

# Agronomic studies on Jersey Giant, JWC1 and Pacific 2000 asparagus in New Zealand

W.T. Bussell<sup>1</sup>, P.G. Falloon<sup>2</sup> and C.M. Triggs<sup>3</sup>

<sup>1</sup>School of Natural Sciences, Unitec New Zealand, Private Bag 92025, Auckland

<sup>2</sup>Aspara Pacific Ltd., PO Box 36, Lincoln, Canterbury

<sup>3</sup>Department of Statistics, University of Auckland, Private Bag 92019, Auckland

## Abstract

Asparagus cultivars Jersey Giant, JWC1 and Pacific 2000 were established on grower properties in evaluation trials in the early and mid 1990's in Canterbury and in 1999 in Hawkes Bay, South West North Island and Canterbury, and were harvested for 3 to 7 seasons. In most trials Pacific 2000 had the highest saleable yield. Plant density trials at Hawkes Bay and Waikato with populations from 25,000 to 55,000 plants ha<sup>-1</sup> were harvested for 3 seasons. The optimum density for Jersey Giant and JWC1 was in the range of densities in the trials but the optimum density for Pacific 2000 was above the range. In all trials saleable yield varied considerably among years, cultivars and trial sites. The robustness of this series of trials is discussed.

**Additional key words:** *Asparagus officinalis*, cultivar evaluation, plant density studies

## Introduction

Jersey Giant, an asparagus (*Asparagus officinalis* L.) cultivar bred by Rutgers University, New Jersey, USA in the 1970's, and JWC1, bred by J. Wattie Canneries, Hastings, New Zealand in the 1980's are both high yielding single cross hybrids, which produce good quality asparagus spears for processing and fresh export under New Zealand conditions (Bussell, 2000; Falloon and Bussell, 2007). Many recently established asparagus beds in the North Island are planted in one of these two superior hybrids. Pacific 2000, bred by Aspara Pacific in the 1990's, is a newer single cross hybrid with better spear quality and crop survival than Jersey Giant and JWC1 (Falloon and Bussell, 2007). Pacific 2000 is the main asparagus cultivar now grown in the South Island. This paper gives the results, and discusses cultivar evaluation and plant density trials conducted on grower properties with these three cultivars over the past 15 years in the four major asparagus growing areas of New Zealand: Canterbury, South West North Island, Hawkes Bay and Waikato.

## Materials and Methods

### (a) Cultivar trials

Three trials were established in Canterbury in the early and mid-1990's (Table 1). Ten-week-old seedling transplants of Jersey Giant, JWC1 and Pacific 2000 were planted, in spring, in rows of 1.5 m with 0.3 m between plants in the row (density 22,222 plants ha<sup>-1</sup>). There were 4 replicates. Each plot contained 15 plants, of each cultivar arranged in a randomised complete block design. Cultural practices before and after planting, fertiliser

application, irrigation, and pest and disease control were the same in the trial areas as in the remainder of the field and followed recommended practices (Falloon and Bussell, 2007). The first harvest season was two years after planting and the season lasted 20 d. The second harvest season was 40 d and subsequent seasons were about 80 d. At each harvest, during a season, all spears 23 cm or taller were cut from each plot. They were later trimmed to 23 cm long, the required length for fresh spears exported from New Zealand. They were then graded into saleable and unsaleable and each grade was counted and weighed. Only saleable yield results are given and discussed.

**Table 1.** Year of planting, first and last harvest and saleable yield ( $\text{t ha}^{-1}$ ) of asparagus cvs. Jersey Giant, JWC1 and Pacific 2000 in three cultivar trials in Canterbury.

	Trial number		
	1	2	3
Planting	1991	1993	1996
First harvest	1993	1995	1998
Last harvest	1998	2001	2001
Cultivar			
Jersey Giant	12.2	15.1	3.9
JWC1	14.8	17.0	6.0
Pacific 2000	21.0	17.6	6.6
LSD <sub>0.05</sub> (df = 36)	5.0	3.4	2.2
P	< 0.001	0.29	0.017

A national trial, Number 5 in a series begun in 1980, was established in the spring of 1999 at one site in each of the Canterbury, South West North Island and Hawkes Bay areas. One-year-old dormant crowns, currently most commonly used by growers, were used as planting material. They were planted in plots containing 25 plants in rows 1.5 m apart and with 0.3 m between plants in the row (density 22,222 plants  $\text{ha}^{-1}$ ) at the Canterbury site and in plots with 25 plants in rows 1.65 m apart and with 0.3 m between plants in the row (density 20,202 plants  $\text{ha}^{-1}$ ) in the two other regions. All other design and cultural details were the same as described for earlier Canterbury trials. The first harvest season, two years after planting, in spring 2001 was 20 d. The spring 2002 and 2003 harvests were 40 and 80 d. The Hawkes Bay site only was harvested for 80 d in spring 2006. On most harvest days the number of saleable spears from each plot was recorded. On the first day, every 10<sup>th</sup> harvest day and the last day of a season all spears 23 cm or taller were cut from each plot. They were later trimmed to 23 cm, graded into saleable and unsaleable and each grade was counted and weighed. The saleable yield for each season was estimated by summing saleable yield on each 'complete' harvest day and the average weight of a saleable spear on each 'complete' harvest day multiplied by sets of saleable spear numbers recorded on all other harvest days of a season. This simplified method of estimating saleable yield gives a value very close to the traditional, more time consuming and expensive, method of obtaining saleable yield used in the Canterbury trials (Bussell *et al.*, 2000).

In all trials plant survival was determined by counting the number of surviving plants in each plot in the summer following planting of the trial and in most summers after each harvest season.

#### (b) Plant density trials

One trial, with Jersey Giant and JWC1, was established in Hawkes Bay in spring 1998 and another trial with Jersey Giant, JWC1 and Pacific 2000 was established in Waikato in

spring 1999. One-year-old dormant crowns were planted in rows 1.5 m apart with plants at 0.45 m, 0.27 m, 0.19 m, 0.15 m or 0.12 m apart in the row in Hawkes Bay and in rows 1.4 m apart and spaced 0.48 m, 0.29 m, 0.20 m, 0.16 m or 0.13 m apart in the row in Waikato, giving populations, at both sites, of 15,000, 25,000, 35,000, 45,000, and 55,000 plants ha<sup>-1</sup>. There were four replicates in a split plot design, with cultivars as main plots and distance within the row as sub-plots. Cultural practices before and after planting were the same as in the above cultivar trials. The first harvest of 20 d was in spring 2000 or 2001, the second of 40 d in spring 2001 or 2002 and the third of 80 d in spring 2002 or 2003. Saleable yield was estimated in both trials by the simplified method used in the national cultivar trial.

Analyses of variance were carried out on data from all of the trials using GENSTAT 10 (Payne *et al.*, 2007). A quadratic equation, used to determine an optimum population in asparagus plant density trials (Bussell *et al.*, 1997), was fitted to plant density data from this study.

## Results and Discussion

In all three Canterbury trials, begun in the early and mid-1990's, Pacific 2000 had the highest total saleable yield (Table 1). Total saleable yield of Jersey Giant was significantly lower than Pacific 2000 in trials 1 and 3, and total saleable yield of JWC1 was significantly lower than in Pacific 2000 in trial 1 (Table 1). The significance of the difference between cultivars varied from year to year in each trial. Yields, in each year, in each trial, varied primarily due to the different climatic conditions in each harvest season.

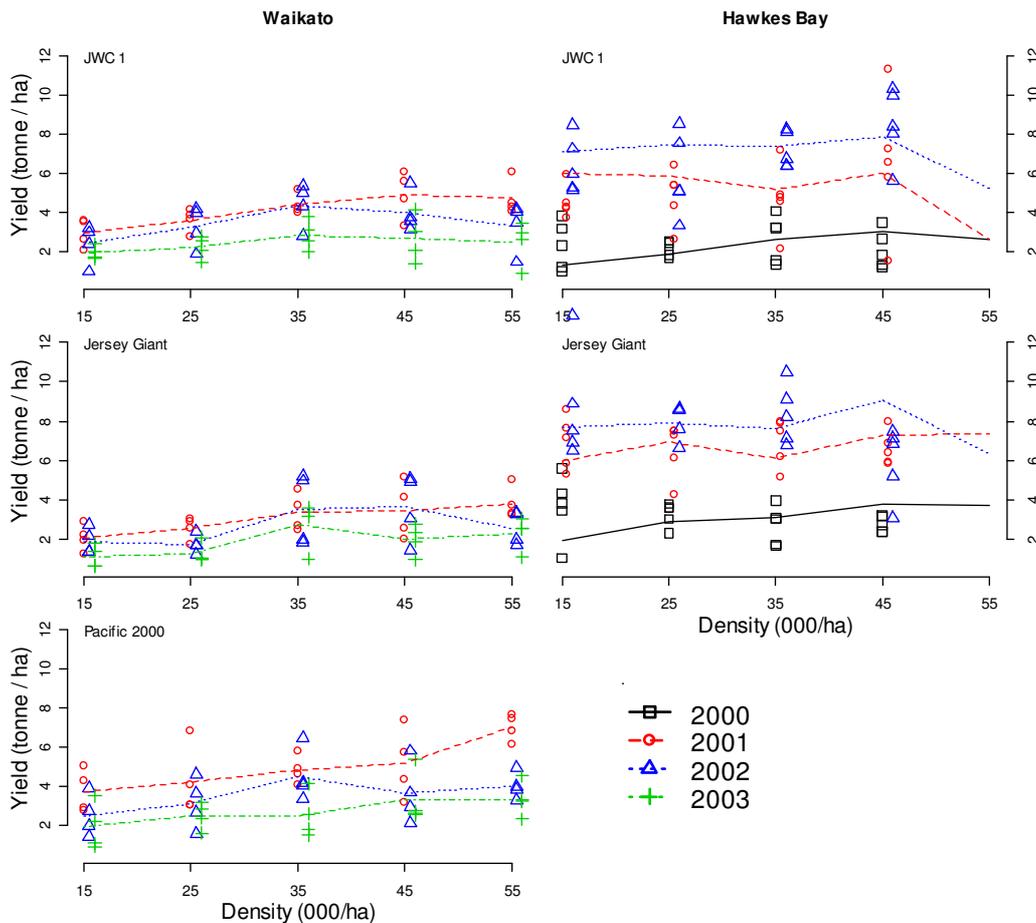
Plant survival in Pacific 2000 was 72, 83 and 78 % at the end of trials 1, 2 and 3 respectively. Plant survival tended to be lower in JWC1 (60, 73 and 70 %) and Jersey Giant (63, 57 and 87 %). After the 2006 season and 5 years after the last yield recordings in trial 3, plant survival was 62 % in Pacific 2000, 52 % in JWC1 and 35 % in Jersey Giant.

At all sites, in the first three seasons, in National Cultivar Trial No 5, Pacific 2000 had the highest, or equal highest, saleable yield (Table 2). Total saleable yield of Jersey Giant was significantly lower than in Pacific 2000 at every trial site ( $p < 0.05$ ) while total saleable yield in JWC1 was significantly lower only at the South West North Island site (Table 2). Total saleable yield of Pacific 2000 was significantly higher than both Jersey Giant and JWC1 in Hawkes Bay in 2006 (Table 2). There was similar variation in saleable yield in this trial among cultivars in each year and among years at each site as found in the earlier Canterbury trials. Plant survival of Pacific 2000 was 77, 77 and 87 % at the end of the 2003 season in Canterbury, South West North Island and Hawkes Bay respectively. Again plant survival tended to be lower in JWC1 (74, 87 and 87 %) and Jersey Giant (68, 63 and 72 %).

**Table 2.** Saleable yield (t ha<sup>-1</sup>) of asparagus cvs. Jersey Giant, JWC1 and Pacific 2000 in the first three harvests (2001, 2002 and 2003) at three sites and 6<sup>th</sup> harvest (2006) only at Hawkes Bay site in National Cultivar Trial No 5.

Cultivar	2001-2003			2006
	Canterbury	South West North Island	Hawkes Bay	Hawkes Bay
Jersey Giant	5.4	9.3	8.3	3.4
JWC1	6.8	10.8	8.7	4.0
Pacific 2000	8.0	15.2	10.4	6.3
LSD <sub>0.05</sub> (df = 6)	1.61	2.32	1.79	0.64
P	0.011	< 0.001	0.023	< 0.001

In the two plant density trials there was considerable variation in yield among plots, at each plant density, and of mean yield in each year (Figure 1). Analysis of variance of saleable yield showed highly significant differences among year, cultivar and planting density ( $p < 0.001$ ). Fitting a quadratic equation to accumulated yield over the three years (Table 3) gives the clearest method of estimating optimum plant density, for each cultivar, at each site. Estimated optimum densities were 43,000 plants  $ha^{-1}$  (SE 14,300) for Jersey Giant and 31,000 plants  $ha^{-1}$  (SE 4,400) for cv JWC1 in Hawkes Bay, and 47,000 plants  $ha^{-1}$  (SE 11,900) for Jersey Giant and 42,000 plants  $ha^{-1}$  (SE 4,100) for JWC1 but outside the range of densities grown in the trial for Pacific 2000 in the Waikato trial.



**Figure 1.** Yield ( $t\ ha^{-1}$ ) in each plot at five populations (15,000; 25,000; 35,000; 45,000 and 55,000 plants  $ha^{-1}$ ) of asparagus cvs. Jersey Giant and JWC1 in Waikato and Hawkes Bay and Pacific 2000 in Waikato only in each of the three years trials harvested (2001 to 2003 in Waikato; 2000 to 2002 in Hawkes Bay). Lines join means of four plots at each population.

It is difficult to make firm optimum plant density recommendations from these trials, as the accumulated yield, over three years, did not differ greatly over the range of populations evaluated (Table 3). It has also been difficult to make firm optimum plant density recommendations for optimum plant densities in many earlier plant density studies on asparagus both in New Zealand and overseas (Bussell *et al.*, 1997). There is a suggestion in

this trial, as in earlier studies (Bussell *et al.*, 1997), that optimum density is lower at a high yielding site.

**Table 3.** Saleable yield (t ha<sup>-1</sup>) from five populations of asparagus cvs. Jersey Giant (JG) and JWC1 in Hawkes Bay and from five populations of cvs. Jersey Giant, JWC1 and Pacific 2000 in Waikato after three harvests.

Site	Cultivar	Plant population (10 <sup>3</sup> ha <sup>-1</sup> )					Mean
		15	25	35	45	55	
Hawkes Bay	JG	15.6	17.7	16.8	20.2	17.4	17.5
	JWC1	14.5	15.3	15.2	17.0	10.5	14.5
	Mean	15.1	16.5	16.0	18.6	13.5	
	Density x Cultivar	LSD <sub>0.05</sub> (df = 72) = 3.61				P = 0.14	
	Density	LSD <sub>0.05</sub> (df = 72) = 2.40				P < 0.005	
	Cultivar	LSD <sub>0.05</sub> (df = 87) = 1.61				P < 0.001	
Waikato	JG	5.1	5.5	9.6	9.0	8.6	7.6
	JWC1	7.4	9.1	11.7	11.7	10.6	10.1
	Pac 2000	8.2	9.9	11.9	12.1	14.4	11.3
	Mean	6.9	8.2	11.1	10.9	11.2	
	Density x Cultivar	LSD <sub>0.05</sub> (df = 108) = 2.58				P = 0.29	
	Density	LSD <sub>0.05</sub> (df = 108) = 1.25				P < 0.001	
	Cultivar	LSD <sub>0.05</sub> (df = 27) = 1.37				P < 0.001	

The results from these trials suggest that Pacific 2000 is likely to be a good asparagus cultivar for new plantings in all asparagus growing regions of New Zealand. The variability of results in these trials is similar to that from National Cultivar Trial No 1 conducted in the early 1980's when Jersey Giant was suggested as a good new cultivar for New Zealand (Bussell *et al.*, 1985). The value of short-term or long-term trials still remains a matter for discussion, as it has for many years in New Zealand (Bussell *et al.*, 1987; Bussell *et al.*, 1988). All of trial sites described in this paper, except the South West North Island site, lost to flooding in February 2004, and the Waikato site sold in 2005, are still available for study provided recording resources are available.

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### References

- Bussell, W.T. 2000. Asparagus production in New Zealand. *Proceedings Agronomy Society of New Zealand* 30: 19-23.
- Bussell, W.T., Connolly, P.G., McKeown, L., Schofield, P.E., Falloon, P.G. and Stiefel, W. 2000. Simplifying recording of asparagus agronomic trials. *New Zealand Journal of Crop and Horticultural Science* 28: 277-281.
- Bussell, W.T., Falloon, P.G. and Nikoloff, A.S. 1987. Evaluation of asparagus yield performance after two years' harvesting. *New Zealand Journal of Experimental Agriculture* 15: 205-208.

- Bussell, W.T., Falloon, P.G. and Stevenson, E. 1988. Modelling of long-term asparagus production based on first year yields -possibilities and limitations. *Proceedings Agronomy Society of New Zealand* 18: 129-132.
- Bussell, W.T., Maindonald, J.H. and Morton, J.R. 1997. What is a correct plant density for transplanted green asparagus? *New Zealand Journal of Crop and Horticultural Science* 25: 359-368.
- Bussell, W.T., Nichols, M.A., McCormick, S.J., Alspach, P., Nikoloff, A.S. and Brash, D.W. 1985. Asparagus cultivar evaluation in New Zealand. *Proceedings of the 6<sup>th</sup> International Asparagus Symposium, Guelph, Canada*: 52-62.
- Falloon, P.G. and Bussell, W.T. 2007. Cultivars and crop establishment. In: *The New Zealand Asparagus Manual*. 4<sup>th</sup> Ed., N.Z. Asparagus Council, Wellington. pp 11-17.
- Payne, R.W., Murray, D.A., Harding, S.A., Baird, D.B. and Soutar, D.M. (2007). *GenStat for Windows* (Edition 10) Introduction. VSN International, Hemel Hempstead.