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Project leader:	Lyndon Mason (Director, The Cut Flower Centre Ltd)
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Date project commenced:	01 January 2018

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AUTHENTICATION

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

Lyndon Mason

Project Manager and Director

Cur Flower Centre Ltd

Signature ..... Date .....

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GROWER SUMMARY

Headline

- *Tanacetum* has been demonstrated to be a crop that can be produced by growers for the home market.
- New micro-propagated varieties of *Limonium* produce high quality long stems and good yield with very few P&D issues.
- *Aster ericoides* has the potential to be produced as a natural season perennial crop in the UK.
- Steam sterilisation is still the only viable way to ensure that *Fusarium oxysporum* is adequately controlled in an insensitive cropping programme for column stocks.
- A new range of column stocks called 'Stox' has been shown to produce flowers in high temperature conditions but more selection work is required by the breeder to ensure a higher percentage of marketable stems.
- There are varying levels of susceptibility of column stock to *Fusarium* amongst more recently introduced varieties as well as those already confirmed in the older, longer established varieties.
- Further investigations into the ongoing sunflower spotting issue has again isolated *Itersonilia* leading to the postulation that it could be the primary cause of the problem.
- Work is ongoing to find new fungicides to incorporate into the CFC/AHDB developed column stock downy mildew fungicide programme and potential candidates do not appear to have phytotoxicity issues.

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Background

The National Cut Flower Trials Centre (CFC) was proposed by industry representatives and subsequently funded by the HDC (now AHDB Horticulture), starting in 2007. Its short-term aim was to provide information on new product development, novel or alternative cut flowers

for production outdoors or in tunnels to stimulate UK production.

2018 was the first year of a new funded project at the CFC and after taking guidance from industry, a new five year programme of work (2018 to 2022) was agreed to broaden the remit of the CFC, addressing a wider range of issues beyond new product development (NPD). Topics addressed in the first three years included: ongoing trials examining *Fusarium* control in column stocks production in conjunction with Warwick University, evaluation of new herbicide products for field-grown crops and reactive trials examining current important industry issues. During 2018 the latter enabled the CFC to quickly investigate the downy mildew outbreak in column stocks, commission sensitivity testing by FERA and recommend a revised spray programme to address the issue of poor control on some nurseries. The spray programme developed as a result of this work continues to be the mainstay of the industry and has avoided any additional major outbreaks of the disease on UK grown column stocks.

The Covid 19 pandemic in 2020 resulted in the CFC losing a full year of trials and because of this the end date of the project has been moved from 2022 to 2023. In 2022 the CFC was able to run a full programme of trials but owing to the purchase of Rookery Farm by Sarah Raven Ltd, the site has had to be cleared by October 2022 which means that ongoing and new trials in 2023 will be undertaken on growers holding. After the industry voted to end the AHDB levy, the AHDB have agreed that the CFC will be one of the ongoing legacy projects ensuring funding will continue to the end of the contract for the work in 2023.

Summary

***Aster ericoides*.**

Aster ericoides is a product that is imported to the UK mainly for use as a filler in mixed bouquets. It naturally flowers in the Autumn but can be manipulated to produce an AYR crop by the use of blackouts and night break lighting. The CFC have investigated the crop in previous years, and it was included in the 2021 trials following a request from a local packer

who was interested in single flowered varieties. The 2021 trials demonstrated that a natural season crop produces flower stems that are too large and heavy to be of practical use as a filler for supermarket bouquets. At the 2021 Open Day it was suggested that once the stems are growing away vigorously, they should be cut back again to encourage shorter and lighter shoots that would be more suited for use as fillers in mixed bouquets. This technique was applied to the 2022 trials with half of each variety being cut back in week 23 and the other half being allowed to develop naturally.

Cutting the crop back to ground level in week 23 of 2022 did help to achieve a more manageable crop but in retrospect this could perhaps have taken place another 2 week later in order to achieve even shorter stems. The crop flowered in the first half of October.

There is a market demand for more UK product at the time of year that these asters flower with the shape of the stems making the product suitable for mail order and wholesale grade, and if cut back later the smaller and lighter stems would be suitable for fillers within bouquets. The white varieties would be popular for autumn weddings and other events and would replace Gypsophila at a time when the UK season would be coming to an end.

Column stocks *(Matthiola)* - Fusarium control using biopesticides

A previous AHDB funded trial investigating *Fusarium* on lettuce has indicated that T34 Biocontrol (*Trichoderma asperellum* – strain T34, a biopesticide for the control of Fusarium) applied to the peat blocks at seeding gave a degree of control of the disease. In 2019, in order to assess the potential of T34 to control Fusarium in column stocks, the CFC replicated this technique by direct seeding stocks into treated peat blocks. The results were not conclusive but were promising enough to continue further trials.

In 2022 trays of very young seedlings which had only recently germinated were drenched on the propagators site (in Holland) with T34 and Prestop (*Gliocadium catenulatum* - another product claimed to have some control of *Fusarium oxysporum).* These were then grown on by the propagator until ready for planting when they were then delivered to the CFC site.

The 2022 *Fusarium* biopesticide trial is a culmination of a number of years trials which have been undertaken by the CFC both on growers holdings and at the CFC site. Unfortunately, none of the biopesticide trials, including those undertaken in 2022 showed any statistically (or visual) improved control of *Fusarium* on column stocks. It should be noted though that these trials were conducted in soils that had a high level of *Fusarium* infection and in some cases during very warm weather which meant that the plants susceptibility to the disease would be at its greatest. It is not now envisaged that the CFC will undertake any additional work on these products unless new information becomes available.

Column stocks *(Matthiola)* - *Fusarium* control using Elicitors

Over recent years a number of plant elicitors have been introduced into the plant protection armoury. The mode of action of elicitors is to stimulate natural defence reactions in plants which in turn helps to make them less susceptible to attack from pests and diseases. In 2002 the CFC undertook a trial to look at the potential of elicitors for controlling *Fusarium* on column stocks.

Unfortunately, the 2022 trial indicated that they are not able to provide enough defence to enable the plant to reduce its susceptibility to *Fusarium* attack in this situation. This result is the same as has been obtained with the other CFC trials investigating *Fusarium* control in column stocks when the plant is subjected to a high level of inoculum. In these situations, the only control option still open to growers producing in intensive production systems if a crop rotational option is not available (which it isn't to most UK producers) is to sterilise with steam.

Column stocks *(Matthiola)* – Late flowering trial of new 'Stox' varieties

Extending the season of column stocks beyond the late spring / early summer period is always an issue because most of the commercially grown varieties do not perform well in hot conditions leading to either blind plants or short and distorted flower spikes. The CFC has previously trialled the 'Iron' series which has been developed by Japanese breeders but while it does perform well in hot weather, it is not easily selectable and hence the crop has a lot of

stems of single flowers (only doubles are saleable to UK supermarkets) as well as some distorted stems of double flowers meaning that there were not enough marketable stems to make the crop economically viable. However a new range of column stocks has recently been introduced to the market called 'Stox' which are a cross between the genetics of the traditional and Japanese varieties. It is claimed that these are fully selectable and will flower during hot weather hence enabling the season to be extended. In order to investigate these claims the CFC made 2 late plantings (week 27 and 30) of the full range of colours of 'Stox' (except white which was not available in week 27).

This trial showed that new 'Stox' series do not have the same issues with hot weather as do the more traditional varieties. July and August of 2022 was excessively hot with temperatures reaching in excess of 40^{o}C yet all of the 'Stox' varieties produced flowers, with the best stems exceeding 60cms in length. However the current selections will not be commercially viable for a UK supermarket crop because of the low percentage of stems that were of high enough quality to market. The number of marketable stems per square metre varied from 12 in the silver up to 34 in the Rose Pink and even the higher value would only be commercially viable if a premium price was being obtained for an out of season product.

From the 2022 observations (both at the CFC and on growers holdings) it can be concluded that the genetics of the 'Stox' variety mean that they could potentially be used to extend the season during the warm summer period but more work is required by the breeder to reduce the high levels of variability and significantly increase the percentage of marketable stems. It is hoped to undertake future trials on growers holdings if improved strains of 'Stox' become available in the future. 'Stox' however is a very confusing name and it has been suggested that they should simply be called 'scented autumn stocks'.

There would be a market for autumn stocks through florist outlets and for autumn weddings but without further market testing it is not possible to determine if they would command a premium price to offset the low yield, although the height variability and irregular column length may be less of an issue than when supplying the supermarkets.

Column stocks *(Matthiola) - Fusarium* varietal susceptibility trial

It is known that some varieties of column stocks are more susceptible to *Fusarium* than others as was clearly demonstrated in previous CFC trials. As there have been a number of new varietal introductions in recent years it was intended to undertake a large scale replicated variety trial in the Haygrove tunnel during the 2023 season. However, after becoming apparent that 2022 would be the final year that the CFC would hosted by Rookery Farm (owing to the sale to Sarah Raven) the decision was taken to bring the trial forward to 2022 and plant it after the biopesticide trial was completed. This meant that the trial was not planted until week 29 which is not ideal for column stocks but the decision was taken that it was worth the risk rather than obtaining no results as would have been the case if no trial was undertaken.

The very hot weather throughout August 2022 meant that a lot of plants were lost at the seedling stage and the plants continued to struggle throughout the period of the trial. However, the results from older varieties did confirm already know susceptibility traits (e.g. Aida purple is much less susceptible than Opera Deborah even though they are similar colours) so while the results obtained from the newer varieties (e.g. 'Stox') must be treated with some caution, they can probably be used as an indication of varietal susceptibility until more information become available.

Column stocks *(Matthiola)* – Phytotoxicity testing of potential new downy mildew fungicides.

Following industry wide issues with the control of downy mildew on column stocks during the 2018 production season, the CFC has undertaken a number of trials to ensure that the industry is able to adequately control the disease. A spray programme developed by the CFC in 2018 has been used very successfully since, but one of the key active ingredient (*dimetomorph)* could be lost in the near future and *Mancozeb* is already difficult to obtain. Earlier CFC funded trials undertaken at FERA have identified a number of potential chemicals that could be incorporated into the spray programme if suitable EAMU's can be obtained for

their use on column stocks. In order to assess potential phytotoxicity issues, four of these products were chosen in 2022 to undertake specific phytotoxicity trials at the CFC. These trials have shown that there is very little risk of phytotoxicity issues occurring when using the selected range of fungicides that have the potential to be introduced to the column stock downy mildew control programme. This information will also be used to support ongoing EAMU applications going forward.

Limonium

Limonium is grown in Holland but is not produced by many UK growers. Of the product that is grown in the UK, most is direct seeded annual varieties with very little vegetatively or micro-propagated crop being produced. New varieties of micro propagated *Limonium* from Danziger were offered to the CFC in 2021 and some of these showed real promise. The best performing varieties were planted on a larger scale at the CFC in 2022 ie 'Sensy Pink Beauty', 'Pinocolada' and 'White.' The 2022 planting produced a superb quality crop with stems being in excess of 1m tall and produced an average of around 100 stems per m^2 of bed. However, because these are produced by micropropagation, the plant price is very expensive at about £1.50 per plant, therefore 15p per stem would be required just to recoup the plant cost. It would therefore need to be sold as a premium product and achieve a stem price (probably around 40 to 45p) that reflected both the high plant cost and long production time.

Peony herbicide trial.

The area of UK grown peony has increased over the past decade and one of the main issues that growers face is weed control. This was highlighted at the 2019 CFC Open Day where it was identified as the top priority for future trials conducted by the CFC. In order to address this need, the CFC has instigated a number of trials to investigate both pre and post weed emergence control. The 2022 trial investigated the use of contact and systemic herbicides applied after the crop has been cut down in the Autumn. The herbicides will be applied again when weed growth occurs in the spring and both weed cover and crop phytotoxic observations will be recorded.

Seed Priming Trial

Seed priming is a technique used quite extensively in the vegetable industry but has not been widely adopted by the cut flower industry. Preliminary trials undertaken by Elsoms Seeds had shown that there may be the potential to prime some flower seeds with the intention of producing an earlier and more even germination hence aiding both weed control and making flower maturity more even. Initial trials undertaken at the CFC in 2021 did not show any differences between the primed and unprimed seeds and it was decided to undertake further trials in 2022. It had been intended to undertake these trials at the CFC site but owing to the sale of Rookery Farm to Sarah Raven the site had to be vacated by October so it was decide sow the trial in a cold tunnel on a growers holding in September.

Unfortunately, the CFC trials undertaken in 2021 and 2022 did not demonstrate any observable differences in the treatments for larkspur and Sweet William. The CFC will investigate this further with Elsoms to see if there are further ongoing developments that would justify future trials on growers holdings.

Sunflower petal spotting issue

The CFC has for some years investigated the petal spotting issues that occur on UK grown sunflowers for cutting, but no conclusive cause of the problem has so far been identified. In previous years the disease *Itersonila perplexans* was isolated from some samples, but not from all, meaning that it could not be categorically identified as the cause of the problem. Unfortunately, the methodology required to identify *Itersonilia* was notoriously difficult but recently been revised for the investigation of parsnip canker which can be caused by *Itersonila spp.* Some of this work on parsnips has been undertaken by Lauren Chappell from Warwick Life Sciences who was contacted by the CFC with a view to develop a joint project to further investigate the sunflower issue. During the 2022 season, Lauren and other colleagues from Warwick visited sunflower fields in Lincolnshire to better understand the production process and also collected samples to return to the labs in order to refine their technique for testing for sunflower *Itersonilia.*

While the 2022 season was mainly used to develop a strategy for further work in 2023, it also produced some useful results with *Itersonilia* being isolated from a number of samples.

Tanacetum parthenium

2021 was the first year that the CFC has investigated *Tanecetum* (also known a *Matricaria*) and the trials proved very encouraging. It was trialled again in 2022 with a particular emphasis on planting dates and continuity. Each planting took around 9 to 10 weeks to produce a marketable crop and the 2022 trials indicate that to achieve a good continuity of cropping, planting would need to be around fortnightly. The crop was easy to grow and suffered from very few problems, although a prophylactic spray programme was applied to control leaf miner which was a slight issue in 2021. Powdery mildew was an issue in the 2022 trial especially on the 'Vegmo Single' but had not been seen in 2021. This is a product that would appear to have a good potential for UK produced filler and its similarity to Santini type chrysanthemums gives it further potential for a wider usage in mixed bouquets. The 2022 trial have shown that continuity is easily achievable and once over harvesting is possible for all except the latest planting dates (week 29 and 30) which produced a crop that is potentially too uneven to apply this harvesting technique.

Financial Benefits

This is the fourth year of the new five-year project and as such any financial benefits reported will not take into account the potential £2.5 million of new product trialled and facilitated by previous CFC trials.

One of the main ongoing financial benefits to the industry from the current 5 year CFC work plan has been from the 2018 work on downy mildew in column stocks. The 2018 work was able to quickly develop an effective new spray programme that when adopted by growers reduced losses considerable. Since then the CFC has continued to monitor the situation and has ensured that the spray programme continues to be effective by followed up with additional sensitivity testing in 2019 and 2021. Phytotoxicity trials were also undertaken in 2022 as part of the scoping work to develop additional products to include in the spray programme. As in

previous years, it is impossible to put an exact figure on the savings, the ongoing adoption of the control measures and spray programme from the 2018 trials resulted in no known major outbreaks of downy mildew on column stocks. The UK produces about 18 million stems at an average of 29p per stem in 2002, making a total industry value of around £5.2m. A conservative industry estimate of potential crop loss from the new strain of downy mildew (based on 2018 losses in Holland and the UK) of 10% represents an annual saving to the industry in 2022 of over half a million pounds.

A number of new products trialled during the first years of the current CFC programme such as *Astrantia*, Lepidium, *Limonium,* Scabious and *Veronica* have been planted by small to medium sized nurseries. An estimate of the total area of these new products in 2022 is 2 ha and if Scabious is used as an example, with a yield of around 30 stems/m^2 at a return of 25p per stem this is an additional annual farm gate value of £150,000.

Other new products have been planted either on a commercial scale or as commercial trials for supply to the supermarkets. These include *Eryngium, Tanacetum* and Willow. An estimate of the area of these products would be 6ha and with an estimated average farm gate value of £30,000 to £50,000 per ha depending on species this amounts to an additional total farm gate value of between £180,000 and £300,000.

Action Points

- Production of Aster ericoides should be considered for production as a natural season perennial crop if the first flush of shoots is cut back at the appropriate time to ensure that the stems are of smaller enough size to be manageable.
- New varieties of micro-propagated Limonium perform very well in UK conditions but may only be considered to be niche crop because they but would need to command a premium price to ensure that the crop is economically viable.

- Growers could consider the large scale commercial production of *Tanacetum* as a summer flowering crop if commitment can be obtained from UK packer and supermarkets.
- Column stock growers should continue to be vigilant to the ongoing threat of the new and very damaging strain of downy mildew identified in 2018, and obtain a copy of, and implement the recommendations of AHDB / CFC Information Sheet 11 *Maintaining successful control of downy mildew in protected crops of cut flower column stocks*. Additional trials on DM are an integral part of the ongoing CFC work and growers should be alert to any updates to the control strategy that develops from this work.
- As part of the column stocks downy mildew work, the CFC is investigating the possibility of obtaining EAMU's to add more fungicides to the DM armoury and growers should therefore keep themselves regularly updated on new EAMU approvals via the internet or their local agronomist.
- Peony growers should keep themselves up to date with the ongoing herbicide trials.
- Sunflower growers will have the opportunity to be involved with the ongoing petal spotting issues and should keep themselves up to date with developments.

SCIENCE SECTION

Introduction

The past decade has seen a rise in imports of cut flowers into the UK at a time when home production has been declining. The crops produced by UK growers have also changed significantly over the past decade, with protected chrysanthemum production (both AYR and natural season) declining to an insignificant area and also a decline in indoor lily bloom production. By contrast, protected tulips and column stock production have increased and are now the most important crops for UK protected flower growers. The production of outdoor flowers has also changed significantly with a major reduction in natural season chrysanthemums and gladioli areas but significant increases in sunflowers, Peony and hardy foliage (including berries). Dried flower production has also decreased significantly and now mainly comprises Larkspur (and a few other species) for the confetti industry). The number of grower holdings has also decreased with the majority of the production area now being controlled by a small number of larger-scale producers, who have made significant investment in new capital facilities including packhouses, glasshouse and grading/packing equipment.

The desire of supermarkets to offer more UK produced flowers to their customers could offer more potential for import substitution with UK grown product having the advantage of freshness and market proximity hence minimising air miles. Brexit had the potential to open up new opportunities for home grown produce, but this has hampered by a shortage of seasonal labour, energy and other rising input costs and to a lesser extent the costs of importing of young plant material.

The National Cut Flower Trials Centre (CFC) was proposed by industry representatives and subsequently funded by the HDC (now AHDB Horticulture), starting in 2007. Its short-term aim was to provide information on new product development, novel or alternative cut flowers for production outdoors or in tunnels to stimulate UK production.

Over the past few years the CFC has concentrated on new product development (NPD) and

despite a wide range of potential products being identified, it has proved difficult to commercialise some of these new products on a large scale. This has been due to a number of issues, not least struggling to provide them at a unit cost that is acceptable to UK supermarkets (although a number of these crops have however been grown on a limited scale by small to medium sized growers). Owing to this fact, after taking guidance from the industry, a new five year trials programme was developed (originally 2018 to 2022 but now extended to 2023 due to trials being postponed in 2020 as a result of Covid) and this programme has a broader remit seeking to address technical issues such as identifying new pest, disease and weed control measures (in the form of Fusarium control and ongoing herbicide evaluations mainly focusing on Peony) and investigating current technical issues of concern to industry (such as the outbreak of downy mildew in column stocks during 2018, where the CFC commissioned sensitivity testing undertaken by FERA and generated revised spray programmes and a summary technical note in early 2019). The CFC also provided grower samples for additional sensitivity testing by the James Hutton Institute in 2019 and 2021.

Materials and methods

By arrangement with David Robinson (managing director, Rookery Farm Packing Ltd), the trials programme was hosted at Rookery Farm, Holbeach St John, Spalding, Lincolnshire. The National Cut Flower Trials Centre (t/a Cut Flower Centre Ltd; CFC) is directed by project leader Lyndon Mason and overseen by a management group comprising representatives of growers, packers, retailers and AHDB Horticulture. As from 2019 the site was only rented from Rookery with all of the labour required to run the trails being provided by the CFC Project Manager and appropriate casual labour. Crop protection advice is provided by a BASIS and FACTS registered consultant who liaised closely with the project leader as well as visiting the site on a weekly basis during the main trial season.

The experimental programme is agreed with the CFC management group (MG) and amended annually, taking into account views received from the industry about technical issues that

need to be addressed as well as possible NPD subjects. Information from the reviews of new cut flower crops and overseas cut flower trials, undertaken as part of the previous CFC project, was also used to identify suitable NPD candidates.

Generic protocols are presented in this section, specific actions are documented within the results section.

Facilities and site preparation

The CFC facility at Rookery Farm comprises a single-span 'Haygrove' tunnel (7.9 m wide × 38.1 m in length; Haygrove Ltd, Redbank, Ledbury, Herefordshire), a triple-span 'Pro-Tech' tunnel (overall 22.7 m wide × 38.0 m in length; Pro-Tech Marketing Ltd, Ironbridge, Telford, Shropshire) and a 600 m^2 adjacent area of outdoor beds provided with anti-rabbit fencing. Since it is an exposed site, wind-breaks of 2.5 m-high polypropylene netting are provided at one end of the tunnel area. The tunnels were covered with a standard polythene film in early April. The Soil Survey of England and Wales' *Soils of England and Wales* describes the soil at the CFC as a deep alluvium drained by ditches and pumps, which is typical of the area.

The soil within the multi-span tunnels was sterlised with steam in early April once they had been re-covered. Before planting, soil samples were taken across the site to undertake a standard glasshouse soil analysis. As fertiliser recommendations don't exist for all cut flower crops, the aim was to bring base nutrient levels up to those required for Chrysanthemum, i.e. indices of 2 for nitrogen, 4 for phosphorus, 3 for potassium and 4 for magnesium. Before planting in 2022 the 'Haygrove' tunnel received 50 g/m^2 sulphate of potash; 'Pro-Tech' bay 1 and 2, 30 g/m^2 ammonium nitrate and 45 g/m^2 of triple superphosphate.

Plant material and planting

Plants were obtained as plug-plants ('plugs'), seeds, or rooted cuttings as appropriate. Seeds were germinated in module trays and then transplanted. Most plants were transplanted into labelled plots along 1m-wide beds at the specified density. Individual plot lengths were dependent on the trial and plant availability, and wherever practical unplanted areas were left

between plots and at the ends of the beds. Crops were watered with a hand-lance immediately after planting and then as and when required to ensure good establishment.

Crop husbandry

Once established, plants were irrigated as required via lay-flat irrigation lines, a hand-lance was also used to provide supplemental irrigation. Once in full growth, plants received a liquid feed at every watering. The liquid fertiliser used was 'Universal® Green' at 5% (23:6:10:2.7 N:P:K:MgO with trace elements).

Beds were provided with one or more layers of support netting as required by the crop, the net was raised in line with crop growth. Sometimes plants were stopped (pinched) or other treatments applied.

Pesticide applications

The crop protection products applied in 2022 are listed in the table below.

Table 1. Crop protection and foliar feed (*) products applied in 2022

WEEK number	Pest/Disease	Product/s	Rates	Crop
Week 17	Powdery Mildew	Amistar + HortiFol*	100ml+ 200g/100L	All crops
Week 18	Powdery Mildew	Fubol Gold +HortiPhyte* + Hallmark	190g+200ml + 9ml/100L	Stocks in fusarium tunnel
Week 20	Powdery mildew	Signum + Karma	135g+300g/100L	Asters and others
Week 21	Downy Mildew	Revus + HortiPhyte* + DiPel	60ml+200ml + 75g/100L	Stocks

Week 22	Downy Mildew + caterpillar	Percos + HortiPhyte* + Hallmark	80ml+200ml + 12.5ml/100L	Stocks
Week 23	Powdery Mildew + Sclerotinia + aphids	Amistar + Mainman + Gazelle	100ml + 14g + 50g/100L	All crops
Week 23	Downy Mildew	Paraat + HortiPhyte*	36g + 200ml/100L	Stocks
Week 24	Spider mites/Leaf miner	Dynamec + SW7	50ml + 50ml/100L	Matricaria
Week 25	Powdery Mildew + aphids	Frupica + SW7 + Gazelle	90ml + 50ml + 50g/100L	All except stocks
Week 25	Downy mildew + aphids	Percos+ HortiPhyte* + Mainman	80ml + 200ml + 14g/100L	All stocks
Week 26	Downy mildew + flea beetle	Amistar + Agree 50	190g + 75g/100L	Stocks
Week 26	Powdery mildew	Systhane + Nimrod	30ml + 100ml/100L	All crops except stocks
Week 29	Downy Mildew+ flea beetle	Paraat + HortiPhyte* + Decis Forte	36g+200ml + 16ml/100L	Stocks
Week 30	Powdery Mildew + aphids +DBM	Signum + Mainman + Decis Forte	135g+14g +16ml /100L	All crops except stocks
Week 34	Powdery mildew	Takumi + Poliverdol*	15ml + 200ml/100L	All crops except stock
Week 35	Downy Mildew+ DBM + Flea beetle	Fubol Gold + HortiPhyte* + Hallmark	190g + 50ml+9ml/100L	Stocks

Week 35	Downy Mildew+ DBM + Flea beetle	Revus + Hortiphyte* + Agree 50	60ml + 200ml + 75g/100L	All crops except stock
Week 37	Downy Mildew+ DBM + Flea beetle	Percos + HortiPhyte* + Hallmark	190g + 50ml+9ml/100L	Stocks
Week 38	Powdery mildew	Potassium Bicarbonate + Systhane[1] + Nimrod	300g + 30ml + 100ml/100L	Asters

[1] for containerised crops under permanent protection only

Crop assessments

Flower stems were picked at the appropriate commercial stage for each crop, wherever practicable taking samples close to the peak cropping date. If applicable to the trial, the number of marketable stems picked was recorded (and converted to numbers per m^2), along with (for an appropriate random sample of each plot) picking dates, lengths and weights of flower stems (either overall figures or after trimming to a specified length) and other measurements as required (such as spike length or flower-head diameter). Other than as required by trimming, the stem lengths and weights quoted always refer to the total weights and lengths of the whole stem (including buds, flowers or inflorescences).

As appropriate to the practical nature of the project, demonstration plots were not usually replicated, but where replicated and randomised trials were used, the data were subjected to statistical analysis. In 2022 the statistical analysis was undertaken by Chris Dyer of ADAS.

Less formally, but importantly, the plots were assessed at intervals by the CFC management group and others from the industry. In the case of preliminary demonstrations, emphasis was placed on photographs and grower comments. Numerous samples of products were made available to the industry to gather feed-back and for promotion. In 2022 (and in previous years) samples of new products grown at the CFC were also provided to Jonathan Mosley

for use in his floral demonstrations at a number of UK shows including the Great Yorkshire Show and the RHS shows including Tatton Park. Numerous samples were also sent to a local marketing company that supplies florists throughout the country. The feedback from this company was incorporated into this report.

Vase-life testing

Vase life testing in 2002 was kindly undertaken by Lambs Flowers and Evolve Flowers.

Results

Aster ericoides.

Aster ericoides is a product that is imported to the UK mainly for use as a filler in mixed bouquets. It naturally flowers in the Autumn, but can be manipulated to produce an AYR crop by the use of blackouts and night break lighting. The CFC have investigated the crop in previous years and it was included in the 2021 trials following a request from a local packer who was interested in single flowered varieties. The 2021 trials demonstrated that a natural season crop produces flower stems that are too large and heavy to be of practical use as a filler for supermarket bouquets. At the 2021 Open Day it was suggested that once the stems are growing away vigorously, they should be cut back again to encourage shorter and lighter shoots that would be more suited for use as fillers in mixed bouquets. This technique was applied to the 2022 trials with half of each variety being cut back in week 23 and the other half being allowed to develop naturally.

Table 2. Details of 2022 demonstration of Aster ericoides varieties

Location	Rookery Farm
Varieties	*Aster ericoides* ‘ ‘Cassandra’, ‘Chanel’, ‘Cirina Pink’, ‘Claudia’, ‘Lesley’ and ‘Monte Cassino’
Plant longevity and hardiness	Frost hardy perennials;
Format(s) and supplier(s)	Plugs from DecoNova.
Propagation and pre-planting treatment(s)	Supplied as plugs in 104 trays.
Planting or sowing date(s)	Well established plugs planted in week 20 of 2021
Plots	3 m-long.
Planting/housing site(s)	‘Pro-Tech’ tunnel bay 3
Layout	Demonstration plots
Plant spacing(s)	12 plants per/m^2
Post-planting treatment(s)	One layer of support netting. Half of each variety cut back to ground level in week 23.
Pests, diseases and disorders	Prone to powdery mildew so prophylactic sprays were applied at regular intervals (see Table 1).
Picking stage(s) and market specification(s)	When 30 to 50% of the buds have opened
Picking and recording date(s)	Most of the plots had some stems ready to harvest in early October and continued for another 2 to 3 weeks.
Records taken	Observations
VL testing	None in 2022

Figure 1. *Aster ericoides* in demonstration plots in 2022; top left trial planted in week 20 of 2021; top right half of each bed cut back in week 23; bottom-left new growth in week 26 and bottom right 'Claudia' in flower in week 41 .

Unfortunately the final stages of this trial clashed with the ongoing clearing of the site which had to be vacated by October 2022 owing to the Sarah Raven purchase of Rookery Farm. However some samples were taken by a local marketing company in week 41 and the feedback was that crop has market potential but even the area cut back in week 23 still

produced stems that were a bit to large (although considerably more manageable than those not cut back) making then hard to harvest and grade as well as hindering powdery mildew control.

Column stocks *(Matthiola)* - Fusarium control using biopesticides

A previous AHDB funded trial investigating *Fusarium* on lettuce has indicated that T34 Biocontrol (*Trichoderma asperellum* – strain T34, a biopesticide for the control of Fusarium) applied to the peat blocks at seeding gave a degree of control of the disease. In 2019, in order to assess the potential of T34 to control Fusarium in column stocks, the CFC replicated this technique by direct seeding stocks into treated peat blocks. The results were not conclusive but were promising enough to continue further trials.

In 2022 trays of very young seedlings which had only recently germinated were drenched on the propagators site (in Holland) with T34 and Prestop (*Gliocadium catenulatum* - another product claimed to have some control of *Fusarium oxysporum).* These were then grown on by the propagator until ready for planting when they were then delivered to the CFC site in week 16.

Table 3. Details of 2022 *Fusarium* T34 and Prestop trial.

Site	Rookery Farm
Varieties	'Debora', and 'Aida White'.
Format(s) and supplier(s)	Plugs from Florensis.
Propagation and pre-planting treatment(s)	Plugs drenched on the propagators holding just after germination with T34 at a rate of 0.5g/m2 at 0.5g/2L of water. 4 trays per m2 so each cell/plant receives 1.2ml solution; and Prestop at a rate of10g/m2 at 10g/2L of water.
Planting or sowing date(s)	Planted in week 17.
Plant spacing(s)	64/ m^2
Planting site(s)	1.5m-long plots.
Layout	Replicated trial
Post-planting treatment(s)	T-34 was applied 0.5g/m2 using a Dosatron at 1% applying 4L/m2. This achieved a rate of 0.5g/4L of water as final solution which is equivalent to 5kg/ha. Prestop was applied at 5g/m2 applied in 4L of water. Same application method as above giving a rate of 50kg/ha.
Pests, diseases and disorders	The very hot weather in 2022 resulted in some issues with growth of the plants which resulted in some losses.
Picking stage(s) and market specification(s)	N/A.
Picking and recording date(s)	Fusarium levels were assessed on 25thth June, 5th July and 16th July 2022
Records taken	Assessment of Fusarium infection score (0 to 5) of the same 10 random stems within each plot. As there was no significant difference in any of the treatments only a summary of the *Fusarium* assessment score has been included in this report.
VL testing	N/A

Figure 2. *Fusarium* T34 trial in 2022; top left seedlings drenched with T34 and Prestop on the propagators holding; top right trial being planted in week 17; bottom-left view of the trial 3 weeks after planting and bottom right 'Deborah' plot at final assessment.

There was no visual difference between treatments but as would be expected from previous observations, 'Deborah' was more severely damaged by *Fusarium* than was the 'Aida white'. The visual observations were confirmed by a statistical analysis undertaken by Chris Dyer of ADAS which showed that none of the treatments were statistically significant but the differences between the varieties were significant. The results of the *Fusarium* assessment scores are shown at Figure 3.

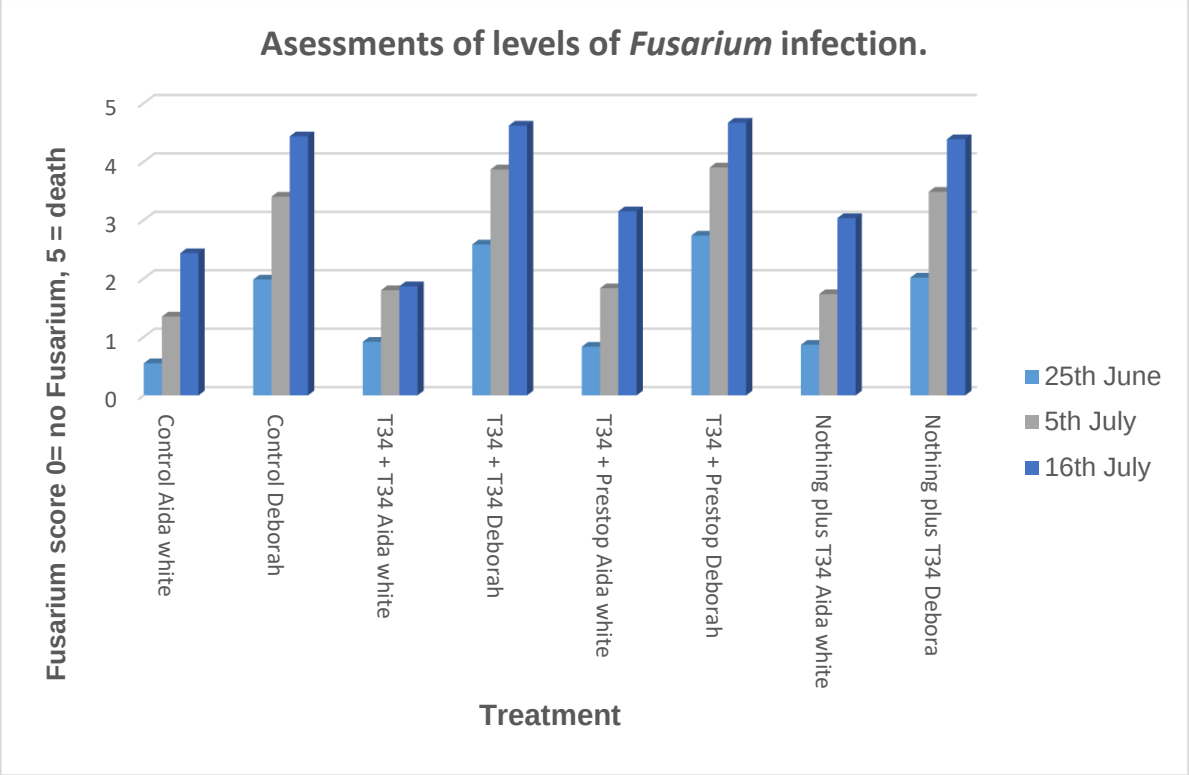

Figure 3. Assessments of levels of Fusarium infection from 10 random plants located in the centre of each plot.

#Column stocks *(Matthiola)* - *Fusarium* control using Elicitors

Over recent years a number of plant elicitors have been introduced into the plant protection armoury. The mode of action of elicitors is to stimulate natural defence reactions in plants which in turn helps to make them less susceptible to attack from pests and diseases. In 2022 the CFC undertook a trial to look at the potential of elicitors for controlling *Fusarium* on column stocks.

Table 4. Details of 2022 *Fusarium* Elicitor Trial.

Site	Rookery Farm
Varieties	'Anytime Lavender'
Format(s) and supplier(s)	Plugs from Florensis.
Propagation and pre-planting treatment(s)	On 20th June the plug trays were drenched with AHDB9808[1] (342g/l Potassium phosphonate) at 450mL/100L (4.5L/ha), FytoSave (12.5g/l COS-OGA) at 300ml/100L (3L/ha), Romeo (Thiophanate Methly 70& WP) at 75g/100L (0.75kg/ha) and Sonata (*Bacillus pumilus)* at 1L/100L (10L/ha). The plugs were drenched at 2,000L/ha.
Planting or sowing date(s)	Planted in week 25.
Plant spacing(s)	64/ m^2
Planting site(s)	1.5m-long plots.
Layout	Replicated trial
Post-planting treatment(s)	Twelve days after planting (1st July 2022) the relevant plots were drenched with each of the same treatments that were drenched in the seedling stage but at a rate of 1,000L/ha of solution.
Pests, diseases and disorders	The very hot weather in 2022 resulted in some issues with growth of the plants which resulted in some losses.
Picking stage(s) and market specification(s)	N/A.
Picking and recording date(s)	*Fusarium* levels were assessed on 18th July, 25th July and 7th August 2022.
Records taken	Assessment was made of the *Fusarium* infection score (0 to 5) of the same random 10 random stems within each plot. As there was no significant difference in any of the treatments only a summary of the *Fusarium* assessment score has been included in this report.
VL testing	N/A

[1] under experimental permit 2022/01331

Figure 4. *Fusarium* Elicitor trial in 2022; top left trial planted in week 25; top right trial being drenched with the Elicitors on 1st July; bottom-left view of the trial in week 30 and bottom right close up of the high levels of *Fusarium* already evident in week 30.

There was no visual difference between treatments and statistical analysis by Chris Dyer of ADAS confirmed that none of the treatments were statistically significant. The results of the *Fusarium* assessment scores are shown at Figure 5.

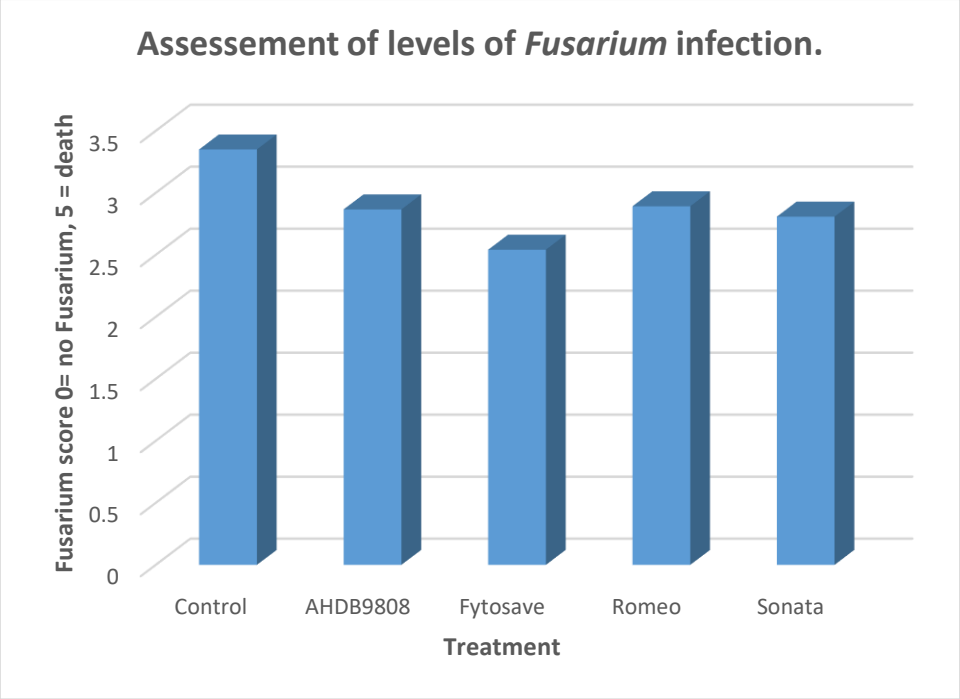

Figure 5. Assessments of levels of Fusarium infection from 10 plants located in the centre of each plot. This is an average of the three assessments

Column stocks *(Matthiola)* – Late flowering trial of new 'Stox' varieties

Extending the season of column stocks beyond the late spring / early summer period is always an issue because most of the commercially grown varieties do not perform well in hot conditions leading to either blind plants or short and distorted flower spikes. The CFC has previously trialled the 'Iron' series which has been developed by Japanese breeders but while it does perform well in hot weather, it is not easily selectable and hence the crop has a lot of stems of single flowers (only doubles are saleable to UK supermarkets) as well as some distorted stems of double flowers meaning that there were not enough marketable stems to make the crop economically viable. However, a new range of column stocks has recently been introduced to the market called 'Stox' which are a cross between the genetics of the traditional and Japanese varieties. It is claimed that these are fully selectable and will flower during hot weather hence enabling the season to be extended. To investigate these claims the CFC made 2 late plantings of the full range of colours of 'Stox' (except white which was unavailable for the second planting)

Table 5. Details of 2022 late planted ‘Stox’ variety trial.

Site	Rookery Farm
Varieties	‘Stox Antique Rose’, ‘Champagne’, ‘Deep Rose’, ‘Rose Pink’, ‘Silver’, ‘White’ and ‘Yellow’.
Format(s) and supplier(s)	Plugs from Stars Plant
Propagation and pre-planting treatment(s)	None
Planting or sowing date(s)	Planted in week 27 and 30.
Plant spacing(s)	64/ m^2
Planting site(s)	5m-long plots.
Layout	Demonstration plots
Post-planting treatment(s)	None
Pests, diseases and disorders	Some downy mildew, diamond back moth (DBM) and *Fusarium.*
Picking stage(s) and market specification(s)	About a third of the florets open.
Picking and recording date(s)	The week 27 planting was harvested from week 34 and the week 30 planting from 38 onwards.
Records taken	Number of marketable stems per sq/m and stem length.
VL testing	Between 7 and 9 days depending on variety.

Figure 6. 'Stox' variety trial in 2022; top left view of trial after planting of the week 30 crop with the week 27 planting in the background; top right view of week 27 planting in full flower in week 35; bottom-left a random sample of 'Stox White' harvested in week 36 showing the wide variability in stem length and bottom right the full range of 'Stox' colours (excluding white which was unavailable) from the week 30 planting harvested in week 39.

The trial produced some variable results which should be interpreted with caution but despite very hot conditions (sometimes in excess of 40^{o}C) all of the 'Stox' colours formed buds and produced flower spikes. Some of these flower spikes were of very good quality and in excess of 60cms but unfortunately the crop was very variable (see pictures above) and the number of marketable stems varied between 12 and 34 per m^2 depending on the colour as show at

Figure 7

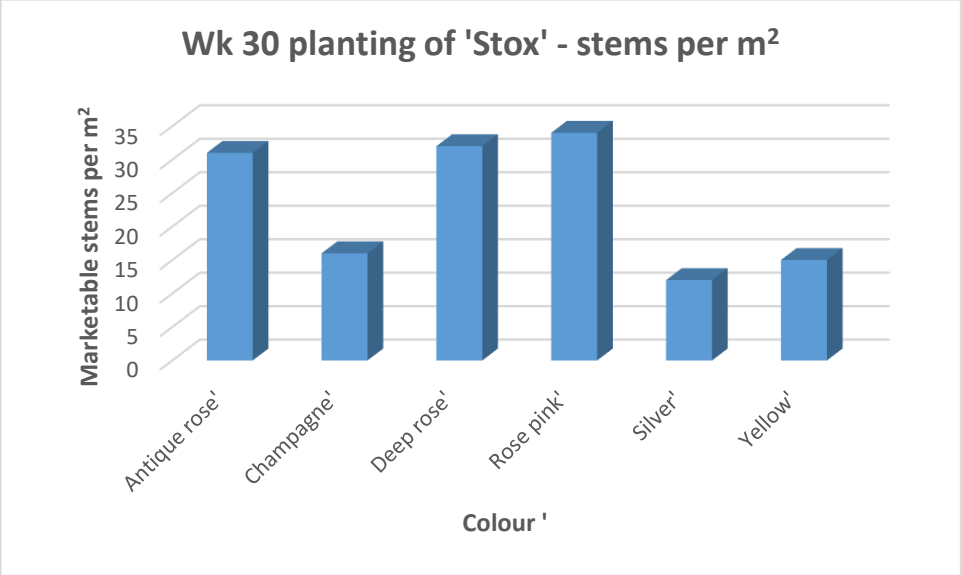

Figure 7. Assessments of number of marketable stems per m^2 from the week 30 planting of the various 'Stox' varieties.

Column stocks *(Matthiola)* - *Fusarium* varietal susceptibility trial

It is known that some varieties of column stocks are more susceptible to *Fusarium* than others as was clearly demonstrated in previous CFC trials. As there have been a number of new varietal introductions in recent years it was intended to undertake a large scale replicated variety trial in the Haygrove tunnel during the 2023 season. However, after becoming apparent that 2022 would be the final year that the CFC would hosted by Rookery Farm (owing to the sale to Sarah Raven) the decision was taken to bring the trial forward to 2022 and plant it after the biopesticide trial was completed. This meant that the trial was not planted until week 29 which is not ideal for column stocks but the decision was

taken that it was worth the risk rather than obtaining no results as would have been the case if no trial was undertaken.

Table 6. Details of 2022 *Fusarium* variety susceptibility trial.

Site	Rookery Farm
Varieties	See list included in the graph at figure 9.
Format(s) and supplier(s)	Plugs from Florensis.
Propagation and pre-planting treatment(s)	Standard propagator treatments.
Planting or sowing date(s)	Planted in week 29
Plant spacing(s)	64/ m^2
Planting site(s)	1m-long plots.
Layout	Replicated trial
Post-planting treatment(s)	None
Pests, diseases and disorders	The very hot weather in 2022 resulted in some issues with both the establishment of plugs and growth of the plants which resulted in some losses and poor growth.
Picking stage(s) and market specification(s)	N/A.
Picking and recording date(s)	Fusarium levels were assessed on 9th August, 28th August and 23rd September.
Records taken	Assessment of Fusarium infection score (0 to 5) of the same random 10 random stems within each plot.
VL testing	N/A

Figure 8. *Fusarium* column stock variety susceptibility trial in 2022; top left trial planted in week 29 ; top right seedling stress caused by the hot weather; bottom-left view of the trial 4 weeks after planting and bottom right poor growth caused by the hot weather plus *Fusarium* starting to develop in week 33.

The results of the *Fusarium* assessment scores on each variety are shown at Figure 9.

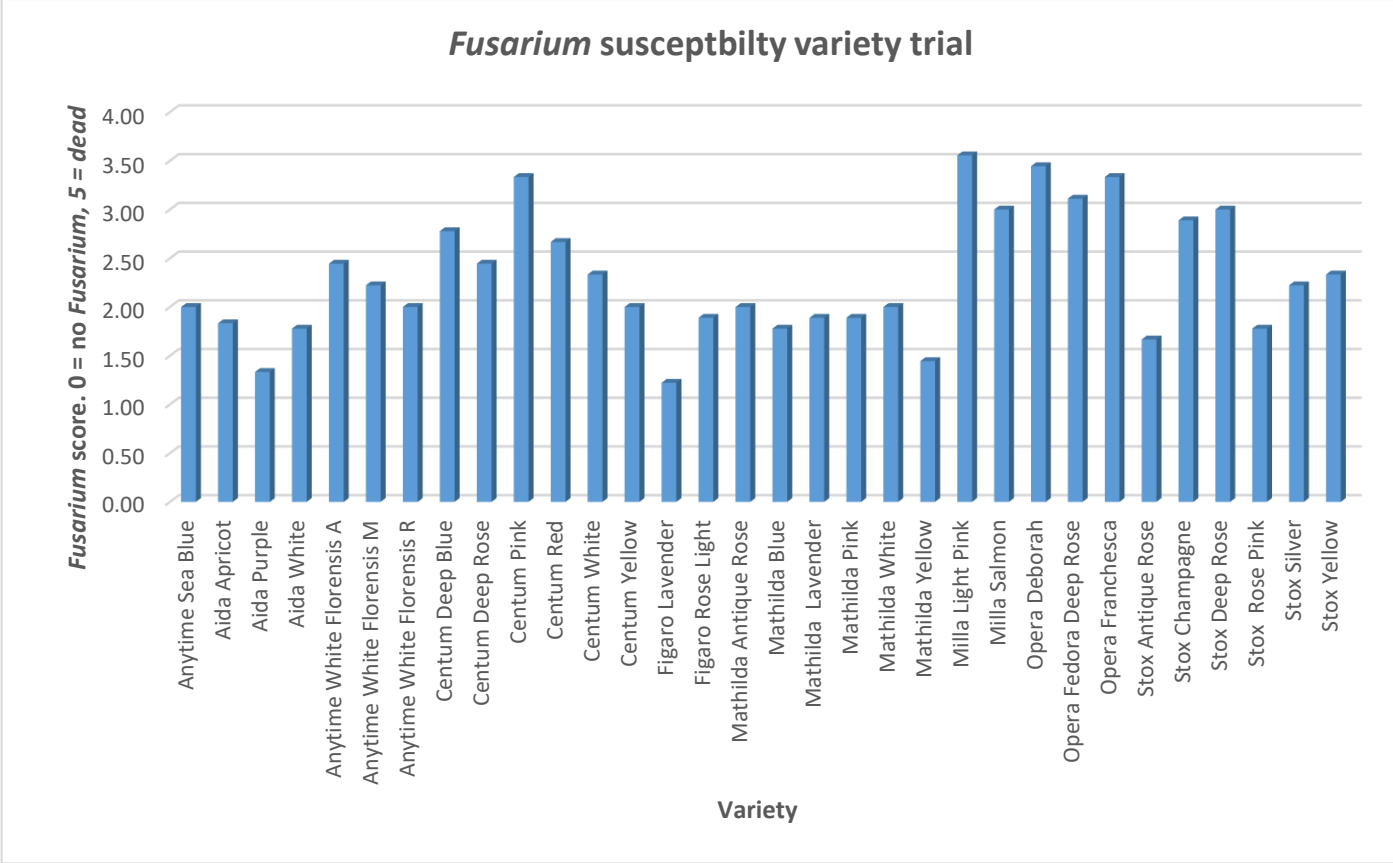

Figure 9. Assessments of levels of Fusarium infection from 10 plants located in the centre of each plot. This is an average of all three assessment dates.

The very hot weather throughout August 2022 meant that a lot of plants were lost at the seedling stage and the plants continued to struggle throughout the period of the trial. However, the results from older varieties did confirm already know susceptibility traits (e.g. 'Aida purple' is much less susceptible than 'Opera Deborah' even though they are similar colours) so while the results obtained from the newer varieties (eg 'Stox') must be treated with some caution, they can probably be used as an indication of varietal susceptibility until more information becomes available.

Column stocks *(Matthiola)* – Phytotoxicity testing of potential new downy mildew fungicides.

Following industry wide issues with the control of downy mildew on column stocks during the

2018 production season, the CFC has undertaken a number of trials to ensure that the industry is able to adequately control the disease. A spray programme developed by the CFC in 2018 has been used very successfully since, but one of the key active ingredients (*dimetomorph)* could be lost in the near future and *Mancozeb* is already difficult to obtain. Earlier CFC funded trials undertaken at FERA have identified a number of potential chemicals that could be incorporated into the spray programme if suitable EAMU's can be obtained for their use on column stocks. To assess potential phytotoxicity issues, four of these products were chosen in 2022 to undertake specific phytotoxicity trials at the CFC.

Table 7. Details of 2022 phytotoxicity downy mildew trial.

Site	Rookery Farm
Varieties	'Aida purple', 'Centum red', ' Figaro Rose Light', 'Mathilda white', 'Mathilda yellow and 'Opera Debora'.
Format(s) and supplier(s)	Plugs from Florensis.
Propagation and pre-planting treatment(s)	Standard propagator treatments.
Planting or sowing date(s)	Planted in week 20.
Plant spacing(s)	64/ m^2
Planting site(s)	3m-long plots.
Layout	Replicated trial
Post-planting treatment(s)	Each bed received a different fungicide which was applied at 3 times the standard rate in week 22, twice the standard rate at week 25 (at bud formation) and standard rate in week 28 when in full flower. Details of the chemical and rates are listed in table 7.
Pests, diseases and disorders	None seen in this crop.
Picking stage(s) and market specification(s)	N/A.
Picking and recording date(s)	Regular visual assessments of any phytotoxicity damage on all varieties
Records taken	Because no phytotoxicity was observed at any stage of the crops development, no formal records were taken.
VL testing	N/A

Figure 10. Column stock phytotoxicity trial in 2022; top left trial being planted in week 20; top right trial in full flower in week 27; bottom-left close up of the trial 2 days after second application of fungicides in week 25 and bottom right close up of flower spikes after final application of fungicides in week 28.

Table 8. Details of the fungicide treatments of the 2022 column stocks phytotoxicity trial.

Treatment	Active ingredient	Dose rate /ha	Application volume.	Concentration – product per L	Approval notice.
AHDB 9747	N/A	0.15	400L	3.75	Not approved
AHDB 9702	N/A	0.5	400L	1.25	Not approved
AHDB 9701	N/A	0.6	400L	1.50	Not approved
AHDB 9808	potassium phosphonate (phosphite) + seaweed	4.5	400ml	5.625	EAMU applied for.

No phytotoxicity or crop damage of any sort was seen on any of the treatment plots at any stage of the crops development and the end product was high quality stems which would have been marketable had this been a commercial crop.

Limonium sinensis

Limonium is grown in Holland but is not produced by many UK growers. Of the product that is grown in the UK, most is direct seeded annual varieties with very little vegetatively or micro-propagated crop being produced. New varieties of micro propagated *Limonium* from Danziger were offered to the CFC in 2021 and some of these showed real promise. The best performing varieties were planted on a larger scale at the CFC in 2022.

Table 9. Details of 2022 Limonium trial.

Site	Rookery Farm
Varieties	‘Sensy Pink Beauty’, ‘Pinocolada’ and ‘White’.
Format(s) and supplier(s)	Plugs from Danziger.
Propagation and pre-planting treatment(s)	From microprop material.
Planting or sowing date(s)	Planted in week 19
Plant spacing(s)	8/m^2 and 13/ m^2
Planting site(s)	18m-long plots.
Layout	Demonstration plots
Post-planting treatment(s)	One layer of support netting
Pests, diseases and disorders	No problems were observed in 2022
Picking stage(s) and market specification(s)	30 to 50% of flowers open
Picking and recording date(s)	‘Sensy Pink Beauty’ and ‘White’ harvested in week 34 and ‘Sensy Pinocolada’ harvested in week 36,
Records taken	Observations, picking dates and yield.
VL testing	VL testing in 2022 showed a 13 day period before the stems began to blacken and the trial was terminated.

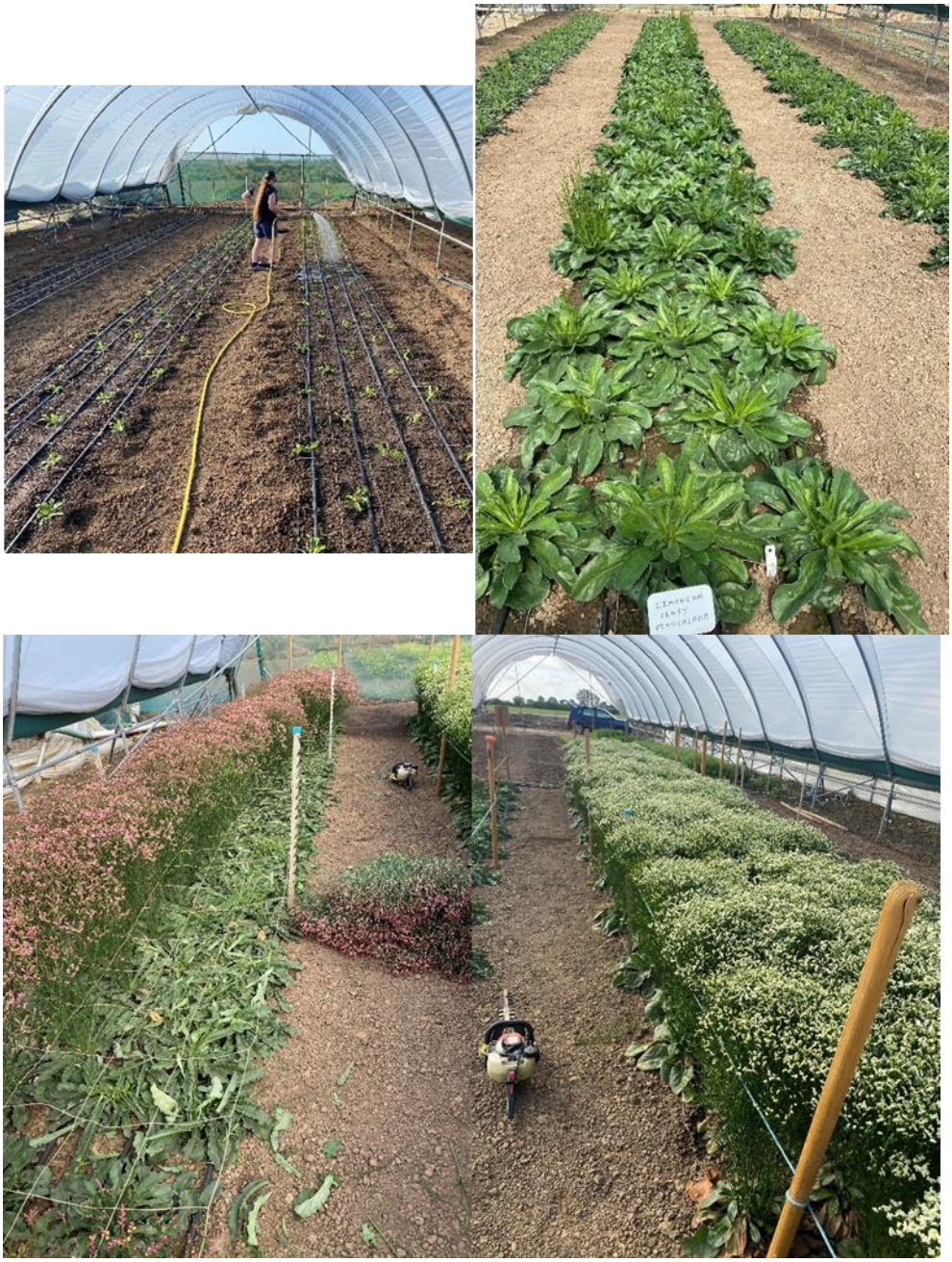

Figure 11 . *Limonium* in demonstration plots in 2022; top left trial planted in week 19; top right well established crop in week 28; bottom-left ‘Sensy Pink Beauty’ being harvested in week 34 and bottom right ‘Sensy Pinacolada’ in full flush in week 36.

The plants established well and grew away without any issues. The ‘Pink Beauty’ and ‘White’ were the first to flower in week 34 with the ‘Pinacolado’ flowering in week 36. Stem strength and length was exceptional with the ‘White’ being in excess of 1m in length. Fixed areas were harvested from all varieties from both planting densities using a hedge trimmer to achieve once over harvesting. These were then put down the packing line at a local marketing

company to assess the yield, but unfortunately the results were mislaid before being given to the CFC. Another marketing company then harvested the remainder of the stems but did not distinguish the two different planting densities. When these were graded out by this company the average number of marketable stems for plant would equate to 72 stems per m^2 at the lower density of 8 plants per m^2 and 117 at 13 plants per m^2 giving an average of around 100 stems per m^2. The trial did not produce a marketable second flush because the stems produced were very short.

Peony herbicide trial.

The area of UK grown peony has increased over the past decade and one of the main issues that growers face is weed control. This was highlighted at the 2019 CFC Open Day where it was identified as the top priority for future trials conducted by the CFC. In order to address this need, the CFC has instigated a number of trials to investigate both pre and post weed emergence control. The 2022 trial investigated the use of contact and systemic herbicides applied after the crop has been cut down in the Autumn. The herbicides will be applied again when weed growth occurs in the spring and both weed cover and crop phytotoxic observations will be recorded.

Table 10. Details of 2022 post cutting back peony weed control trial.

Location	New Horizon Flowers Pinchbeck site.
Variety	'Sarah Bernhardt'.
Plant longevity and hardiness	Hardy long lived perennial propagated from tubers.
Format(s) and supplier(s)	Long established crop and original supplier not known.
Layout	Three replicates randomised trial
Post-planting treatment(s)	Herbicides applied over the top of the crop in week 41 2022.
Pests, diseases and disorders	None evident during the period of the trial.
Picking stage(s) and market specification(s)	N/A
Picking and recording date(s)	N/A
Records taken	N/A at this stage
VL testing	N/A

Table 11. Details of the specific herbicide treatments of the 2022 peony herbicide trial.

Treatment	Active ingredient	Dose rate /ha	Application volume.	Concentration	Approval notice.
Untreated	N/A	N/A	N/A	N/A	N/A
Shark + Toil	60g/l carfentrazone-ethyl	0.8L + 1.00L	400L	2.0 + 2.5ml/L	Approved
AHDB 9897	N/A	0.8L + 1.00L	400L	2.0 + 2.5ml/L	Not approved, pending approval.
Corzal SC	160g/l	3.0L	400L	7.5ml /L	Approved

	phenmedipham				
Dow Shield	400g/l clorpyralid	0.5L	400L	1.25ml/L	Approved
Starane Hi-Load	333g/L fluroxypyr	0.6L	400L	1.5ml/L	Approved
Starane XL	2.5g/L florasulam and 100g/L fluroxypyr	1.8L	400L	4.6ml/L	Approved for use until 31st March 2023.
Basagram	Bentazone 87% w/w SG	1.65L	400L	4.13g/L	Approved
AHDB 9700	N/A	1.0L	400L	2.5ml/L	Not approved, EAMU applied for.
AHDB 9699	N/A	3.5L	400L	8.75ml/L	Not approved
AHDB 9698	N/A	1.2L	400L	3ml/L	Not approved

As this is the first year of the trials there are no meaningful results to report owing to the herbicides not being applied until early winter. Full results and interpretation will be included in the 2023 CFC annual report.

Seed Priming Trial

Seed priming is a technique used quite extensively in the vegetable industry but has not been widely adopted by the cut flower industry. Preliminary trials undertaken by Elsoms Seeds had shown that there may be the potential to prime some flower seeds with the intention of producing an earlier and more even germination hence aiding with both weed control and making flower maturity more even. Initial trials undertaken at the CFC in 2021 did not show any differences between the primed and unprimed seeds and it was decided to undertake further trials in 2022. It had been intended to undertake these trials at the CFC site but owing to the sale of Rookery Farm to Sarah Raven the site had to be vacated by October so it was decide sow the trial in a cold tunnel on a growers holding. Sowing of larkspur and sweet William (4.5gms per 25m run) were made on the 30 of September and 14 of October.

Figure 12. Seed priming trials in 2022; top left, first sowing in week 39; top right first sowing of larkspur in week 49; bottom left, second sowing of primed sweet William in week 49 and bottom right, second sowing of unprimed sweet William also in week 49.

The 2021 trials did not show up any clearly observable differences between the primed and non-primed crops and it is unlikely that the CFC will continue with seed priming trials.

Sunflower petal spotting issue.

The CFC has for some years investigated the petal spotting issues that occur on UK grown sunflowers for cutting, but no conclusive cause of the problem has so far been identified. In

previous years the disease *Itersonila perplexans* was isolated from some samples, but not from all, meaning that it could not be categorically identified as the cause of the problem. Unfortunately, the methodology required to identify *Itersonilia* was notoriously difficult but recently been revised for the investigation of parsnip canker which can be caused by *Itersonila spp.* As *Itersonilia* produces ballistospores suspended plating is used to capture the ballistospores. These the spores will start growing and form a mycelial colony which is quite specific because very few fungi grow in this way. And then to be absolutely certain, molecular testing with PCR is undertaken and samples can then be sent off for sequencing to see how alike it is to other *Itersonilia* samples that has already been isolated. This can be helpful if you want to see the similarities or differences between samples from different sites or hosts. Some of this work on parsnips has been undertaken by Lauren Chappell from Warwick Life Sciences who was contacted by the CFC with a view to develop a joint project to further investigate the sunflower issue. During the 2022 season, Lauren and other colleagues from Warwick visited sunflower fields in Lincolnshire to better understand the production process and also collected samples to return to the labs in order to refine their technique for testing for sunflower *Itersonilia.*

While the 2022 season was mainly used to develop a strategy for further work in 2023, it also produced some useful results with *Itersonilia* being isolated from a number of samples.

Tanacetum vulgare

Tanacetum (also known as Matricaria) is a member of the Asteraceae family and produces a mass of small flower heads similar to Santini chrysanthemums. They are widely grown in Holland and imported to the UK to be used mainly as a filler. A small trial in 2021 indicated that the crop is relatively easy to produce and could be considered as a potential candidate for import substation.

The purpose of the 2022 trial was to further investigate the potential for *Tanacetum* to be grown as a UK crop with a specific emphasis on continuity of cropping achieved through appropriate planting dates.

Table 12. Details of 2022 Tanacetum variety demonstration

Site	Rookery Farm
Varieties	‘Amazone’, ‘Vegmo Single’ and ‘Rio’
Plant longevity and hardiness	Grown as a non hardy annual.
Format(s) and supplier(s)	Plugs from Florensis
Propagation and pre-planting treatment(s)	None
Planting or sowing date(s)	Planted in week 18, 23, 26, 29 and 30. They were supported with one layer of wire.
Plots	6 m-long plots
Planting site(s)	‘Pro-Tech’ tunnel bay 1
Layout	Demonstration plots
Plant spacing(s)	64/m^2
Post-planting treatment(s)	N/A.
Pests, diseases and disorders	Last year the crop had a small amount of leaf miner but it was kept under control in 2022 by an appropriate prophylactic spray programme. Powdery mildew occurred on the later plantings especially the ‘Vegmo single’.
Picking stage(s) and market specification(s)	With a maximum of 30 to 50% of flower heads open
Picking and recording date(s)	Week 18 planting was harvested from week 27, week 23 planting was harvested from week 31, week 26 planting was harvested from week 33, week 29 planting was harvested from week 37 and the week 30 planting was harvested from week 40 onwards.
Records taken	Observations
VL testing	One packer tested at their own facility and obtained a VL of 15 days.

Figure 13. *Tanacetum* trials in 2022 (various dates); top left; second planting in week 23 with week 18 planting on the left; top right 'week 17 planting in flower week 27; bottom left powdery mildew on 'Vegmo single' in week 38 and bottom right 'Amazone' also in week 38.

All plantings established well and grew away with no issues except for an infection of powdery mildew in the later plantings, especially in the 'Vegmo single'. The first flowers were cropped 7 to 8 weeks after planting with the 'Vegmo Single' consistently flowering 7 to 10 days earlier than the other varieties. All of the varieties produced an even crop with strong stems of which most were in excess of 70cms long. The week 29 and 30 planting did not flower as evenly

as the earlier plantings and the advice from the propagator is that week 28 to 30 is latest recommended planting dates for this crop.

Discussion

Aster ericoides

Aster ericoides is a crop that is in demand for use as a filler in UK provenance bouquets and is already widely grown in Holland but mainly as a daylength manipulated crop. Its production as a natural season crop will be more problematic owing to the limited window of supply but it could have a place in a seasonal bouquet. However, for this to be successful the flower stems need to be smaller (in terms of length, bulk and weight) than those produced in the 2021 trial. Cutting the crop back to ground level in week 23 of 2022 did help to achieve a more manageable crop but in retrospect this could perhaps have taken place another 2 weeks later in order to achieve even shorter and less bulky stems.

There is a market demand for more UK product at the time of year that these asters flower (late September to early October) with the shape of the stems making the product suitable for mail order and wholesale grade, and if cut back later the smaller and lighter stems would be suitable for fillers within bouquets. The white varieties would be popular for autumn weddings and other events and would replace Gypsophila at a time when the UK season would be coming to an end.

Column stocks *(Matthiola)* - *Fusarium* control using biopesticides

The 2022 *Fusarium* biopesticide trial is a culmination of a number of years trials which have been undertaken by the CFC both on growers holdings and in the CFC Haygrove tunnel which was previously intentionally inoculated with a *Fusarium oxysporum* culture originally obtained from growers holdings. Unfortunately none of the biopesticide trials, including those undertaken in 2022 showed any statistically (or visual) improved control of *Fusarium* on column stocks. It should be noted though that these trials were conducted in soils that had a high level of *Fusarium* infection and in some cases during very warm weather which meant that the plants susceptibility to the disease would be at its greatest. It is not now envisaged

that the CFC will undertake any additional work on these products unless new information becomes available.

Column stocks *(Matthiola)* - *Fusarium* control using Elicitors

The CFC has not previously investigated the use of Elicitors for the control of *Fusarium* in column stocks. Unfortunately the 2022 trial indicated that they are not able to provide enough defence to enable the plant to reduce its susceptibility to *Fusarium* attack in this trial. This result is the same as has been obtained with the other CFC trials investigating *Fusarium* control in column stocks when the plant is subjected to a high level of inoculum. In these situations, the only control option still open to growers producing in intensive production systems if a crop rotational option is not available (which it isn't to most UK producers) is to sterilise with steam.

Column stocks *(Matthiola)* – Late flowering trial of new 'Stox' varieties

This trial showed that new 'Stox' series do not have the same issues with hot weather as do the more traditional varieties. July and August of 2022 was excessively hot with temperatures reaching in excess of 40^{o}C yet all of the 'Stox' varieties produced flowers, with the best stems exceeding 60cms in length. However the current selections will not be commercially viable for a UK supermarket crop because of the low percentage of stems that were of high enough quality to market. The number of marketable stems per square metre varied from 12 in the silver up to 34 in the Rose Pink and even the higher value would only be commercially viable if a premium price was being obtained for an out of season product.

From the 2022 observations (both at the CFC and on growers holdings) it can be concluded that the genetics of the 'Stox' variety mean that they could potentially be used to extend the season during the warm summer period but more work is required by the breeder to reduce the high levels of variability and significantly increase the percentage of marketable stems. It is hoped to undertake future trials on growers holdings if improved strains of 'Stox' become available in the future. 'Stox' however is a very confusing name and it has been suggested that they should simply be called 'scented autumn stocks'.

There would be a market for autumn stocks through florist outlets and for autumn weddings but without further market testing it is not possible to determine if they would command a premium price to offset the low yield, although the height variability and irregular column length may be less of an issue than when supplying the supermarkets.

Column stocks *(Matthiola)* - *Fusarium* varietal susceptibility trial

While the 2022 trial results must be treated with a degree of caution owing to the late planting and very hot weather, the results would seem to be robust enough for growers to make variety choices based on the time of planting or/and known *Fusarium* issues in the soil.

Column stocks *(Matthiola)* – Phytotoxicity testing of potential new downy mildew fungicides

The 2022 trials have shown that there is very little risk of phytotoxicity issues occurring when using the range of fungicides that have the potential to be introduced to the column stock downy mildew control programme. This information will also be used to support ongoing EAMU applications going forward.

Limonium sinensis

The three varieties of 'Sensy' planted in 2022 produced a superb quality crop with stems being in excess of 1m tall and producing an average of around 100 stems per m^2 of bed. However, because these are produced by micropropagation, the plant price is very expensive at about £1.50 per plant, therefore 15p per stem would be required just to recoup the plant cost. It would therefore need to be sold as a premium product and achieve a stem price (probably around 40 to 45p) that reflected both the high plant cost and long production time.

Peony herbicide trial

The 2022/23 herbicide trial is one of a number of trials to be undertaken by the CFC as a direct result of grower feedback, which has identified such work as having a high priority. The 2022 trial treatments were applied in late Autumn and the treatments will be repeated in Spring 2023. Results will therefore not be available until the 2023 season and will be

documented in the 2023 annual report.

Seed priming trial

In principle seed priming should be very advantageous to flower crops to both produce a more even stand of seedlings and also aid herbicide efficacy and general weed control owing to an earlier emergence of the crop which should then outcompete the weeds. Unfortunately the CFC trials undertaken in 2021 and 2022 did not demonstrate any observable differences in the treatments for larkspur and Sweet William. The CFC will investigate this further with Elsoms to see if there are further ongoing developments that would justify future trials on growers holdings.

Sunflower petal spotting issue

The 2022 work in conjunction with Warwick Life Sciences has indicated that *Itersonila* could be the primary cause of the ongoing sunflower spotting issue. However this will be investigated further in 2023 when the project will tap into other funding which Warwick has obtained to enable trials to be undertaken to attempt to infect healthy plants with the fungus in a controlled environment in order to reproduce the symptoms seen in the field. If this is successful and further field samples in 2023 consistently confirm the presence of *Itersonilia* the CFC will move onto the final stage of this work i.e. the development of control strategies.

Tanacetum parthenium

2021 was the first year that the CFC has investigated *Tanecetum* and the trials proved very encouraging. It was trialled again in 2022 with a particular emphasis on planting dates and continuity with crops being planted in week 18, 23, 26, 29 and 30. Each planting took around 9 to 10 weeks to produce a marketable crop and the 2022 trials indicate that to achieve a good continuity of cropping, planting would need to be around fortnightly. The crop was easy to grow and suffered from very few problems, although a prophylactic spray programme was applied to control leaf miner which was a slight issue in 2021. Powdery mildew was an issue in the 2022 trial especially on the ‘Vegmo Single’ but had not been seen in 2021. This

is a product that would appear to have a good potential for UK produced filler and its similarity to Santini type chrysanthemums gives it further potential for a wider usage in mixed bouquets. The 2022 trial have shown that continuity is easily achievable and once over harvesting is possible for all except the latest planting dates (week 29 and 30) which produced a crop that is potentially too uneven to apply this harvesting technique.

Knowledge and Technology Transfer

Website

The CFC website (www.thecutflowercentre.co.uk) carries news of events, notifications of handouts and reports.

Events

The CFC Open Days have consistently attracted 80–100 delegates and continue to be the only national event attended by a large proportion of UK cut flower industry including associated members of the retail sector. The final Open CFC Day to be hosted by Rookery Farm was help on 17 August 2022.

Publications

Factsheet 01/20. Guidelines for the post-harvest handling of cut flowers and foliage.

Webpage. Scabious as a new flower for the UK market.

Webpage. Seed raised species suitable for use as 'fillers' in mixed bouquets.

Webpage. Management of botrytis in cut flower peony crops.

Webpage. Ornamental grasses suitable for use as 'fillers' in mixed bouquets.

