



Horticultural
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Grower summary

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Establishing a Trials Centre for
the Cut-Flower Sector

Final Report 2009

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Horticultural Development Company
Tithe Barn
Bradbourne House
East Malling
Kent
ME19 6DZ

Tel: 01732 848 383
Fax: 01732 848 498

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Headline

Seven crops have been identified as having definite potential for further exploitation and commercialisation in the UK: ornamental brassica, 'German asters' (new German varieties of China aster), delphinium, annual dianthus, larkspur, phlox and sedum.

Background and expected deliverables

The past 10 to 20 years saw a marked increase in *per capita* purchases of cut-flowers in the UK, with consumption moving up from what was a very low level by European standards. There has been a spectacular and continuing increase in the imports of cut-flowers to the UK. Despite this, the UK's own production of cut-flowers is still very limited. The production of more cut-flowers in the UK would have the advantage of closeness to markets, delivering freshness without air-miles, a lack of know-how may be critical in holding back expansion and enterprise. In 2007 the Cut Flower Centre was established at Kirton to supply this practical knowledge.

The expected deliverables were:

- Demonstrations, trials and problem-solving experiments in cut-flower production;
- Evaluation of selected crops on a commercial scale;
- 'Best Practice' for the most promising varieties;
- Promotion of UK cut-flower production;
- Stimulation of further R&D and promotional projects.

Summary of the project and main conclusions

1. Seven crops were identified as having definite potential for further exploitation and commercialisation in the UK: ornamental brassica, 'German aster' (new German varieties of China aster), delphinium, annual dianthus, larkspur, phlox and sedum.
2. Three crops were thought to have some potential for further exploitation if better varieties become available: ageratum, amaranthus and aster (*Aster pringlei* Monte Casino type).
3. Thirteen crops were eliminated from trials as having little or no potential for exploitation under present conditions, either because:
 - o the economics of the crop were negative (antirrhinum, spray carnation, godetia, ornamental grasses and pinks),
 - o there were specific negative points (caryopteris and zinnia) or
 - o there was no clear indication of commercial appeal and uptake (cynara, echinops, eryngium, lychnis, solidago and veronica).

1. Crops recommended for further development in the UK

1.1. Brassica (ornamental)

The popularity of ornamental brassica is a recent phenomenon that is currently met almost entirely by imports. Trials were set up to investigate a range of varieties and planting dates, to see the potential for production in the UK and highlight any likely problems. In 2008 twelve varieties were transplanted into tunnel or outside plots (week 26). In tunnels the plants became etiolated and the stems were unmarketable. Grown outside, the different varieties started to show the required colour change between weeks 34 and 40, producing yields between 31 and 45 stems/m². However, stem lengths failed to reach specification.

Five 'Crane' varieties were drilled into outside plots (weeks 21, 26 and 30) and cropping started in week 29 for the first drilling and week 35 for the second. The third drilling was too late, the plants remained small and the leaves did not colour. Yields fell off in some varieties with the third planting. None of these produced sufficiently long stems.

The post-harvest quality of stems was assessed in vases following conditioning in CVBN. Their vase-life ranged from 7 to 17 days, with high leaf quality scores, though in many cases the vase-water became unpleasant.

Ornamental brassica are likely to remain in demand for some time, but to maintain economic production with the current price, and considering the requirement for providing herbicides and support netting, the crop needs to be direct-drilled and grown cheaply in the open. Despite the problems referred to, the trials also demonstrated the potential for the crop in the UK. Early planting (weeks 16 to 18) is important if short stems are to be avoided. There is a need to examine newer varieties with foliage that changes colour better and earlier, and to see if high-density drilling can avoid the need for support netting and the labour involved in moving netting up with the crop. For these reasons a larger trial is planned for 2009.

1.2. China aster ('German asters')

China asters are annuals with generally low yields, but some recent selections in Germany have robust and highly attractive blooms and seem to have potential for growing under protection in the UK. For convenience these are referred to here as 'German asters'. In 2007 commercial evaluations were planted at two nurseries. Although one trial was destroyed by the severe wet weather, the other generated significant interest amongst supermarkets to justify further work. In 2008 a further commercial evaluation was conducted under glass, and raised several further issues: there is a lot that we do not know about these plants!

The issues to be resolved include planting dates, planting density, height restriction (probably using Alar), achieving earlier and later cropping, seed provenance (varieties are not uniform, and appear to be coming from more than one source), control of (possibly seed-borne) mould, and quality in the vase. It is proposed that in 2009 a further evaluation should take place on a commercial nursery, and that specific issues should be addressed in trials at Kirton, including demonstrations that include a range of varieties from all suppliers, and post-harvest work to reduce the rapid leaf yellowing or blackening that occurs in the vase.

1.3. Delphinium

Although delphiniums are a widely grown outdoor crop, there are problems in achieving continuity and the high quality demanded by supermarkets, and trials were set up to explore these issues. In 2007 the effects of planting date on continuity were investigated in thirteen varieties, including representatives from three important series ('Scent', 'Takii Aurora' and 'Pan American Guardian'). They were transplanted to outside plots and tunnels in weeks 21, 23 and 27. Stem lengths and weights were longer and heavier in tunnel-raised plants. Flowers were produced over the period week 27 to week 36, and, despite using three planting dates and up to 15 varieties, there were breaks in continuity, particularly in weeks 29 and 33-34. For the delphinium crop to be economically viable, this lack of continuity needs to be rectified. Further issues were that several varieties from the first tunnel planting developed mildew, while in the third planting some varieties produced poor, short stems.

In the crop's second year, for any given planting date or flowering flush, cropping dates were similar whether the plants had been grown in tunnels or outside. The plots started cropping between week 19 and 40, but even then cropping was not continuous, with gaps in weeks 25-29 and 35-38, so more work is needed. Stem lengths and weights were always greater in tunnel-grown plants, with the stems exceeding the 75cm-length for a premium product for all three planting dates and all three flushes. Many, but not all, of the batches of stems from outside plots also exceeded 75cm in length. Varieties of the 'Scent' series consistently produced stems of good length and weight, while some 'Takii Aurora' varieties were short, especially from the second and third plantings. Stem weights generally fell from later plantings and in later flushes. Mildew remained a problem, despite the fungicides applied.

In 2008 a second trial was planted, with varieties 'Aurora', 'Aurora Blue', 'Aurora Light Blue', 'Centurion Gentian', 'Guardian Blue' and 'Guardian Early Blue' planted in tunnels in weeks 15, 17, 19 and 21. The crop produced two flushes and an overall cropping period from week 26 to week 43, but despite using six varieties and four planting dates there were still distinct peaks and troughs in production, with gaps in weeks 32 to 33 and 38 and 42. 'Guardian Blue' and 'Guardian Early Blue' were particularly productive at the beginning of each flush. Spike length ranged from 46 to 75cm. Most stems from the first flush reached 75cm in length, while in the second flush this proportion fell to around 50%. 'Guardian Blue', 'Guardian Early Blue' and 'Aurora' all produced high total yields of stems in the 75+cm grade from the two earlier plantings (at least 45 stems/m²) and this productivity fell off in later plantings. However, some varieties had low yields, particularly from the later plantings.

A selection of varieties from the 2008 trial was subjected to vase-life testing. Stems were conditioned in AVB or plain water, moved to water with a T-bag conditioner for a transport/retail period, and placed in vases with flower food. There was a marked effect of using conditioner, with treated stems showing a doubling of vase-life. Varietal differences in vase-life and flower quality were small, and poor leaf quality and poor water quality were the exception.

Besides the evaluation of a range of varieties, the main concern with delphinium cut-flowers is the need for a continuity programme. Although some gaps in production were still evident, the trials advanced the quest for continuity of supply stretching over a 16-week period. Continuity would be improved if it were practical to start planting earlier, but growing in Spanish tunnels means that planting cannot begin before week 15. A less vulnerable, low tunnel might be more suited for starting an

earlier round, but would be uneconomic with delphiniums as they could be planted only in the middle of the tunnel. But since delphiniums are suitable for growing in cold glass, continuity could almost certainly have been extended by planting the first rounds under glass.

A review of the literature suggested several ways in which the flowering season might be extended. The simplest, and possibly the most effective, way to extend the season would be through combining first-year and over-wintered plantings with additional variety selection and pinching part of the crop (pinching delays flowering but increases quality). Since delphinium have a quantitative response to vernalisation in advancing flowering and improving spike length, cold treatments could be applied to seedlings, or possibly even to seed.

1.4. Dianthus (annual)

The main aim of the trials on annual dianthus was to provide sufficient data on yields and continuity to decide whether the crop is worth considering for UK production. In 2007 the effects of planting date and variety on continuity and vase-life were investigated in eleven varieties, including several from the 'Amazon' and 'Sweet' series. They were transplanted to tunnels and outside plots in weeks 22 and 26. Tunnel-raised stems were consistently heavier and longer than those raised outside. The results demonstrated a clear potential for this crop in the UK, with flowers picked from week 27 to week 36 (though with some gaps in weeks 28, 34 and 35).

In 2008, seven varieties from the 'Amazon' and 'Scent' series were transplanted to tunnels in weeks 17, 19 and 28, with a further planting outside in week 18. The effect of pinching or not pinching was also investigated. In the main varieties cropping started in weeks 26 to 30 for tunnel plantings in weeks 17 and 19, in weeks 35 to 41 for tunnel planting from week 28, and in week 29 to 32 for the outdoor planting in week 18. Thus, some small gaps in continuity remained. There was a marked effect of planting date on the proportion of stems above or below 60cm in length. For tunnel-grown plants planted week 17, about two-thirds were in the longer grade, while tunnel plants planted in week 19 had many more short stems. For the outside plants planted in week 18, three varieties produced predominantly long stems ('Amazon Neon Cherry', 'Duo' and 'Purple') and the others predominantly short ones. There were large differences between the varieties in productivity and stem length: grown in tunnels, 'Amazon Neon Duo' and 'Purple' and 'Amazon Rose Magic' produced good yields of long stems, and 'Amazon Neon Cherry' produced poorer yields of long stems, while 'Sweet Coral', 'Purple' and 'Scarlet' produced still good but smaller yields of long stems.

In this trial, pinching or not pinching did not affect the start of cropping and had little effect on the total yield of stems (150 to 200 stems/m²). Non-pinched plants produced longer and heavier stems than pinched plants.

In 2007, selected varieties were subjected to vase-life testing. In vases with flower food vase-life varied from 7 to 14 days. Leaf quality was good throughout, but flower quality was poorer in two varieties. In 2008, a selection of varieties from early and late planting was taken through vase-life testing on plain water, following conditioning in plain water or RVB. Vase-life varied from 10 to 25 days, but this spread was due to one poorly performing variety and one long-lived one, and without them vase-life

varied between 11 and 18 days only. Using RVB increased vase-life by about a day. Early plantings had a vase-life about 1 day longer than late plantings. Flower and leaf quality scores and water clarity scores were high, with a few exceptions. The varieties tested had long vase-lives and, usually, high quality scores. There clearly were varietal differences that need to be taken into account, for example the differences between the responses of 'Amazon' and 'Sweet' varieties. The data also suggested a strong effect related to planting date. The vase-life in this trial of 'Green Trick' appeared to be exceptional and should be checked.

The trials indicated that reasonable continuity could be obtained, that outdoor growing was not worthwhile, and that pinching had a detrimental effect on stem length and weight. To achieve likely specifications, stems needed to be over 60cm in length, and this might be difficult in some situations. Head size and bunch weight are important and varieties of the naturally smaller 'Sweet' series needed three times as many stems to achieve the bunch weight as the 'Amazon' varieties. There was potential for further development of the crop, provided it did not appear on the market at the same season as sweet William. The crop was probably economic if 60 stems/m² could be cropped and realised 20p per stem.

1.5. Larkspur

The main aim of the trials on larkspur was to establish whether it could be improved sufficiently to make a worthwhile crop, through scheduling, variety selection, manipulating planting density, disease control or other means. At present larkspurs are perceived as having inconsistent quality and poor post-harvest quality, though it might be possible to produce a high-quality, graded stem under tunnels. In 2007, eight varieties were transplanted to outdoor plots (week 21) as a variety demonstration, but the very wet weather resulted in no meaningful results being obtained, except that 'Single Red', 'Single White' and 'Sydney Pink' stood out as being the more vigorous. In 2008, a factorial trial was set up with two varieties ('Sydney Blue' and 'Sydney Pink') planted under tunnels on three planting dates (weeks 17, 21 and 23) and three planting densities (64, 80 and 100 plants/m²). Continuity of cropping was obtained from week 27 to beyond week 31, and over this period stem lengths and weights were acceptable. There were no consistent effects on stem length or weight of planting date or planting density. The start of cropping was unaffected by variety and planting density and was simply delayed by later planting. Stem length was shorter in 'Sydney Pink' than in 'Sydney Blue', as planting was later, and was reduced at planting densities of 80 and 100 plants/m² compared with 64 plants/m². Stem weight was similar in the varieties, was lower with later planting, and was reduced at planting densities of 80 and 100 plants/m². Flower yield was similar in each variety and greatest from the middle planting date and with increasing planting density.

Samples were subjected to vase-life testing after conditioning in water or AVB followed by RVB. There were few differences in post-harvest quality between the treatments, though there was a slight benefit to vase-life where the conditioner was used. Further data on the post-harvest quality of larkspur from different treatments is needed.

If consistent quality and an eight-day vase-life could be achieved, the crop would have great potential for use in bouquets. However, unlike delphinium, larkspur

appears to be relatively unresponsive to post-harvest treatments and is severely affected by damp weather with mildew and loss of the lower florets. Further trials are needed to resolve these issues.

1.6. Phlox

The main aim of growing phlox was to assess the quality of the stems, including vase-life, for a selection of varieties. In 2007, varieties 'Icecap', 'Miss Marple', 'Miss Fiona' and 'Sugar Missy' were transplanted to tunnel and outside plots (week 25), which was probably too late. Some varieties were slow to flower in outside plots. For plants grown in tunnels there were large between-variety differences in stem weight in stems of similar length. Despite this disappointing performance the variety plots generated considerable interest amongst UK retailers that viewed it. The crop was grown on in 2008, with some further varieties added ('Magical Dream', 'Magical Fragrance' and 'Magical Surprise' planted in week 18). The original varieties started to crop in weeks 24 to 27 in tunnel and outside plots. Stem length and weight of tunnel-raised plants were consistently 10-20% greater than those from outside plots. The yield of stems was highly variable (44 to 101 stems/m²), one variety producing similar yields whether in tunnels or outside and the others more productive outside. The three first-year crops flowered in significant numbers only in the protected plots, where they were later, had poorer yields and stems were shorter and lighter than for the previous year's plantings.

In 2007 samples of phlox from the tunnels were subjected to vase-life testing. All varieties exceeded their expected 5-day vase-life by two or more days, one lasting for 9 days. Leaf quality remained excellent in all varieties, but flower quality was poorer and the vase-water was generally turbid. Further samples were tested in 2008 after conditioning in RVB or plain water. The effects of treatments were modest. Vase-life ranged from 5 to 9 days, flower quality was generally high and leaf quality and water clarity scores were consistently high. There was a one-day increase in vase-life when conditioner had been used.

Although phlox are traded widely, disadvantages are high cost of plant material, restricted colour range, limited availability and need for careful choice of varieties. These issues will be addressed by the Centre in 2009.

1.7. Sedum

The main aim of growing sedum in the trials was to determine how well it would perform as a commercial crop under typical Lincolnshire conditions. In 2007, due to problems in availability and delivery, eight varieties of sedum were transplanted to outside plots in week 28 or 39, too late to achieve any meaningful results in year 1, and their potential was assessed in 2008. Two *S. tephilium* varieties started to crop in week 30 and all others followed between weeks 32 and 35. Average stem length varied from 25 to 40cm, which may be insufficient, though stem weight was impressive (82 or 164g). *S. spectabile* 'Brilliant' planted in July gave twice the stem length and weight of the September planting.

Samples were subject to vase-life testing. Except for the two *S. tephilium* varieties there was a very long vase-life (23 to 34 days). In the *S. tephilium* varieties vase-life was 6 or 8 days. Flower quality scores were high except for the *S. tephilium* varieties.

Leaf quality was acceptable for most varieties but poor in two cases. Water clarity was very high.

As a cut-flower sedum has a number of advantages: adequate length and high weight, making it ideal for use in bouquets, and it is attractive in the vase over a long period. All varieties tested here would easily achieve the 300g bunch specification. The disadvantages are that plants are expensive, it occupies a large amount of space but only crops for about a month each year, and it is available in pink only. Nevertheless, one supermarket has used sedums in bouquets and has trialled them as a bunch, but the grower needs to realise 70p/bunch to allow for the high plant costs and space needed. With some exceptions, sedums have a long vase-life and high flower and leaf quality. Growing sedums was considered a practical option up to the point of sale, but wider acceptance by the supermarkets is needed. Possibly it is a crop for a smaller, specialist grower. Further information is needed – the plants in this trial had all been grown outside in an un-amended soil, and the potential for cropping over a three-year cycle needs to be tested.

2. Crops with potential for commercialisation if better varieties become available

2.1. Ageratum

Ageratum has only recently been bred for cutting as well as for bedding, and little is known about its market potential, continuity and performance of ageratum in commercial cut-flower production. 'Blue Horizon', one of the first long-stemmed varieties, was transplanted to tunnel and outside plots in week 21, 2007, as a demonstration. The plantings produced their first flowers in week 26 and stems grown outside were markedly taller than those from tunnels.

Ageratum has a small colour range and the flowers may be too delicate for other than short transport periods. But the demonstration generated sufficient interest from major retailers to justify including ageratum in later trials if some of the newer, cutting-raised varieties can be sourced.

2.2. Amaranthus

Five varieties were transplanted into tunnel and outside plots in week 22, 2008. The two dwarf varieties, 'Green Thumb' and 'Pygmy Torch', started to flower in week 27, whether grown under protection or outside. They produced stems about 50cm long in tunnels and up to 20% less outside. Three tall varieties cropped successfully only in outside plots, starting between week 29 and 35, with stems averaging 77 to 110cm in length.

Amaranthus generate very different reactions from different customers. Following the demonstration there were still questions about the commercial acceptability of the crop and its market potential, though some varieties have fashionably green flowers. A further variety demonstration would be justified as other suitable varieties become available.

2.3. Aster (*Aster pringlei*) (Monte Casino type)

New aster varieties have been attracting attention amongst growers, and a demonstration was included to assess their commercial potential. Three September-flowering varieties were planted in tunnel and outside plots in week 25, 2007 and assessed in 2008.

The relative performance of the three varieties was not consistent, so it was not possible to generalise. Those grown in the demonstration proved to be very vigorous, but it was clear much remains to be learned about them. Interest in the crop remains, but there was no immediate potential for further trials at present. Improved seed stocks might alter this perception.

3. Crops without potential for commercialisation under present conditions

3.1. Antirrhinum

Despite a large body of information on antirrhinum and wide appreciation of the flowers and the colour range available, in the UK this crop has been almost entirely imported. A large commercial evaluation was carried out on a commercial nursery in 2007. The grower reported "the flowers are attractive, but relatively delicate, and we thought a more durable product might be obtained by production in the UK, close to the markets. The main question for us, and the reason for the commercial evaluation, was to find out whether the flowers could be managed down the line... could we handle and pack within a budget?"

"Antirrhinums were planted in beds worked with a bed former, so the slightly raised beds allowed water to run off. They were transplanted through carrot film at a planting rate of 64/m². Support netting was provided - and this had to be shaded from the wind because the flowers bruise easily. The nets had to be lifted regularly. Although 2007 was extremely wet the antirrhinums did not suffer as some crops would, though it was difficult getting enough good days to plant. Because of the weather it was not possible to apply the appropriate amounts of feed in the growing period. Overall the 'Potomac' series was the best and most even producer, though this may be different in a drier year. The most attractive variety was 'Apple Blossom'. 'Deep Orange', 'Early White', 'Ivory White', 'Plum Blossom', 'Royal' and 'Yellow' were other good varieties. The stems were no better grown in tunnels than outside. They grow too fast in the warm, and come harder outside - a better product altogether."

"But specifications demand a 40g stem, which is far too ambitious - realistically it should be nearer 30 or 35g. The specification was originally set up at a time of year when quality is naturally higher. The plants were cropped every 48 hours with a bloom count of five open florets and a column length of 15cm. A length of 60cm was required and only 74% made this specification, so they need to fetch 19 or 20p per stem. We will not be growing snaps again! Growing snaps in the UK would only be possible on a very restricted scale for a niche market - and a very well researched market at that."

Vase-life trials showed the potential for several varieties of antirrhinum to perform well in the vase under a range of flower treatments.

The extensive commercial evaluation undertaken in 2007 provided useful experience with the crop, demonstrated the value of outdoors growing, and identified a number of good varieties. However, in the evaluation only 74% of the plants reached the high specification demanded by a UK supermarket, and at the poor price that could be obtained the crop was uneconomic unless for a specialised market.

3.2. Carnation (spray)

UK growers believe the quality of UK-grown spray carnations is superior to that of imported produce. In 2007 a demonstration was set up with two varieties both autumn- and spring-planted. The main purpose was to determine market potential and performance of the crop and to benchmark spray carnations against pinks. Varieties 'Natila' and 'Scarlet Queen' were transplanted to tunnels in September 2007 (week 39) and April 2008 (week 15). The September plantings started cropping in week 30, three weeks earlier than the spring plantings. Planting in September also resulted in longer, heavier stems and a markedly greater yield of stems. Both varieties produced stems of about the same length and weight and at about the same time. In general stem length and head size were good, and there were plenty of breaks. Stems of each variety were tested in vases following conditioning in plain water, AVB followed by CVBN, or AVB followed by RVB. 'Scarlet Queen' showed a longer vase-life and higher flower quality score than 'Natila', and leaf quality and water clarity scores were similar. Vase-life was all increased when a conditioner had been used, and generally the best results were obtained with the combination of AVB+RVB.

The stems produced were of high quality and excellent for bouquet work, but thought it unlikely such a crop could be marketed at a premium price. Post-harvest quality was good, though there may be some varietal differences, and there was a good response to conditioners. However, with a supermarket price war and large quantities of good, cheap spray carnations being imported from Kenya, it was thought unlikely that UK production could be profitable.

3.3. Caryopteris

Little is known about the cultivation of caryopteris for cut-flowers, although they are prolific growers. In 2008 three varieties were planted in a tunnel (week 15). All varieties started flowering in week 37 and achieved broadly similar yields of stems (108 to 114 stems/m²). 'Large Blue' produced longer, but lighter, stems than the other varieties. Mildew was a problem in these plots. Concerns were expressed about the unacceptable aroma sometimes associated with the crop, mainly at the point when stems were cut or re-cut. Although individual opinions varied and there appeared to be differences between varieties, sufficient concerns were raised to discourage further trialling. Samples were vase-life tested and there was little difference in vase-life, flower or leaf quality, water clarity or water uptake between them. Vase-life was acceptable at about 9 days.

Although good stem yields, lengths and weights were obtained from all varieties tested, caryopteris was judged to be a doubtful subject for exploitation because of its aroma. This aspect of the plant should be further discussed with plant breeders.

3.4. Cynara

Little is known of the commercial possibilities of cynara, so a small variety demonstration was planted in 2007. Two new lines were transplanted to outside and tunnel plots (week 22), which proved to be too late for flowering by a reasonable date. Because of their large size in tunnels, only the outside plots were kept for assessment in 2008. Cropping started in week 30 and the average stem length and weight were 80cm and 755g.

At the present time there is no clear market potential for cynara. If this situation changes, specifications will have to be addressed and the effects of pinching assessed, since, in a non-pinched plant, the central stems tend to be too large and the side shoots too small. A further issue is that the leaves die in the bucket within a few days of cropping, so an effective treatment would be needed to delay this.

3.5. Echinops

A single variety of echinops was included in the project in 2007 to assess its commercial potential. 'Veitch's Blue' was transplanted to tunnel and outside plots (week 18) and its flowering performance assessed in 2008. In the first year the crop was seriously affected by mildew and its appearance overall was poor; nevertheless, when both outside and protected plots started to produce flowers in late-June, and noteworthy interest was generated among the retailers who saw it. In 2008 stem yields were poor in the first flush (starting in week 25), though stem length and weight under protection were reasonable. The second flush started in week 41-42, and yields were just over 100 stems/m², but stem length and weight were poor compared with those from the earlier flush. Although echinops is well liked by many, no clear potential for developing its production in the UK was seen at this time.

3.6. Eryngium

A small variety demonstration of eryngium was included in the project. In 2007 seven varieties were transplanted to outside and tunnel plots (week 17 or 24). In the first growing season variety 'Belladonna' was the most attractive variety and produced the largest number of flowers, but other varieties showed a number of problems such as variable height, shyness to flower, poor growth in outside plots, and tip-burn. In 2008 there were wide differences between varieties in the start of cropping (from week 21-22 to week 29). For each variety, generally the dates of starting cropping were similar, whether grown in tunnels or outside. Overall, stems were longer and heavier from tunnel plantings than from outside plots, but there were large differences in response between varieties. All varieties produced 40-55 stems/m² in the first flush when grown in tunnels, and when grown outside only one variety produced such a yield. In the second flush only two tunnel-grown varieties produced over 20 stems/m². No clear potential for commercialising eryngium was seen at this time.

3.7. Godetia

For godetia the main requirement was to assess marketable yield, stem length and vase-life, and a selection of varieties was set up in two demonstrations. In 2007 four varieties of the 'Grace' series were transplanted to outside plots and tunnels (weeks 21 and 25). One variety produced inferior quality blooms, and poor yield from the

second planting, but the trial demonstrated the potential of godetia for production in the UK and generated interest amongst some retailers.

In 2008 four varieties were transplanted to tunnels in weeks 17 and 26. From both plantings, stem length was notably greater in one variety than in the others, though differences in stem weights were less. Godetia produced a high number of stems (210 to 273/m² from the first planting, and 116 to 227/m² from the second). Stems were tested in vases following conditioning in RVB or plain water. The vase-life attributes showed there was no notable difference in vase-life, flower or leaf quality or water clarity between the four varieties. There was a small but beneficial effect of adding a conditioner, a 1-day increase in vase-life.

The demonstrations highlighted a number of difficulties in exploiting godetia as a large-scale cut-flower. The stems need to be cut as soon as there is the slightest show of colour, which accentuates the low stem weight of the product. When a conditioner was used the vase-life was adequate, but not outstanding, at about 7 days. Godetia is probably more suitable for growing as a florist's speciality, though some packers did feel that it could have supermarket potential.

3.8. Grasses (ornamental)

Ornamental grasses find many applications in bouquet work, so there is an interest in determining whether they might be a commercial possibility for growers in the UK. A straightforward demonstration plot was set up. Four grasses, varieties of *Panicum* and *Setaria*, were transplanted to outdoor plots in 2007 (weeks 22 or 25), and two further grasses – *Chasmanthium* and *Miscanthus* – in 2008 (week 18). In 2007 the four grasses started flowering 5 to 6 weeks after transplanting. *Setaria italica* produced taller and much heavier stems (85cm, 29g) than the *Panicum* varieties (60-70cm, 10-11g). In the next growing season *S. italica* started to flower in week 28, 2-4 weeks before the *Panicum* grasses, and produced stems of similar length but heavier than in the previous year. *P. virginatum* 'Fontane' produced stems of similar weight to the previous year, but the other *Panicum* varieties were markedly shorter (about 45cm, compared with 70cm) than before. In 2008 the first-year *Miscanthus* started cropping relatively late (week 35), but produced very long (124cm) and heavy (31g) stems. *Chasmanthium latifolium* started to produce a few flowers in 2008, but nothing of marketable quality could be cropped.

Samples were taken through a vase-life test, following conditioning in RVB or plain water. Using conditioner had no effect on vase-life. There was a much longer vase-life for *Miscanthus* than the other varieties, and the leaf quality score of *Panicum* 'Fontaine Virgatum' was superior to the other varieties.

Ornamental grasses are probably better grown in a hot, moist environment, for example under polythene. Additionally, it would not be possible to compete with the large production areas of ornamental grasses that are grown in Costa Rica.

3.9. Lychnis

A single variety of lychnis was included in the project to assess its potential as a cut-flower. In 2008 lychnis 'Jenny' was transplanted to outside plots (week 3). Cropping started in week 19, and average stem length was 61cm and weight 8g. The first flush

looked very encouraging, but disappointingly the plants failed to produce another good quality flush, just flowers with weak stems. The very light stems were not suitable as a cut-flower, although stem length and the general look of the flower were all adequate. It may be interesting to see the performance of these plants grown-on in 2009.

3.10. Pinks

The main aim of the pinks trials, which included both spring- and autumn-plantings, was to introduce an 'old traditional' crop to a new generation of consumers, and to identify the best yielding varieties for meeting supermarket specifications. In 2007 varieties 'Bright Eyes', 'Lily the Pink', 'Monica Wyatt' and 'Rose Monica' were transplanted (week 18) to outdoor and tunnel plots. All plantings started to produce flowers in the second week of July, and there was continuous cropping between July and November. In general the tunnel-raised plants produced more stems per plant and heavier stems than those grown outdoors. Protection was needed to produce stems of sufficient length and quality. There were marked differences in productivity between varieties.

In 2008 (week 15) the tunnel where the above varieties were growing was damaged by wind and the plants were moved to an adjacent tunnel alongside new plants of 'Dancing Queen', 'Devon Cream', 'Gran's Favourite' and 'Letitia Wyatt'. All varieties commenced cropping in week 23. Mean stem length varied from 33 to 50cm, and stem weights from 7 to 18g. Varieties with the best combinations of stem length and weight included 'Devon Cream', 'Monica Wyatt' and 'Rose Monica', but, of these, 'Monica Wyatt' and 'Rose Monica' produced low yields of flowers (less than 300/m²) compared with some others. 'Dancing Queen', 'Devon Cream', 'Gran's Favourite' and 'Laetitia Wyatt' produced well over 300 stems/m².

In 2007, 'Bright Eyes', 'Dancing Queen', 'Devon Cream' and 'Gran's Favourite' were transplanted (week 42) to tunnel and outside plots. These autumn plantings outside produced double the yield, and autumn plantings under protection treble the yield, of the spring-planted, tunnel-grown crop.

A vase-life experiment was set up over four cropping dates to study the effects of conditioner and storage temperature using the eight pinks varieties flowering in 2008. The conditioner treatments were 1 or 2 ml/L AVB or plain water, and stems were stored at 5 or 20°C. All varieties gave a very acceptable vase-life. Overall, the average for the eight varieties varied from 11.8 days ('Devon Cream') to 15.5 days ('Dancing Queen'). Flower quality was high in 'Bright Eyes', 'Dancing Queen', 'Letitia Wyatt', 'Monica Wyatt' and 'Rose Monica', and lower in 'Devon Cream', 'Gran's Favourite' and 'Lily the Pink'. Overall, using 1ml/L AVB increased vase-life by about 1 day, and using 2ml/L increased it by about 3 days. There was little effect on post-harvest measures of storing stems at either 5 or 20°C. Leaf quality scores and water clarity scores were high in all cases. One variety, 'Gran's Favourite', was especially responsive to AVB. Pinks have a good vase-life which is boosted by use of a conditioner.

The trials enabled a younger generation of retail buyers to look at pinks again. As a direct result of the 2007 trial, one major UK retailer decided to use the product in 2008. Despite this encouraging outcome, producing supermarket-quality pinks is a

difficult task with current prices and no room for sub-standard stems. Unless there is an outlet for bouquet work, pinks are required in consistently high volumes which are difficult to achieve with the peaks and troughs in production. A further issue is that one supermarket requires fragrant varieties, which have poorer yields. Adding to these marketing difficulties, it is more difficult to purchase high-quality planting material than it was 20 years ago.

3.11. Solidago

Solidago media was included in the trials as a demonstration of a new line in 2007. It was transplanted to tunnel and outside plots in week 17. In 2008, earlier, taller and heavier stems were obtained from the tunnel-grown plots than from the outside ones. Cropping started in week 32 (tunnel) or 33 (outside). Stem length and weight averaged 124cm and 274g for tunnel-grown plants, and 106cm and 222g for outside plots. Solidago is often used as a filler with flowers such as freesia, requiring small stems weighing 15g, whereas those produced in the trial were heavy and suitable only as a straight line.

3.12. Veronica

Some growers have wondered about the potential of veronica as a UK crop, and so in 2007 a small demonstration was included in the project. Four varieties were transplanted to tunnels and outside plots (week 25). In the tunnel 'Blue Spark' was the first variety to flower (week 30) and 'Pink Spark' the latest (week 33), while in outside plots all four varieties began flowering in week 32. Lodging was a problem in some plants. All varieties produced considerably longer and heavier stems when tunnel-grown (overall, 55% longer and 78% heavier grown under protection).

For a number of reasons, mainly the low price of the imported stems and the small production window, it was concluded that veronica was probably not a crop likely to be economic in the UK. Consequently, no further trials were planned.

3.13. Zinnia

It is widely accepted that zinnia is a very attractive flower with a spectacular colour range, but its vase-life and neck-strength are key issues that would affect any future development of the crop. The trials aimed to assess post-harvest quality, and especially neck strength, across a range of varieties. In 2007 ten varieties were grown to test vase-life and stem strength. They were direct-drilled outside in week 21, direct-drilled in tunnels in week 24, and grown as plugs and transplanted to outside plots and tunnels in week 27. Marketable stems were obtained from many of the plots, and at cropping a simple assessment of neck strength was made. This identified 'Zowie Yellow Flame' as having the greatest stem strength of those grown.

In 2008 varieties 'Zowie Yellow Flame', 'Meteor', 'Purple Prince' and 'Uproar' were planted in tunnels (week 28). Flower cropping started in week 30. Depending on variety, between 104 and 152 stems/m² were picked, the most productive variety being 'Zowie Yellow Flame'. While stem lengths were similar to those in 2007, stem weight was disappointing at only about 20g in 'Meteor' and 'Purple Prince' and 13g in 'Uproar' and 'Zowie Yellow Flame'. At cropping samples stems each were again

assessed for neck strength as in 2007. This confirmed that 'Zowie Yellow Flame' possessed markedly greater neck strength than the other varieties tested.

From the 2007 trials samples of six selected varieties were subjected to vase-life testing. Stems were harvested at three stages of maturity and conditioned after cutting by standing in either CVBN or RVB Clear prior to vase-life testing. Vase-life ranged from 5 to 9 days. Cropping at Stage 1 (flower open) resulted in the longest vase-life (8 days) and highest flower quality score, while cropping at Stages 2 (one cluster of stamens visible) or 3 (two clusters of stamens visible) gave a vase-life of 6 and lower quality scores. A conditioning treatment in CVBN produced a longer vase-life (7 days) than using RVB Clear.

Samples of the four varieties grown in 2008 were cropped at Stage 2-3 and subjected to vase-life testing. Stems were conditioned in CVBN or plain water, followed by transfer to water with a 'T-bag' for 1 day at 5°C followed by 4 days at 20°C, after which they were placed in vases containing plain water. In 'Purple Prince' and 'Uproar' using CVBN increased vase-life. Despite its many attractive qualities, it was considered that the weakness of the zinnia stem posed severe problems to its wider exploitation as a cut-flower at this time.

Financial benefits

The project identified seven crops as having definite potential for further exploitation and commercialisation in the UK: ornamental brassica, 'German asters' (new German varieties of China aster), delphinium, annual dianthus, larkspur, phlox and sedum. A further year's development work is needed on most of these crops. It is estimated that two or three new products would help to maintain a significant number of larger or medium-sized businesses.

Action points for growers

Growers interested in investigating new options for their cut-flower production could consider these findings and begin to look at the economics and market opportunities. For larger growers, ornamental brassica, 'German asters', delphinium, annual dianthus, larkspur, phlox and sedum are suggested, but some of these (phlox, sedum) might also suit more specialist growers.

Growers who would like to know about other novel cut-flowers should contact the project leader or the HDC with suggestions for the Centre's programme in 2009 and 2010.