



HORTICULTURE RESEARCH INTERNATIONAL

KIRTON

HDC Contract FV60

**Winter cabbage - finding a means
of bridging the April-May gap
between traditional and imported crops
1991-1993**

Final Report

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Final Report: May 1993

Project Number: FV60

Project Title: Winter cabbage and savoy - finding a means of bridging the April - May gap.

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Location of project: HRI Kirton

Date commenced: May 1991

Date completed: April 1993

Key words: Cabbage, overwintering

PRINCIPAL WORKER

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AUTHENTICATION

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

.....*M. J. Leatherland*.....
(Signature)

M J Leatherland

Date *26/5/93*.....

Report authorised by *M B Wood*.....
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Relevance to growers and practical application

Application

Varieties, planting dates and covering regimes were manipulated to ascertain the feasibility of delaying the harvest of overwintered green cabbage into late April/early May. The normal marketing period ends in early April and there is usually a gap of four to six weeks before imports begin and therefore a marketing shortfall for UK growers to try to exploit.

Summary

In 1991/92 a range of cabbage varieties was planted between June and August. All varieties and planting dates were covered with non woven polyester (Agryl P30) at the end of February. It was found that covering the plots reduced quality by encouraging damage, caused by frosts prior to covering to develop into rotting. Also, it was clear that only recognised long standing varieties such as Tundra would be suitable for this kind of manipulation. The late planted treatments (August) did not form heads before the winter but bolted in April directly from the rosette stage.

The work continued in 1992/93 with a single variety, Tundra. The same range of planting dates was included but with an additional treatment aimed at irrigating the latest planting if required to promote autumn growth. The covering treatments were also extended to three occasions, early December, early and late January to ensure at least one set of covers was in place before heavy frosts started.

The first cover was applied on 9 December prior to two weeks of persistent frost over the Christmas period. All treatments were harvested on 8 April following the onset of bolting as had occurred in 1992. There was no evidence that the treatments had moved the harvest date towards the target period.

The basic physiology of the cabbage is such that a period of cold is required to initiate flowers on the stem apex. Once this has happened, subsequent long, warm days occurring

in the spring would stimulate stem elongation (bolting). In warm weather cabbage plants remain vegetative so the early sowings produce more leaves and, potentially, heavier heads. Plants from later sowings in this trial, therefore, initiated fewer leaves than those from early ones so when the cold stimulus arrived - perhaps simultaneously across all plantings - the late-sown plants bolted more readily even though they probably initiated flowers at the same time as early-sown ones. In theory, warmer conditions could delay the onset of flowering but it is unlikely that the temperature difference caused by covers would be sufficient to do this. In any case, all treatments are likely to have had the required accumulation of cold relatively early on in the winter.

It appears that with present varieties, the scope for delaying harvest date is limited. The only practical solution is to grow further south where higher light levels and average temperatures would enable more growth to be made from later plantings during the autumn. Such plants would, perhaps, have the ability to hold later in the spring also.

Experimental section

Introduction

The main production period for winter cabbage to be sold as a fresh green product and including savoy types is from November to March by which time approximately 85% of the crop is marketed. Imports, primarily from Spain, begin in mid May although there is now some evidence that this is being brought forward to fill a market void. There is however, potentially, a period of about six weeks from late March to early May when at present, UK crops are in short supply but consumption is high.

Rough calculations indicate that a modest 50% increase in cabbage production over the winter/spring period would represent a value to the industry of around £7.8 m so there is a good case for examining ways of extending the season beyond March.

In 1991/92 a range of varieties was planted from June to August and grown with or without covers applied in February. Most treatments did not hold until the required period and it was felt that the relatively late covering had increased damage caused by early frosts. In 1992/93 a further trial was set up with the variety Tundra, a recognised winter standing type. Plantings were again made from June to August but covers were applied at various times from December to late January. This report gives details of the 1992/93 trial and summarizes the conclusions based on two years work.

Materials and methods

Treatments:

Planting dates:

1. 23 June (sown 8 May)
2. 7 July (sown 18 May)
3. 16 July (sown 28 May)
4. 4 Aug (sown 18 June)
- 5*. 4 Aug (sown 18 June)

* The 4 August planting was duplicated. Following work in 1991/92 it was decided that planting on 14 August was too late for sufficient plant frame to form in the autumn to overwinter. However, it was suggested that with good cultural conditions, an early August planting would be worth another try. Treatment five therefore, was to be a repeat of treatment four but with irrigation as and when required. In the event treatment five received one application of water by hand on the 5 August. Rainfall was sufficiently regular after that for no further watering to be required.

Covering dates:

1. No covering
2. 9 December
3. 8 January
4. 29 January

Full details of cultural details can be found in Appendix 1.

The covering material was initially 'Agryl P17' (17 g/m² non woven polyester) with which the 9 December plots were covered. This however became badly damaged by wind and was replaced on 8 January with the heavier grade material, Agryl P30 used on all subsequent coverings.

All covers were removed on 11 March 1993.

Experimental design and layout

The trial was set out as a split plot design with covering treatments as the main plots and planting dates as the sub plots. Sub plots were allocated at random to main plots. Main plots were randomized within each of three replicates. Each plot consisted of four rows of 22 plants of which the middle two rows of 20 plants were recorded giving a total of 40 recorded plants per plot.

Assessments

1. Regular observations to determine maturity
2. Yield and quality at harvest

Results and discussion

In the first season's work covers were not applied until February by which time the worst of the winter frosts were over. In 1992/93 the first covers were applied in early December prior to two weeks of continuous frost over the Christmas periods. In 1991/92 frost damage was exaggerated under covers leading to excessive rotting of heads. This damage was not seen in 1992/93 to the same extent but in most cases, covering still gave a reduction in the number of marketable heads and in the marketable tonnage. All figures are summarised in Table 1.

The earliest planting suffered from the highest proportion of rotten heads and this was greatly exaggerated by any of the covering treatments. This is perhaps not surprising. NIAB data (2) indicates that from planting to the end of the possible standing period is around 216 days. From a June 23 planting therefore it might be expected to be showing signs of senescence by early February.

In the 1992/93 trial, all treatments were harvested on 8 April. It was clear by then that bolting was occurring and that within seven to ten days there would be very few marketable heads remaining. The decision was therefore taken to record all plots at that time.

The extent of bolting appeared greater with later planting. The August plantings did not produce many heads and bolted directly from the rosette stage in early April. The earlier plantings did not appear to bolt until later. The expression of the symptoms takes longer in a more densely packed mature head than it does in a rosette plant.

The overriding factor is probably increasing temperature and light levels. Although cabbages are day neutral for vernalization (ie not affected by daylength) they will be encouraged to

bolt by improved growing conditions. It is likely that by March all plants have become vernalized and that the flower parts have formed. All that is required to bolt is the arrival of warmer days in late March. This explains why all treatments tend to bolt at a similar time.

It is known that mature cabbages can be vernalized to flower at temperatures below about 10°C. There is also evidence that above 15°C and particularly at temperatures of 25-30°C the response can be reversed (3 & 4). Thus the flowering trigger is quantitative. It might seem possible that warmer conditions experienced under covers should delay bolting. Except for the July planting however this does not seem to have been the case. Also, the untreated control gave the lowest bolting rate of all. It is unlikely in any case that covers would raise the temperature sufficiently to reverse vernalization to any great extent. Furthermore, it is possible that covers might increase the risk of bolting as in very cold conditions (below 3°C) no vernalisation will occur but it could proceed at 7°C.

There is some evidence that vernalization can be reversed more easily in the absence of light (3 & 4). It might be worth looking at covering for short periods using dark screens. This however is a 'long shot' and will be complicated by the likely problems associated with advanced senescence.

Table 1 The effect of planting date and cover treatment on overwintered cabbage 1992/93

| <u>Treatment</u> | | Marketable heads:- | | | Unmarketable:- | | | |
|-----------------------|---------------|--------------------|------|------------|----------------|-------|-------------|-----------|
| Planting date | Covering date | % by number | t/ha | wt/head kg | % bolted | % rot | % *immature | % missing |
| 23 June | none | 63 | 21.3 | 1.28 | 26 | 8 | 2 | 1 |
| | 9 Dec | 45 | 16.1 | 1.35 | 16 | 28 | 8 | 3 |
| | 8 Jan | 27 | 8.2 | 1.16 | 36 | 28 | 4 | 5 |
| | 29 Jan | 43 | 14.8 | 1.29 | 23 | 23 | 6 | 5 |
| 7 July | none | 43 | 16.9 | 1.50 | 46 | 0 | 3 | 8 |
| | 9 Dec | 36 | 13.1 | 1.36 | 40 | 6 | 14 | 4 |
| | 8 Jan | 46 | 16.5 | 1.36 | 42 | 3 | 4 | 5 |
| | 29 Jan | 33 | 13.0 | 1.49 | 56 | 2 | 6 | 3 |
| 16 July | none | 45 | 8.9 | 0.74 | 48 | 0 | 5 | 2 |
| | 9 Dec | 38 | 13.6 | 1.36 | 55 | 0 | 1 | 6 |
| | 8 Jan | 23 | 7.6 | 1.23 | 65 | 0 | 6 | 6 |
| | 29 Jan | 25 | 8.5 | 1.28 | 67 | 0 | 3 | 5 |
| 4 Aug | none | 0 | 0.0 | - | 100 | 0 | 0 | - |
| | 9 Dec | 0 | 0.0 | - | 100 | 0 | 0 | - |
| | 8 Jan | 0 | 0.0 | - | 100 | 0 | 0 | - |
| | 29 Jan | 0 | 0.0 | - | 100 | 0 | 0 | - |
| 4 Aug (irrigation) | none | 0 | 0.0 | - | 100 | 0 | 0 | - |
| | 9 Dec | 0 | 0.0 | - | 100 | 0 | 0 | - |
| | 8 Jan | 0 | 0.0 | - | 100 | 0 | 0 | - |
| | 29 Jan | 0 | 0.0 | - | 100 | 0 | 0 | - |

* NB if counted as bolted, not counted as immature

Conclusions

The traditional date for planting overwintering cabbage is mid July. This allows for sufficient growth to occur before the winter and with longer standing varieties such as Tundra enables harvesting to occur as late as early April. Two factors, the natural standing ability of the crop, and the bolting response caused by a cold period followed by longer spring days make later marketing difficult. This has now been shown in two seasons work. The potential for later marketing appears to be in more southerly parts of the UK where warmer overwintering conditions and better light enable later plantings to be made but the development of varieties needing longer daylengths to stimulate stem elongation and production of more leaves would be beneficial.

Acknowledgements

The author would like to thank the HDC for its funding of this work and Mr G Steele (HRI-Kirton) for his technical support.

References

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2. Anon (1992) Descriptive list of varieties of cabbages. NIAB.
3. Friend, D.J.C., (1985) Brassica in: Handbook of flowering, (ed) Halevy, A.H., pp 48-77. Boca Raton, Florida CRC Press.
4. Heide, O.M., (1970) Seed stalk formation and flowering in cabbage. I Day length, temperature, and time relationships.
Scientific reports of the Agricultural College of Norway.

Appendix 1Cultural Diary

Field: 40 Acres 2

Soil type: Silt loams

Previous cropping: 1990 Grass
1991 Grass

Soil analysis: pH = 7.7; P₂O₅ index = 4; K₂O index = 2; Mg index = 4

Cultivations: 5/12/91 Ploughed
23/6/92 1 pass Lely rotterra + Cambridge roll
4/8/92 repeated 1 pass 'Lely' for plantings 4+5

Fertiliser: 22/6/92 Base dressing of 167 kg/ha N as Kaynitro (25% N, 16% K₂O)
7/8/92 Plantings 1,2+3 topdressed with 110 kg/ha N as Nitram (33% N)
9/9/92 Plantings 4+5 top dressed with 110 kg/ha N as Nitram

Variety: Tundra

Spacing: 450 mm x 380 mm

Herbicides: All plots were sprayed with propachlor as Portman propachlor at 9 l/ha and chlorthal-dimethyl as Dacthal at 6 kg/ha in 400 l/ha water shortly after planting.

Insecticides: All plants drenched with Chlorpyrifos (as Dursban) as 10 ml in 1.5 l water over 1 m²
20/7/92 Plantings 1,2+3 sprayed with demeton-S-methyl as Campbell's DSM at 560 ml/ha and cypermethrin as Cypermethrin 10 at 250 ml/ga in 600 l/ha water.

10/9/92 Trial sprayed with pirimicarb as Aphox at 420 g/ha and cypermethrin as Ambush at 250 ml/ha in 600 l/ha water.

9/10/92 Trial sprayed with pirimicarb as Aphox at 420 g/ha and cypermethrin as Ambush at 250/ha in 600 l/ha water.

Fungicides: 17/9/92 Trial sprayed with chlorothalonil+metalaxyl as Folio at 2 l/ha triadimenol as Bayfidan at 500 ml/ha.

Appendix 2. The effect of variety and planting treatment on yield and maturity, 1991/92

| <u>Variety</u> | <u>Planting</u> | <u>Harvest</u> | <u>Yield t/ha</u> (kg/head) | <u>Comments</u> |
|----------------|-----------------|----------------|--------------------------------|--|
| NZ 86-502 | June - | 2 Oct | 61 (1.65) | All class I but would not hold. |
| | June + | 2 Oct | 59 (1.58) | All class I but would not hold. |
| | Early July + | 2 Oct | 49 (1.34) | All class I but would not hold. |
| | Mid July + | 10 Oct | 44 (1.26) | Beginning to split when cut. |
| | Early Aug + | 30 March | - | 100% bolted |
| Castello | June - | 10 Oct | 79 (1.88) | All class I |
| | June + | 10 Oct | 78 (1.94) | All class I |
| | Early July + | 6 Nov | 65 (1.74) | All class I |
| | Mid July + | 6 Nov | 54 (1.47) | All class I |
| | Early Aug + | 30 March | - | 20% immature 80% small and bolted |
| Tundra | June - | 10 April | 47 (1.96) | 50-70% marketable (depending on plot) but only after peeling |
| | June + | 10 April | - | 100% split and/or rotten |
| | Early July + | 10 April | 57 (2.16) | 50-70% marketable after peeling. Remainder split or rotten. |
| | Mid July + | 10 April | 59 (1.91) | As above but a small proportions just OK without peeling. |
| | Early July + | 10 April | - | 20% bolted 80% just about to bolt. |
| Wintessa | June - | 30 March | - | All bolted |
| | June + | 30 March | - | All bolted |
| | Early July | 30 March | - | All bolted |
| | Mid July | 30 March | - | All bolted |
| | Early Aug | 30 March | - | 80% immature 20% formed heads but bolted. |

Note + with covers
- without covers

Contract between HRI (hereinafter called the "Contractor") and the Horticultural Development Council (hereinafter called the "Council") for a research/development project.

PROPOSAL

1. TITLE OF PROJECT

Contract No: FV/60
(Modification for year 2)

WINTER CABBAGE - FINDING A MEANS OF BRIDGING THE APRIL-MAY GAP BETWEEN TRADITIONAL AND IMPORTED CROPS

2. BACKGROUND AND COMMERCIAL OBJECTIVE

As for FV/60.

3. POTENTIAL FINANCIAL BENEFIT TO THE INDUSTRY

There is scope to increase national grower income by up to £1m, if an out-of-season crop of winter cabbage could be produced.

4. SCIENTIFIC/TECHNICAL TARGET OF THE WORK

The aim will be to provide crops of winter cabbage reaching peak maturity in sequence during the six week period when there is a shortage of UK crops. Careful manipulation of sowing dates and the use of non woven polypropylene covers will be employed.

5. CLOSELY RELATED WORK - COMPLETED OR IN PROGRESS

The first year's work (1991-92) showed that of two varieties of Savoy and two of cabbage tested, only Tundra had any potential for bridging the April-May gap. This proposal utilises the most promising aspects of the 1991 trial combining them with earlier covering and covering on more dates than used hitherto.

6. DESCRIPTION OF THE WORK IN YEAR 2

1. Varieties

a. Winter cabbage - Tundra

2. Sowing dates

a. 8 May

b. 18 May

c. 28 May

d. 18 June

e. 18 June + irrigation as required

3. Agryl P17 covers applied

- a. No cover
- b. Mid December
- c. Early January
- d. Late January

4. Cover removal (target date but dependent on prevailing winter conditions)

- a. Mid March

5. Plant raising and planting dates

Plants to be raised in 308 modules and planted out 6-7 weeks after each sowing.

6. Spacing

- a. 450mm x 380mm

7. Storage

Samples will be stored to examine the potential of each treatment beyond maturity and standing ability attained in the field.

8. Design

Randomised split plot - main plots covering treatments, sub-plots sowing dates consisting of 60 plots in 3 replicates. Plots consisting of 40 recorded plants surrounded by a single row 'picture frame' of guards.

7. Recording

- a. Crop diary
- b. Maturity
- c. Yields
- d. Quality assessments and defects

7. COMMENCEMENT DATE AND DURATION OF YEAR 2

May 1992 - July 1993

8. STAFF RESPONSIBILITIES

Project Co-ordinator: A J Whitlock - HDC Vegetable Panel
Project Leader: M B Wood, HRI Kirton

A Mead - HRI, Statistics Dept, Wellesbourne

Experiment Leader: M J Leatherland

9. LOCATION

HRI-Kirton

10. COSTS (for years 1 and 2)

| | | |
|------------------|---------|------------------|
| Year 1 (1991/92) | £ 7,400 | |
| Year 2 (1992/93) | £ 8,500 | (over 15 months) |
| | <hr/> | |
| Total cost | £15,900 | |
| | <hr/> | |

11. NEW PAYMENT SCHEDULE (replaces payment schedule in original contract)

On each quarter day the Council will pay to the Contractor in accordance with the following schedule:

| Quarter/Year | 1991 | 1992 | 1993 |
|--------------|------|------|------|
| 1 | - | 1850 | 1670 |
| 2 | 1230 | 1830 | 1670 |
| 3 | 1850 | 1670 | 610 |
| 4 | 1850 | 1670 | - |

TERMS AND CONDITIONS

The Council's standard terms and conditions of contract shall apply.

Signed for the Contractor(s) Signature..... *R. P. O'Connell*
Position..... *Commercial and Marketing Manager, H&M*
Date..... *19/6/92*

Signed for the Contractor(s) Signature.....
Position.....
Date.....

Signed for the Council Signature..... *[Signature]*
Position..... CHIEF EXECUTIVE
Date..... *26.5.92*