REPORT ON CELERY QUALITY SURVEY
- HDC PROJECT No. PC 99
AUGUST 1994

Report prepared by:

DAVID STOKES
ADAS Huntingdon
Chequers Court
Huntingdon
Cambridgeshire
PE18 6LT

Tel: 0480 52161
Fax: 0480 412049

TIM O'NEILL
ADAS Cambridge
Brooklands Avenue
Cambridge
CB2 2BL

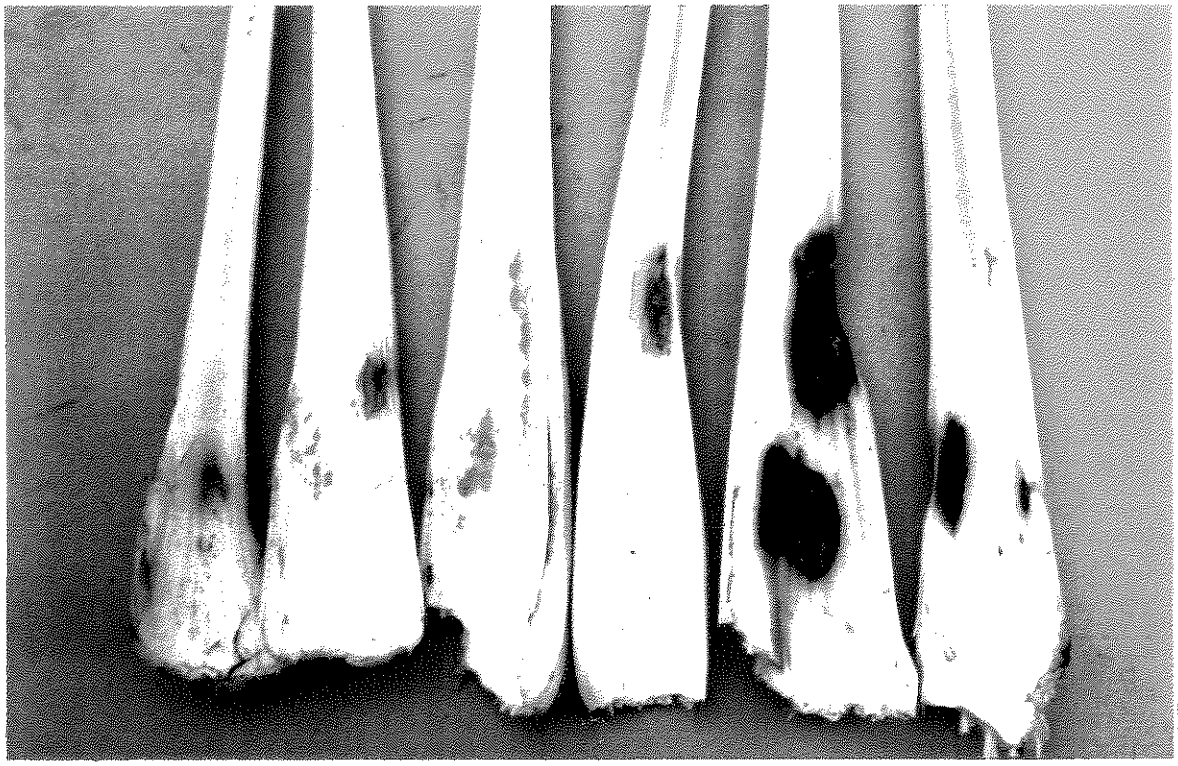
Tel: 0223 455852
Fax: 0223 455911

FINAL REPORT - AUGUST 1994

Project Number:	PC99
Project Title:	Celery quality
Project Leader:	David Stokes, ADAS Huntingdon
Key Staff:	Dr Tim O'Neill, ADAS Cambridge Alan Wright, ADAS Chichester David Ann, ADAS Winchester
Project Co-ordinator:	Mr A Weissenborn, Sidlesham
Locations:	Glasshouse nurseries on the South Coast at Southgate Growers and Siddlesham Growers
Commenced:	May 1994
Completed:	August 1994

Brown flecking and dark lesions at petiole bases of celery, cv. Lorete.

Close up of bacterial breakdown (*Erwina carotovora* ssp. *carotovora*) and flecking caused by *Rhizoctonia*.



Progression of symptoms from brown flecking to bacterial soft rot.

CONTENTS **Page**

APPLICATION

The objective of this work was to investigate possible reasons for a celery quality and breakdown problem. Rhizoctonia was identified as the primary cause; *Erwinia carotovora* ssp. *carotovora* and various fungi caused secondary soft rotting. Various cultural aspects were found which may have contributed to the occurrence of rhizoctonia and the diseases. Action points for growers to minimise risk of celery breakdown, and recommendations for future development work, are listed.

SUMMARY OF RESULTS

A questionnaire was devised and 20 holdings on the south coast growing protected celery were visited in May or June 1994.

Seven plant samples showing breakdown were examined and rhizoctonia was found to be the primary cause. *Erwinia carotovora* ssp. *carotovora* and various fungi were associated with secondary soft rotting. Environmental conditions in some of the glasshouses were conducive to development and spread of rhizoctonia and *E. carotovora.*

ACTION POINTS FOR GROWERS

1. Consider using soil sterilisation more frequently in the cropping programme.

2. Ensure that rhizoctonia is treated for in the previous crop.

3. Ensure that plant debris from the previous lettuce crop is minimised and removed as fully as practicable.

4. Analyse the soil before planting celery to correct any imbalances (avoid high nitrogen levels) and raise potash levels where necessary.

5. Avoid close spacing of plants; a minimum spacing of 9" x 9" is recommended.

6. Apply an MBC fungicide soon after planting and repeat just before full canopy closure. Continue to use a chlorothalonil product for leaf spot control.

7. Consider introducing more positive night ventilation earlier in the life of the crop especially in structures with poor ventilation.

8. Consider removing more panes of glass to increase air movement. This should be done several weeks before harvest (if left too late, infection and damage may already have occurred).

9. Also consider the use of circulation fans to improve air-movement in still, humid conditions.

INTRODUCTION

The area of protected celery in England and Wales in 1992 was 159 ha (MAFF census) with the main production areas being the South East, East Anglia, Lancashire and Yorkshire. The gross value of the industry in 1992 was £5.2 million.

Early protected celery occupies a potentially profitable slot between the cessation of imports in April and the start of the outdoor production in early July.

This early production from glass and polythene extends the UK season and enables producers to source UK celery from April to November.

The South East area is particularly important as it is the earliest production area, enabling English glasshouse celery to be available from April onwards. In 1993 the area of protected celery was 35 ha (MAFF census) of which 95% is on the South Coast.

In the period late May to early June last year (1993) a number of holdings on the South Coast experienced quality problems with the protected celery crop after a period of hot weather. Problems included rapid deterioration and breakdown of the sticks in the growing house, poor flavour and post-harvest breakdown of apparently healthy sticks.

The severity of the quality problems varied from holding to holding but it was estimated that 75% of the holdings on the South Coast area were affected. An estimated 10% of the crop was not marketable, valued at £100,000. The quality of the majority of the remaining crop was not suitable for the supermarket outlets normally supplied. This resulted in the loss of marketing through supermarket outlets and a general loss of market confidence in the crop on the South Coast.

OBJECTIVES

1. To investigate the possible reason for the breakdown by conducting a detailed survey of the holdings affected. The survey to include all aspects of culture, glasshouse/polythene structure design, ventilation and heating systems. A copy of survey form is included in Appendix I.

2. To investigate the extent of the problem and if possible determine ways of avoiding it.

3. To look at any areas of future development work, if they arise, out of the results of the survey.

DESCRIPTION OF WORK

Following the first reported case of quality problems in late May 1994, surveys were conducted over the following 4 weeks.

Date	Site	No. of holdings	No. of samples collected
25 May	Southgate Growers	11	2
3 June	Sidlesham Growers	12	4
22 June	Sidlesham Growers	1	1

On each holding visited the survey forms were filled in and in any plant samples, where appropriate were taken. The samples were forwarded to Tim O'Neill, Plant Pathology ADAS Cambridge for examination and confirmatory tests to be conducted.

Meteorological data for the South Coast (the nearest meteorological station being Bognor Regis) was obtained from ADAS Agromet for the three months April, May and June. (See Appendix II, III and IV).

RESULTS

Survey Information

The forms were divided into three sections to cover

- propagation
- planting
- greenhouse structure details

Each section was sub-divided into a series of questions to cover all aspects of production and the type of structure used. (See Appendix I for details of all the questions asked).

A total of 20 survey forms were completed and the results have been summarised below under the individual questions where appropriate.

Variety

Q4. The main variety was Lorete with smaller quantities of Celebrity.

Propagation

Q5. **Raised own plants:** 30%

The majority of the crop was sown in November and December over a range of dates from 7 November to 21 December. Germination temperatures varied from 18 C - 24 C with propagation house temperatures of 15 C. 90% of the crops were propagated with no insecticides or fungicides. Where pesticides were used, Filex and Ambush C were the main products.

Q11. **Plants bought in:** 70%

Where plans were bought in, no pesticides were used pre-planting.

Planting

Understandably, the previous crop rotations varied across the survey but a common rotation was lettuce, celery and either peppers or tomatoes or cherry tomatoes. Other crops occasionally included were cucumbers and aubergines. Many comments were made on problems of *Botrytis, Rhizoctonia* or *Sclerotinia* in previous crops over the last four years.

Q14. Previous crop debris: 50% of the holdings raked and removed the previous lettuce debris before planting celery. 30% cut into bins and only 20% rotavated - in the debris; some commented that they only rotavated debris in if it was clean and healthy.

Q15. Soil preparation: Rotavation was the most common method with 90% chisel ploughing or deep cultivating before rotavation.

Q16. Soil analysis: 85% of nurseries had soil analysis done before planting celery, though in a few cases it was done before the previous lettuce crop.

Q17. Soil analysis results: The soil type was generally a light silty loam soil. Many of the analysis only gave an index number rather than actual ppm. so it is difficult to determine the precise levels as an individual index number covers a wide range of ppm.

There was a lot of variation across the analysis results supplied so the following are general trends:

pH - on many sites it was low 6.3+
Phosphorus - generally around 5+
Potassium - 3+ (with the occasional low (index 1) or high (index 6)
Magnesium - generally 4+
Conductivity - generally 2400 - 2500 except where nitrogen was very high.
Nitrate - 40 - 60 ppm with some very high ones.

Some straight fertilisers were used but generally it was ICI or Eclipse compounds.

Q18. Planting date: From early-January to mid-March with the majority in the period 27 January to 1 March.

Q19. Spacing: The following spacings were used.

		Sq. inches/plant
30%	9" x 8 "	72
20%	9" x 9"	81
15%	8" x 10"	80
10%	8½" x 9"	76
10%	9" x 9½"	85

Other spacings used included 6½" x 9½", 8½" x 9½" and 10" x 10".

Q20. Temperature regimes: A wide variety of regimes were used (see below) but for the majority of the early plantings a high temperature (from 10°C - 15°C) was used for a period after planting, varying from 2 weeks - 6 weeks; then temperatures were gradually reduced to anywhere from 5°C - 8°C until harvest.

The later plantings were grown at cooler temperatures, from 5 - 7°C down to frost protection. Some crops in early March were grown cold.

Permanent night ventilation was introduced on some nurseries by early to mid April, but on many nurseries it was well into May.

Temperature at planting	Time in weeks from planting	Then reduced to
15°C	2	10°C
15°C	3	10°C
12°C	3-4	10°C
10°C	6	8°C
10°C	4	8°C
10°C	4	7°C
10°C	3	7½°C
10°C	3	7°C
10°C	2	8°C
10°C	2	5°C
7-8°C	1	6°C
5°C from planting		
Frost protection from planting		
Unheated		

Q21. Watering regimes: This was a difficult question to answer as it depended on so many factors - soil type, dryness of soil, how sunny or dull, hot or cold the weather was, pump pressure, nozzle size and so on.

From the survey though the following general patterns showed up:

a) at planting: a general watering - in (anything up to 40-45 minutes) usually once, sometimes twice, then light waterings (3-4 minutes) to keep blocks moist. Then watering approximately once a week for 10-15 minutes.

b) subsequent to harvest: On a regular pattern of every 2-3 days (the amount varying from 15-30 minutes), gradually increasing the time as the crop matured.

Q22. Top dressing: 35% of growers used dry feed only using Nitrochalk at around 3-4 weeks from planting, sometimes followed by a second dressing 3 weeks later.

35% of growers used liquid only, using Nitram, usually from planting or soon after.

30% of growers used a mix of dry feed followed by liquid feeds.

Q24. Fungicides/Herbicides/Insecticides:

For weed control: 80% of growers used Gesagard; 20% did not treat for weeds.

For leaf spot/botrytis/sclerotinia: 65% used either Repulse or Bravo, often more than once; 15% used Carbate Flowable and 10% used Benlate. 10% applied no fungicides. Bavistin was occasionally used alongside Bravo or Repulse.

For insect control: 55% of growers used Ambush C, sometimes more than once, and 30% used Hostaquick; 15% used no insecticides.

General: 10% of the crops received a herbicide spray and no further chemical treatments, and 10% received no sprays at all.

Q25. Ventilation procedures: The survey showed a variation in procedures but for the early planted crop (January and February) the general principle was to leave vents closed for the first 2-4 weeks. Then they gradually started opening on the leeward side when the days temperatures rose above 20 C (some started at 18 C). When into March, some night ventilation was left on if night temperatures were above 8 C.

The time at which permanent night ventilation was left on varied considerably from late March to mid May.

The later planting in March received ventilation more quickly after planting as the ambient temperatures and day length increased.

Q27. Problems seen: There were many comments about *Botrytis, Rhizoctonia* and *Sclerotinia* affecting previous lettuce crops. Generally this spring (May 1994), the severity of disease and breakdown problems reported on celery was less than last year, although comments were made on soft rots, sclerotinia and botrytis.

Glasshouse Structure Details

All the celery crops in the survey were grown under glass. The glasshouse structure varied from wooden Dutch light to aluminium venlo and double venlo to Robinson 22'. With a wide range of structures, the height to gutter and height to ridge varied considerably, as did the type and amount of ventilation.

Ventilation varied from single pane both sides of the ridge, to 2 x 1/2 pane and 3 x 1/2 pane both sides of the ridge, to continuous ridge ventilation.

In structures where ventilation was considered inadequate, only 30% of the growers removed panes of glass and/or opened doors etc. to increase air movement. Some only removed glass 2 weeks before harvest and others up to 4 weeks before harvest.

Q33. Heating: 80% of growers used warm air heaters, either free-blowing or from metal ducting at one end of the house.

15% of growers used direct-fired heaters and 5% used a piped heating system.

The use of direct-fired heaters gave some incidental CO2 enrichment to the crops, otherwise CO2 enrichment was not used.

15% of growers used circulation fans within the structure to improve air movement.

Q.37 Grower comments:

Many growers reported they were now sterilising soil with methyl bromide less frequently than 5-10 years ago. For the celery crops visited in May and June this year in connection with this work, the soil was last sterilised with methyl bromide anything from 1 to 4 years ago, and in some cases even longer.

Tolchofos-methyl or qintozene was often used on the intervening lettuce crops.

Where extra potash had been used, improvements in quality and stick weight were commented on.

Where circulation fans had been used, the improvement in the environment was noticed.

Generally, where ventilation was considered inadequate (10-15% of floor area) more problems of soft growth and disease were reported. Also, where there were "wet" areas under gutters etc.

For most growers, problems of disease and soft rots have been around for the last 5 years or so and were reported to be increasing.

B. Investigation Of Samples

Sample number	Date collected	Symptoms	Pathogen identification
1.	23 May	Brown flecking at petiole bases. Fungal hyphae between petiole bases Brown root rot	*Rhizoctonia* *Rhizoctonia* *Rhizoctonia & Pythium*
2.	23 May	Brown flecking at petiole bases Fungal hyphae between petiole bases Brown root rot	*Rhizoctonia* *Rhizoctonia* *Rhizoctonia & Pythium*
3.	3 June	Light brown soft rot of petioles	*Verticillium* (slight)
4.	3 June	Soft breakdown of petioles	*Botrytis & Verticillium*
5.	3 June	Soft rot of petioles	No fungi
6.	3 June	Soft rot of petioles	*Erwinia carotovora* ssp. *carotovora*
7.	22 June	Brown flecking at petiole bases Fungal hyphae between petiole base Soft rot at petiole base (see photographs at front)	*Rhizoctonia* *Rhizoctonia* Bacteria & *Fusarium*

Rhizoctonia sp. was consistently associated with the brown flecking symptoms. In some instances the initial rot caused by *Rhizoctonia* had progressed to a dark-coloured soft rot, and *Erwinia carotovora* ssp. *carotovora* was isolated from these tissues. Other fungi found associated with some soft rot lesions were grey mould (*Botrytis cinerea*), *Fusarium* sp., *Verticillium* sp.; *Pythium* was identified associated with brown root rot on sample 1.

DISCUSSION

Rhizoctonia was identified as the primary cause of the quality and breakdown problems which were severe in late spring/early summer 1994 and occurred to a lesser degree during the same period this year. The symptoms described here of brown flecking and soft rotting of petiole bases had also been observed by growers in 1993.

Rhizoctonia has previously been reported as a disease problem affecting celery, described as crater spot. In the late 1950's it was extensive and severe in some parts of Norfolk every year (Baker, 1967). It was worse in over-mature plants and caused worry especially to growers washing and preparing pre-packed celery. Work at that time at NVRS Wellesbourne identified *Rhizoctonia* as the most likely pethogen causing crater spot on celery (Keyworth & Dow, 1962).

Rhizoctonia is a soil-borne fungus affecting a number of protected crops, especially lettuce and tomatoes. It infects and invades healthy tissue at or near soil level, usually causing a dryish, brown tissue decay. The more extensive areas of soft rotting found at petiole bases in the samples examined this year were caused by *Erwina carotovora*, a soil and water borne bacterium, often found as a secondary cause of tissue breakdown. The other fungi found on rotting tissue (*Botrytis, Fusarium* and *Verticillium*) are all probably secondary invaders of tissue already damaged by rhizoctonia.

Rhizoctonia occurs in a wide range of soil types but tends to be most damaging to crops grown on lighter, sandy soils. In lettuce crops basal rot caused by Rhizoctonia is often absent in the first crop after soil sterilisation, but builds up with repeated cropping. Soft rotting caused by *Erwinia* is encouraged by moisture and high temperatures (20-30°C).

The soil type on the majority of the holdings were generally light, probably favourable to spread of Rhizoctonia. Many of the nurseries had grown lettuce or tomato as the proceeding crop and on some it was reported that Rhizoctonia had caused problems in these crops.

The trend towards less frequent soil sterilisation, (often encouraged by supermarket policy) could have contributed to the increase in rhizoctonia generally, and specifically to its increased occurrence on celery. Increasing glasshouse temperatures through the

spring and early summer would favour rapid bacterial breakdown. From the survey results, it was apparent that the ventilation of some glasshouses was insufficient to prevent high temperatures and long periods of high humidity, thereby making crops more vulnerable to soft rot. Also, the time at which permanent night ventilation started was left late into the spring in some glasshouses; this would encourage long periods of high humidity and may have encouraged spread and development of rhizoctonia. (It is appreciated that though celery requires a lot of water and the soil is likely to be moist most of the time). Examination of the met data (Appendices II, III and IV) shows periods of high day and night temperatures in late April, early May and early June; temperatures under glass would obviously be higher than these.

In celery (and lettuce) it has been found that high levels of soil potash (index 4; 600+ ppm) helps to produce a heavier stick and maintain product quality. On some nurseries potash levels were low.

From the survey it was found that 65% of growers were applying chlorothalonil (Bravo 500 etc.) for control of *Septoria* leaf spot; this fungicide would have little or no effect on Rhizoctonia, (Humphreys-Jones 1977a). Twenty-five % of growers used an MBC fungicide (e.g. Benlate, Bavistin, Carbate Flowable); these products, if applied at or before infection occurred, may have provided some control of the disease. It may be relevant that few fungicides and no MBC products were applied to the samples where severe rhizoctonia was confirmed. In an experiment on cv. Fenlander growing on a fen soil with a history of severe crater spot, applications of benodonil as a spray significantly reduced the crater spotting on celery sticks (Humphreys-Jones, 1977b); this fungicide is no longer available in the UK.

CONCLUSION

1. Rhizoctonia was identified as the primary cause of quality and breakdown problems. The fungus has previously been described affecting field-grown celery when the initial symptoms were called crater spot.

2. Bacterial soft rotting was caused by *Erwinia carotovora* ssp. *carotovora*. It appears that this disease followed initial damage to petioles caused by Rhizoctonia.

3. The environment inside some glasshouses would have been conducive to the spread and development of both pathogens.

4. Spacing between plants was closer than ideal on some nurseries; this would have contributed to poor air movement and high humidity around plants, increasing the risk of rhizoctonia and other diseases.

5. The reduced use of soil sterilisation with methyl bromide would appear to have contributed to an increasing incidence of rhizoctonia and other soil-borne diseases affecting celery (and lettuce) in recent years.

6. Chlorothalonil, the fungicide most widely used on celery, would not have controlled rhizoctonia or bacterial soft rot.

RECOMMENDATIONS FOR FUTURE WORK

1. To investigate the efficacy and timing of MBC sprays for control of rhizoctonia in protected celery.

2. To investigate the efficacy of pre-planting soil treatments (tolclofos-methyl and quintozene) for control of rhizoctonia in protected celery and to secure efficacy and residue data for submission for an on-label or specific off-label approval.

ACKNOWLEDGEMENTS

Grateful thanks are given to all growers on the south coast who participated in the survey.

REFERENCES

BAKER, J. J. (1972). Disease of Cultivated Plants, 1957-1968. MAFF Technical Bulletin 25 HMSO, London.

HUMPHREYS-JONES, D.R. (1977a). Chemical control of *Pythium* species and *Rhizoctonia solani* in celery. MAFF/ADAS Review of Experiments and Development - Eastern Region, 1977, p.94.

HUMPHREYS-JONES, D.R. (1977b). Chemical control of crater sport (*Rhizoctonia solani*) on celery. MAFF/ADAS Review of Experiments and Development - Eastern Region, 1977, p.95.

KEYWORTH, W.G. & DOW, J.M. (1962). Crater spot of celery. Twelfth Annual report of the National Vegetable Research Station, p.57.

HDC PROJECT NO. PC99 CELERY QUALITY

Survey Information

1. Name:

2. Address:

3. Tel No:

4. Variety:

PROPAGATION

5. Raised own plants: YES/NO

6. Sowing date:

7. Pricking date:

8. Temperatures:

9. Fungicides/Insecticides:

10. Any other treatments:

11. Plants bought in: YES/NO

12. Any treatments before planting:

PLANTING

13. Previous cropping: 1990
1991
1992
1993

14. Previous crop debris:

15. Soil preparation:

16. Soil analysis: YES/NO

17. Soil analysis results: ( ) = Index No.

pH P ( ) K ( ) Mg ( ) N ( ) Cond ( )

17. Fertiliser applied: Date:

18. Planting date:

19. Spacing:

20. Temperature regimes:

21. Watering regimes: a) at planting

b) subsequent to harvest

22. Top dressing: YES/NO

23. Type/rate of feed.

Date	Type	Rate	How Often

24. Fungicides/Herbicides/Insecticides

Date	Product	Rate	What for

25. Ventilation procedures:

26. Harvesting date:

27. Problems seen (description, when, pattern in house)

28. Samples taken: YES/NO

STRUCTURE DETAILS

29. Type: glass/polythene

30. Orientation:

31. Glasshouse details: bay width: bay length:

single/multispan: gutter height: ridge height:

ventilation type:

No. of vents/ridge:

Any glass removed during growing:

32. Polythene house details: bay width: bay length:

single/multispan gutter height: ridge height:

ventilation type:

33. Heating system type:

fuel type:

ducted/free blowing

34. Circulation fans: YES/NO

35. How often used:

36. CO_2 used:

37. Any other comments:

32. Polythene house details: bay width: bay length:

single/multispan gutter height: ridge height:

ventilation type:

33. Heating system type:

fuel type:

ducted/free blowing

34. Circulation fans: YES/NO

35. How often used:

36. CO_2 used:

37. Any other comments:

APPENDIX II

METEOROLOGICAL DATA FOR THE SOUTH COAST
FOR APRIL 1994

DAY	MAX TEMP (09-09) (DEG C)	MIN TEMP (09-09) (DEG C)	RAINFALL (09-09) (MM)	SUNSHINE (00-24) (HOURS)
01	9.7	7.1	4.8	4.1
02	9.5	3.6	0.3	7.5
03	10.2	- 0.5<	13.8	3.3
04	10.3	6.7	0.7	9.2
05	11.8	3.7	1.0	9.3
06	12.8	2.5	2.1	9.1
07	10.0	3.0	2.8	6.0
08	10.0	2.4	15.0>	5.1
09	9.0	0.7	7.3	5.4
10	10.4	2.1	0.8	9.9
11	14.0	2.5	NIL	12.5>
12	12.4	1.0	1.6	0.1
13	11.0	4.7	NIL	6.8
14	8.2<	2.6	0.8	4.7
15	8.6	3.0	2.0	2.5
16	11.8	4.7	TRACE	4.8
17	11.0	2.7	NIL	6.7
18	8.8	2.9	NIL	3.6
19	11.5	2.6	NIL	0.5
20	12.0	7.8	NIL	4.1
21	12.9	4.7	NIL	11.0
22	13.1	8.0	6.8	11.1
23	15.3	10.1	4.4	8.8
24	14.2	9.4	NIL	12.1
25	13.5	4.0	1.4	8.5
26	15.8	10.2	3.4	9.3
27	12.1	9.4	TRACE	NIL
28	15.1	10.3>	NIL	3.2
29	17.8	6.5	NIL	11.2
30	20.5>	9.1	NIL	11.7
MONTH TOTAL			69.0	202.1
MONTH MEAN	12.1	4.9		
1961-90 AVERAGE	11.6	5.3	50.0	184.4
COMPARISON WITH AVERAGE	+0.5	-0.4	138.0%	109.6%

KEY: > = MAXIMUM VALUE FOR MONTH. < = MINIMUM VALUE FOR MONTH

APPENDIX III

METEOROLOGICAL DATA FOR THE SOUTH COAST FOR MAY 1994

DAY	MAX TEMP (09-09) (DEG C)	MIN TEMP (09-09) (DEG C)	RAINFALL (09-09) (MM)	SUNSHINE (00-24) (HOURS)
01	14.0	6.1	NIL	13.6
02	13.9	5.9	NIL	11.0
03	15.2	10.0	TRACE	12.8
04	14.7	9.7	0.2	8.0
05	12.0	8.0	4.6	NIL
06	13.6	10.4	0.7	0.2
07	12.3	10.9	6.1	NIL
08	14.2	6.0	NIL	13.2
09	13.5	6.0	NIL	6.7
10	16.0	5.2	NIL	6.5
11	19.0	12.1	7.5	10.5
12	15.6	10.4	NIL	9.9
13	19.8>	6.2	NIL	10.9
14	17.5	13.0>	4.8	NIL
15	17.5	9.5	0.3	7.3
16	17.0	11.3	22.6>	2.3
17	10.6<	7.7	2.6	NIL
18	13.4	6.8	TRACE	1.1
19	13.3	5.0	NIL	6.9
20	14.5	6.0	3.3	NIL
21	13.1	11.3	11.2	0.1
22	15.0	11.2	TRACE	7.0
23	15.6	9.5	NIL	8.4
24	14.5	8.6	2.4	0.8
25	15.3	10.3	11.6	1.7
26	12.2	10.7	4.6	NIL
27	12.2	7.1	NIL	6.3
23	13.2	8.0	NIL	0.7
29	15.5	4.7	NIL	12.0
30	15.3	4.1	NIL	15.3
31	17.2	4.0<	NIL	15.5>
MONTH TOTAL			82.5	188.7
MONTH MEAN	14.7	8.2		
1961-90 AVERAGE	14.9	8.5	48.0	231.4
COMPARISON WITH AVERAGE	- 0.2	-0.3	171.9%	81.5%

KEY: > = MAXIMUM VALUE FOR MONTH < = MINIMUM VALUE FOR MONTH

APPENDIX IV

METEOROLOGICAL DATA FOR THE SOUTH COAST FOR JUNE 1994

DAY	MAX TEMP (09-09) (DEG C)	MIN TEMP (09-09) (DEG C)	RAINFALL (09-09) (MM)	SUNSHINE (00-24) (HOURS)
01	20.8	5.0<	NIL	10.6
02	16.7	12.0	0.4	3.8
03	15.5	12.1	1.2	9.4
04	12.6<	10.4	7.6	0.4
05	16.0	5.6	0.7	12.8
06	17.6	11.6	NIL	2.7
07	17.0	12.0	3.1	5.7
08	17.2	10.1	0.7	8.5
09	17.8	5.9	NIL	6.8
10	16.0	10.2	NIL	1.3
11	17.9	6.5	NIL	12.5
12	17.7	6.1	NIL	14.6
13	20.0	7.5	NIL	14.8
14	23.7	9.1	NIL	14.8
15	19.3	8.9	NIL	15.7>
16	24.0	10.4	NIL	14.5
17	20.5	10.1	NIL	12.5
18	19.1	12.0	NIL	14.9
19	20.0	11.7	NIL	8.7
20	17.6	14.4	0.9	2.5
21	17.4	13.7	0.4	NIL
22	20.5	14.4	NIL	14.8
23	19.8	8.5	NIL	14.7
24	25.0>	14.8	13.4>	11.1
25	19.2	15.2>	NIL	4.2
26	18.1	11.8	NIL	9.8
27	19.2	14.1	NIL	8.0
28	21.6	9.6	NIL	15.3
29	20.0	14.2	NIL	15.1
30	21.9	8.0	NIL	15.6
MONTH TOTAL			28.4	296.1
MONTH MEAN	19.0	10.5		
1961-90 AVERAGE	17.9	11.3	47.0	234.1
COMPARISON WITH AVERAGE	+1.1	-0.8	60.4%	126.5%

KEY: > = MAXIMUM VALUE FOR MONTH < = MINIMUM VALUE FOR MONTH

1. **TITLE OF PROJECT**

Celery quality - HDC Project No PC99

2. **BACKGROUND AND COMMERCIAL OBJECTIVE**

In the period late May to early June last year (1993) a number of holdings on the South Coast experienced quality problems with the protected celery crop after a period of hot weather. Problems included rapid deterioration and breakdown of the sticks in the growing house, poor flavour and post-harvest breakdown of apparently healthy sticks. Occasional cases of breakdown in celery crops are reported from other areas of the country but nothing to the extent that occurred on the South Coast in 1993. The quality problems caused a serious loss of market confidence. The commercial objective is to identify if possible the reasons for the breakdown and to provide any recommendations if possible on ways of avoiding the problem.

3. **POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY**

The area of protected celery in England and Wales in 1992 was 159 ha (MAFF census) with the main production areas being South East, East Anglia, Lancashire and Yorkshire. The gross value of the industry is £5.2 million.

The South East area is particularly important as it is the earliest production area, enabling English glasshouse celery to be available from April onwards. In 1993 the area of protected celery was 35 ha (MAFF census) of which 95% is on the South Coast. The severity of the quality problems varied from holding to holding but it was estimated that 75% of the holdings on the South Coast area were affected. 10% of the crop was not marketed valued at £100,000, the quality of the majority of the remaining crop was not suitable for the supermarket outlets. This resulted in the loss of supermarket outlets which is difficult to put a financial value to. There is an urgent need to restore market confidence in the protected celery crop from the South Coast. The problem has not been seen to the extent in other areas of the country.

4. **TECHNICAL TARGET OF THE WORK**

If the same problems should occur this year, a survey of the holdings affected would be undertaken as soon as possible after notification of a problem showing to determine the extent of the problem, the possible causes and any ways of avoiding it.

5. CLOSELY RELATED WORK COMPLETED - OR IN PROGRESS

A report on the celery industry by D Hand for the HDC, completed in 1993.

6. DESCRIPTION OF THE WORK

1. Visit the nurseries affected to record details of crop culture, glasshouse and/or polythene design, the amount of ventilation and other factors, and the pattern and extent of the problem within the structure.

2. Collect samples of plants affected for examination by Tim O'Neill, Plant Pathology ADAS Cambridge, and for laboratory tests and chemical analysis.

3. Record details (if any) of quality problems in the market boxes and collect samples if necessary.

4. Obtain via ADAS Agromet meteorological data for the area for the month preceding the appearance of the symptoms.

5. Produce a report on the problem as observed, possible associated factors and results of laboratory tests and diagnosis of the probable cause.

   The report will include any recommendations on future development work necessary, and if possible, the ways of avoiding the problem.

6. Prepare and deliver a talk on the results of the survey at a grower's meeting on the South Coast in the autumn (September or October).

7. COMMENCEMENT DATE

This is dependant on the weather conditions and if the problem arises. If it does, it is expected to be around late May-early June. Results of laboratory tests will be faxed to the project leader.

Final report to be produced within three months of the completion of the laboratory tests.

8. STAFF RESPONSIBILITIES

Project leader: D A Stokes, ADAS Huntingdon

Other staff: T M O'Neill, ADAS Cambridge
A Wright, ADAS Cambridge

9. LOCATION

Sussex - primarily at Southgate Growers and Sidlesham Growers.