

**FINAL REPORT
PROJECT FV 151**

**ASPARAGUS:
PREVENTION OF DECLINE
PROBLEM BY USE OF SALT
(ADAS CONTRACT XHACA)**

FINAL REPORT

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Project Title: Asparagus: Prevention of Decline Problem by use of Salt.

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INDEX

	Page No.
Practical section for growers	1
Authentication	4
Introduction	5
Objective	5
Materials and methods	5
Site	5
Treatments	5
Husbandry	6
Assessments	6
Design and analyses	6
Results and Discussion	
Harvest data 1996	7
Harvest data 1993-96	16

Practical section for growers

Asparagus crops are very expensive to establish and it is therefore to the grower's advantage to maintain a crop producing at economic levels for as many years as possible. For a number of reasons, cropping performance declines over a period of years, resulting in lower yields of poorer quality spears.

Normally asparagus crops should be highly productive for about 15 years, but it is estimated that 80% of crops are grubbed much earlier than this as a result of the decline problem.

Decline is a complex of disease, physiological and soil related problems. There is research evidence from overseas that indicates the use of soil applied salt will reduce the problem and enhance yields. No work has been carried out on preventing decline of asparagus crops in the UK.

This study was started in the spring of 1993 on a crop that was beginning to show signs of declining. The crop was established in May 1987 with the all male Dutch variety, Limbras 118, and grown in double row beds.

A range of rates of salt (0 to 4.0 t/ha) were applied each year for the period 1993 to 1996 inclusive, with half applied pre harvest (April) and half post harvest (end June). Applications were made 16 April and 21 June in 1993, 29 April and 23 June in 1994, 29 April and 20 June 1995 and 23 April and 22 June 1996.

Yield data and records of fern numbers were recorded in each year.

Yields 1996

Although many of the differences between treatments (rates of salt per hectare) were not significant there was a tendency to produce higher numbers and weights of spears from 0.5 and 1.0 t/ha of salt. Both the 0.5 and 1.0 t/ha rates produced significantly ($P=0.05$) higher weights excluding blown and twisted spears and at the 0.5 t/ha rate when this category was included.

Both the 0.5 and 1.0 t/ha rates of salt gave significantly higher ($P=0.05$) number of spears and weights of spears above 10 mm diameter. Rates of 4.0 t/ha tended to have a deleterious effect on the number and weight of spears above 10 mm diameter.

Fern Numbers 1996

There were no significant differences ($P=0.05$) between treatments for both total numbers and live numbers of ferns.

There was a significant difference ($P=0.05$) between treatments with the percentage of dead ferns with the nil treatment at a significantly higher number than the salt treatment at 2.0 t/ha.

Yields 1993-96. Please refer to Tables 10-13.

Total numbers of spears including blown and twisted spears.

Generally salt treatments produced higher total numbers of spears and in 1994 rates of application of 0.5, 1.0 and 2.0 t/ha were significantly higher ($P=0.05$) than the nil treatment.

Total weights including blown and twisted spears.

In 1994, 1995 and 1996 all salt treatments produced higher total weights than the nil treatment. Treatments were significantly higher ($P=0.05$) at rates of 0.5, 1.0, and 4.0 t/ha in 1993, 0.5 t/ha in 1994, 1.0 t/ha in 1995 and 0.5 t/ha in 1996.

Numbers of spears below 10 mm diameter.

In 1993 the nil treatment and salt treatment of 1.0 t/ha produced significantly higher ($P=0.05$) numbers. In all the other years there were no significant differences and numbers were very similar within a year between treatments.

Number of spears above 10 mm diameter.

Generally salt treatments produced higher numbers of spears than the nil treatment and to a significantly higher ($P=0.05$) level in 1993 when all four treatments were higher and 1996 when the 0.5 and 1.0 t/ha treatments were significantly higher.

Weights of spears below 10 mm diameter.

In 1993 and 1994 significant differences ($P=0.05$) were produced with the nil and 1.0 t/ha rate of salt in 1993 and 0.5 and 1.0 t/ha rates in 1994. In 1995 and 1996 there were no significant differences ($P=0.05$) between treatments.

Weights of spears above 10 mm diameter.

Generally salt treatments produced higher weights than the nil treatment and to a significantly higher ($P=0.05$) level in 1993 when all treatments were higher and in 1996 when the 0.5 and 1.0 t/ha rates were of statistical significance.

Summary

This trial has been run for four years during which time detailed harvest data has been collected.

Whilst the results are not always statistically significant ($P=0.05$) within the categories of data there tends to be a consistent trend towards benefits to the asparagus crop when salt is applied at the 0.5 and 1.0 t/ha rates (split with half being applied pre harvest in April and half post harvest at the end of June).

This essentially is a long term project and it can be expected that differences will continue to develop between treatments over a prolonged number of years.

ADAS - FOOD, FARMING, LAND AND LEISURE

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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.

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INTRODUCTION

Decline in the productivity of asparagus crops is a very serious problem resulting in reduction in marketable yield and ultimate death of plants.

Decline is a complex of disease, physiological and soil-related problems. Research evidence from overseas indicates the use of soil applied salt will reduce the problem and enhance yields. It has been recorded that disease levels are sometimes reduced as a result of the treatment.

No work has been carried out in the UK on preventing decline in asparagus crops.

This study was started in the spring of 1993 on a crop that was beginning to show signs of decline.

The crop was established in May 1987 with the all male variety, Limbras 118, planted in double row beds.

A range of rates of salt were applied each year for the period 1993 to 1996 inclusive, with rates being split with half applied pre harvest (April) and half post harvest (end June).

Yields were recorded in each season from 1993 to 1996 inclusive.

OBJECTIVE

Asparagus - To measure the effects of using salt applied annually to reduce the rate of decline.

MATERIALS AND METHODS

Site

The experiment was carried out at Portwood Farm, Gt Ellingham, Nr Attleborough, Norfolk. The soil type is a sandy loam with some stones, of approximately 30 cm (12 ins) depth, over a sandy clay loam. The site is well drained.

Treatments

Rates of Salt (applied as Agricultural Salt)

- A. Nil
- B. 0.5 tonne/hectare - split, half pre harvest (April) and half post harvest (end June)
- C. 1.0 tonne/hectare - split, half pre harvest (April) and half post harvest (end June)
- D. 2.0 tonne/hectare - split, half pre harvest (April) and half post harvest (end June)
- E. 4.0 tonne/hectare - split, half pre harvest (April) and half post harvest (end June)

Treatments were applied 18 April and 21 June 1993, 29 April and 23 June 1994, 29 April and 20 June 1995 and 23 April and 22 June 1996.

Husbandry

The crop was planted in May 1987 using the all male Dutch variety, Limbras 118. It was established from container raised transplants, planted in double rows at 1.63 m (5 ft 5 ins) centres with an in row spacing in each row of 50 cm (20ins), providing a plant population of 24,540 per hectare (9,935 per acre).

Routine levels of phosphate, potash and nitrogen were applied according to current ADAS recommendations.

The crop was very well managed.

Assessments

Records were taken of yield during the cropping period 1 May to 18 June 1993, 3 May to 21 June 1994, 5 May to 20 June 1995 and 8 May to 20 June 1996 when the crop was assessed for numbers and weights of spears above and below 10 mm diameter and spears in the blown and twisted category.

Measurements of plant losses were made in the fern growing period on 6 July 1993 and fern numbers on 15 October 1993 and fern numbers on 23 September 1994 , 28 September 1995 and 2 October 1996.

Design and Analyses

The trial design consists of a Latin square with 5 replications.

Plot size - 18 m x 6.50 m (4 double row beds) totalling 117 sq m with the number of plants planted being 576.

Recordable area - 12 m x 3.25 m (2 double row beds) totalling 39 sq m with the number of plants planted being 192.

All data has been statistically analysed.

RESULTS AND DISCUSSION

Harvest Data

Table 1 Total numbers of spears ('000/ha) and total weight (t/ha) including blown and twisted spears in 1996.

Treatment	Number ('000/ha)	Weight (t/ha)
Nil	259.2	5.80
Salt 0.5 t/ha	264.9	6.34
Salt 1.0 t/ha	270.4	6.29
Salt 2.0 t/ha	251.2	5.68
Salt 4.0 t/ha	251.5	5.57
Mean	259.5	5.94

SED (12 df)	16.08	0.332
LSD (P=0.05)	35.39	0.730
CV% Row.Column	9.8	8.8

Comment

There were no overall differences between treatments for the number of spears per hectare. All treatments gave similar weights of spears. However, salt at 0.5 and 1.0 t/ha tended to improve the yield (weight) of asparagus spears and the 0.5 t/ha was significantly higher (P=0.05) than the 4.0 t/ha rate. Rates of salt at 2.0 t/ha and 4.0 t/ha tended to have a deleterious effect.

RESULTS AND DISCUSSION

Harvest Data

Table 2 Total numbers of spears ('000/ha) and weight (t/ha) excluding blown and twisted spears in 1996.

Treatment	Number ('000/ha)	Weight (t/ha)
Nil	228.9	5.28
Salt 0.5 t/ha	232.8	5.71
Salt 1.0 t/ha	237.1	5.71
Salt 2.0 t/ha	219.8	5.12
Salt 4.0 t/ha	221.6	5.04
Mean	228.0	5.37

SED (12 df)	12.65	0.296
LSD (P=0.05)	27.84	0.651
CV% Row.Column	8.8	8.7

Comment

Each treatment produced similar numbers of spears with no significant differences (P=0.05).

Both the 0.5 t/ha and 1.0 t/ha treatments of salt gave a significantly higher (P=0.05) weight than the highest rate of 4.0 t/ha.

RESULTS AND DISCUSSION

Harvest Data

Table 3 Total numbers of spears ('000/ha) and weights (t/ha) of blown and twisted spears in 1996.

Treatment	Number ('000/ha)	Weight (t/ha)
Nil	30.3	0.52
Salt 0.5 t/ha	32.1	0.64
Salt 1.0 t/ha	33.3	0.59
Salt 2.0 t/ha	31.4	0.56
Salt 4.0 t/ha	30.0	0.53
Mean	31.4	0.57

SED (12 df)	4.45	0.067
LSD (P=0.05)	9.79	0.147
CV% Row.Column	22.4	18.7

Comment

There were no significant differences ($P=0.05$) between the numbers of blown and twisted spears harvested from each treatment.

There were no significant differences ($P=0.05$) between the weight of blown and twisted spears harvested from each treatment although the 0.5 and 1.0 t/ha treatments of salt gave the highest weights.

RESULTS AND DISCUSSION

Harvest Data

Table 4 Total number of spears ('000/ha) and weight (t/ha) below and above 10 mm spear diameter, excluding blown and twisted spears in 1996.

Treatment	Number ('000/ha)		Weight (t/ha)	
	<10 mm diam.	>10 mm diam.	<10 mm diam.	>10 mm diam.
Nil	132.3	96.6	2.00	3.28
Salt 0.5 t/ha	124.7	108.1	1.93	3.78
Salt 1.0 t/ha	133.4	103.7	2.03	3.68
Salt 2.0 t/ha	124.7	95.1	1.88	3.24
Salt 4.0 t/ha	132.7	88.9	2.01	3.03
Mean	129.6	98.5	1.97	3.40

SED (12 df)	9.77	6.14	0.130	0.253
LSD (P=0.05)	21.50	13.51	0.286	0.556
CV% Row.Column	11.9	9.9	10.5	11.8

Comment

Number of spears

There were no significant differences ($P=0.05$) between treatments in the numbers of spears below 10 mm diameter, but both the 0.5 and 1.0 t/ha treatments of salt gave a significantly higher ($P=0.05$) number of spears above 10 mm diameter than the highest salt treatment of 4.0 t/ha.

Weight

There were no significant differences ($P=0.05$) between treatments for weights in the below 10 mm diameter spear size. Both the 0.5 and 1.0 t/ha treatments of salt gave significantly higher ($P=0.05$) weights than the highest salt treatment at 4.0 t/ha.

Salt at 4.0 t/ha tended to have a deleterious effect on the number and weight of spears above 10 mm diameter.

RESULTS AND DISCUSSION

Harvest Data

Table 5 Weekly pattern of numbers ('000/ha) of small (<10 mm diam.) spears harvested in 1996.

Salt Treatment Weight (t/ha) of <10 mm diam. spears						
Week No	Nil	0.5 t/ha	1.0 t/ha	2.0 t/ha	4.0 t/ha	Mean
1	2.51	2.10	3.38	2.41	2.92	2.67
2	9.03	8.67	10.10	7.85	10.62	9.25
3	14.56	11.74	13.90	16.56	14.92	14.34
4	24.51	22.51	24.87	25.03	27.38	24.86
5	37.08	37.18	37.85	34.82	34.87	36.36
6	39.64	37.90	38.87	32.92	38.05	37.48
7	4.92	4.62	4.46	5.08	3.95	4.61
Total	132.25	124.72	133.43	124.67	132.71	129.57

RESULTS AND DISCUSSION

Harvest Data

Table 6 Weekly pattern of weight (t/ha) of small (<10 mm diam.) spears harvested in 1996.

Salt Treatment Weight (t/ha) of <10 mm diam. spears						
Week No	Nil	0.5 t/ha	1.0 t/ha	2.0 t/ha	4.0 t/ha	Mean
1	0.035	0.032	0.045	0.037	0.045	0.039
2	0.130	0.129	0.154	0.126	0.169	0.142
3	0.202	0.170	0.207	0.199	0.203	0.196
4	0.388	0.351	0.388	0.391	0.422	0.388
5	0.624	0.620	0.626	0.582	0.571	0.604
6	0.560	0.564	0.552	0.480	0.549	0.541
7	0.064	0.059	0.057	0.065	0.047	0.058
Total	2.003	1.925	2.029	1.88	2.006	1.968

RESULTS AND DISCUSSION

Harvest Data

Table 7 Weekly pattern of number ('000/ha) of large (>10 mm diam.) spears harvested in 1996.

Salt Treatment Weight (t/ha) of >10 mm diam. spears						
Week No	Nil	0.5 t/ha	1.0 t/ha	2.0 t/ha	4.0 t/ha	Mean
1	2.62	2.97	2.46	2.05	3.38	2.70
2	11.90	13.13	13.64	12.62	13.95	13.05
3	31.20	34.20	34.20	32.20	27.00	31.80
4	23.54	24.10	21.08	20.97	20.82	22.10
5	13.23	17.49	16.36	13.03	12.46	14.51
6	12.82	14.67	13.95	13.23	10.62	13.06
7	1.33	1.54	2.00	1.03	0.62	1.30
Total	96.64	108.1	103.69	95.13	88.85	98.52

RESULTS AND DISCUSSION

Harvest Data

Table 8 Weekly pattern of weight (t/ha) of large (>10 mm diam.) spears harvested in 1996.

Salt Treatment Weight (t/ha) of >10 mm diam. spears						
Week No	Nil	0.5 t/ha	1.0 t/ha	2.0 t/ha	4.0 t/ha	Mean
1	0.092	0.104	0.084	0.074	0.119	0.095
2	0.421	0.477	0.508	0.446	0.477	0.466
3	1.075	1.238	1.239	1.127	0.928	1.121
4	0.798	0.854	0.749	0.718	0.731	0.770
5	0.463	0.615	0.590	0.449	0.443	0.512
6	0.386	0.452	0.445	0.395	0.319	0.400
7	0.040	0.043	0.063	0.029	0.017	0.039
Total	3.275	3.783	3.678	3.238	3.034	3.403

RESULTS AND DISCUSSION

Table 9 Fern numbers per square metre and number of dead ferns (%)
2 October 1996.

Treatment	Fern numbers per square metre		% dead ferns
	Total numbers	Live numbers	
Nil	12.69	10.38	18.08
Salt 0.5 t/ha	12.87	10.93	15.02
Salt 1.0 t/ha	13.00	10.65	18.01
Salt 2.0 t/ha	12.82	11.02	13.97
Salt 4.0 t/ha	12.38	10.24	17.37
Mean	12.75	10.64	16.49

SED (12 df)	0.631	0.537	1.854
LSD (P=0.05)	1.388	1.170	4.080
CV% Row.Column	7.8	8.0	17.8

Comment

There were no significant differences ($P=0.05$) between treatments for both total numbers and live numbers of ferns.

There was a significant difference ($P=0.05$) between treatments with the percentage of dead ferns with the nil treatment at a significantly higher number than the salt treatment at 2.0 t/ha.

RESULTS AND DISCUSSION

Harvest Data

Table 10 Total numbers of spears ('000/ha) including blown and twisted spears 1993-96 inclusive.

Treatment	Number ('000/ha)			
	1993	1994	1995	1996
Nil	312.6	201.5	243.5	259.2
Salt 0.5 t/ha	323.0	222.4	264.2	264.9
Salt 1.0 t/ha	325.0	219.7	274.3	270.4
Salt 2.0 t/ha	312.3	216.9	253.2	251.2
Salt 4.0 t/ha	320.2	213.5	255.9	251.5
Mean	318.7	214.8	258.2	259.5

SED (12 df)	20.63	6.60	16.72	16.08
LSD (P=0.05)	13.05	14.38	36.43	35.39
CV% Row.Column	6.5	4.9	10.2	9.8

Comment

Generally salt treatments produced higher total numbers of spears and in 1994 rates of application of 0.5, 1.0 and 2.0 t/ha were significantly higher (P=0.05) than the nil treatment.

RESULTS AND DISCUSSION

Harvest Data

Table 11 Total weight (t/ha) including blown and twisted spears 1993-96 inclusive.

Treatment	Weight (t/ha)			
	1993	1994	1995	1996
Nil	8.52	5.00	5.42	5.80
Salt 0.5 t/ha	9.47	5.76	6.29	6.34
Salt 1.0 t/ha	9.11	5.63	6.40	6.29
Salt 2.0 t/ha	8.86	5.45	5.54	5.68
Salt 4.0 t/ha	9.13	5.26	5.43	5.57
Mean	9.02	5.42	5.82	5.94

SED (12 df)	0.534	0.309	0.419	0.332
LSD (P=0.05)	0.338	0.673	0.913	0.730
CV% Row.Column	5.9	9.0	11.4	8.8

Comment

In 1994, 95 and 96 all salt treatments produced higher total weights than the nil treatment and were significantly higher (P=0.05) at rates of 0.5, 1.0, and 4.0 t/ha in 1993, 0.5 t/ha in 1994, 1.0 t/ha in 1995 and 0.5 t/ha in 1996.

RESULTS AND DISCUSSION

Harvest Data

Table 12 Total numbers of spears ('000/ha) below and above 10 mm diameter, excluding blown and twisted spears 1993-96 inclusive.

Treatment	Number ('000/ha)							
	<10 mm diam.				>10 mm diam.			
	'93	'94	'95	'96	'93	'94	'95	'96
Nil	112.3	81.3	104.5	132.3	146.2	75.3	55.1	96.6
Salt 0.5 t/ha	99.2	89.7	112.7	124.7	166.5	86.1	66.3	108.1
Salt 1.0 t/ha	111.7	85.8	119.4	133.4	156.6	85.5	63.0	103.7
Salt 2.0 t/ha	101.5	87.4	115.2	124.7	154.7	84.3	55.1	95.1
Salt 4.0 t/ha	103.1	85.7	115.8	132.7	162.2	81.6	55.8	88.9
Mean	105.5	86.2	113.5	129.6	157.2	82.5	59.1	98.5

SED (12 df)	13.72	3.97	9.89	9.77	11.97	5.75	5.16	6.14
LSD (P=0.05)	8.68	8.65	21.55	21.50	7.57	12.53	11.24	13.51
CV%	13.0	7.3	13.8	11.9	7.6	11.0	13.8	9.9
Row.Column								

Comment

Spears below 10 mm diameter

In 1993 the nil treatment and salt applied at 1.0 t/ha produced significantly higher numbers ($P=0.05$). In all the other years there were no significant differences and numbers were very similar within a year between treatments.

Spears above 10 mm diameter

Generally salt treatment produced higher numbers of spears than the nil treatment and to a significantly higher ($P=0.05$) level in 1993 when all four treatments were higher and 1996 when the 0.5 and 1/0 t/ha treatments were significantly higher.

RESULTS AND DISCUSSION

Harvest Data

Table 13 Weight (t/ha) of spears below and above 10 mm diameter, excluding blown and twisted spears 1993-96 inclusive.

Treatment	Weight (t/ha)							
	<10 mm diam.				>10 mm diam.			
	'93	'94	'95	'96	'93	'94	'95	'96
Nil	1.98	1.37	1.80	2.00	5.47	2.86	1.92	3.28
Salt 0.5 t/ha	1.77	1.57	2.03	1.93	6.49	3.31	2.39	3.78
Salt 1.0 t/ha	2.02	1.54	2.27	2.03	5.97	3.23	2.25	3.68
Salt 2.0 t/ha	1.79	1.50	1.98	1.88	5.91	3.16	1.87	3.24
Salt 4.0 t/ha	1.85	1.46	1.93	2.01	6.21	3.01	1.89	3.03
Mean	1.88	1.49	2.00	1.97	6.01	3.12	2.06	3.40

SED (12 df)	0.224	0.07	0.227	0.130	0.469	0.282	0.225	0.253
LSD (P=0.05)	0.141	0.15	0.495	0.286	0.297	0.602	0.490	0.556
CV%	11.9	7.6	17.9	10.5	7.8	14.0	17.2	11.8
Row.Column								

Comment

Weights below 10 mm diameter

In 1993 and 1994 significant differences ($P=0.05$) were produced with the nil and 1.0 t/ha rate of salt in 1993 and the 0.5 and 1.0 t/ha rates of salt in 1994. In 1995 and 1996 there were no significant differences ($P=0.05$) between treatments.

Weights above 10 mm diameter

Generally salt treatments produced higher weights than the nil treatments and to a significantly higher ($P=0.05$) level in 1993 when all treatments were higher, 1995 when the 0.5 rate was higher and in 1996 when the 0.5 and 1.0 t/ha rates were of statistical significance.