

REPORT FOR HORTICULTURAL DEVELOPMENT COUNCIL

ASPARAGUS. EVALUATION OF 15 CULTIVARS

Research Leader: Mrs J R A Steckel,
Horticultural Research International
Wellesbourne
Warwick CV35 9EF Wks
Tel: 0789 470382
Fax: 0789 470552

Year of experiment: 6

Objective

To evaluate the performance of new asparagus varieties of French, Dutch, American, German and English origin.

Introduction

The area of asparagus in the UK has steadily increased over the last few years and there is substantial interest in the new hybrid varieties becoming available from around the world. It was considered that these new varieties should be evaluated in comparative trials using established English stocks as controls. Fifteen varieties were planted including material from Holland, Germany, France and the USA. The experiment was established in 1986 at Luddington EHS.

Materials and methods

The fifteen varieties and their country of origin are listed below.

*Geynlim (Holland)	*Cito (France)
*Boonlim (Holland)	UC157 (USA, California)
*Venlim (Holland)	Delmonte 361 (USA, California)
*Backlim (Holland)	Jersey Giant (USA, New Jersey East Coast)
*Franklim (Holland)	*Rekord (Germany)
*Larac (France)	Regal (UK)
*Mira (France)	*Connovers Colossal (UK)
*D231 (France)	

*Varieties harvested 1991.

Seed was raised in Hassy 104 trays. Transplanting was carried out in early July 1986. The full cultural details are given in Appendix I. Three replicates of 50 plants each were planted out at a spacing of 1.33 m between rows and 0.30 m between plants (52 x 12 in). The first harvest lasted only 4½ weeks and was taken in April-May 1988, and the second and third full harvests were cut in 1989 and 1990. Spears were graded into <8, 8-10, 10-16, 16-20, >20 mm diameter sizes with a further category of 'blown' and twisted spears, i.e. waste material.

The fourth harvest was cut in 1991 when only 11 varieties were recorded. Those selected were the 10 highest yielding varieties in 1990 together with the UK variety Connovers Colossal. The spears were graded into unmarketable (Class II) which included <8mm, 8-10 mm, 'blown' and 'twisted' and three other size grades 10-16, 16-20 and >20 mm. As in previous years the number and weights were recorded for all these categories.

Results

1. Yield, kg/ha in size grades

In 1991 spear emergence was slow and harvesting did not start until 3 May, it was continued until 15 June and a total of 24 cuts were made during the 6 week harvest period.

Yield data for 1991 is shown in Table 1 and all spear categories are listed. Varieties are ranked in order of total grade 1 yield (grades 10-16, 16-20, >20 mm). Figures significantly higher than the trial mean are underlined with a solid line, those significantly lower with a dotted line.

Table 1: Yields kg/ha in size grades (mm) 1991
(varieties ranked in order of total yield Class 1)

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II	Grand Total
Boonlim	1718	3224	<u>4289</u>	<u>9230</u>	1148	<u>10378</u>
Backlim	1167	2580	<u>5239</u>	<u>8985</u>	1010	<u>9995</u>
Franklim	<u>2888</u>	<u>4026</u>	1645	<u>8559</u>	1485	<u>10044</u>
Venlim	1729	3447	3332	<u>8508</u>	1615	<u>10123</u>
Rekord	<u>2461</u>	3512	2041	8014	1503	<u>9517</u>
D231	<u>1567</u>	2641	3112	7321	1466	8787
Cito	1603	3197	1795	6594	1688	8282
Geynlim	<u>2520</u>	2558	<u>1229</u>	6307	1041	7348
Mira	<u>720</u>	<u>1691</u>	3156	5567	1168	6735
Larac	1196	1903	1759	<u>4857</u>	1124	<u>5981</u>
ConColossal	1233	<u>812</u>	<u>687</u>	<u>2732</u>	781	<u>3513</u>
MEANS	1709	2690	2571	6970	1275	8250
LSD 5% from mean	610	858	951	1500	509	1638

The cultivars Boonlim, Backlim, Franklim and Venlim all gave significantly higher Class I and total yields than the trial mean and Larac and Connovers Colossal significantly lower. Backlim and Boonlim gave significantly higher yields of spears >20mm and Franklim, Geynlim and Rekord higher yields of spears 10-16 mm.

2. Number of spears (thousands/ha)

Table 2 shows the number of spears in thousands/ha in all size grades and total numbers. Figures showing significant differences compared to the trial means are underlined as in Table 1.

The cultivars Franklim and Rekord gave significantly higher numbers of spears in grades 10-16 mm, 16-20 mm, Class I and overall total. Franklim was the only cultivar to give a significantly higher number of spears in Class II; the unmarketable grade. Boonlim and Backlim gave the highest number of spears >20 mm.

Table 2: Number of spears (thousands/ha) in size grades (mm) 1991 (varieties ranked in order of total Class I)

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II	Grand Total
Franklim	<u>98.0</u>	<u>80.8</u>	23.2	<u>202.0</u>	<u>66.9</u>	<u>268.9</u>
Rekord	<u>87.8</u>	<u>74.5</u>	27.5	<u>189.8</u>	56.3	<u>246.1</u>
Boonlim	54.0	63.3	<u>55.6</u>	172.9	35.1	208.0
Venlim	56.6	65.9	43.4	165.9	52.3	218.2
Geynlim	<u>89.4</u>	55.6	<u>17.9</u>	162.9	56.0	218.9
D231	54.0	60.6	40.4	155.0	47.4	202.4
Backlim	40.1	50.0	<u>63.9</u>	154.0	30.1	184.1
Cito	56.0	65.9	26.2	148.0	60.6	208.6
Larac	40.7	40.7	23.2	<u>104.7</u>	38.1	<u>142.7</u>
Mira	<u>24.5</u>	<u>35.1</u>	40.4	<u>100.0</u>	<u>24.5</u>	<u>124.5</u>
ConColossal	43.7	<u>16.9</u>	<u>8.9</u>	<u>69.5</u>	33.1	<u>102.7</u>
MEANS	58.6	55.4	33.7	147.7	45.5	193.2
LSD 5% from mean	20.1	18.3	11.0	32.9	17.0	42.5

The percentages, by number, of the spears in the size grades are shown in Table 3. Percentages have been angularly transformed for statistical analysis but the original percentages are shown in brackets. Again statistical differences from the trial means are underlined as in Table 1.

The cultivar Backlim gave significantly higher % spears >20 mm and Class I but significantly lower % 10-16 mm and Class II. Connovers Colossal gave the lowest % spears in 16-20 mm, >20 mm and Class I but the highest % 10-16 mm and Class II than the other 10 varieties.

Table 3: Percent spears (by number) in size grades (mm)
 (varieties ranked in order of percent Class I)
 Figures angularly transformed, actual % in brackets

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II
Backlim	(21.3) <u>27.2</u>	(27.0) 31.3	(35.5) <u>36.4</u>	(83.9) <u>66.5</u>	(16.1) <u>23.5</u>
Boonlim	(26.0) 30.6	(30.2) 33.3	(27.0) <u>31.3</u>	(83.2) 65.8	(16.8) 24.2
Mira	(19.5) <u>26.2</u>	(27.3) 31.5	(33.7) <u>35.4</u>	(80.5) 63.8	(19.5) 26.2
Rekord	(35.6) 36.6	(30.4) 33.4	(11.3) 19.6	(77.2) 61.5	(22.8) 28.5
D231	(26.5) 31.0	(30.0) 33.2	(20.4) 26.7	(76.9) 61.3	(23.1) 28.7
Venlim	(26.0) 30.4	(30.1) 33.2	(19.8) 26.4	(75.9) 60.6	(24.1) 29.4
Franklim	(36.5) 37.2	(30.0) 33.2	(8.7) <u>17.0</u>	(75.1) 60.1	(24.9) 29.9
Geynlim	(41.1) <u>39.9</u>	(25.1) 30.1	(7.9) <u>16.2</u>	(74.2) 59.5	(25.8) 30.5
Larac	(28.6) 32.2	(28.5) 32.3	(16.8) 24.1	(73.9) 59.4	(26.1) 30.6
Cito	(26.7) 31.1	(31.3) 34.0	(12.5) 20.7	(70.6) 57.2	(29.4) 32.8
ConColossal	(42.3) <u>40.6</u>	(16.7) <u>24.1</u>	(8.9) <u>17.1</u>	(68.0) <u>55.7</u>	(32.0) <u>34.3</u>
MEANS	(30.0) 33.1	(27.9) 31.8	(1814) 24.6	(76.3) 61.0	(23.7) 29.0
LSD 5% from mean	4.8	3.3	5.6	5.1	5.1

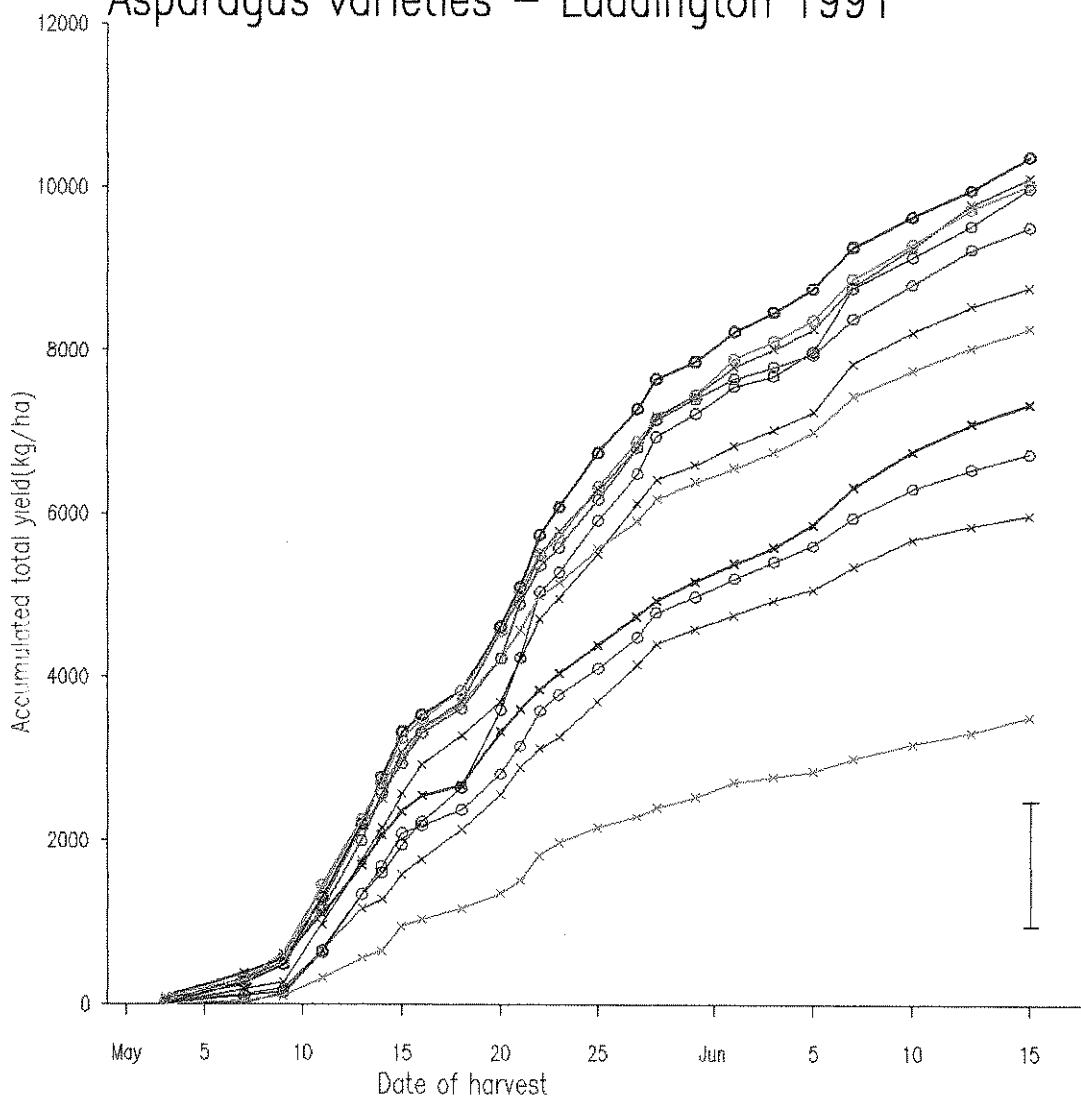
Figures 1 and 2 show the accumulation of yield and number of spears throughout the cutting period in 1991.

The total yield and number of spears for each variety from each year are shown in Figure 3. In all varieties, the total number of spears cut was lower in 1991 than 1990, but in the varieties Backlim and Venlim the total yield increased in 1991 and in Boonlim, Franklim and Mira the total yield was the same in both years. Franklim produced 10,000 kg/ha in the 3 years 1989-91.

Spearman Rank correlations (Table 4) were calculated to compare the rankings of the 11 varieties over the 4 years of harvesting. A figure of one indicates that the position of a variety by its yield in each year was the same and a value of zero indicates that relative performance in one year did not predict that in another year. There were significant correlations between the last two years, 1990-91, for total yield and total number of spears and yield and number of Class I spears. Also between the total number of spears in years 1989-90 and 1989-91.

Figure 1

Asparagus varieties – Luddington 1991

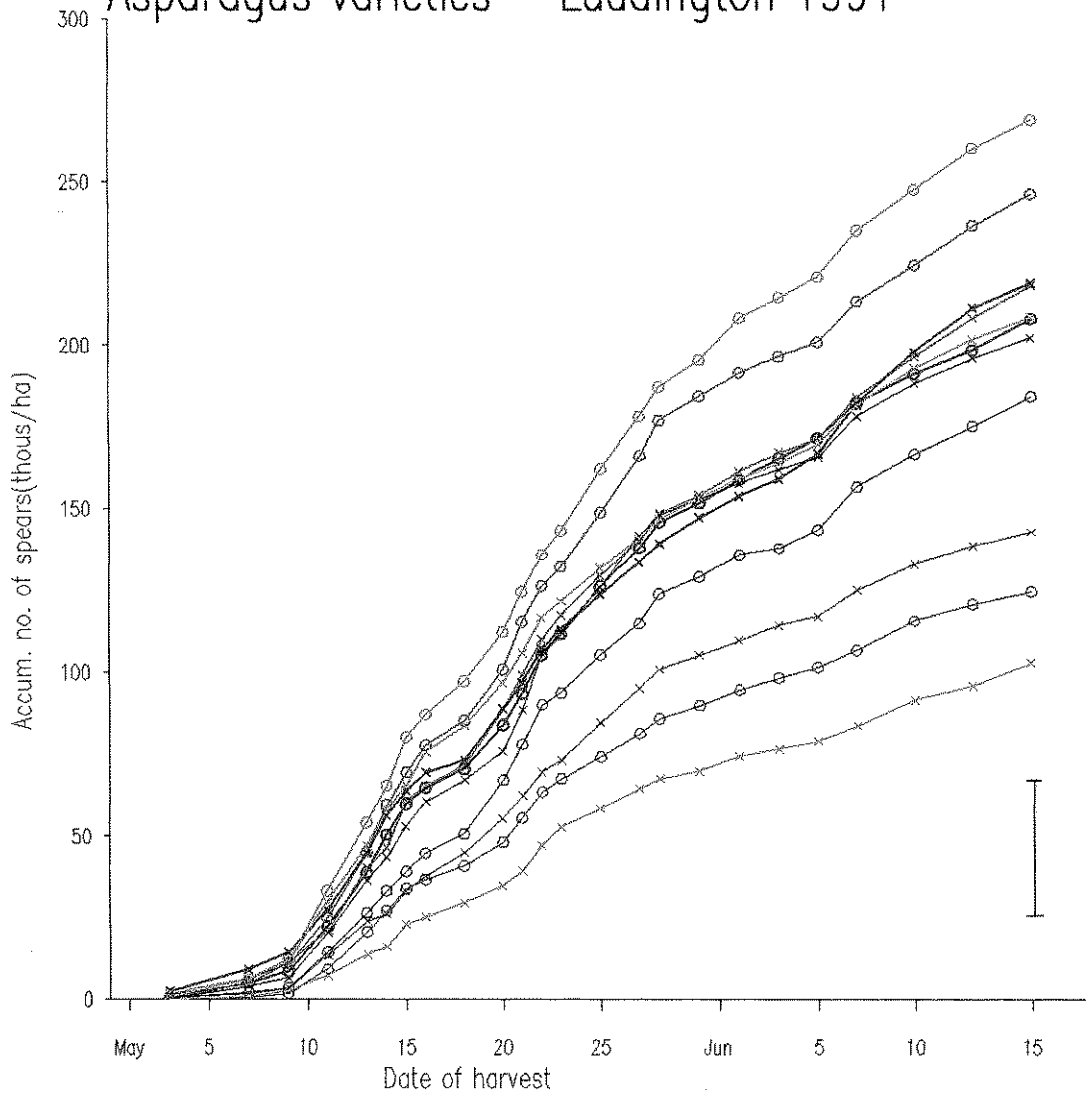


- Boonlim
- Backlim
- Venlim
- × D231
- × Rekord
- × Geynlim
- Franklim
- × Cito
- Mira
- × Larac
- × ConColos

LSD $p = 0.05$

Figure 2

Asparagus varieties – Luddington 1991



- Boonlim
- Backlim
- Venlim
- × D231
- × Rekord
- Geynlim
- × Franklim
- Cito
- Mira
- × Larac
- × ConColos

┌ LSD p = 0.05

Figure 3

ASPARAGUS VARIETIES 1988-91

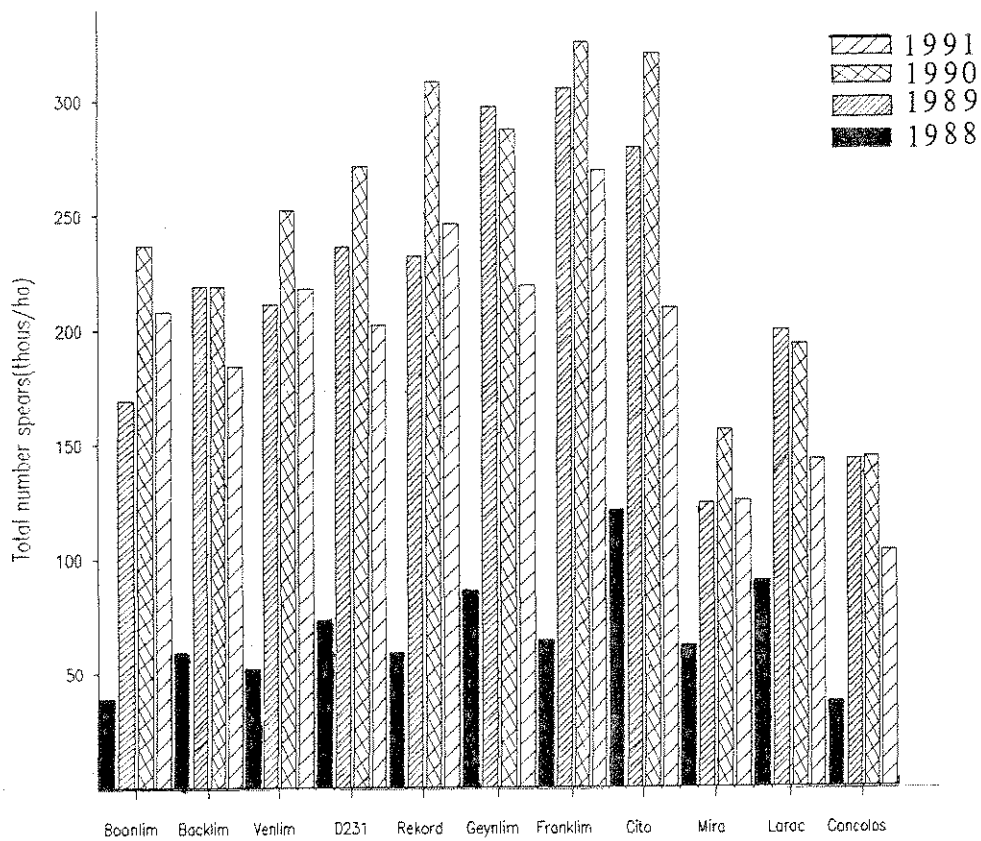
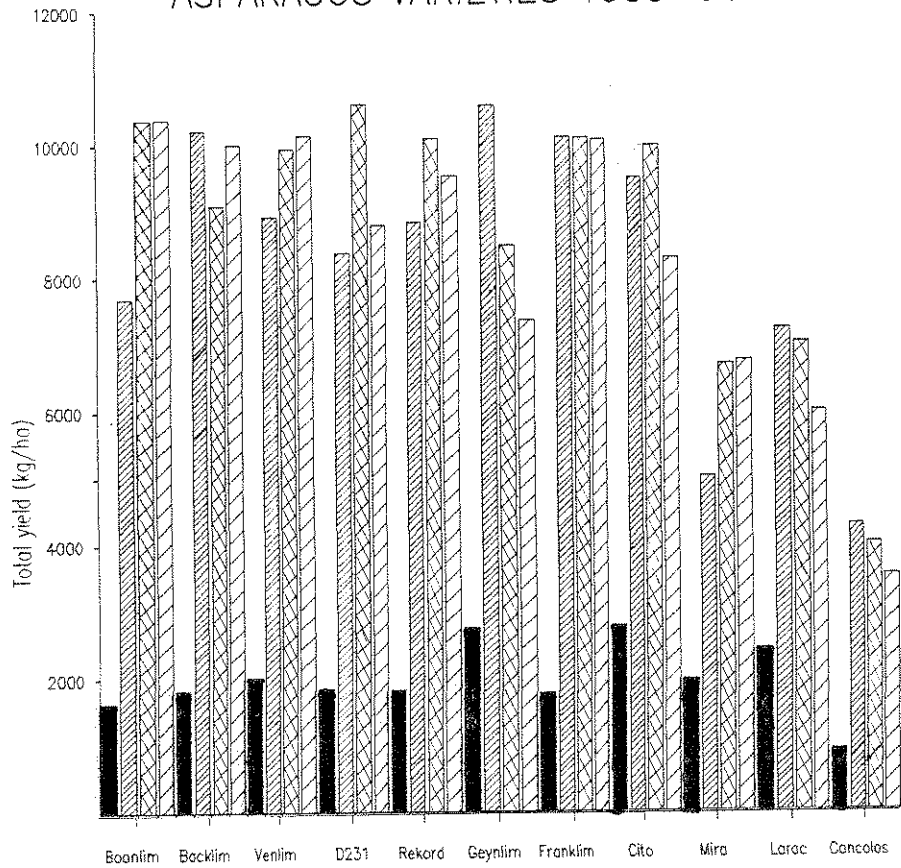


Table 4: Spearman rank correlations for 4 harvest years 1988-91

	Total Yield	Yield Class I	Total Number	Number Class I
1988-89	0.35	0.30	0.56	0.34
1989-90	0.28	0.55	0.90**	0.65*
1990-91	0.72*	0.88**	0.91**	0.86**
1988-90	-0.16	0	0.44	-0.09
1988-91	-0.25	-0.18	0.19	-0.26
1989-91	0.44	0.62*	0.78**	0.58

Degrees of freedom = 9

* Significant @ 5%

** Significant @ 1%

Discussion

The 1989 harvest was first full cut from this trial. There had been good fern growth, post harvest, for most varieties in 1988 and this, coupled with the best 'Asparagus spring' for many years, resulted in some very high yields from the better varieties. However, three varieties UC157, Delmonte and Regal continued to decline and the population and vigour became so poor that yields were very low. The decline of the Californian bred varieties could be the result of a genotype/environment reaction, indicating that they were not suited to the conditions of this trial. Reasons for the decline of Regal, an East Anglian selection similar to Connovers Colossal, are inexplicable, particularly as the latter is doing quite well. Examination for pathogens were made from the three stocks but no definite cause of death was established.

The conclusions from the first full cut in 1989 were that Dutch bred hybrids yielded exceptionally well and produced good quality spears. The evidence from two harvests indicates that they are suited to the UK climate. French hybrids gave high yields but generally slightly below the Dutch varieties. They have a tendency to produce poorer quality spears. Mira showed a more rapid deterioration than from a previous trial. Californian bred varieties continued to decline in spite of their initial good establishment and early signs of vigour. Jersey Giant, an East Coast American variety yielded disappointingly and there was

significant crown death. However spear quality was good. Rekord, a Lucullus selection gave better results than the Lucullus grown in the earlier 1981 planted trial. Connovers Colossal, a commercial English selection, has been quite good for its type.

In 1990, the performance of the Dutch bred varieties continued to be good with the possible exception of Franklim. Though this variety gave high total yields it did produce a large proportion of Class II spears. The selection from Lucullus, Rekord, again performed well but the French varieties again produced lower yields than the Dutch ones with the possible exception of D231. Yields from the English and especially the American cultivars were poor.

After the 1990 harvest it was decided to exclude the 4 varieties UC157, Delmonte 361, Jersey Giant and Regal from future harvest recordings because of their low plant stands.

The weather in 1990 during the period of fern growth, June to September, was warmer and drier than average (see Appendix I). This was followed by a cool Spring when the daily mean temperatures were lower than in 1990. In spite of these factors and the cooler temperatures during the harvest period, the mean total yield from the 11 varieties only decreased by 500 kg/ha in 1991. The spears were of better quality in 1991, there was a mean of 20 percent more spears in Class I.

All the Dutch bred varieties except for Geynlim performed well. Franklim performed better than in 1990 as there were fewer spears in the 'blown' and 'twisted' category probably due to the cooler temperatures during the harvest period in 1991. Rekord again performed well and the best French variety was D231. Connovers Colossal produced the lowest yields of spears in both Class I and Class II grades.

Appendix I

Crop culture

Soil type: light sandy loam to depth

Crop diary1986

15 March Seed sown in all types of containers, kept at 20°C
 21 April Moved into 10°C glass
 21 April) Liquid feeds 200/200 N/K every 14 days
 8 July)
 30 May Moved into open
 15 April Land ploughed
 7 July Land cultivated with Lely Roterra
 7 July 127kg/haN, 60kg/haP, 165kg/haK applied and worked in
 8 July Planted in furrows, tops of plants 100 mm below mean
 soil level, spacing 1320x305mm. Furrows left open.
 8 July 25 mm water applied
 8 August)Hand weeded
 26 September)

23 December Fern cut and burned and furrows filled in

1987

5 February 4.0 l/ha paraquat applied
 5 March Simazine + paraquat (2.24 kg/ha + 4.0 l/ha)
 19 March 127 kg/haN, 60 kg/haP, 165 kg/haK applied over top
 8 June Hand weeded
 27 June Top dressed 127 kg/ha N as nitrochalk
 25 November Fern removed and burned

1988

12 February Ridged with mechanical ridger
 23 February 2.24 kg/ha Simazine 50 applied
 21 April Twitch and big weeds, spot treated with glyphosate
 (Round-Up)
 22 Apr-20 May Harvest
 25 May 125 kg/ha N all trials
 15-19 November Fern removed
 23 November Paraquat 4.0 l/ha
 23 December Plots re-ridged

1989

27 March 2.8 kg/ha Sinbar (terbacil)
 4 April 1st cut CITO + COVERED PLOTS IN BURNING OVER trial
 12-20 June Harvesting ceased (date dependent on trial)
 16 June Hand hoed to remove big weeds
 17 June 130 kg/ha N (4cwt/acre nitrochalk)
 19/20 June Irrigation 25 mm (1 in) to activate nitrogen
 application

1990

12 March Paraquat application
 Simazine
 3,4,5 April Overnight frost min temperatures -4.9, -6.6, -4.1°C
 6 April Frosted spears counted
 20 April 1st cut

1-7 May Temperatures above average weekly max 23.2°C;
 weekly min 6.1°C
 Monthly mean max 19.6°C (39yr mean=16.3°C)
 min 5.9°C (39yr mean= 6.3°C)
 Warmest May recorded during 39 year period at
 Wellesbourne/Luddington
 3 June Final cut - quality of spears deteriorating
 late June Nitrogen 130 kg ha⁻¹ applied top dressing

	Mean temperature (°C)	Rainfall (mm)
June	14.0(+0.2)*	46.0(-5.3)*
July	17.7(+1.5)*	14.3(-33.7)*
August	18.8(+2.8)*	20.6(-45.3)*
September	13.5(-0.2)*	42.9(-9.3)*

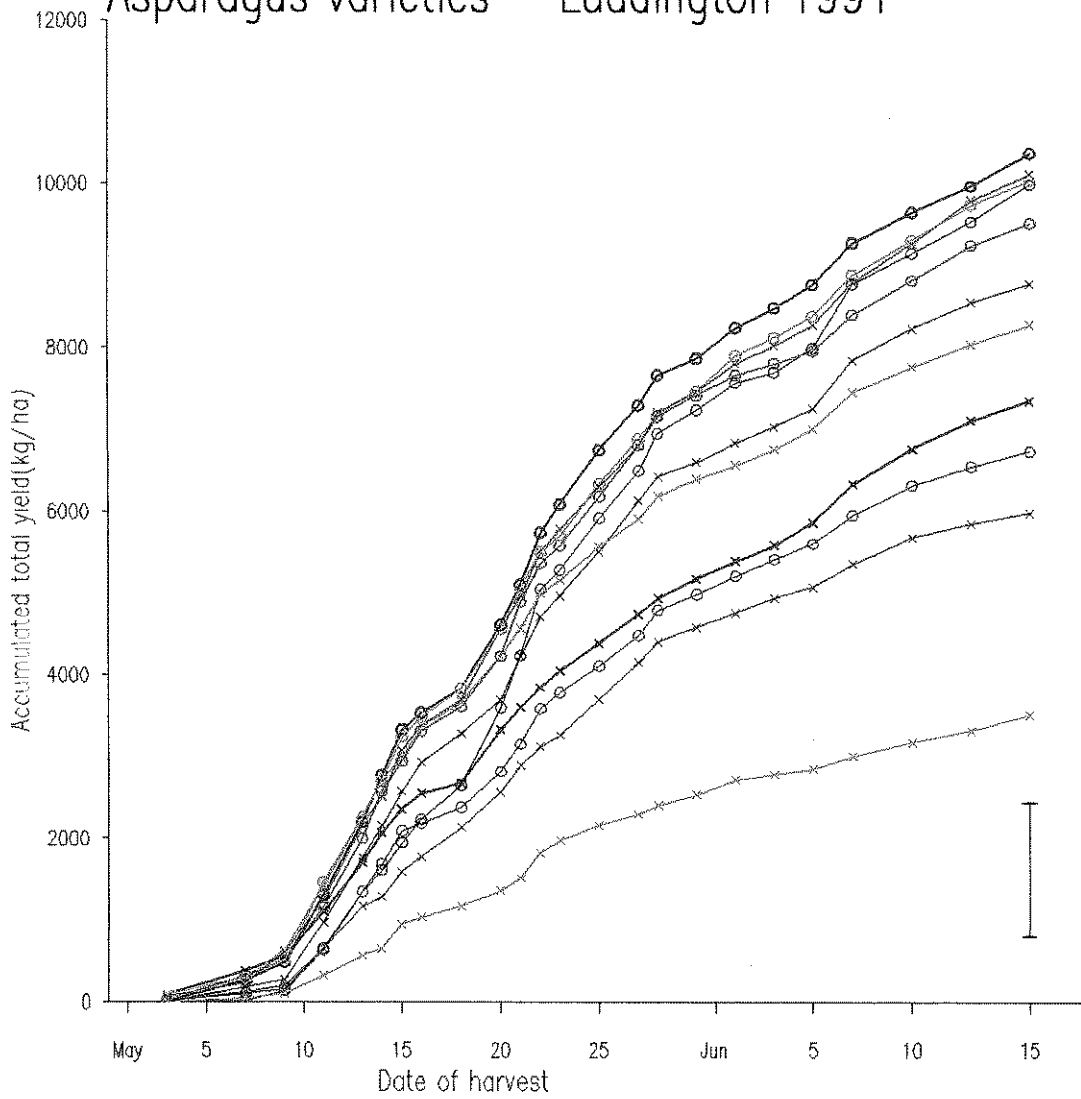
* Deviation from 40 year average.

<u>1991</u>	Mean Temperature (°C) 1990	1991
January	6.7	3.1
February	7.6	1.4
March	8.3	8.0
April	7.7	8.1
May	12.7	11.1

5 April Plot re-ridged and Sinbar (Terbacil) applied
 3 May 1st harvest
 15 June Final cut after 23 harvests

Figure 1

Asparagus varieties – Luddington 1991

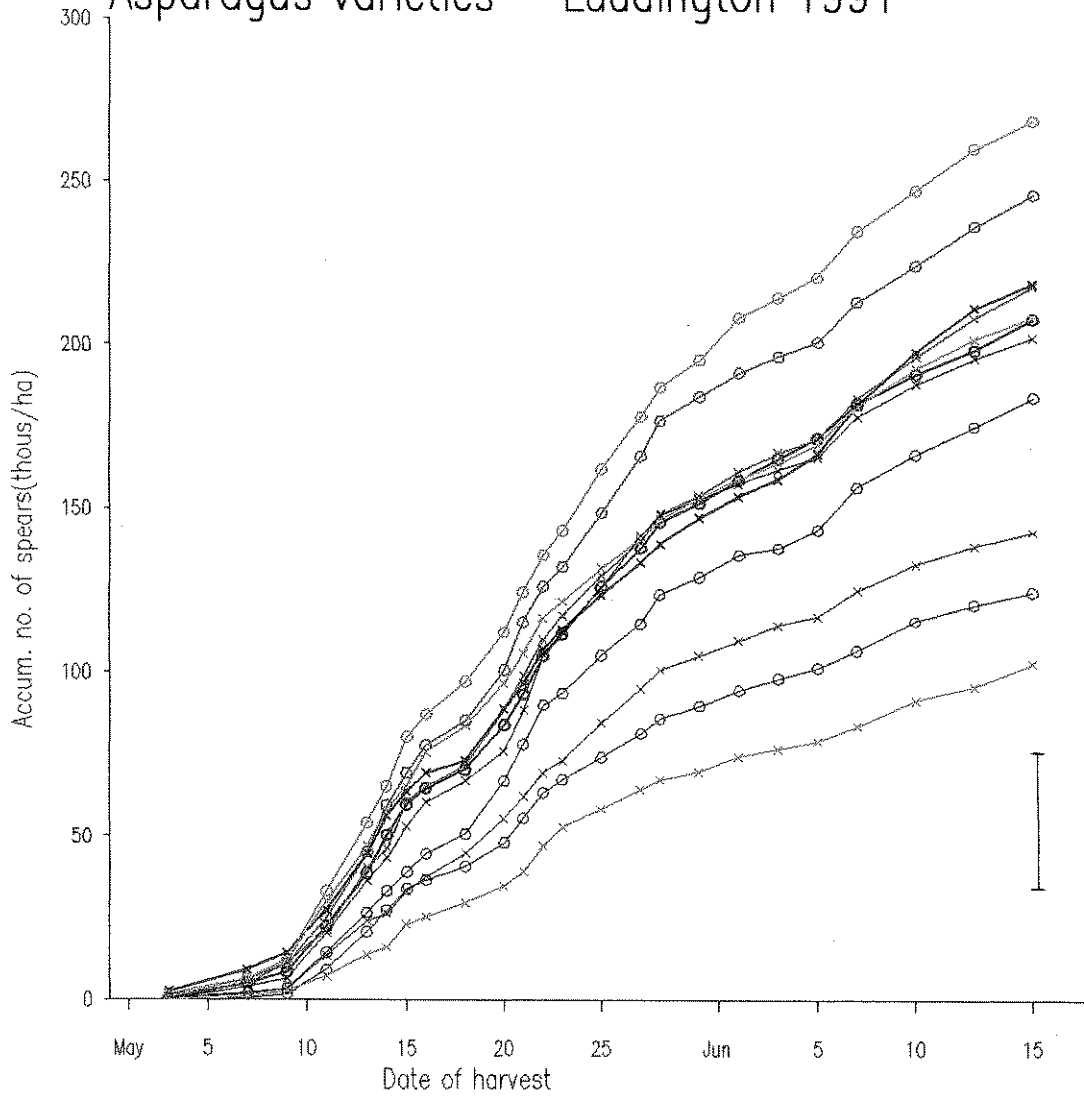


- Boonlim
- Backlim
- Venlim
- × D231
- × Rekord
- × Geynlim
- Franklim
- × Cito
- Mira
- × Larac
- × ConColos

LSD $p=0.05$

Figure 2

Asparagus varieties – Luddington 1991



- Boonlim
- Backlim
- Venlim
- × D231
- × Rekord
- × Geynlim
- Franklim
- × Cito
- Mira
- × Larac
- × ConColos

┌ LSD p = 0.05

Figure 3

ASPARAGUS VARIETIES 1988-91

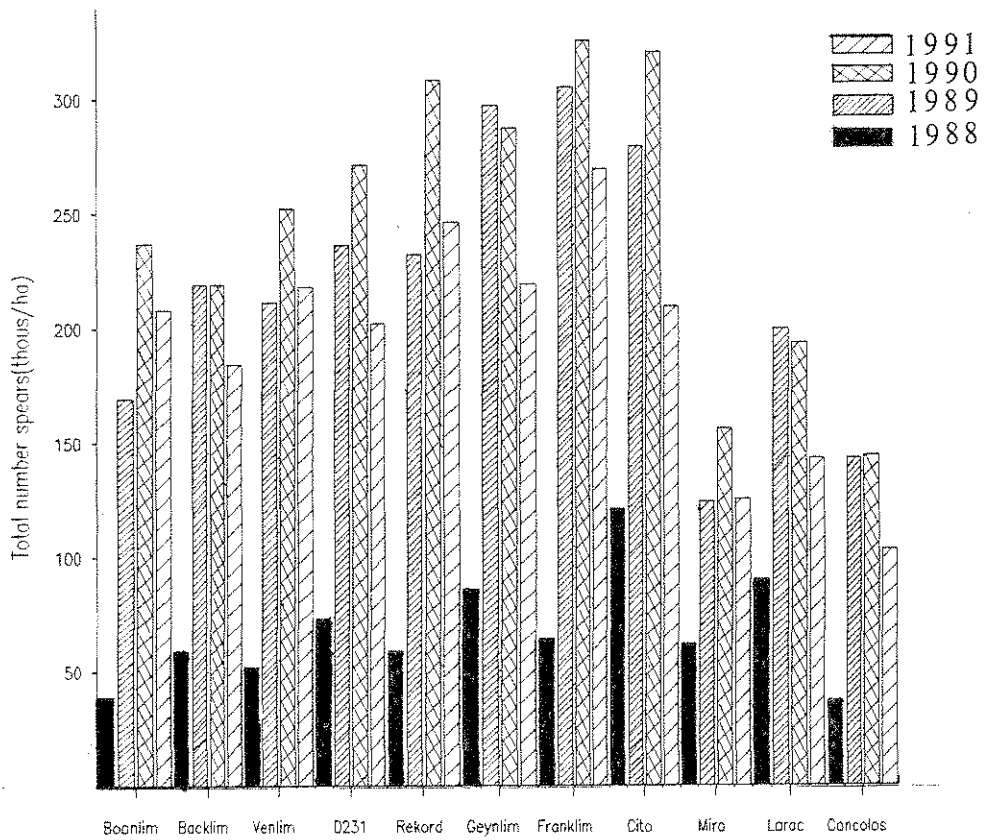
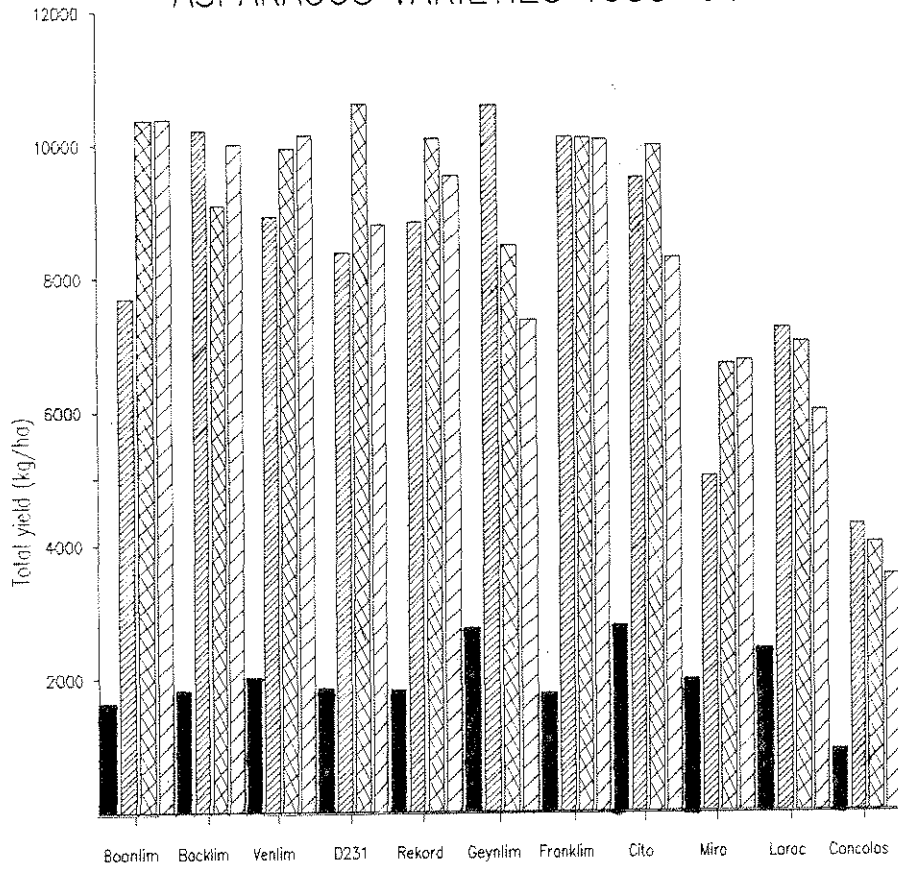


Table 4: Spearman rank correlations for 4 harvest years 1988-91

	Total Yield	Yield Class I	Total Number	Number Class I
1988-89	0.35	0.30	0.56	0.34
1989-90	0.28	0.55	0.90**	0.65*
1990-91	0.72*	0.88**	0.91**	0.86**
1988-90	-0.16	0	0.44	-0.09
1988-91	-0.25	-0.18	0.19	-0.26
1989-91	0.44	0.62*	0.78**	0.58

Degrees of freedom = 9

* Significant @ 5%

** Significant @ 1%

Discussion

The 1989 harvest was first full cut from this trial. There had been good fern growth, post harvest, for most varieties in 1988 and this, coupled with the best 'Asparagus spring' for many years, resulted in some very high yields from the better varieties. However, three varieties UC157, Delmonte and Regal continued to decline and the population and vigour became so poor that yields were very low. The decline of the Californian bred varieties could be the result of a genotype/environment reaction, indicating that they were not suited to the conditions of this trial. Reasons for the decline of Regal, an East Anglian selection similar to Connovers Colossal, are inexplicable, particularly as the latter is doing quite well. Examination for pathogens were made from the three stocks but no definite cause of death was established.

The conclusions from the first full cut in 1989 were that Dutch bred hybrids yielded exceptionally well and produced good quality spears. The evidence from two harvests indicates that they are suited to the UK climate. French hybrids gave high yields but generally slightly below the Dutch varieties. They have a tendency to produce poorer quality spears. Mira showed a more rapid deterioration than from a previous trial. Californian bred varieties continued to decline in spite of their initial good establishment and early signs of vigour. Jersey Giant, an East Coast American variety yielded disappointingly and there was

significant crown death. However spear quality was good. Rekord, a Lucullus selection gave better results than the Lucullus grown in the earlier 1981 planted trial. Connovers Colossal, a commercial English selection, has been quite good for its type.

In 1990, the performance of the Dutch bred varieties continued to be good with the possible exception of Franklim. Though this variety gave high total yields it did produce a large proportion of Class II spears. The selection from Lucullus, Rekord, again performed well but the French varieties again produced lower yields than the Dutch ones with the possible exception of D231. Yields from the English and especially the American cultivars were poor.

After the 1990 harvest it was decided to exclude the 4 varieties UC157, Delmonte 361, Jersey Giant and Regal from future harvest recordings because of their low plant stands.

The weather in 1990 during the period of fern growth, June to September, was warmer and drier than average (see Appendix I). This was followed by a cool Spring when the daily mean temperatures were lower than in 1990. In spite of these factors and the cooler temperatures during the harvest period, the mean total yield from the 11 varieties only decreased by 500 kg/ha in 1991. The spears were of better quality in 1991, there was a mean of 20 percent more spears in Class I.

All the Dutch bred varieties except for Geynlim performed well. Franklim performed better than in 1990 as there were fewer spears in the 'blown' and 'twisted' category probably due to the cooler temperatures during the harvest period in 1991. Rekord again performed well and the best French variety was D231. Connovers Colossal produced the lowest yields of spears in both Class I and Class II grades.

Appendix I

Crop culture

Soil type: light sandy loam to depth

Crop diary1986

15 March Seed sown in all types of containers, kept at 20°C
 21 April Moved into 10°C glass
 21 April) Liquid feeds 200/200 N/K every 14 days
 8 July)
 30 May Moved into open
 15 April Land ploughed
 7 July Land cultivated with Lely Roterra
 7 July 127kg/haN, 60kg/haP, 165kg/haK applied and worked in
 8 July Planted in furrows, tops of plants 100 mm below mean
 soil level, spacing 1320x305mm. Furrows left open.
 8 July 25 mm water applied
 8 August)Hand weeded
 26 September)

23 December Fern cut and burned and furrows filled in

1987

5 February 4.0 l/ha paraquat applied
 5 March Simazine + paraquat (2.24 kg/ha + 4.0 l/ha)
 19 March 127 kg/haN, 60 kg/haP, 165 kg/haK applied over top
 8 June Hand weeded
 27 June Top dressed 127 kg/ha N as nitrochalk
 25 November Fern removed and burned

1988

12 February Ridged with mechanical ridger
 23 February 2.24 kg/ha Simazine 50 applied
 21 April Twitch and big weeds, spot treated with glyphosate
 (Round-Up)
 22 Apr-20 May Harvest
 25 May 125 kg/ha N all trials
 15-19 November Fern removed
 23 November Paraquat 4.0 l/ha
 23 December Plots re-ridged

1989

27 March 2.8 kg/ha Sinbar (terbacil)
 4 April 1st cut CITO + COVERED PLOTS IN BURNING OVER trial
 12-20 June Harvesting ceased (date dependent on trial)
 16 June Hand hoed to remove big weeds
 17 June 130 kg/ha N (4cwt/acre nitrochalk)
 19/20 June Irrigation 25 mm (1 in) to activate nitrogen
 application

1990

12 March Paraquat application
 Simazine
 3,4,5 April Overnight frost min temperatures -4.9, -6.6, -4.1°C
 6 April Frosted spears counted
 20 April 1st cut

1-7 May Temperatures above average weekly max 23.2°C;
 weekly min 6.1°C
 Monthly mean max 19.6°C (39yr mean=16.3°C)
 min 5.9°C (39yr mean= 6.3°C)
 Warmest May recorded during 39 year period at
 Wellesbourne/Luddington

3 June Final cut - quality of spears deteriorating
 late June Nitrogen 130 kg ha⁻¹ applied top dressing

	Mean temperature (°C)	Rainfall (mm)
June	14.0(+0.2)*	46.0(-5.3)*
July	17.7(+1.5)*	14.3(-33.7)*
August	18.8(+2.8)*	20.6(-45.3)*
September	13.5(-0.2)*	42.9(-9.3)*

* Deviation from 40 year average.

<u>1991</u>	Mean Temperature (°C) 1990	1991
January	6.7	3.1
February	7.6	1.4
March	8.3	8.0
April	7.7	8.1
May	12.7	11.1

5 April Plot re-ridged and Sinbar (Terbacil) applied
 3 May 1st harvest
 15 June Final cut after 23 harvests

REPORT FOR HORTICULTURAL DEVELOPMENT COUNCIL

ASPARAGUS. EVALUATION OF 15 CULTIVARS

Research Leader: Mrs J R A Steckel,
Horticultural Research International
Wellesbourne
Warwick CV35 9EF Wks
Tel: 0789 470382
Fax: 0789 470552

Year of experiment: 6

Objective

To evaluate the performance of new asparagus varieties of French, Dutch, American, German and English origin.

Introduction

The area of asparagus in the UK has steadily increased over the last few years and there is substantial interest in the new hybrid varieties becoming available from around the world. It was considered that these new varieties should be evaluated in comparative trials using established English stocks as controls. Fifteen varieties were planted including material from Holland, Germany, France and the USA. The experiment was established in 1986 at Luddington EHS.

Materials and methods

The fifteen varieties and their country of origin are listed below.

*Geynlim (Holland)	*Cito (France)
*Boonlim (Holland)	UC157 (USA, California)
*Venlim (Holland)	Delmonte 361 (USA, California)
*Backlim (Holland)	Jersey Giant (USA, New Jersey East Coast)
*Franklim (Holland)	*Rekord (Germany)
*Larac (France)	Regal (UK)
*Mira (France)	*Connovers Colossal (UK)
*D231 (France)	

*Varieties harvested 1991.

Seed was raised in Hassy 104 trays. Transplanting was carried out in early July 1986. The full cultural details are given in Appendix I. Three replicates of 50 plants each were planted out at a spacing of 1.33 m between rows and 0.30 m between plants (52 x 12 in). The first harvest lasted only 4½ weeks and was taken in April-May 1988, and the second and third full harvests were cut in 1989 and 1990. Spears were graded into <8, 8-10, 10-16, 16-20, >20 mm diameter sizes with a further category of 'blown' and twisted spears, i.e. waste material.

The fourth harvest was cut in 1991 when only 11 varieties were recorded. Those selected were the 10 highest yielding varieties in 1990 together with the UK variety Connovers Colossal. The spears were graded into unmarketable (Class II) which included <8mm, 8-10 mm, 'blown' and 'twisted' and three other size grades 10-16, 16-20 and >20 mm. As in previous years the number and weights were recorded for all these categories.

Results

1. Yield, kg/ha in size grades

In 1991 spear emergence was slow and harvesting did not start until 3 May, it was continued until 15 June and a total of 24 cuts were made during the 6 week harvest period.

Yield data for 1991 is shown in Table 1 and all spear categories are listed. Varieties are ranked in order of total grade 1 yield (grades 10-16, 16-20, >20 mm). Figures significantly higher than the trial mean are underlined with a solid line, those significantly lower with a dotted line.

Table 1: Yields kg/ha in size grades (mm) 1991
(varieties ranked in order of total yield Class 1)

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II	Grand Total
Boonlim	1718	3224	<u>4289</u>	<u>9230</u>	1148	<u>10378</u>
Backlim	1167	2580	<u>5239</u>	<u>8985</u>	1010	<u>9995</u>
Franklim	<u>2888</u>	<u>4026</u>	1645	<u>8559</u>	1485	<u>10044</u>
Venlim	1729	3447	3332	<u>8508</u>	1615	<u>10123</u>
Rekord	<u>2461</u>	3512	2041	8014	1503	<u>9517</u>
D231	1567	2641	3112	7321	1466	8787
Cito	1603	3197	1795	6594	1688	8282
Geynlim	<u>2520</u>	2558	<u>1229</u>	6307	1041	7348
Mira	<u>720</u>	<u>1691</u>	3156	5567	1168	6735
Larac	1196	1903	1759	<u>4857</u>	1124	<u>5981</u>
ConColossal	1233	<u>812</u>	<u>687</u>	<u>2732</u>	781	<u>3513</u>
MEANS	1709	2690	2571	6970	1275	8250
LSD 5% from mean	610	858	951	1500	509	1638

The cultivars Boonlim, Backlim, Franklim and Venlim all gave significantly higher Class I and total yields than the trial mean and Larac and Connovers Colossal significantly lower. Backlim and Boonlim gave significantly higher yields of spears >20mm and Franklim, Geynlim and Rekord higher yields of spears 10-16 mm.

2. Number of spears (thousands/ha)

Table 2 shows the number of spears in thousands/ha in all size grades and total numbers. Figures showing significant differences compared to the trial means are underlined as in Table 1.

The cultivars Franklim and Rekord gave significantly higher numbers of spears in grades 10-16 mm, 16-20 mm, Class I and overall total. Franklim was the only cultivar to give a significantly higher number of spears in Class II; the unmarketable grade. Boonlim and Backlim gave the highest number of spears >20 mm.

Table 2: Number of spears (thousands/ha) in size grades (mm) 1991 (varieties ranked in order of total Class I)

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II	Grand Total
Franklim	<u>98.0</u>	<u>80.8</u>	23.2	<u>202.0</u>	<u>66.9</u>	<u>268.9</u>
Rekord	<u>87.8</u>	<u>74.5</u>	27.5	<u>189.8</u>	56.3	<u>246.1</u>
Boonlim	54.0	63.3	<u>55.6</u>	172.9	35.1	208.0
Venlim	56.6	65.9	43.4	165.9	52.3	218.2
Geynlim	<u>89.4</u>	55.6	<u>17.9</u>	162.9	56.0	218.9
D231	54.0	60.6	40.4	155.0	47.4	202.4
Backlim	40.1	50.0	<u>63.9</u>	154.0	30.1	184.1
Cito	56.0	65.9	26.2	148.0	60.6	208.6
Larac	40.7	40.7	23.2	<u>104.7</u>	38.1	<u>142.7</u>
Mira	<u>24.5</u>	<u>35.1</u>	40.4	<u>100.0</u>	<u>24.5</u>	<u>124.5</u>
ConColossal	43.7	<u>16.9</u>	<u>8.9</u>	<u>69.5</u>	33.1	<u>102.7</u>
MEANS	58.6	55.4	33.7	147.7	45.5	193.2
LSD 5% from mean	20.1	18.3	11.0	32.9	17.0	42.5

The percentages, by number, of the spears in the size grades are shown in Table 3. Percentages have been angularly transformed for statistical analysis but the original percentages are shown in brackets. Again statistical differences from the trial means are underlined as in Table 1.

The cultivar Backlim gave significantly higher % spears >20 mm and Class I but significantly lower % 10-16 mm and Class II. Connovers Colossal gave the lowest % spears in 16-20 mm, >20 mm and Class I but the highest % 10-16 mm and Class II than the other 10 varieties.

Table 3: Percent spears (by number) in size grades (mm)
 (varieties ranked in order of percent Class I)
 Figures angularly transformed, actual % in brackets

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II
Backlim	(21.3)27.2	(27.0)31.3	(35.5)36.4	(83.9)66.5	(16.1)23.5
Boonlim	(26.0)30.6	(30.2)33.3	(27.0)31.3	(83.2)65.8	(16.8)24.2
Mira	(19.5)26.2	(27.3)31.5	(33.7)35.4	(80.5)63.8	(19.5)26.2
Rekord	(35.6)36.6	(30.4)33.4	(11.3)19.6	(77.2)61.5	(22.8)28.5
D231	(26.5)31.0	(30.0)33.2	(20.4)26.7	(76.9)61.3	(23.1)28.7
Venlim	(26.0)30.4	(30.1)33.2	(19.8)26.4	(75.9)60.6	(24.1)29.4
Franklim	(36.5)37.2	(30.0)33.2	(8.7)17.0	(75.1)60.1	(24.9)29.9
Geynlim	(41.1)39.9	(25.1)30.1	(7.9)16.2	(74.2)59.5	(25.8)30.5
Larac	(28.6)32.2	(28.5)32.3	(16.8)24.1	(73.9)59.4	(26.1)30.6
Cito	(26.7)31.1	(31.3)34.0	(12.5)20.7	(70.6)57.2	(29.4)32.8
ConColossal	(42.3)40.6	(16.7)24.1	(8.9)17.1	(68.0)55.7	(32.0)34.3
MEANS	(30.0)33.1	(27.9)31.8	(18.1)24.6	(76.3)61.0	(23.7)29.0
LSD 5%					
from mean	4.8	3.3	5.6	5.1	5.1

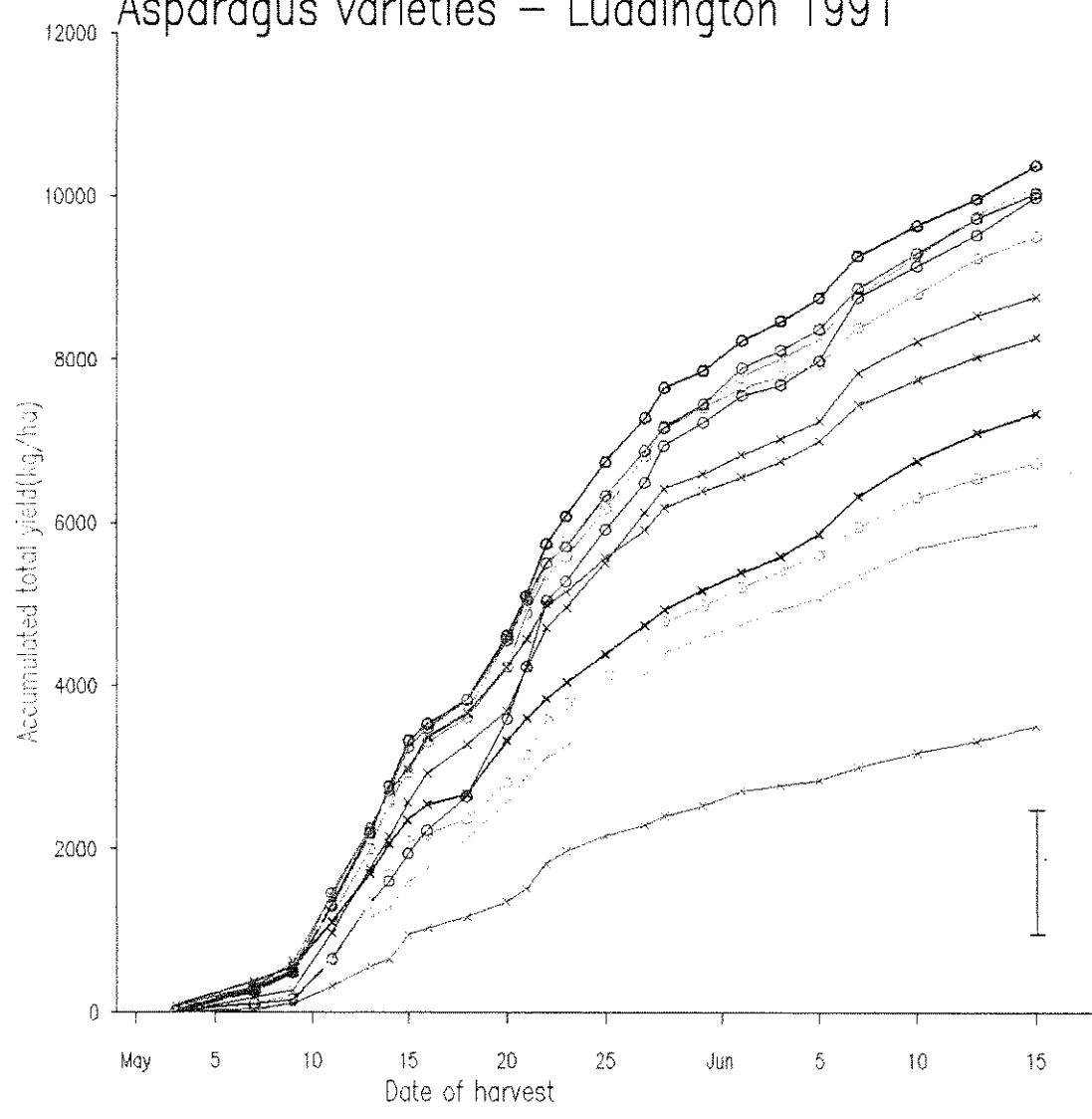
Figures 1 and 2 show the accumulation of yield and number of spears throughout the cutting period in 1991.

The total yield and number of spears for each variety from each year are shown in Figure 3. In all varieties, the total number of spears cut was lower in 1991 than 1990, but in the varieties Backlim and Venlim the total yield increased in 1991 and in Boonlim, Franklim and Mira the total yield was the same in both years. Franklim produced 10,000 kg/ha in the 3 years 1989-91.

Spearman Rank correlations (Table 4) were calculated to compare the rankings of the 11 varieties over the 4 years of harvesting. A figure of one indicates that the position of a variety by its yield in each year was the same and a value of zero indicates that relative performance in one year did not predict that in another year. There were significant correlations between the last two years, 1990-91, for total yield and total number of spears and yield and number of Class I spears. Also between the total number of spears in years 1989-90 and 1989-91.

Figure 1

Asparagus varieties – Luddington 1991

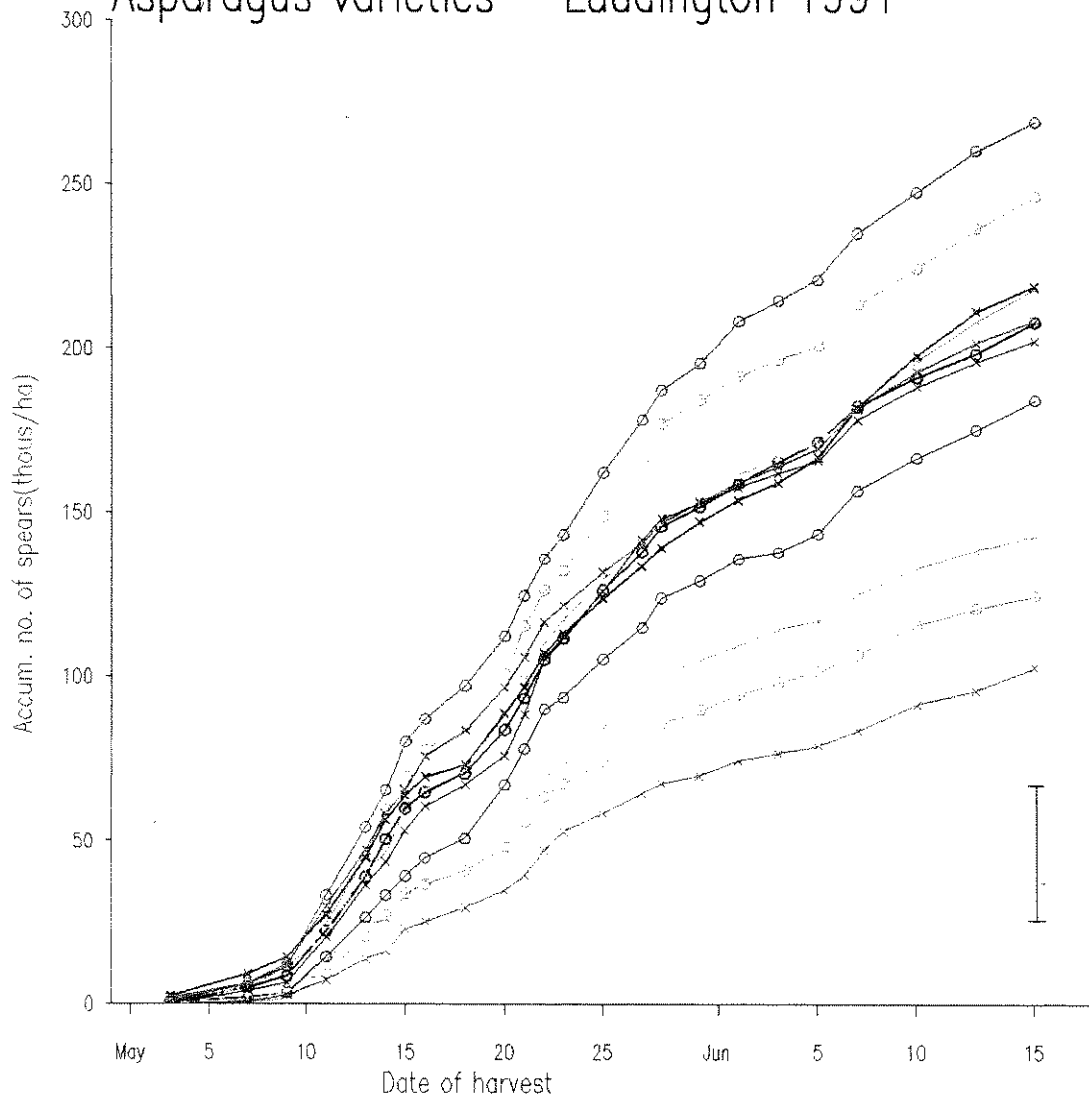


- Boonlim
- Backlim
- enlim
- x D231
- Rekord
- x Geynim
- Franklim
- x Cito
- Uira
- Lerac
- x ConColos

LSD $p = 0.05$

Figure 2

Asparagus varieties – Luddington 1991



- Boonlim
- Backlim
- Inim
- × D231
- Telkom
- × Geynlim
- Franklim
- × Cito
- Tira
- Lirac
- ConColos

LSD $p = 0.05$

Figure 3

ASPARAGUS VARIETIES 1988-91

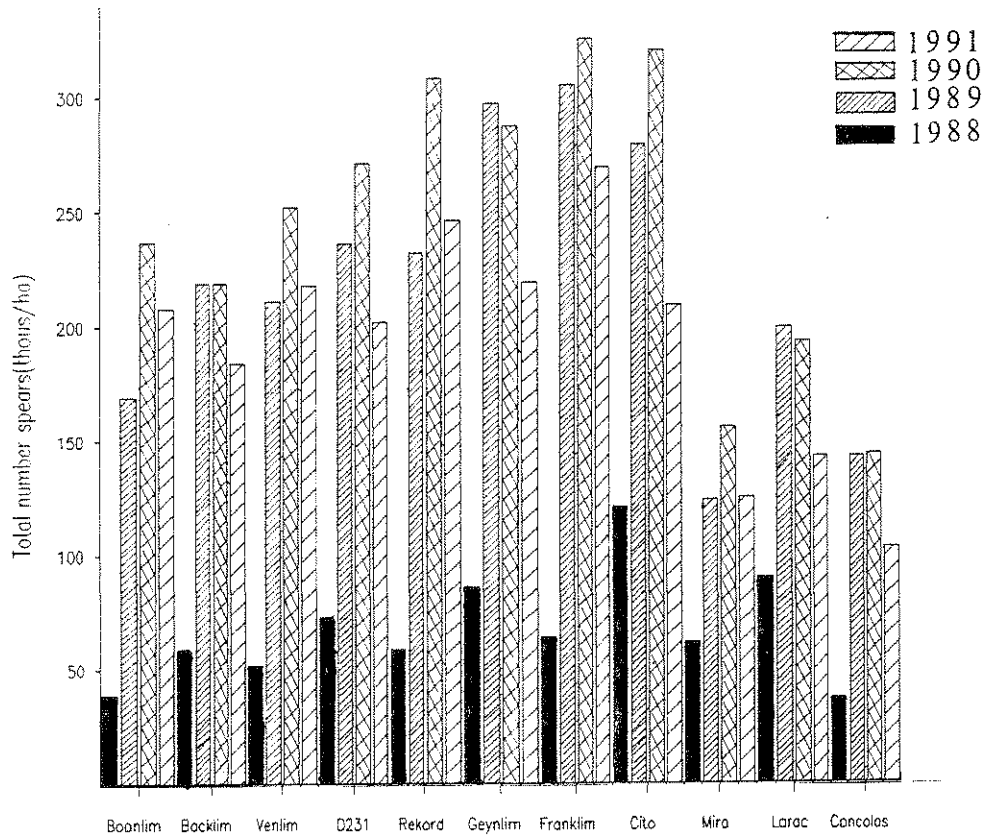
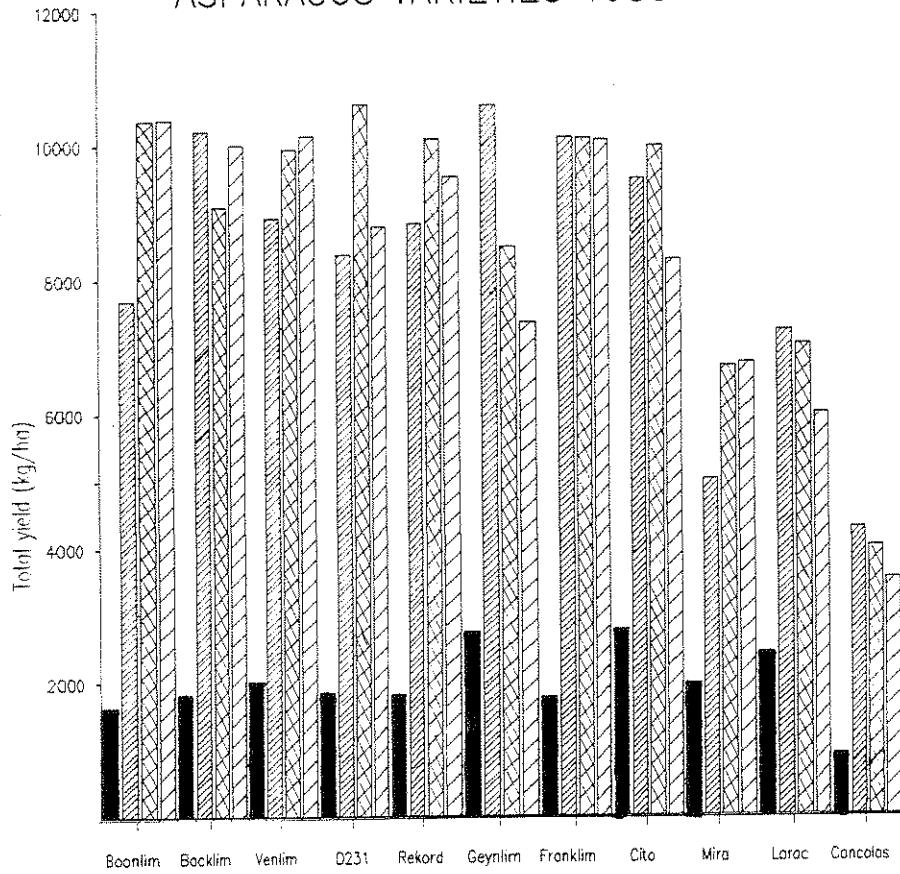


Table 4: Spearman rank correlations for 4 harvest years 1988-91

	Total Yield	Yield Class I	Total Number	Number Class I
1988-89	0.35	0.30	0.56	0.34
1989-90	0.28	0.55	0.90**	0.65*
1990-91	0.72*	0.88**	0.91**	0.86**
1988-90	-0.16	0	0.44	-0.09
1988-91	-0.25	-0.18	0.19	-0.26
1989-91	0.44	0.62*	0.78**	0.58

Degrees of freedom = 9

* Significant @ 5%

** Significant @ 1%

Discussion

The 1989 harvest was first full cut from this trial. There had been good fern growth, post harvest, for most varieties in 1988 and this, coupled with the best 'Asparagus spring' for many years, resulted in some very high yields from the better varieties. However, three varieties UC157, Delmonte and Regal continued to decline and the population and vigour became so poor that yields were very low. The decline of the Californian bred varieties could be the result of a genotype/environment reaction, indicating that they were not suited to the conditions of this trial. Reasons for the decline of Regal, an East Anglian selection similar to Connovers Colossal, are inexplicable, particularly as the latter is doing quite well. Examination for pathogens were made from the three stocks but no definite cause of death was established.

The conclusions from the first full cut in 1989 were that Dutch bred hybrids yielded exceptionally well and produced good quality spears. The evidence from two harvests indicates that they are suited to the UK climate. French hybrids gave high yields but generally slightly below the Dutch varieties. They have a tendency to produce poorer quality spears. Mira showed a more rapid deterioration than from a previous trial. Californian bred varieties continued to decline in spite of their initial good establishment and early signs of vigour. Jersey Giant, an East Coast American variety yielded disappointingly and there was

significant crown death. However spear quality was good. Rekord, a Lucullus selection gave better results than the Lucullus grown in the earlier 1981 planted trial. Connovers Colossal, a commercial English selection, has been quite good for its type.

In 1990, the performance of the Dutch bred varieties continued to be good with the possible exception of Franklim. Though this variety gave high total yields it did produce a large proportion of Class II spears. The selection from Lucullus, Rekord, again performed well but the French varieties again produced lower yields than the Dutch ones with the possible exception of D231. Yields from the English and especially the American cultivars were poor.

After the 1990 harvest it was decided to exclude the 4 varieties UC157, Delmonte 361, Jersey Giant and Regal from future harvest recordings because of their low plant stands.

The weather in 1990 during the period of fern growth, June to September, was warmer and drier than average (see Appendix I). This was followed by a cool Spring when the daily mean temperatures were lower than in 1990. In spite of these factors and the cooler temperatures during the harvest period, the mean total yield from the 11 varieties only decreased by 500 kg/ha in 1991. The spears were of better quality in 1991, there was a mean of 20 percent more spears in Class I.

All the Dutch bred varieties except for Geynlim performed well. Franklim performed better than in 1990 as there were fewer spears in the 'blown' and 'twisted' category probably due to the cooler temperatures during the harvest period in 1991. Rekord again performed well and the best French variety was D231. Connovers Colossal produced the lowest yields of spears in both Class I and Class II grades.

Appendix I

Crop culture

Soil type: light sandy loam to depth

Crop diary1986

15 March Seed sown in all types of containers, kept at 20°C
 21 April Moved into 10°C glass
 21 April) Liquid feeds 200/200 N/K every 14 days
 8 July)
 30 May Moved into open
 15 April Land ploughed
 7 July Land cultivated with Lely Roterra
 7 July 127kg/haN, 60kg/haP, 165kg/haK applied and worked in
 8 July Planted in furrows, tops of plants 100 mm below mean
 soil level, spacing 1320x305mm. Furrows left open.
 8 July 25 mm water applied
 8 August)Hand weeded
 26 September)

23 December Fern cut and burned and furrows filled in

1987

5 February 4.0 l/ha paraquat applied
 5 March Simazine + paraquat (2.24 kg/ha + 4.0 l/ha)
 19 March 127 kg/haN, 60 kg/haP, 165 kg/haK applied over top
 8 June Hand weeded
 27 June Top dressed 127 kg/ha N as nitrochalk
 25 November Fern removed and burned

1988

12 February Ridged with mechanical ridger
 23 February 2.24 kg/ha Simazine 50 applied
 21 April Twitch and big weeds, spot treated with glyphosate
 (Round-Up)
 22 Apr-20 May Harvest
 25 May 125 kg/ha N all trials
 15-19 November Fern removed
 23 November Paraquat 4.0 l/ha
 23 December Plots re-ridged

1989

27 March 2.8 kg/ha Sinbar (terbacil)
 4 April 1st cut CITO + COVERED PLOTS IN BURNING OVER trial
 12-20 June Harvesting ceased (date dependent on trial)
 16 June Hand hoed to remove big weeds
 17 June 130 kg/ha N (4cwt/acre nitrochalk)
 19/20 June Irrigation 25 mm (1 in) to activate nitrogen
 application

1990

12 March Paraquat application
 Simazine
 3,4,5 April Overnight frost min temperatures -4.9, -6.6, -4.1°C
 6 April Frosted spears counted
 20 April 1st cut

1-7 May Temperatures above average weekly max 23.2°C;
 weekly min 6.1°C
 Monthly mean max 19.6°C (39yr mean=16.3°C)
 min 5.9°C (39yr mean= 6.3°C)
 Warmest May recorded during 39 year period at
 Wellesbourne/Luddington
 3 June Final cut - quality of spears deteriorating
 Late June Nitrogen 130 kg ha⁻¹ applied top dressing

	Mean temperature (°C)	Rainfall (mm)
June	14.0(+0.2)*	46.0(-5.3)*
July	17.7(+1.5)*	14.3(-33.7)*
August	18.8(+2.8)*	20.6(-45.3)*
September	13.5(-0.2)*	42.9(-9.3)*

* Deviation from 40 year average.

<u>1991</u>	Mean Temperature (°C) 1990	1991
January	6.7	3.1
February	7.6	1.4
March	8.3	8.0
April	7.7	8.1
May	12.7	11.1

5 April Plot re-ridged and Sinbar (Terbacil) applied
 3 May 1st harvest
 15 June Final cut after 23 harvests

REPORT FOR HORTICULTURAL DEVELOPMENT COUNCIL

ASPARAGUS. EVALUATION OF 15 CULTIVARS

Research Leader: Mrs J R A Steckel,
Horticultural Research International
Wellesbourne
Warwick CV35 9EF Wks
Tel: 0789 470382
Fax: 0789 470552

Year of experiment: 6

Objective

To evaluate the performance of new asparagus varieties of French, Dutch, American, German and English origin.

Introduction

The area of asparagus in the UK has steadily increased over the last few years and there is substantial interest in the new hybrid varieties becoming available from around the world. It was considered that these new varieties should be evaluated in comparative trials using established English stocks as controls. Fifteen varieties were planted including material from Holland, Germany, France and the USA. The experiment was established in 1986 at Luddington EHS.

Materials and methods

The fifteen varieties and their country of origin are listed below.

*Geynlim (Holland)	*Cito (France)
*Boonlim (Holland)	UC157 (USA, California)
*Venlim (Holland)	Delmonte 361 (USA, California)
*Backlim (Holland)	Jersey Giant (USA, New Jersey East Coast)
*Franklim (Holland)	*Rekord (Germany)
*Larac (France)	Regal (UK)
*Mira (France)	*Connovers Colossal (UK)
*D231 (France)	

*Varieties harvested 1991.

Seed was raised in Hassy 104 trays. Transplanting was carried out in early July 1986. The full cultural details are given in Appendix I. Three replicates of 50 plants each were planted out at a spacing of 1.33 m between rows and 0.30 m between plants (52 x 12 in). The first harvest lasted only 4½ weeks and was taken in April-May 1988, and the second and third full harvests were cut in 1989 and 1990. Spears were graded into <8, 8-10, 10-16, 16-20, >20 mm diameter sizes with a further category of 'blown' and twisted spears, i.e. waste material.

The fourth harvest was cut in 1991 when only 11 varieties were recorded. Those selected were the 10 highest yielding varieties in 1990 together with the UK variety Connovers Colossal. The spears were graded into unmarketable (Class II) which included <8mm, 8-10 mm, 'blown' and 'twisted' and three other size grades 10-16, 16-20 and >20 mm. As in previous years the number and weights were recorded for all these categories.

Results

1. Yield, kg/ha in size grades

In 1991 spear emergence was slow and harvesting did not start until 3 May, it was continued until 15 June and a total of 24 cuts were made during the 6 week harvest period.

Yield data for 1991 is shown in Table 1 and all spear categories are listed. Varieties are ranked in order of total grade 1 yield (grades 10-16, 16-20, >20 mm). Figures significantly higher than the trial mean are underlined with a solid line, those significantly lower with a dotted line.

Table 1: Yields kg/ha in size grades (mm) 1991
(varieties ranked in order of total yield Class 1)

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II	Grand Total
Boonlim	1718	3224	<u>4289</u>	<u>9230</u>	1148	<u>10378</u>
Backlim	1167	2580	<u>5239</u>	<u>8985</u>	1010	<u>9995</u>
Franklim	<u>2888</u>	<u>4026</u>	1645	<u>8559</u>	1485	<u>10044</u>
Venlim	1729	3447	3332	<u>8508</u>	1615	<u>10123</u>
Rekord	<u>2461</u>	3512	2041	8014	1503	<u>9517</u>
D231	1567	2641	3112	7321	1466	8787
Cito	1603	3197	1795	6594	1688	8282
Geynlim	<u>2520</u>	2558	<u>1229</u>	6307	1041	7348
Mira	<u>720</u>	<u>1691</u>	3156	5567	1168	6735
Larac	1196	1903	1759	<u>4857</u>	1124	<u>5981</u>
ConColossal	1233	<u>812</u>	<u>687</u>	<u>2732</u>	781	<u>3513</u>
MEANS	1709	2690	2571	6970	1275	8250
LSD 5% from mean	610	858	951	1500	509	1638

The cultivars Boonlim, Backlim, Franklim and Venlim all gave significantly higher Class I and total yields than the trial mean and Larac and Connovers Colossal significantly lower. Backlim and Boonlim gave significantly higher yields of spears >20mm and Franklim, Geynlim and Rekord higher yields of spears 10-16 mm.

2. Number of spears (thousands/ha)

Table 2 shows the number of spears in thousands/ha in all size grades and total numbers. Figures showing significant differences compared to the trial means are underlined as in Table 1.

The cultivars Franklim and Rekord gave significantly higher numbers of spears in grades 10-16 mm, 16-20 mm, Class I and overall total. Franklim was the only cultivar to give a significantly higher number of spears in Class II; the unmarketable grade. Boonlim and Backlim gave the highest number of spears >20 mm.

Table 2: Number of spears (thousands/ha) in size grades (mm) 1991 (varieties ranked in order of total Class I)

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II	Grand Total
Franklim	<u>98.0</u>	<u>80.8</u>	23.2	<u>202.0</u>	<u>66.9</u>	<u>268.9</u>
Rekord	<u>87.8</u>	<u>74.5</u>	27.5	<u>189.8</u>	56.3	<u>246.1</u>
Boonlim	54.0	63.3	<u>55.6</u>	172.9	35.1	208.0
Venlim	56.6	65.9	43.4	165.9	52.3	218.2
Geynlim	<u>89.4</u>	55.6	<u>17.9</u>	162.9	56.0	218.9
D231	54.0	60.6	40.4	155.0	47.4	202.4
Backlim	40.1	50.0	<u>63.9</u>	154.0	30.1	184.1
Cito	56.0	65.9	26.2	148.0	60.6	208.6
Larac	40.7	40.7	23.2	<u>104.7</u>	38.1	<u>142.7</u>
Mira	<u>24.5</u>	<u>35.1</u>	40.4	<u>100.0</u>	<u>24.5</u>	<u>124.5</u>
ConColossal	43.7	<u>16.9</u>	<u>8.9</u>	<u>69.5</u>	33.1	<u>102.7</u>
MEANS	58.6	55.4	33.7	147.7	45.5	193.2
LSD 5% from mean	20.1	18.3	11.0	32.9	17.0	42.5

The percentages, by number, of the spears in the size grades are shown in Table 3. Percentages have been angularly transformed for statistical analysis but the original percentages are shown in brackets. Again statistical differences from the trial means are underlined as in Table 1.

The cultivar Backlim gave significantly higher % spears >20 mm and Class I but significantly lower % 10-16 mm and Class II. Connovers Colossal gave the lowest % spears in 16-20 mm, >20 mm and Class I but the highest % 10-16 mm and Class II than the other 10 varieties.

Table 3: Percent spears (by number) in size grades (mm)
 (varieties ranked in order of percent Class I)
 Figures angularly transformed, actual % in brackets

Variety	10-16mm	16-20mm	>20mm	Total Class I	Total Class II
Backlim	(21.3) <u>27.2</u>	(27.0) 31.3	(35.5) <u>36.4</u>	(83.9) <u>66.5</u>	(16.1) <u>23.5</u>
Boonlim	(26.0) 30.6	(30.2) 33.3	(27.0) <u>31.3</u>	(83.2) 65.8	(16.8) 24.2
Mira	(19.5) <u>26.2</u>	(27.3) 31.5	(33.7) <u>35.4</u>	(80.5) 63.8	(19.5) 26.2
Rekord	(35.6) 36.6	(30.4) 33.4	(11.3) 19.6	(77.2) 61.5	(22.8) 28.5
D231	(26.5) 31.0	(30.0) 33.2	(20.4) 26.7	(76.9) 61.3	(23.1) 28.7
Venlim	(26.0) 30.4	(30.1) 33.2	(19.8) 26.4	(75.9) 60.6	(24.1) 29.4
Franklim	(36.5) 37.2	(30.0) 33.2	(8.7) <u>17.0</u>	(75.1) 60.1	(24.9) 29.9
Geynlim	(41.1) <u>39.9</u>	(25.1) 30.1	(7.9) <u>16.2</u>	(74.2) 59.5	(25.8) 30.5
Larac	(28.6) 32.2	(28.5) 32.3	(16.8) 24.1	(73.9) 59.4	(26.1) 30.6
Cito	(26.7) 31.1	(31.3) 34.0	(12.5) 20.7	(70.6) 57.2	(29.4) 32.8
ConColossal	(42.3) <u>40.6</u>	(16.7) <u>24.1</u>	(8.9) <u>17.1</u>	(68.0) <u>55.7</u>	(32.0) <u>34.3</u>
MEANS	(30.0) 33.1	(27.9) 31.8	(1814) 24.6	(76.3) 61.0	(23.7) 29.0
LSD 5% from mean	4.8	3.3	5.6	5.1	5.1

Figures 1 and 2 show the accumulation of yield and number of spears throughout the cutting period in 1991.

The total yield and number of spears for each variety from each year are shown in Figure 3. In all varieties the total number of spears cut was lower in 1991 than 1990 but in the varieties Backlim and Venlim the total yield increased in 1991 and in Boonlim, Franklim and Mira the total yield was the same in both years. Franklim produced 10,000 kg/ha in the 3 years 1989-91.

Spearman Rank correlations (Table 4) were calculated to compare the rankings of the 11 varieties over the 4 years of harvesting. A figure of one indicates that the position of a variety by its yield in each year was the same and a value of zero indicates that relative performance in one year did not predict that in another year. There were significant correlations between the last two years, 1990-91, for total yield and total number of spears and yield and number of Class I spears. Also between the total number of spears in years 1989-90 and 1989-91.