Project title:	**Lavender: A review of factors affecting quality production at different times of the year.**
Project number:	**HNS 81**
Project leader:	**Dr Jim Monaghan** **HRI-Efford** **Lymington** **Hants. SO41 0LZ**
Report:	**Final report (May 2000)**
Previous reports:	**None**
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Location:	**HRI-Efford**
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Date commenced:	**1st Jan 1999**
Date completed:	**31st March 2000**
Key words:	**Lavender, agronomy, diseases, grower survey**

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Background and Objectives

Lavender is an important containerised HNS crop, with approximately 2 million plants being produced per annum. There are two main periods of production:

- over wintered material for spring sale
- spring potted material for summer sale.

Lavender can be a difficult crop to grow well and losses are often quite substantial. Anecdotal evidence suggests that plant losses can be in the region of up to 30% of plants grown under protection and 50% of outdoor grown plants. There are problems with quality plant production in the UK at different times of the year, particularly maintaining quality over winter, with some evidence that cultural/environmental factors are influencing losses (e.g. overhead watering is associated with *Botrytis*). However, limited information is available on best cultural practices. Additionally, lavender is of Mediterranean origin, preferring a relatively dry growing medium of approximately pH 7. In contrast, the UK container production of lavender relies on peat-based media and this relatively acid growing medium may be another factor in reducing plant quality, though this needs further investigation.

This review was commissioned by the HDC to ascertain the severity of production problems and to supply information on the current growing practices and factors associated with fewer plant losses. Additionally, it was intended to highlight areas/factors that may benefit from further focussed research.

The objectives of this survey were to:

a) Carry out a survey of lavender growers from the HDC database, asking questions about production systems, sources of material, disease occurrence/seasonality, and the effects of cultural and environmental conditions.

b) Collect a small number of samples of plant material displaying common symptoms from growers at different times of the season and carry out isolations and screening to identify causal pathogens.

c) Recommend an R & D programme which will address the common problems highlighted.

Summary of results

Views were obtained from 20 lavender growers whose scale of production ranged from 1,000 to 220,000 plants per year, with a combined total production of 1.24 million plants per year. A summary of the conclusions of the survey are detailed below.

- Attention to detail at all stages is required to produce a quality crop with minimal losses.

- Lavender losses are least in systems with:
    - capillary irrigation
    - correct watering
    - well vented protected structures
    - moderate rates of CRF

- There is the opportunity for scheduling for specific target markets/dates throughout year, especially with greater understanding of manipulation – A current MAFF project on lavender will enable crops to be programmed with a degree of accuracy hitherto not possible.

- The most important pathogens appeared to be *Botrytis cinerea* and *Phomopsis lavandulae* both from the survey and from the samples analysed at HRI-Efford.

Recommendations for further work

1. Variability in the vigour of cuttings and the effect on cutting establishment could be reduced through clonal selection, with the best stock maintained through micropropagation, where it can be held in a 'library' for accession for new stock as required.

2. Study is needed on the propagation of lavender, with high losses reported at this stage. Work should investigate the effect of stock plant management on the quality of cuttings and cutting survival.

3. Further study is needed on growing substrate structure. The findings from PC 157 showed the important role of Media Air-Filled Porosity (AFP) and biological activity in the establishment of strong and healthy roots. AFP would also have a direct effect on water retention and hence on the watering regimes best suited to lavender. This area has not been studied in HNS before.

4. The effect of pH has not been studied in detail before. This is another channel of research with potential for leading to improved plant quality.

5. The quality of lavender growth may be improved through the use of higher potash feeds/CRF as used with other herbaceous species. Currently there is no information on the best fertiliser analysis for growing lavender.

6. Further study is also needed to address more applied questions regarding scheduling of plants in flower over an extended season. The principles have been established and demonstrated already in a MAFF funded programme and further work is needed to develop growing 'protocols'.

Science Section

Introduction

Lavender is an important containerised HNS crop, with approximately 2 million plants being produced per annum. There are two main periods of production:

- over wintered material for spring sale
- spring potted material for summer sale.

Lavender can be a difficult crop to grow well and losses are often quite substantial. Anecdotal evidence suggests that plant losses can be in the region of up to 30% of plants grown under protection and 50% of outdoor grown plants. There are problems with quality plant production in the UK at different times of the year, particularly maintaining quality over winter, with some evidence that cultural/environmental factors are influencing losses (e.g. over-head watering is associated with *Botrytis*). However, limited information is available on best cultural practices. Additionally, lavender is of Mediterranean origin, preferring a relatively dry growing medium of approximately pH 7. In contrast, the UK container production of lavender relies on peat-based media and this relatively acid growing medium may be another factor in reducing plant quality, though this needs further investigation.

A three year MAFF funded project on the factors that influence flowering in lavender (HH1525THN) is currently underway at HRI-Efford in collaboration with HRI-Wellesbourne. Lavender was also one of the species in the CRF screening trial (HDC 43d) and was grown under protection, following potting in autumn 1998. It has become clear, in the course of these trials, that lavender is a difficult crop to grow with only limited information available on the current solutions to these problems.

This review was commissioned by the HDC to ascertain the severity of production problems and to supply information on the current growing practices and factors associated with fewer plant losses. Additionally, it was intended to highlight areas/factors that may benefit from further focussed research.

Objectives of this review were to:

a) Carry out a survey of selected lavender growers, asking questions about production systems, sources of material, disease occurrence/seasonality, and the effects of cultural and environmental conditions.

b) Collect a small number of samples of plant material displaying common symptoms from growers at different times of the season and carry out isolations and screening to identify causal pathogens.

c) Recommend an R & D programme which will address the common problems highlighted.

Materials and Methods

Questionnaire

The questionnaire was written with the help of the grower co-ordinators.

The questions were aimed at identifying:

- Scale of lavender production
- Methods of lavender production
- Production problems
- Disease problems

In addition, anecdotal evidence was collected to help identify important cultural and environmental factors involved.

It was originally intended to undertake the questionnaire by phone. Following initial phone calls, it became apparent that most growers preferred to reply to a faxed questionnaire. Twenty-five growers were selected following initial phone calls, and were faxed a prepared questionnaire (see Appendix II).

Samples

A number of diseased plant samples were collected from commercial nurseries during 1999 for analysis. Plants were assessed for visual symptoms and any clear symptom-types, such as leaf spots, were photographed for later reference. Isolations were attempted from pieces of diseased tissue by cutting out, surface sterilising pieces of 'leading edge' in sodium hypochlorite followed by sterile distilled water rinses, and plating these out on a range of selective and general isolation media [potato dextrose agar (PDA), BNPPA – phycomycete selective agar (Pettitt & Pegg, 1991) and hyphomycete selective agar (Parry, 1990)]. In addition, pieces of diseased tissue were; (a) floated in sterile pond water and observed after 1-2 days for phycomycete sporulation; (b) placed in damp chambers (100% RH) to encourage pathogen sporulation.

Results

Questionnaire

Twenty-five growers were phoned initially. With the telephone responses, answers were written on the questionnaire forms during the telephone conversations for later analysis. However, the majority of respondents preferred the faxed questionnaire. In total, twenty questionnaires were completed giving a good response rate of 80%.

Scale of production

The growers surveyed were growing a total of 1.24 million lavender plants. On average, each nursery was producing 62,050 plants each year. The numbers ranged from 1,000 plants bought in to grow on, to 220,000 plants produced predominantly from own stock. As a consequence, this survey identifies problems associated with growing lavender across most of the situations current in the UK.

The most commonly sold cultivars in the UK are those of *Lavandula angustifolia* and *Lavandula stoechas*. On average, each nursery was producing 8 *L. angustifolia* and 4 *L. stoechas* cultivars. However, a small number of growers (15% of respondents) produced greater than 20 lavender cultivars, and the average for the 'non specialist' nurseries was 6 *L. angustifolia* and 2-3 *L. stoechas* cultivars. Of all species, Hidcote was the most popular cultivar followed by Munstead, with 85% and 45% of nurseries reporting them as amongst their top sellers, respectively. Other popular cultivars were Sawyers, Papillon and Vera (25, 15 and 10% of nurseries reporting them as amongst their top sellers, respectively).

Most nurseries were producing plants for more than one market. Garden centres were the predominant target market with 80% of nurseries supplying plants, although this survey did not identify the number of lavender plants sold through them. Multiples were supplied by 40% of the nurseries; mail order (20%), other growers (20%), amenity (15%) and direct sales (10%) were supplied by a limited number of nurseries.

The main marketing periods reported were spring and summer. Plants were produced to different timetables for these two markets. Generally, all nurseries were following the same production schedules, dictated by the growing conditions and availability of cutting material. Cuttings are taken from March to October/November:

- spring cuttings are potted in 9 cm pots for summer sale (either sold in summer or potted on into 2-3 litre containers and over-wintered for spring sale).

- mid summer cuttings are potted in 9 cm pots, over wintered and sold in early spring (either sold in spring or potted on into 2-3 litre containers for summer sale).

- late summer cuttings are overwintered as plugs then potted into 9cm pots for spring sale the following year (either sold in spring or potted on into 2-3 litre containers for summer sale).

Lavender can be grown from seed, cuttings or micro-propagated plants. From this survey most nurseries (80%) were producing plants from rooted cuttings. Micro-propagated plants were bought in on 45% of the nurseries, whereas seed raised material was grown on 20% of nurseries. Half of all respondents supplemented the material produced from their own stock plants with bought-in material. Of the remaining nurseries 30% grew on material propagated from their own stock, only; and 20% grew on material propagated elsewhere and bought in. Overall, from responses that specified plant number and origin, 441,000 plants were produced from spring cuttings for summer sale, and 90% of the rooted cuttings originated from growers' own stock material. Over wintered rooted cuttings accounted for 339,000 plants, of which 81% were from growers' own material; and 253,000 plants were produced from over wintered liners, with 72% from growers' own material. These numbers show that over half (57%) of plant material on a nursery in a growing year had been over-wintered.

Production systems

Plants were being sold in a wide range of unit sizes: from rooted plugs, for growing on, to 7.5 litre containers. The most common unit size was the 9 cm pot, with 45% of nurseries selling material in this container. The proportion of nurseries producing containers above this size decreased the larger the container size, with only one nursery surveyed selling plants in 7.5 litre containers. All nurseries were producing material in plastic pots, and one nursery was also using alternative pot materials.

All the nurseries surveyed were growing in a peat based growing media. Peat alternatives were being used on a few nurseries (10%) but were not replacing peat in general production. All growers were aiming to produce an open mix by using a coarse peat mix and/or adding bark, perlite or vermiculite. Controlled release fertiliser was systematically incorporated into the growing media of containerised plants on all the nurseries, liquid feeding was used in the propagation stage on 30% of nurseries. Target pH varied between 5.5 and 7.0 with similar numbers of growers aiming for 5.5 - 6.0 (40%) as 6.0 - 6.5 (45%). Only 15% of growers were growing lavender in a pH greater than 6.5.

Most nurseries (60%) were irrigating plants using overhead systems. The remaining nurseries were either sub-irrigating or spot watering. However, a combination of systems was often used with 20% of nurseries switching from overhead to spot watering during the winter.

Pots were standing on a range of bases: gravel, sand and gravel / sand / soil / capillary matting covered with Mypex. Mypex covered standing areas can have some capillary action. This can help to prevent waterlogging, especially over winter. However, no capillary contact is possible for containers standing on gravel (with or without Mypex). Overall, 35% of nurseries were growing plants on a gravel standing base for some or all of the containerised production cycle. The majority of nurseries (70%) were standing containers on a base with some capillary properties.

All nurseries trimmed plants at each potting stage. Once in the 9 cm pot or liner stage, plants can be trimmed from March-October / November for cuttings, as well as building the framework of the saleable plant. A few (20%) of nurseries were using mechanical trimmers, the rest were trimming by hand.

Growing took place in a number of environments depending on target market and selling season. Half of the nurseries grew plants outdoors for some of the growing cycle, and 15% of nurseries grew plants without protection for the entire growing cycle. Conversely, half the nurseries grew under protection, glass or polythene, for the entire growing cycle, with 85% growing under protection for some of the season.

Nurseries separated into two categories for their pest and disease regimes: broad spectrum preventative regime (80%) and as a response to P&D problems (20%).

Production problems

When asked what caused the *majority* of plant losses, lavender growers highlighted the two following factors: environmental factors (60% respondents), i.e. water-logged pots, cold and humid growing environment with poor air movement, excessive nutrition from fertilisers, and weak propagation material (30% respondents).

A proportion of plant losses over winter, especially plants outside, was attributed to waterlogging by 35% of respondents, with all growers in the survey trying to avoid this problem by using high AFP, open growing mixes. Nonetheless, these losses could account for up to 70% of plants in a specific batch. The diseases associated with these conditions are discussed below.

A number of nurseries (45%) reported that weak material led to losses in the propagation stage in the year surveyed (1999). This was attributed to problems with the stock plants or weak clones of certain cultivars, which were susceptible to disease.

Disease problems

It was clear from the phone conversations that disease was a major cause of plant losses. Reported numbers ranged between 5 and 70%, although the latter figure was from a bad year for one nursery, and the average was closer to 40%. Nevertheless, a significant number (30%) of nurseries stated that losses greater than one third of all plants were common.

Botrytis

All respondents reported losses due to botrytis or botrytis-like symptoms. These were most commonly seen winter and early spring, especially under protection (Table 1 and Plates 1 - 4). The general consensus was that reasonable control was being achieved with regular fungicide applications. A number of growers reported that venting of protected structures and even the use of fans to circulate the air was of benefit. An interesting comparison was available on one nursery where plants were either grown under well vented polythene or cold glass. Those in the well vented structure faired well in comparison to the glass, and this was attributed to increased air movement reducing the humidity and therefore both the incidence and severity of botrytis infections. Botrytis was also observed where plants were too closely spaced, again limiting air movement and raising humidity, but also preventing penetration of canopy by fungicide sprays.

Phytophthora & Pythium

Phytophthora was reported by 35% of nurseries. This was most commonly seen in summer (Table 1 and Plate 5). The symptoms of both *Pythium* and *Phytophthora* are very similar and can occur weeks after initial infection. Infections can come from introductions of contaminated plant material, but large scale disease spread is usually the result of either splash or the presence of plenty of contaminated free water (bad drainage). The dangers of spreading these pathogens are well known and have been the subject of HDC-funded research (PC 97a). Contaminated water supplies can be successfully cleaned using a number of techniques including slow sand filtration (HDC reports HNS 88 & HNS 88a).

Shab (*Phomopsis lavandulae*)

A large proportion of disease samples assessed in this study showed symptoms of shab, and this disease was widely reported (45% of respondents) as important in the questionnaire. This is also a disease readily transmitted by water splash and is most commonly seen in the Summer (Table 1 and Plate 6a & b). Symptoms are commonly seen after pruning, although this may be no more than a coincidence of the season and pruning regimes (as well as increased observation during the pruning).

Rhizoctonia

Thirty percent of growers reported plant losses due to rhizoctonia. This is especially a problem in hot years and under protection, as the pathogen thrives in warm, moist conditions. Good plant hygiene can limit infection.

Leaf spots

Leaf spots were not widely reported as causing concern although a significant quantity of leaf spot sample were sent for assessments. Bacterial leaf spot was reported by one respondent although the bacterial species was not specified. Also reported was *Septoria* leaf spot (one respondent) which in past seasons has been recorded as widespread in UK lavender crops (Baker, 1972). *Septoria* leaf spot was expected but not seen in the relatively small number of samples assessed for this study. All of the leaf spotted material sent in for disease assessments was confirmed as being caused by *B. cinerea.*

Samples

Photographic plates of symptoms are presented in Appendix I.

Table 1. Results of isolations from samples of lavender tissues of different ages and from five different UK nurseries, showing a range of different disease symptoms.

Symptoms	Season	Nurseries	Pathogen / suspected pathogens isolated
General shoot dieback; some whole shoots dying back, also whole plants. = Root rot problems.	Summer, Autumn	A,B,E	*Phytophthora* sp. isolated from roots?
as above	as above	B,E	No pathogen confirmed, suspect *Phytophthora* sp.
Individual shoots chlorotic and dying back. Some shoots looking 'grey' and 'lifeless'. = Root rot problems.	Summer	C	*Phytophthora* sp. isolated from roots
Wilt; shoots, usually young, wilting, collapsing and dying back. Localised shoot death.	Summer, Autumn	A,B,C,D,E	All strongly suspected as 'Shab', although *Phomopsis lavandulae* not confirmed in every case
Scorch/Tip burn: necrosis on leaves and young shoot tips, with appearance of scorch or frost damage.	Spring, Summer, Autumn	A,B,D,E	*Botrytis cinerea* consistently confirmed.
Stem necrosis: necrosis on young plant stems, sometimes spreading onto leaves and wilting small side shoots.	Spring, Autumn	A,B,E	*Botrytis cinerea* consistently confirmed.
Leaf spots; foliage 'peppered' with small, often necrotic, spots 1 - 4 mm in diameter	Spring	A,B,E	*Botrytis cinerea* consistently confirmed.

Discussion

Lavender can be a difficult crop to grow. This is underlined by the extent of losses reported in the survey with up to 70% losses in individual batches. The majority of the losses were attributed to disease but it was clear that certain environmental conditions were associated with higher plant losses and a greater occurrence of disease. In general, the proportion of losses were greater on those nurseries with mixed croppings. This may be due to greater problems in the 'fine tuning' of the growing environment to suit lavender. A number of areas were identified as being a particular problem.

Watering

The majority of growers reported that water logging was a significant cause of plant losses. Experience at HRI-Efford has shown that lavender in 9cm pots can quickly become waterlogged with overhead irrigation. Waterlogging will increase the occurrence of *Pythium* and *Phytophthora*. One solution is to irrigate from beneath, via a capillary matting or sand bed system; and the survey clearly indicated that those growers with the fewest losses were sub irrigating. Overhead irrigation also increases canopy humidity, which leads to increased risk of *Botrytis* infection. Sub-irrigation has the added advantage of keeping the tops of the pots relatively dry, preventing the wet conditions associated with *Botrytis*. This effect can also be increased through growing in a well vented environment, and/or the use of fans to keep the air circulating thus preventing high canopy humidity.

Another solution to the problem of waterlogging is to use a more open mix that can drain more freely. However, this can lead to the problem of drying out. Over dry mixes are sometimes more difficult to rehydrate due to the hydrophobic qualities of dry peat (and breaking of the capillary contact with the growing base if capillary irrigation is used). Drying out can also exacerbate CRF flash release effects with a 'pulsing' of high EC solution around the roots on re-wetting. The use of wetting agents can improve water recapture and distribution with dry mixes, but care is still needed not to overwater. Ideally "little and often" is the best approach to irrigation rather than drying back then watering to field capacity. Monitoring equipment is becoming available that is capable of measuring the water status of individual containers, and in the future growers will have greater opportunity to ensure they water to plant requirements rather than excess.

Batches of lavender are often grown adjacent to general HNS species which may require higher levels of watering. The irrigation of the bed as a whole has to be based on a compromise between the two requirements, with the lavender receiving more water than required, hence becoming waterlogged. This was highlighted in HNS 38 where in a mixed bed this compromise led to no plants getting their ideal irrigation regime.

Nutrition

A large number of growers remarked on nutrition of lavender, and that high rates of CRF can lead to disease problems and plant death. High rates of nutrients especially nitrogen, lead to soft growth that is more prone to fungal attack. Additionally, high salt levels in the substrate can lead to root death. Manufacturer's recommended rates of CRF were compared in HNS 43d for a number of species including lavender. Lavender appeared to be particularly sensitive to the higher rates of incorporation and it was clear that much of the industry were using lower rates. In the survey, growers reported that moving to lower rates of incorporation (~2.5 kg/m^3) was associated with a reduction in plant deaths. This aspect is being further examined in a new HDC funded trial (HNS 43f).

pH

Lavender is of Mediterranean origin, often found growing in relatively alkaline soils. However, the survey showed that target pH varied between 5.5 and 7.0, with similar numbers of growers aiming for 5.5 - 6.0 as 6.0 - 6.5, and only a minority of growers aiming for a pH greater than 6.5. In work carried out at HRI-Efford studying the role of pH 'stress' on lavender flowering, results were inconclusive as to the effect on plant quality. Nevertheless, some growers felt that low pH substrates were leading to a loss of quality and had observed improvements when moving to a higher pH growing media. Care is needed when raising substrate pH, as there could be a risk of magnesium toxicity at levels greater than 2.4 kg/m^3 of magnesium limestone, and further lime requirements are added as ground lime. Additionally, some elements may become deficient at high levels of pH and/or magnesium (e.g. iron). The optimum target pH has not been established and further work is needed in this area.

Weak material

A significant number of growers reported losses due to weak plant material of reduced vigour: due to either problems with the stock plants; or weak clones of certain cultivars which were susceptible to disease. These problems could be reduced through clonal selection, with the best stock maintained through micropropagation, where it can be held in a 'library' for accession for new stock as required. Additionally, there is often confusion as to the cultivar, (especially with imported lines) and care is needed to ensure true to type and currently named materials are used.

Rooting success may be improved through stock plant maintenance, ensuring vigorous cuttings. There are also exciting prospects for the use of spectral filters to 'stretch' cutting internodes and aid collection of cuttings of a uniform size. This approach, linked with information available from the 'designer liner' work at HRI-East Malling, offers potential to improve rooting success, but needs further study to establish the benefits.

There is always interest in new varieties although it is clear that *L. angustifolia* 'Hidcote' is dominant at the moment. New cultivars may be available that are better suited to large scale production i.e. reduced susceptibility to disease, and there is potential to develop new lines for the UK market.

Overwintering

A lot of the problems with lavender occur during the overwintering phase of production. The survey showed that over half of plant material on a nursery in a growing year had been over-wintered. In some cases this is necessary to ensure a) material for early sale, and b) older, larger plants for sale in large containers. However, with the smaller containers (~ 9cm) it is now possible to produce flowering plants for early sale from micropropagated plugs bought in year round. The work underway at HRI-Efford and Wellesbourne has established the environmental requirements for producing flowering lavender (HH1525SHN). So far, the requirements for *L. angustifolia* 'Hidcote' have been established, and currently the applicability of these results to other cultivars of *L. angustifolia, L. stoechas* and *L. x intermedia* are being studied. The use of scheduling may also allow access to 'impulse sales' through the production of material in flower over an extended season.

Disease

The survey showed very clearly that disease was considered to be the major cause of losses, often associated with sub-optimal environmental conditions, especially the stress associated with over wet plants during winter. Of the diseases reported, *Botrytis* was seen as the greatest problem. A current MAFF LINK programme (HL0107LHN) is studying the integrated chemical and environmental control of this disease on a number of containerised ornamental species, including lavender, and results are encouraging at this stage.

Some root disease may possibly be avoided by using stronger cuttings and plugs with improved AFP, in an attempt to improve plants vigour and resistance to root rots. Promising results have been obtained in the propagation of chrysanthemum plants, where propagation media of differing AFP and biological activity significantly improved the resistance and performance of young plants in the face of severe *Pythium* disease pressure (PC 157). A similar approach may benefit a number of HNS species including lavender. By adopting best cultural practices, it may be possible to improve the ability of plants to withstand disease challenge and fungicide programmes may then become more effective.

Summary

- Attention to detail at all stages required.

- Lavender losses are least in systems with:
    - capillary irrigation
    - avoidance of overwatering
    - well vented protected structures
    - moderate rates of CRF

- There is the opportunity for scheduling for specific target markets/dates throughout year, especially with greater understanding of manipulation - MAFF project on lavender will enable crops to be programmed with a degree of accuracy hitherto not possible.

- The most important pathogens appeared to be *Botrytis cinerea* and *Phomopsis lavandulae* both from the survey and from the samples analysed at HRI-Efford.

Recommendations for further work

7. Variability in the vigour of cuttings and the effect on cutting establishment could be reduced through clonal selection, with the best stock maintained through micropropagation, where it can be held in a 'library' for accession for new stock as required.

8. Study is needed on the propagation of lavender, with high losses reported at this stage. Work should investigate the effect of stock plant management on the quality of cuttings and cutting survival.

9. Further study is needed on growing substrate structure. The findings from PC 157 showed the important role of AFP and biological activity in the establishment of strong and healthy roots. AFP would also have direct effect on water retention and hence on the watering regimes best suited to lavender. This area has not been studied in HNS before.

10. The effect of pH has not been studied in detail before. This is another channel of research with potential for leading to improved plant quality.

11. The quality of lavender growth may be improved through the use of higher potash feeds/CRF as used with other herbaceous species. Currently there is no information on the best fertiliser analysis for growing lavender.

12. Further study is also needed to address more applied questions regarding scheduling of plants in flower over an extended season. The principles have been established and demonstrated already in a MAFF funded programme and further work is needed to develop growing 'protocols'.

Current programmes of research studying or of relevance to lavender:

- Optimal CRF nutrition (HNS 43f)
- Incorporation of mycorrhizas in the growing substrate (HNS 99)
- Integrated chemical and environmental control of botrytis (Botrytis Link project)

Additionally, the following new project being commissioned in 2000 will be of direct relevance:

- Use of capillary matting in production systems (HDC)

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Appendices

Appendix I. Photographic plates

Plate 1. Leaf spots caused by *Botrytis cinerea* in *Lavandula angustifolia* 'Munstead'

Plate 2. Close up of *B. cinerea* leaf spots in *Lavandula angustifolia* 'Hidcote'

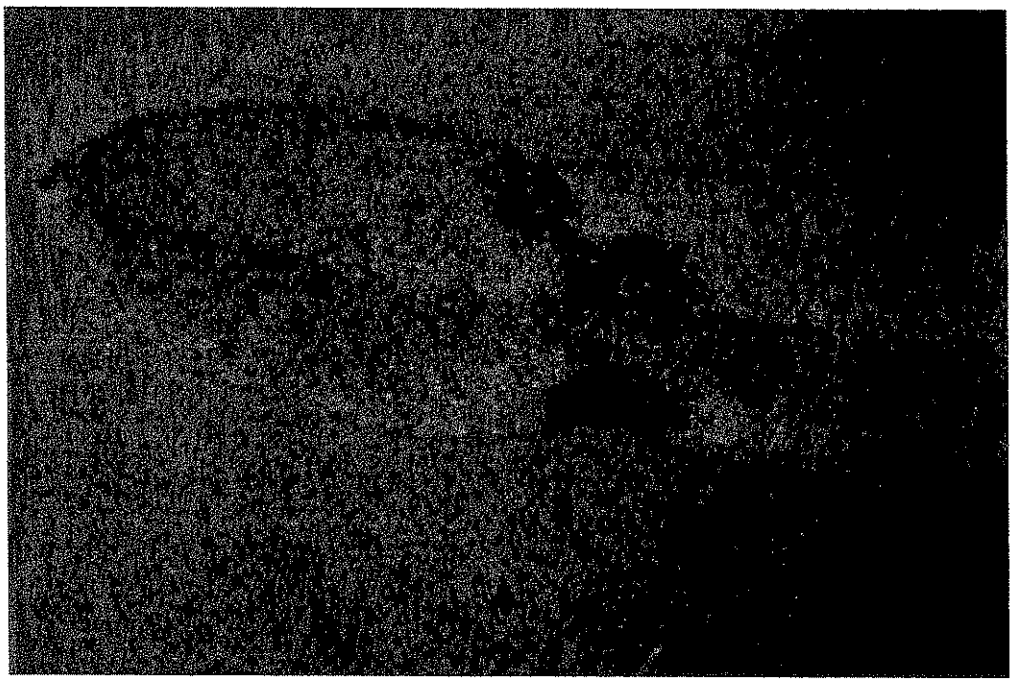


Plate 3. Scorch / 'Tip burn' caused by *B. cinerea* in *Lavandula angustifolia* 'Little Lottie'

Plate 4. Close up of stem necrosis caused by *B. cinerea* in *Lavandula stoechas* 'Papillon'

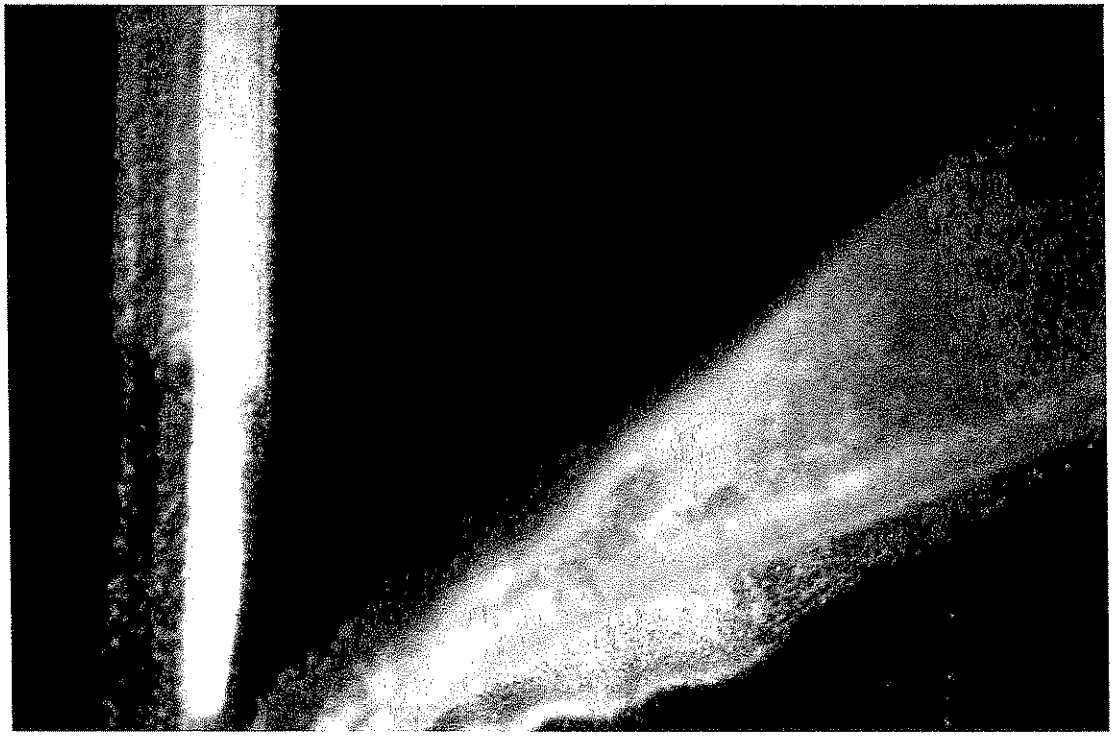


Plate 5. General shoot die-back caused by phytophtora root rot in *Lavandula angustifolia* 'Little Lottie'

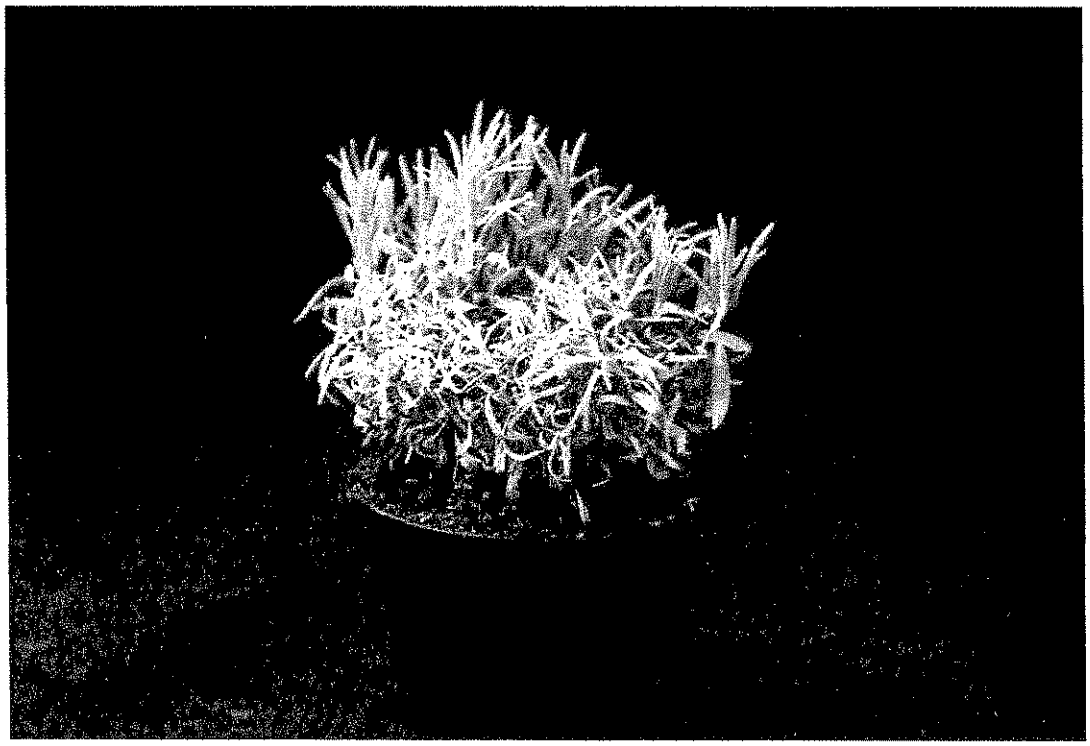
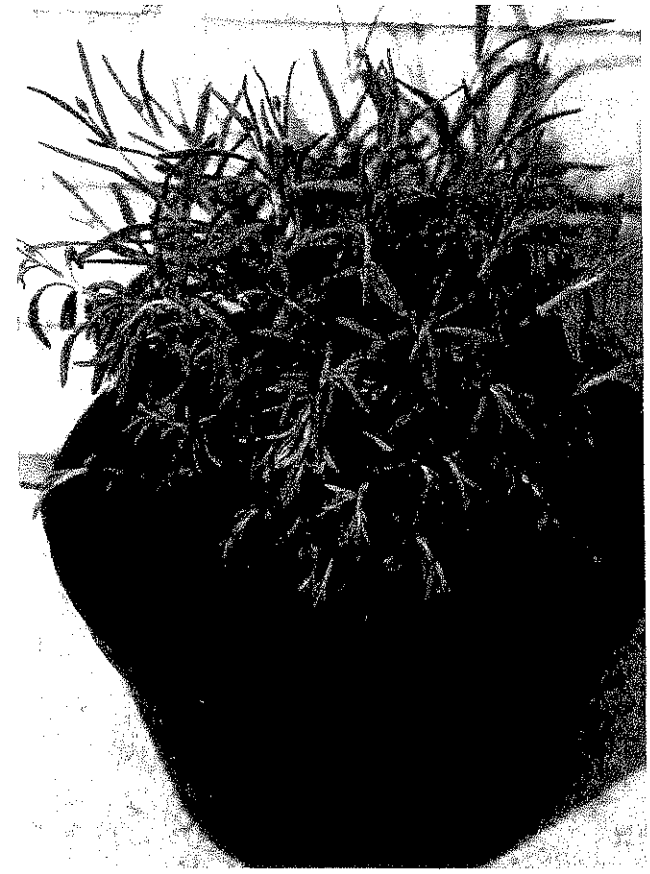


Plate 6a & b. Shoot die-back and collapse caused by 'Shab' *Phomopsis lavandulae* in *Lavandula angustifolia* 'Hidcote'.



Appendix II. Questionnaire

F.a.o.
Date:

Please reply to Jim Monaghan by
Fax: 01590 – 671553

Lavender: A Review of Factors Affecting Quality Production at Different Times of the Year (HNS 81)

Growers have requested the Horticultural Development Council to fund a survey which will give industry the means to improve the production of lavender, and reduce the number of plants that are unsaleable. Please could you complete the following questions by either indicating your choice of answer or briefly outlining your answer.

1) What species/cultivars of lavender are you growing?

a) number of species: *angustifolia* ..... ; *stoechas* .....

b) top sellers.....

2) Approximately how many plants do you produce annually, from:

a) over wintered liners ..... Own material Bought in

b) over wintered cuttings ..... Own material Bought in

c) Spring cuttings ..... Own material Bought in

3) What are your target markets ***(please circle as appropriate)***

Multiples Garden Centres Amenity Direct sales Mail order

4) What system of production are you using?

a) Seed Raised from cutting Microprop Other

b) Origin of material

Own stock plants Bought in

c) Saleable pot size .....

d) Pot material e.g. plastic, peat .....

e) Fertiliser

Liquid fertiliser CRF Combination

f) Growing media eg. Irish peat .....

g) Target *p*H .....

h) Production schedule (please briefly describe)

i) Irrigation

OH Capillary Spot watering

j) Standing base

Gravel Mypex on sand / gravel / soil Mypex on capillary Other

k) P&D routine (please briefly describe)

l) Trimming regime (please briefly describe)

m) Outdoor / Protection

Outdoor Glass Polythene

5) Have you experienced Disease problems?

a) What?

Botrytis Phytophthora Phoma Shab Rhizoctonia Other

b) When? .....

c) Estimated % plant losses .....

d) What level of success have you had with control measures?.....

6) Have you experienced *production* problems with lavender?

a) At what stage?

Propagation Under protection Outside

b) What?

Waterlogging Drying out Weak material Other

c) Estimated % plant losses? .....

d) Remedial action? .....

7) Have you any opinion on the causes of problems with lavender? .....

Samples of diseased tissue from Winter, Spring and Summer plants will be collected from a selection of sites and the main pathogens involved will be identified.

8) Would you be happy to assist? Y / N

Many thanks for your help with the questionnaire. Should you wish to discuss any of the questions please contact Jim Monaghan (01590-673341). The final report will be available through the HDC.

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