' and 'Dafna' were subjected to standard vase-life testing by JZ Flowers Ltd (Fast Track Flowers Ltd). Stems were harvested to buckets and placed in a cold store on 31 August 2011, moved to a vase-life test room the next day, and placed in vases after a further 4 days. The results are given in Table 17. The outstanding result was the quality and long vase-life of cultivar 'Dafna'.

Table 17. Vase-life performance sunflower cultivars. See text for further details.

Cultivar	Stem weight (g)	Stem length (cm)	Disc diameter (cm)	Vase-day when 20% over (with comments)	Vase-day when 50% over (with comments)
'Galilee'	480	65	4.5-5.5	Day 8 Stems becoming weak	Day 11 Petals starting to drop or turn back on themselves
					
'Happy Face'	1189	70	4.5-7.0	Day 8 All fully open, a few petals dropping	Day 11 Dropping a lot of petals
					
'KB105'	618	65	5.0-6.0	Day 8	Day 11 Flowers shattered
					

Cultivar	Stem weight (g)	Stem length (cm)	Disc diameter (cm)	Vase-day when 20% over (with comments)	Vase-day when 50% over (with comments)
'Sunrich'	1686	65	7.0-8.5	Day 8 Small amount of shattering started	Day 11 Flowers shattered
					
'Dafna'	1233	70	5.0-7.0	Day 11	Day 15 Very long-lasting and held its colour to the end of the trial
					

14. SWEET PEAS (*LATHRYUS ODORATUS*)

Recurrent expressions of interest in developing a low-input system of sweet pea production led to trials at the Centre in 2011.

1. Testing a low-input system

A metal 'A' frame with netting was erected along the length of 'Pro-Tech' bay 1. Seed was sourced by Simon Crawford (Flowers By Design) from various seed-houses. Seeds were germinated in small, individual pots that were transplanted as required. Five varieties were planted in rows along either side of the framework in week 22 at each of 30 or 50cm-spacings, each plot ca 5m-long. The 50cm-plants were pinched once, while the 30cm-plants were not pinched.

The first stems were picked in mid-July, cropping continuing for an extended period. The initial results were very encouraging, with a large number of long, high-quality stems being produced from both growing formats. Data are summarised in Table 18. The average length of stems approached 30cm, with slightly longer stems from the 50cm, pinched plots. However, floret numbers were consistently low, with 3.3 to 3.8 florets per stem. Table 18 also shows the very high yields obtained with sweet peas – usually between 1,000 and 2,000 per 5m-long plot. Vase-life testing was carried out on sample bunches.



Table 18. Flowering performance in 2011 of sweet pea cultivars sown in 'Pro-Tech' bay 1, either as a non-pinched crop spaced 30cm apart, or a pinched crop spaced 50cm apart. Stem lengths and floret counts recorded as the trial progressed; the figures are means of 50 stems shown with standard deviations (SD).

Cultivar	Growing system	Total number of stems cropped*	Stem length (mm)		Floret count (no./stem)	
			Mean	SD	Mean	SD
'Bristol'	30cm, non-pinched	1610	24.0	3.68	3.6	0.53
'Gwendoline'		1939	26.4	3.02	3.8	0.43
'Our Harry'		661	28.6	3.73	3.6	0.57
'Valerie Harrod'		1751	27.0	3.71	3.6	0.49
'White Supreme'		2279	25.7	3.00	3.7	0.44
'Bristol'	50cm, pinched	1208	27.7	4.73	3.4	0.61
'Gwendoline'		808	31.3	3.79	3.6	0.50
'Our Harry'		1126	27.9	4.21	3.4	0.53
'Valerie Harrod'		1798	29.4	4.12	3.7	0.46
'White Supreme'		1775	26.1	3.95	3.3	0.63

* until 30 September 2011



2. Vase-life testing

Samples of 'Valerie Harrod' and 'Gwendoline' (chosen to be representative of the range of varieties) were picked in week 34 and supplied to Intergreen (UK) Ltd for vase-life testing. There were two bunches for each cultivar. The stems were harvested into buckets of water containing CVBN, transported to the test site, and, still in their buckets with CVBN, moved to a cold-store (5°C) for 2 days and then to a vase-life test room (20±1°C, 60±5% relative humidity) for 3 days. Finally, the stems were re-cut and placed in vases with fresh water containing a sachet of Chrysal Universal flower food (powder or liquid formulation). Stems were monitored daily and records taken, including date of first stem failure, foliage condition, opening stages, water clarity and date of bouquet failure (when 50% of the stems had failed).

All bunches had a similar performance irrespective of cultivar or whether a powder or liquid flower food formulation was used. Stems started to fail from vase-day 2 onwards, and all bunches showed 50% stem failure on vase-day 5 due to bud drop. Photographs of the stems of 'Valerie Harrod' (pink) and 'Gwendoline' (purple) at the start and end of vase-life appear on the next page.



Discussion and conclusions.

Findings in 2011 and plans for 2012

The following notes summarise recent findings, views of the Centre MG, and feedback from growers, packers and retailers given at individual visits and at the Open Day.

Amaranthus

At the suggestion of a grower, cultivars of amaranthus were included for the first time in the centre's programme. The quality of the inflorescences grown in tunnels was impressive and the unusual form of the inflorescence has appeal as a novelty. The overall view was that some cultivars such as green thumb and Caudatus red would have potential as novel additions to bouquets, hence the cultivar demonstration will be continued in 2012. However, the sheer bulk of the inflorescence in some cultivars suggests that cropping at an earlier stage than in 2011 (which was very mature in order to see the full potential of each variety) should be investigated.

***Antirrhinum* ('trumpet' varieties).**

These peloric cultivars of antirrhinum continued to be well received by the industry, though the colour range is relatively restricted and needs to be expanded with at least the addition of a red. Little was previously known about their vase-life, but standard tests carried out this year showed a satisfactory vase-life of 10 days. In order to display the unusual form of the flowers it would be necessary to pick and retail them at a more advanced stage of development than is normal for antirrhinums when usually only the bottom few flowers are open.. Substantial differences between varieties were found in 2011, in stem length and weight and the number of flowers cropped. Good quality flowers were produced from a late-planted (week 27) crop as well as the crop transplanted in week 21. To realise the commercial potential of the cultivars, the following aspects of their cultivation will be studied in 2012:

- The effect of planting dates and season extension
- . All three of the colour in the Peloric range produced a very good quality product but further testing is required on varieties that will extend the colour range beyond the white, yellow and pick currently available in Peloric.

Aster ericoides

The industry again recognised the potential of *A. ericoides* cultivars, or at least of the double varieties, for September-flowering. In 2011 a late-planted crop (week 28, compared with week 19) was grown, three of the varieties producing stems of only half the weight and

length of the earlier crop, and the other three failing to produce marketable stems. In vase-life testing most material tested had a vase-life in excess of the likely guaranteed 5 or 7 days. Further studies should address a number of issues.

- Season extension needs to be further investigated in 2012, involving tunnel and outside, and pinched and non-pinched crops
- Vase-life assessment and improvement
- Further varietal assessment generally
- Improving husbandry to keep growth better under control (considerable labour was required in trimming stems to a suitable size and shape)
- Cost-reduction (to counter the relatively high cost of planting material)
- The potential for a single-stem crop using black-out curtains to manipulate flowering time.

China asters ('German asters')

In 2011 these attractive new German 'Gremlin' and 'Krallen' cultivars of China aster again attracted much attention at the trials. However, a further attempt to restrict stem growth by applying the growth regulator (growth retardant) daminozide again failed to achieve a useful effect. None of the varieties trialled showed any promise of being able to match Krallen for colour, bloom size and overall visual impact. Vase-life testing suggested that further selection for post-harvest quality is desirable; in addition, three areas of interest will be considered in 2012:

- Developing and improving the effect of growth retardants
- Studying the cause and remedy for 'petal tipping', a disorder that becomes evident only at the retailer stage and only in some cultivars
- Testing alternatives to the 'Krallen' series, which has dominated the Centre's trials so far.

Eryngium

A variety demonstration was planted in 2011 and will be assessed at flowering in 2012.

Hardy foliage

Observations on a wide range of hardy foliage plants will begin once the 2010 and 2011 plantings have become established.

Lisianthus (Eustoma)

The high quality of tunnel-grown lisianthus over 2010 and 2011 – weather-wise 'good' and 'bad' years, respectively, for growing this crop – strengthened the interest in lisianthus as a UK tunnel crop. In the 'Haygrove' tunnel, with closed ends, high-quality, unusually strong

stems were produced, with negligible amounts of disease, whereas in the 'Pro-Tech' tunnel, with open ends, growth was weaker and significant amounts of *Fusarium* and *Pythium* damage were seen. This may have been due to the different microclimates in the two structures, and/or to the different modes of soil sterilisation used in each tunnel – in the closed, 'Haygrove' tunnel dazomet had been applied in the autumn and the soil was left sheeted over winter. The effects of tunnel environment and soil sterilisation need to be investigated in 2012. Despite these promising results, eight out of the 28 cultivar x planting date plantings in the 'Haygrove' tunnel failed to reach the required specification for stem length, so there is a need to investigate further cultivars at a range of planting dates. The best performing varieties in terms of weight were Arene Rose, Papillion Flash Pink, Excalibur Pure White, and Papillion Rose Pink. The varieties that produced the longest stems were Excalibur green, Minuet Dark Purple, Papillion Flash Pink, Excalibur Pure White, ABC 2-3 Blue Rim, Papillion Rose Pink, Piccolo 2 Deep Blue and Rosita 3 Yellow. While all the cultivars subjected to vase-life testing achieved the 7-day vase-life required for use in bouquets, only half of the cultivars attained the 9-day vase-life needed for use in straight bunches, so there is a need to improve post-harvest quality, or at least varietal selection. The need for three further studies was also perceived:

- Planting density
- Growing through black polythene versus on bare soil.
- Comparison of sterilisation techniques.

Ornamental brassicas

In 2011 an excellent range of new cultivars was demonstrated, with a good range of head colour (from white to purple/pink) and many attractive heads, including ones with white-veining. Nevertheless, some cultivars gave an unacceptably low yield of stems, while other resulted in picking rates of over 90%. Vase-life varied from 12 to 23 days. Together with the demonstrated success of direct-drilling in 2010, there should be a good future for several of these cultivars. Direct drilling selected cultivars should be investigated in 2012. In a trial in 2010 it was observed that the 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. As this could represent a significant loss to the grower, the 'edge-effect' should be investigated as part of the 2012 programme.

Phlox

Trials at the Centre have clearly demonstrated the superior quality of phlox grown in tunnels rather than outside. There was, however, a considerable range of productivity between the cultivars tested, and variety trialling should continue in 2012. The results of vase-life testing

were encouraging: despite some early flower drop, other flowers were still opening and sustaining the appearance of the stems, resulting in a 9- to 11-day vase-life, and in one cultivar – ‘Miniature Pink’ – there was no flower drop and a vase-life of 14 days. This suggests there is scope for vase-life testing and selection as part of future variety trials. By far the strongest and best yielding variety is Icecap.

Rudbeckia

A varietal assessment was carried out in 2011, using seed-raised annual varieties. While these produced attractive flowers, the plants were unduly vigorous and unruly for a cut-flower crop. In 2012 a variety demonstration of perennial cultivars, expected to be more robust under flower cropping conditions, will be included in the Centre’s programme.

Sedum

Further cultivars of sedum were planted in outside beds in 2011 for variety assessment and vase-life testing in 2012.

Stocks (column)

Column stocks had been included in the Centre’s trials up to 2009. The crop is susceptible to high temperatures in summer, and the ‘Katz’ series had been bred for heat-tolerance. Summer-growing trials of ‘Katz’ were planned for 2011, but late delivery of the plugs resulted in a very late crop growing in a tunnel from which the polythene cover had already been removed. Despite this, surprisingly good quality stems were obtained in December 2011, raising the possibility of a productive late-season tunnel crop in some years. As ‘Katz’ is not easily selectable for doubles, wastage would mean they would only be practical where the stocks could be grown at minimal costs (in tunnels or cold glass). Half of the lines tested in 2011 produced 40 to 60% of doubles, the others less than this. In 2012 the following should be included:

- Investigating ‘Katz’ as a summer crop
- Column stocks as a very late crop
- New variety testing and selection
- Health assessment of column stocks from HDC project PO 005.

Sunflowers

In 2011, as strategies to reduce the handling costs of growing standard cultivars, a range of dwarf cultivars was grown, with good results, and the application of daminozide growth retardant to the standard variety ‘Sunrich Orange’ was tested, though without any clear restriction of stem growth. Vase-life tests showed cultivar ‘Dafna’ had an exceptional vase-

life (15 days). Hence, despite the established popularity of sunflowers, there is still scope for further trialling in 2012:

- Further variety trialling, including naturally dwarf and novelty cultivars
- Improving the handling of standard cultivars, including maximising the effects of growth retardants.

In the Centre's trials with daminozide, on China asters as well as sunflowers, at best only weak retardant effects have been obtained. This should be addressed in 2012 through varying the precise method of application and testing other growth regulators (such as 'Regalis', 'Cerone', 'Modulus' and 'paclobutrazol' and triazole fungicides⁶).

Sweet peas

Sporadic interest has been shown by retailers in these very popular flowers, though the climbing mode of growth makes it a testing and labour-intensive operation. In 2011 trials stems considered of good quality were obtained: the average length was nearly 30cm, floret numbers were highly consistent throughout, and usually between 1000 and 2000 stems were cropped from each 5m-long plot. As would be expected, the closer planted crop produced slightly more stems but on average they were slightly lighter than the wider spaced, pinched crop. Despite producing a different product on this low-cost system, there is no retailer support for the crop specification that was produced in this trial. While a possibility for a specialised grower, it was decided not to take the crop forward at the Centre at this time. Vase-life was 5 days in the samples tested.

Other trials and demonstrations planned for 2012

Largely as a result of consulting with cut-flower growers, the following work is also planned for the Centre's programme in 2012:

- Lilies and gladiolus - although not included so far, there is no reason to exclude bulbous types from the Centre's trials, and there has been support for carrying out demonstrations of new cultivars
- Calla lilies - an exploratory trial outdoors and in tunnels has been supported
- Herbaceous perennials – demonstration plots of alchemilla, solidago and molucella
- Natural-season chrysanthemums – to be investigated as a late crop for Spanish tunnels
- 'American' asters – which have been investigated at Greenmount College, Northern Ireland, with encouraging results.
- Carnations (small-flowered) – an investigation of small or single-flowered cultivars including 'Raffine' and 'Solemio' (HilverdaKooij BV, Aalsmeer, the Netherlands)
- Sweet William - investigate 'Breanthus' (HilverdaKooij).

⁶ e.g. see report on HDC projects PO 004 and HNS 103b, *HDC News* 170 (February 2011), p. 26-27

Technology transfer and other outputs in 2011

- The MG met formally on three occasions (7 April, 13 September and 14 December)
- The HDC conducted a project review on 13 September
- A successful Open Day with hog-roast was held on 25 August 2011, with over 70 attendees
- Many visitors were shown round the trials on an informal basis
- Reports on the work of the Centre appeared in *HDC News* issues for June (no. 174, p. 29) and October (no. 177, p. 24-25)
- A Centre web-site was set at <http://www.thecutflowercentre.co.uk/about-us/>
- Connections made through the Centre resulted in the setting up of a new HDC project, PO 005, to define the factors responsible for the unreliability in the current production of column stock
- Discussion were held on setting up a PhD project to address the improvement of dahlia vase-life
- A project to test cut-flower production in hydroponics systems was discussed and continues to be developed.
- A major part of the Centre's extension work was once again providing large numbers of samples – mainly of 'trumpet' antirrhinums, lisianthus, *Aster ericoides* and 'German' asters, and more limited numbers of other species, to staff from major supermarkets and packers, and, in some cases, to local florists. The lisianthus were especially well received, and the MG considered that some supermarkets would pay a premium for it as a UK crop, though this would have to be balanced by the long time the crop is in the ground. The 'trumpet' antirrhinums also impressed, though with a concern that they might be more cheaply sources from abroad. 'German' asters, *A. ericoides* and phlox were also promising, though more attention must to be paid to the marketing stage of *A. ericoides* and phlox. While the sweet peas were considered a good quality product for a relatively low-cost production system, it was felt they would not compete with a more specialist F1 product raised under glass and giving a more florets and a much longer stem.

Acknowledgments

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Particular thanks are due to Sue Lamb for her vigorous promotion of the Centre and especially her work in ensuring a large number of cut-flower samples have been made available to supermarkets, packers and others.

APPENDIX

Index to crops included in each year's trials					
Ageratum (<i>Ageratum houstonianum</i>)	2007				
Amaranthus (<i>Amaranthus caudatus</i>)		2008			2011
Antirrhinum (<i>Antirrhinum majus</i>), inc. 'Trumpet' cultivars		2008	2009	2010	2011
Aster (<i>Aster pringlei</i>), 'Monte Cassino' type		2008			
Aster, heath (<i>Aster ericoides</i>)	2007			2010	2011
Brassica, ornamental (<i>Brassica oleracea</i>)		2008	2009	2010	2011
<i>Callistephus chinensis</i>	See china aster				
Carnation, spray (<i>Dianthus caryophyllus</i>)		2008			
Caryopteris (<i>Caryopteris x clandonensis</i>)		2008			
<i>Chasmanthium</i> spp.	See grasses, ornamental				
China aster (<i>Callistephus chinensis</i>), 'German' varieties	2008	2008	2009	2010	2011
<i>Clarkia grandiflora</i>	See godetia				
Column stocks	See stocks, column				
<i>Consolida ajacis</i>	See larkspur				
Cynara (<i>Cynara cardunculus</i>)	2007	2008			
Dahlia (<i>Dahlia hortensis</i>), inc. 'Karma' cultivars			2009	2010	
Delphinium (<i>Delphinium elatum</i>)	2007	2008			
<i>Delphinium consolida</i>	See larkspur				
<i>Dianthus caryophyllus</i>	See dianthus, annual				
Dianthus, annual (<i>Dianthus barbatus</i>)	2007	2008	2009		
Dianthus, annual (<i>Dianthus</i> spp.)	2007	2008			
Echinops (<i>Echinops</i> spp.)	2007	2008			
Eryngium (<i>Eryngium</i> spp.)	2007	2008			2011
<i>Eustoma</i>	See lisianthus				
Foliage, foliage plants	See foliage, hardy				
'German' asters	See china aster				
Godetia (<i>Godetia grandiflora</i>)	2007	2008			
Grasses	See grasses, ornamental				
Grasses, ornamental (various species)	2007	2008			

Hardy foliage (various species)				2010	2011
Heath aster	See aster, heath				
<i>Helianthus annuus</i>	See sunflower				
'Karma' dahlia	See dahlia				
Larkspur (<i>Delphinium consolida</i>)	2007	2008			
<i>Lathyrus odoratus</i>	See sweet pea				
Lisianthus (<i>Eustoma grandiflorum</i>)				2010	2011
Love-lies-bleeding	See amaranthus				
Lychnis (<i>Lychnis chalcedonica</i>)		2008			
<i>Matthiola incana</i>	See stock, column				
<i>Miscanthus</i> spp.	See grasses, ornamental				
'Monte Cassino' aster	See aster (<i>Aster pringlei</i>)				
Ornamental brassica, ornamental cabbage	See brassicas, ornamental				
Ornamental grasses	See grasses, ornamental				
<i>Panicum</i> spp.	See grasses, ornamental				
Phlox (<i>Phlox paniculata</i>)	2007	2008	2009	2010	2011
Pinks	See dianthus, annual				
Rudbeckia (<i>Rudbeckia hirta</i>)					2011
Sedum (<i>Sedum</i> spp.)		2008	2009	2010	2011
<i>Setaria italica</i>	See grasses, ornamental				
Snapdragons ('Trumpet' cultivars)	See antirrhinum				
Solidago (<i>Solidago media</i>)		2008			
Spray carnation	See carnation, spray				
Stock, column (<i>Matthiola incana</i>)			2009		2011
Sunflower (<i>Helianthus annuus</i>)				2010	2011
Sweet pea (<i>Lathyrus odoratus</i>)					2011
'Trumpet' antirrhinums	See antirrhinum				
Veronica (<i>Veronica</i> spp.)	2007				
Zinnia (<i>Zinnia elegans</i>)	2007	2008			