



HORTICULTURE RESEARCH INTERNATIONAL
STOCKBRIDGE HOUSE

**A REPORT TO THE HORTICULTURAL DEVELOPMENT COUNCIL,
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**ENDIVE: PRODUCTION TECHNIQUES TO
INCREASE BLANCHING AND EVALUATION OF
VARIETIES FOR TIPBURN SUSCEPTIBILITY
(FV117)**

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PART I
PRODUCTION TECHNIQUES TO INCREASE BLANCHING

Summary

Endive was planted in mid July and covered from late August to assess the effect of a range of cover materials on head blanching. The varieties Ione and Sally were grown and covered close to harvest with black Agryl (P60), Lutrasil Photoselect, white polythene and plastic saucers. The covers were removed after 3, 5, 7 or 10 days.

Blanching was encouraged by all cover treatments. The black Agryl and Photoselect produced well-blanching heads within 5 days for Ione but required slightly longer for Sally.

Head deterioration was rapid after 5 days beneath all treatments except the plastic caps. Temperatures recorded under the plastic caps were lower than beneath the other covers and this could be the main reason why they could be left on for longer without a reduction in crop quality.

Introduction

The market for endive demands heads which are well-blanching. Varieties and types of endive differ in their natural ability to produce yellow centres. The proportion of the head which naturally blanches is low for the frisee types but higher for the wallone types due to the upright habit and shading of the inner leaves.

Over the past season nonwoven covers have become available which may have potential to increase blanching. One such material is Lutrasil Photoselect which has been developed for this specific use. In France plastic caps are widely used but these are expensive and have a high labour requirement.

Objective

To compare a range of cover materials and duration of covering for their effect on head blanching using two types of endive.

Materials and Methods

Site

Horticulture Research International, Stockbridge House, Cawood, Selby, North Yorkshire, YO8 0TZ.

Soil Type

Sandy loam of the Quorndon Series.

Treatments

1. Cover treatments
 - a. Black Agryl (60 g/m²)
 - b. Lutrasil Photoselect (80 g/m²)
 - c. White polythene (30 um)
 - d. Plastic saucers (25 cm diameter)

2. Cover Removal
 - a. Cover removed after 3 days
 - b. Cover removed after 5 days
 - c. Cover removed after 7 days
 - d. Cover removed after 10 days

3. Cultivars
 - a. Ione (Enza) - Frisee type
 - b. Sally (Yates) - Semi-Frisee type

Husbandry

Seed of each of the cultivars was sown into 38 mm peat blocks on 16 June and propagated in an unheated glasshouse. The trial was planted in mid July at 350 mm x 300 mm spacing and grown according to good commercial practice. The cover treatments were laid on 27 August using soil to secure the edges of the covers. The plastic caps were laid on top of the endive heads. The covers were removed after 3 days

(30 August), 5 days (1 September), 7 days (3 September) and 10 days (6 September). All husbandry details are given in Appendix I.

Assessments

Ten heads from each cover treatment were assessed at each cover removal date for blanching and quality. For blanching a scoring technique was used with a range of 1 to 9, where 1 was green and 9 was very pale. For most markets a score of 6 or 7 would be required. The air temperatures beneath the covers were also recorded using a Squirrel Data Logger.

Design

The experiment was of a split plot design with cover materials at the main plot level, split for each cover removal date. There were 3 replicates of each treatment. Each plot consisted of 40 plants (4 rows x 10 plants).

Results

At each uncovering the heads were harvested, trimmed to remove the outer leaves and then weighed. Each head was then trimmed again with the blanched portion weighed. The results for the blanching scores are summarised in Table 1.

Table 1: Blanching Score (1 = green, 9 = white).

Cover Treatment	Days of Covering			
	3	5	7	10
<u>Ione</u>				
Black Agryl	4.4	6.5	7.9	5.7
Lutrasil Photoselect	4.1	7.2	7.8	5.6
White polythene	4.6	6.1	7.5	5.5
Plastic saucers	4.4	4.9	7.3	6.8
<u>Sally</u>				
Black Agryl	3.9	6.4	7.3	6.2
Lutrasil Photoselect	4.4	5.6	7.3	6.5
White polythene	3.1	3.8	6.2	6.1
Plastic saucers	4.1	4.9	7.6	7.9

The blanching scores taken at each removal date showed that for Ione just 3 days was necessary to promote blanching of the outer heart with all treatments similar. After covering for 5 days the black Agryl, Photoselect and white polythene had a greater effect on blanching than the plastic saucers. By 7 days, however all treatments had blanched to a similar extent. For Sally the heads took longer to blanch with 3 days too short to have any significant effect on blanching. The dense nature of the heads delayed blanching but black Agryl and Photoselect encouraging blanching. By 7 days the plastic saucers had had a similar effect to the two nonwoven cover types.

The weights of the blanched portion of each head given in Figures 1 and 2 (Appendix II, Table A).

FIG 1. WEIGHT OF BLANCHED HEAD (g)- IONE

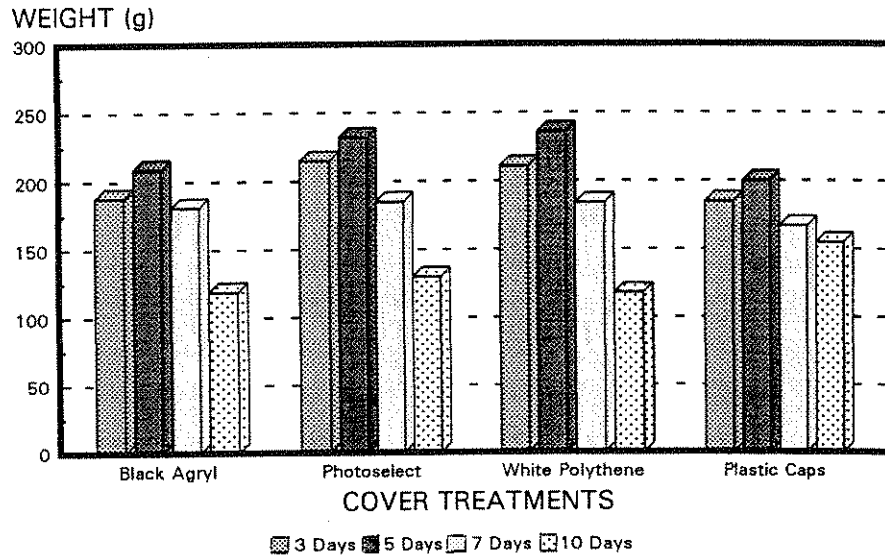
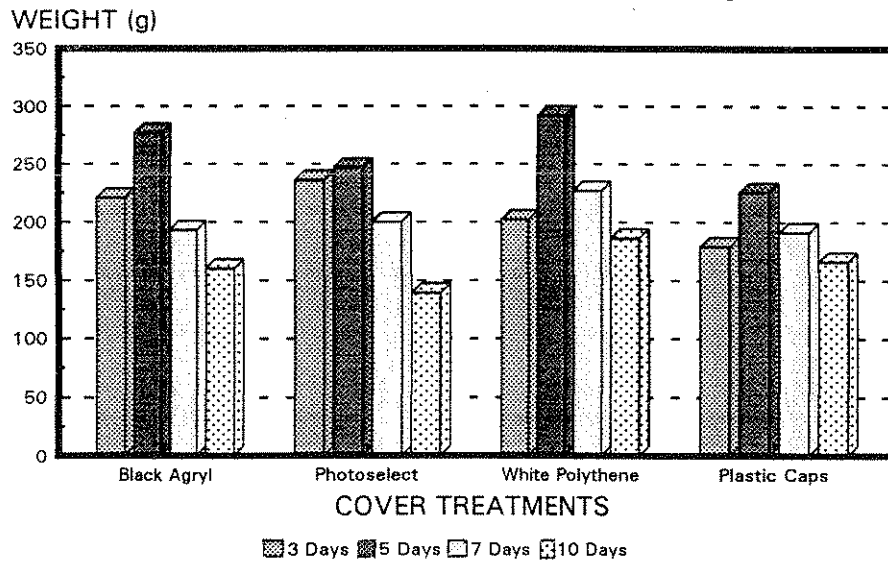


FIG 2. WEIGHT OF BLANCHED HEAD (g)- SALLY



For both Ione and Sally the weight of the blanched head was highest for all treatments after covering for just 5 days. Extending the duration of covering reduced the weight as physiological disorders such as tipburn increased, possibly due to the condensation which formed beneath the Photoselect and white polythene. The plastic caps took longer to blanch the heads but there was a slower rate of deterioration compared to the other covers used.

The total head weights were similar for all cover treatments (Appendix II, Table B). The proportion (by weight) of the head which had blanched was similar for all cover materials (Appendix III, Table C).

The air temperatures recorded beneath the cover materials are shown in Table 2.

Table 2: Maximum Air Temperatures (°C).

Date	No Cover	Black Agryl	Photoselect	White polythene	Caps
28 Aug	19.8	18.7	25.7	25.0	17.0
29 Aug	25.4	21.5	33.7	28.0	19.0
30 Aug	16.7	16.1	21.0	19.7	15.0
31 Aug	20.8	18.7	29.3	25.0	17.0
1 Sept	20.2	16.7	24.7	23.9	16.1
2 Sept	20.5	17.2	22.8	22.7	18.0
3 Sept	20.3	17.6	25.3	20.8	16.9
4 Sept	21.0	15.2	23.6	23.6	18.0
5 Sept	25.1	19.3	35.0	23.0	21.5
6 Sept	21.8	19.3	21.3	18.4	20.5
Mean	21.2	18.0	26.2	23.0	17.9

The results show that the temperatures beneath the Photoselect were higher than under the black Agryl and the white polythene. The fluctuations in the non-covered treatments were high, possibly due to direct heating of the probes by the sun. Temperatures beneath the plastic caps were lower.

Discussion

In general, commencement of blanching occurred within 3 days but it was not until after 5 days that it was considered adequate. Where covering had been carried out for 7 days the heads were almost cream and this would be considered too blanched for some markets.

The best materials used in this trial were the Photoselect and the black Agryl. Both these materials worked well when left on the plants for 5 days. The increased air temperatures recorded beneath the Photoselect encouraged heavier heads but deterioration occurred at a faster rate after 5 days than where the black Agryl had been used.

The white polythene gave good results with soft, well-blanched leaves produced. The condensation which occurred beneath this cover would limit its potential, however as it would speed up the rate of deterioration and could encourage disease.

The plastic caps also worked well but required more labour than the nonwoven covers and took longer to reach an acceptable blanch colour. The cooler temperatures under the caps resulted in smaller heads and lower weight of blanched leaves.

Conclusions

1. All treatments increased the blanching of the endive with the black Agryl and Photoselect nonwoven covers working quicker than the plastic caps.
2. The optimal length of covering was about 5 days for the nonwoven cover type. The plastic caps needed to be in place over the heads for about 2 days longer to achieve the same affect.
3. Condensation was present beneath the Photoselect and the white polythene and under warmer temperatures this could increase rotting and hasten deterioration.
4. The maximum air temperatures were highest beneath the Photoselect which was of a thicker gauge than the black Agryl. Problems might occur in very hot weather if this cover is used.

APPENDIX I: CROP DIARY

16 June	Seed sown into 38 mm peat blocks.
6 July	94 kg/ha N; 50 kg/ha P ₂ O ₅ ; 150 kg/ha K ₂ O applied and incorporated.
8 July	Beds formed.
10 July	46 kg/ha N.
14 July	Planted.
15 July	Irrigated 20 mm.
29 July	Irrigated 25 mm.
27 August	Covers laid.
30 August	Covers removed (after 3 days).
1 September	Covers removed (after 5 days).
3 September	Covers removed (after 7 days).
6 September	Covers removed (after 10 days).

APPENDIX II:

Table A: Weight of blanched head (g).

Cover Treatment	Days of Covering			
	3	5	7	10
<u>Ione</u>				
Black Agryl	188	209	181	119
Lutrasil Photoselect	215	232	185	130
White polythene	211	236	184	118
Plastic saucers	185	200	167	155
<u>Sally</u>				
Black Agryl	221	277	193	160
Lutrasil Photoselect	236	247	200	139
White polythene	202	292	227	186
Plastic saucers	179	226	191	166

Table B: Mean Total Head Weight (g).

Cover Treatment	Days of Covering			
	3	5	7	10
<u>Ione</u>				
Black Agryl	419	461	460	372
Lutrasil Photoselect	476	511	492	369
White polythene	468	497	512	436
Plastic saucers	409	428	507	462
<u>Sally</u>				
Black Agryl	475	547	545	473
Lutrasil Photoselect	472	550	524	446
White polythene	495	614	596	551
Plastic saucers	480	531	512	496

APPENDIX III:

Table C: Proportion of head blanched (%).

Cover Treatment	Days of Covering			
	3	5	7	10
<u>Ione</u>				
Black Agryl	44.7	45.5	39.4	32.2
Lutrasil Photoselect	45.4	45.5	37.6	35.2
White polythene	44.9	47.5	35.8	27.1
Plastic saucers	45.6	46.6	32.9	33.5
<u>Sally</u>				
Black Agryl	46.5	50.5	35.4	33.9
Lutrasil Photoselect	50.0	44.9	38.1	31.2
White polythene	41.0	47.6	38.1	33.8
Plastic saucers	38.0	42.5	37.2	33.5

PART II
EVALUATION OF VARIETIES FOR TIPBURN SUSCEPTIBILITY

Summary

A range of endive varieties were planted in mid July and assessed for leaf habit and susceptibility to tipburn when grown at two spacings. The plants established well and were mature by early September.

The effect of the plant spacing on the levels of tipburn in late August was not consistent but by early September heads grown at the wider spacing appeared more susceptible to the disorder. Of the frisee type the varieties Tosca, Glory and Oxalie appeared less susceptible to tipburn early on, with Midori, Dorana and Elodie of the semi-frisee types also being less susceptible. The varieties Minerva and Melie of the wallone type appeared more resistant to tipburn than Lorca.

Introduction

A wide selection of endive varieties are available from UK seed companies with new numbered ones often offered for trials on growers holdings. This study aimed to evaluate a range of varieties of various leaf habits and assess their susceptibility to tipburn.

Objective

To compare a range of varieties of endive when grown at two spacings for their susceptibility to tipburn and their suitability to produce well-blanching heads.

Materials and Methods

Site

Horticulture Research International, Stockbridge House, Cawood, Selby, North Yorkshire, YO8 0TZ.

Soil Type

Sandy loam of the Quorndon Series.

Treatments

1. Varieties

- a. Tosca (NIZ)
- b. Glory (Yates)
- c. Sally (Yates)
- d. Coquette (R. Sluis)
- e. Ione (Enza)
- f. Midori (Enza)
- g. Oxalie (R. Zwaan)
- h. Minerva (R. Zwaan)
- i. Melie (Breeders)
- j. Elodie (Breeders)

Single Plot Observations

- k. Priscilla (R. Zwaan)
- l. Lorca (NIZ)
- m. E616 (Enza)
- n. Dorana (Yates)
- o. F716 (Yates)

2. Spacings

- a. 300 x 300 mm
- b. 400 x 400 mm

Husbandry

Seed of each variety was sown into 38 mm peat blocks on 16 June and propagated in an unheated glasshouse. The blocks were planted on 14 July at either 300 x 300 mm or 400 x 400 mm and irrigated to aid establishment. The trial was irrigated again on 29 July to reduce the risk of tipburn. The full trial diary is given in Appendix I.

Design

The experiment was of a split plot design with spacing at the main plot level. There were 2 replicates of each treatment. The plots were 8.8 m² with 4 rows per 1.83 m bed with either 64 or 48 plants depending on spacing.

Results and Discussion

The trial established well in mid July and continued to grow well during August. The varieties were assessed in late August, early September and mid September when the numbers of heads with tipburn and general head characteristics were recorded.

Table 1: Number of plants with tipburn symptoms (% plants affected).

	27 August		4 September	
	300 x 300	400 x 400	300 x 300	400 x 400
Tosca	5	15	79	97
Glory	13	13	55	98
Sally	68	30	66	59
Coquette	20	28	80	100
Ione	40	53	98	100
Midori	5	3	2	51
Oxalie	15	3	92	55
Minerva	1	3	0	2
Melie	0	3	0	1
Elodie	10	50	22	55

The varieties most affected in late August by tipburn were Sally, Ione and Elodie. There did not appear to be any correlation between spacing and the number of heads with tipburn at this stage.

In early September only the varieties Minerva and Melie, both of the wallone frisan type, had negligible levels of tipburn. Growing the plants at the closer spacing appeared to reduce the incidence of tipburn, but levels were still high.

Description of Each Variety

- Tosca A vigorous, coarse, long leaved frisee type, resistant to tipburn early on but symptoms appeared on all heads by early September. Uniformity was good but even at the closer spacing ground cover was not complete.
- Glory A coarse, long leaved upright frisee type which was very similar to Tosca, with similar tipburn susceptibility, mainly confined to the lower leaves.
- Sally A semi-frisee type with a very dense well-blanché centre. Tipburn was present on the outer edges of the middle leaves in late August.
- Coquette A vigorous coarse, long leaved frisee type which produced a large well-blanché centre.
- Ione A moderately vigorous frisee type, very compact habit with a good centre blanch.
- Midori A vigorous semi-frisee type with a large open habit which formed a dense moderately well-blanché centre in early September. The heads were resistant to tipburn.
- Oxalie A moderately vigorous frisee type which produced a very compact head with good centre blanch.
- Minerva A wallone frisan type with a large open habit. The heads were very resistant to tipburn and had good centre blanch.

Melie A wallone frisan type with a large open habit which blanched well but was still very bitter. The heads looked free from tipburn but the lower leaves were severely affected.

Elodie A semi-frisee type which produced a small well-blanched centre. The heads often had a twisted appearance and were not very attractive. One plant had bolted.

Single Plot Observations

Priscilla An escarole/broad leaved type with very high amounts of tipburn on each head.

Lorca A wallone frisan type which on close inspection had high levels of tipburn restricted to the lower outer leaves.

E616 A cross between a wallone and semi-frisee type with only moderate bitterness. The leaves were highly serrated but very prone to tipburn.

Dorana A cross between a wallone frisan and semi-frisee type which looked attractive and was fairly resistant to tipburn. The leaves were light green in colour, sweet and not at all bitter.

F716 A wallone frisan type with tipburn present on most plants but at very low levels.

Conclusions

1. Spacing did not have a consistent affect on the levels of tipburn early on but the wider spacing appeared to increase tipburn near to harvest.
2. Of the frisee types the varieties Tosca, Glory and Oxalie appeared to be less susceptible to tipburn than Ione and Coquette.
3. Of the semi-frisee types the varieties Midori, Dorana and Elodie were less susceptible to tipburn than Sally. Elodie had poor head shape however.
4. Of the wallone type the varieties Minerva and Melie were more resistant to tipburn than Lorca.

APPENDIX I: CROP DIARY

16 June Seed sown into 38 mm peat blocks.

6 July 94 kg/ha N; 50 kg/ha P₂O₅; 150 kg/ha K₂O applied and
incorporated.

8 July Beds formed.

10 July 46 kg/ha N.

14 July Planted.

15 July Irrigated 20 mm.

29 July Irrigated 25 mm.

Overall Recommendations

The work on encouraging blanching has produced some useful information on Lutrasil Photoselect. This material looks promising but it may be unsuitable for use during hot summer months due to the increased maximum temperature which was recorded in this trial. Any future trial should look at this material on crops grown at other times of the year with temperatures recorded beneath the covers. The black Agryl gave good results and as it is thinner may have more potential despite its colour.

The frisee and semi-frisee types were particularly sensitive to tipburn. There is an HDC trial underway at HRI Kirton on tipburn control in chinese cabbage. Any treatments which are found to have a benefit in reducing tipburn should also be evaluated on endive.