NEW ZEALAND
DEPARTMENT OF
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Internal Report No. 58

Summer Irrigation of Established Asparagus - 1991

Progress Report to the New Zealand Asparagus Council

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April 1992

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CONTENTS

1 Executive Summary

1 A field experiment was continued for the fourth year in which five irrigation treatments are being applied to three asparagus cultivars during the summer-autumn fern growth period. The objective is to define the best irrigation management in order to obtain optimum spear yield and quality during the following spring harvest.

2 The number of irrigations applied in 1991 ranged from none to three. No water was applied to three treatments because there was enough rainfall to prevent the target soil moisture deficits being reached. Irrigations were stopped at the end of February.

3 Fern growth was clearly more vigorous in the irrigated treatments.

4 Export yields of Jersey Giant and UC157 were similar, and both were better than 75x73, a DSIR experimental hybrid. In previous seasons, UC157 had outyielded Jersey Giant.

5 The irrigation treatments had little effect on Jersey Giant but did affect the yields of the other two cultivars. Their best yields were obtained when irrigations were triggered at relatively high soil moisture deficits, and yields were reduced in the high irrigation treatments.

6 There is evidence that a negative effect on yield of not irrigating for several years may be emerging.

2 Introduction

The yield of asparagus during a spring harvest period is very dependent on the amount of assimilate accumulated in the storage root system during the preceding summer-autumn fern growth period. Many factors can affect fern growth, and therefore assimilate storage, so management of the crop during this period is critical. One major factor is water availability. There have been no previous studies reported in New Zealand to define the water requirements or yield responses to irrigation of an established crop. Preliminary studies have shown that irrigation during the two establishment years increases the yield of asparagus grown on sandy soils by between 35 and 72% (Bussell et al., 1987).

We began a field experiment in 1987 to define the best irrigation management to use during fern growth in order to obtain optimum spear yield and quality during the following spring harvest. During each fern growth season, the amount and timing of irrigations applied to three cultivars were varied, and the results used to determine the conditions required to produce optimum spear yield and quality during the following spring harvest. The irrigation treatments used in the experiment were selected on the basis of trigger soil moisture deficits so that the results can be applied anywhere in New Zealand. They allow fluctuations in summer rainfall and differences in water use rates between locations to be accounted for.

In this report we present yield results from the fourth harvest season (1991). Results from the second and third seasons, presented in previous reports (Falloon et al., 1989, 1990), indicated that the best yields were obtained from treatments in which irrigations were triggered at relatively high soil moisture deficits. Either too much or too little irrigation reduced yields in all three cultivars in the experiment. Among the cultivars, Jersey Giant responded more to irrigation than UC157.

3 Materials and Methods

The experiment was established at Lincoln in 1987 using seedling transplants. Three cultivars (UC157, Jersey Giant and 75x73, a DSIR experimental hybrid) were planted in single rows 1.5 m apart. All plots were spray irrigated during the first year to ensure good crop establishment. In the second summer of fern growth (1988-89), five irrigation treatments were started and have continued during each season since then:

I_0 - no irrigation
I_1 - irrigated when the soil moisture deficit = 210mm
I_2 - irrigated when the soil moisture deficit = 160mm
I_3 - irrigated when the soil moisture deficit = 110mm
I_4 - irrigated when the soil moisture deficit = 60mm

Water was applied to each plot using trickle irrigation when the trigger soil moisture deficit in the top 1.1 m of soil was reached. Each irrigation consisted of 50 mm of water. The soil moisture deficits were determined by measuring soil moisture contents weekly. A neutron probe was used to take readings at intervals of 0.2 m from 0.3 m to 1.1 m, and gravimetric analyses were done in the top 0.2 m of soil.

As in the previous years, the trial was sprayed before harvest with metalaxyl (Ridomil MZ72) to control Phytophthora rot. The plots were harvested from 23 September to 29 November 1991 (68 days). Spears were trimmed to 23 cm long, graded and weighed. They were graded before weighing according to their diameters 23 cm from the tip.

Grade 1	20+ mm
Grade 2	15-20 mm
Grade 3	10-15 mm
Grade 4	6-10 mm
Rejects	Frosted, diseased, deformed, or open bracts.
	Butts of spears >23cm long.

4 Results

Weather during the 1990/91 season was slightly drier than average in Canterbury. A total of 350 mm of rain fell during the six month period from 1 November 1990 to 30 April 1991 while potential evapotranspiration (PET) during the same period was 710 mm. Thus the PET - rainfall deficit was 360 mm. Long term mean rainfall and PET values for the period are 320 and 630 mm respectively (i.e. 310 mm deficit).

The number of irrigations required to maintain soil moisture deficits above the target levels varied from 0 to 3 (Table 1), with the earliest irrigation in treatment I_4 applied on 18 January 1991 and the latest applied to the same treatment on 11 February. No irrigations were applied to treatments I_1 and I_2, for two reasons. First, there was enough rainfall to prevent the target deficits being reached and, second, irrigations were stopped at the end of February. This was earlier than in the previous seasons and was done to ensure production of new spears and vigorous fern growth was not encouraged too late into the autumn. Fern growth was clearly more vigorous in the irrigated treatments.

Table 1. Numbers of irrigations and amounts of water applied (irrigation and rainfall) between 1 November 1990 and 30 April 1991 at Lincoln.

Treatment	Number of Irrigations	Amount of water applied (mm)		
		Irrigation	Rainfall	Total
I_0	0	0	349	349
I_1	0	0	349	349
I_2	0	0	349	349
I_3	2	100	349	449
I_4	3	150	349	499

Jersey Giant produced the highest total spear yield (Table 2). Its mean yield was 24% higher than that of UC157 and 35% more than 75x73. However, yields of export grade spears were similar for Jersey Giant and UC157, so the proportion of non-export quality yield was greater for Jersey Giant (48% compared with 33% for UC157). The export yield of 75x73 was substantially lower than the other two cultivars.

Table 2. Effects of the irrigation treatments on the total and export yields (t/ha) of the three cultivars.

Treatment	Total				Export			
	Jersey Giant	UC157	75x73	Mean	Jersey Giant	UC157	75x73	Mean
I_0	10.21	9.22	6.87	8.77	5.01	6.13	3.63	4.92
I_1	10.74	10.37	8.72	9.95	5.39	6.91	4.59	5.63
I_2	11.52	8.82	9.25	9.86	5.97	5.80	4.96	5.58
I_3	9.97	7.97	7.07	8.34	5.30	5.49	3.71	4.83
I_4	10.42	6.36	7.15	7.98	5.69	4.40	3.82	4.64
Mean	10.57	8.55	7.81		5.47	5.75	4.14	
LSD(0.10)				1.49				0.9

There were export yield differences among the irrigation treatments, but the high variability meant that few of the differences were statistically significant (Table 2). In Jersey Giant, there were no differences. The yield in the unirrigated treatment (I_0) was low but it had been treated the same as I_1 and I_2 (Table 1). In UC157 and 75x73, there was a clear tendency for yields to decline in the high irrigation treatments.

5 Discussion

These results supported the findings from the previous two seasons except that the relative performance of Jersey Giant was different. In the earlier years, UC157 out yielded Jersey Giant but in 1991 their yields were similar. The irrigation treatments had little effect on Jersey Giant but clearly affected the yields of the other two cultivars. Their yields declined in the high irrigation treatments. It was interesting to note that even though the I_0, I_1 and I_2 plots were treated the same in 1990/91, I_0 yields were lower in all three cultivars. This could be the first indication that a long term effect of not irrigating may be emerging.

We recommend that the trial continues for at least two further harvest seasons so that long term trends such as the possible effects of either not irrigating or over-irrigating for several successive seasons can be established. However, three modifications are proposed.

1 75x73 will be omitted in view of its poor performance so far, thus more effort will be concentrated on UC157 and Jersey Giant.

2 The irrigation management will be changed. The target soil moisture deficits will stay the same but only 25 mm of water will be applied at each irrigation. This will have the effects of increasing the numbers of irrigations and giving more discrimination among the treatments, but the total amount of water applied in a season will be unchanged.

3 We will revert to the original procedure of continuing irrigations later than the arbitrary cut-off at the end of February. This will also enhance discrimination among the treatments, probably mainly at the expense of more irrigation and therefore poorer performance in the I_3 and I_4 treatments.

As well as the irrigation management objective, the scope of the project was expanded recently to include research funded by the Foundation for Research, Science and Technology on the effects of other environmental factors (temperature and radiation) on asparagus yield physiology and quality, and these aspects will continue during the next two seasons.

6 References

Bussell, W.T., Stiefel, W., and Swain, D.J. 1987. Irrigation increases asparagus yields on sandy soils. *N.Z. Commercial Grower 42(8):* 38-39.

Falloon, P.G., Jamieson, P.D., Wilson, D.R., Nikoloff, A.S., Fraser, H.A., Rea, M.B., and Vickers, R. 1990. Summer irrigation of established asparagus, 1989. Report to the N.Z. Asparagus Council, 5pp.

Falloon, P.G., Fraser-Kevern, H.A., Jamieson, P.D., Wilson, D.R. and Rea, M.B., 1991. Summer irrigation of established asparagus, 1990. Report to the N.Z. Asparagus Council, 7pp.