Relationships between crown size at planting, yield and growth in strawberries

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Abstract

Runner plants of two cultivars (Pajaro and Camarosa) of strawberries from two nurseries (Katikati and Ohakune), and with crown diameters ranging from 8 to 20mm were planted in late autumn in an Auckland fruit production bed. Yield during the season and measurements of crown diameter, number and fresh weight at the end of the season were greatest in plants with greater crown diameter at planting. There was a strong linear relationship between diameter at planting and fruit yield and end of season growth measurements. Calculated fruit yields and measures of end of season growth were significantly lower for a plant with a small (8mm) diameter at planting time than for a plant with a large (18mm) diameter at planting time. The significance of these relationships for commercial strawberry production is also discussed.

Additional key words: crown diameter, crown fresh weight, *Fragaria x ananassa*

Introduction

Strawberry (*Fragaria x ananassa* Duch.) fruit growers in New Zealand mainly replant annually with runner plants of variable size into fruiting beds. Reports (Rogers and Edgar, 1938; Guttridge and Anderson, 1973; Kramer and Schultze, 1985; Rice and Duna, 1986; Human, 1999) on trials studying the influence of crown size on yield and later growth give varying results. These studies suggest, however, that an influence of crown size at planting on later growth and yield is strongest when the first fruit harvest is within about 6 months of planting, as is the case in Auckland. We conducted this study to obtain information on the relationship between crown size at planting on yield and growth and to determine whether there is an optimal runner crown size for strawberry production in the Auckland region.

Materials and Methods

This trial was conducted during the 2000-01 season at a commercial property at Mangere, Auckland (37°01′S, 174°48′E). Plants were grown on 4-row black plastic mulched beds, 120 cm wide at the top, with 160 cm bed centres, on methyl bromide: chloropicrin-fumigated soil. Plant spacing was 36 cm within each row and 25 cm between rows in each bed giving a density of 69,444 plants/ha, which is about half the density used by many Auckland growers. An optimum density has not been determined for any cultivar for the Auckland region. Cultural practices related to bed preparation and planting, fertiliser application, irrigation, and pest and disease control followed standard commercial practice at the garden.

Runner plants of two Californian-bred cultivars, Pajaro (the standard cultivar in the Auckland region for the past 15 years) and Camarosa (a recently introduced (Ennis et al. 2001) higher yielding cultivar) were planted on 3 May 2000. The plants had been dug within the previous 24 hours from commercial nurseries at Katikati (a warm environment) and Ohakune (a cool environment). Prior to planting, crown diameter of individual plants in the sample from the nurseries was measured, by a caliper measurement of the widest point. There were twelve plants of each cultivar from each nursery site in each of the 4 to 8mm, 8 to 12mm, 12 to 16mm and 16 to 20 mm crown diameter grades, except for the Camarosa 16 to 20mm diameter grade from Katikati, where there were 7 plants in the nursery sample. The four 'plots' of each grade were planted in adjacent beds in the field to minimise border effects of plants of quite different initial and subsequent size.

Fruit was harvested twice weekly for 17 weeks from 3 October 2000 to 25 January 2001. At each harvest and from each plant individually, the number and weight of total and unmarketable

(diseased, rain damaged, bird eaten, or < 10g weight) ripe fruit was recorded. On 5 February 2001 plants were dug from the field and crown number, crown fresh weight, crown diameter (a caliper measurement of the widest point) and runner number recorded for each plant.

Analyses of variance and covariance and regression analysis were undertaken with the GENSTAT statistical package GenStat® Release 6.1 (Payne, 2002).

Results and Discussion

Mean crown diameters at planting of Pajaro and Camarosa from both Katikati and Ohakune nurseries (Table 1) were not significantly different. Total yields obtained in this trial are in Table 2. The significant differences between cultivars and nurseries were similar to those found in adjacent trials conducted at the same time (Ennis et al. 2001, Pringle et al. 2002).

Table 1. Mean crown diameter (mm) of strawberries from two nurseries at planting time.

	Nursery		
Cultivar	**Katikati**	**Ohakune**	**MEAN**
Camarosa	12.1	12.3	12.2
Pajaro	12.2	12.7	12.4
MEAN	12.1	12.5	

$LSD_{0.05}$ (df = 8) to compare Cultivar means: = 0.7
to compare Nursery means: = 0.7
to compare Cultivar x Nursery means: = 0.9

Table 2. Total yield (g/plant) of strawberries from two nurseries.

	Nursery		
Cultivar	**Katikati**	**Ohakune**	**MEAN**
Camarosa	864	1036	950
Pajaro	559	646	602
MEAN	712	841	

$LSD_{0.05}$ (df = 8) to compare Cultivar means: = 73
to compare Nursery means: = 84
to compare Cultivar x Nursery means: = 107

There was a linear relationship between crown diameter at planting and both total and marketable yield (R^2 = 50.8%, 59.6%, p-values = 0.036, 0.011 respectively) (Figure 1). Both total and marketable yield increased at the same rate in both cultivars from both nurseries. The rate of increase of total and marketable yield respectively was 27g (s.e. 3.9) and 15g (s.e. 3.3) for every 1 mm increase in initial crown diameter. The fitted regressions were summarised by comparing fitted total and marketable yields from plants with an initial crown diameter of 8mm (near the smallest planted commercially in New Zealand) and from plants with an initial crown diameter of 18mm (near the largest planted commercially in New Zealand). Fitted values from 8mm diameter plants were significantly lower than from 18mm diameter plants (Table 3).

There were also linear relationships between crown diameter at planting and crown fresh weight and crown diameter at the end of the season (R^2 = 37.3%, 49.7%, p-values = 0.006, 0.007 respectively) (Figure 2). The rate of increase in crown fresh weight was similar in both cultivars and in plants from both nurseries. For a 1 mm increase in the initial crown diameter, there was an increase in crown fresh weight at the end of harvest of 1.4g (s.e. = 0.29). The rate of increase in crown diameter at the end of the harvest season was similar in plants from both nurseries but was higher in Pajaro, 1.7 mm (s.e. 0.30) for every 1 mm increase in the initial crown diameter, than in Camarosa, 0.67 mm (s.e. 0.22) for every 1mm increase in initial crown diameter. The fitted regressions were summarised by comparing fitted crown diameter and crown fresh weight from plants with initial crown diameters of 8mm and 18mm. Fitted values from 8mm diameter plants were significantly lower than from 18mm diameter plants (Table 3).

The number of crowns per plant at the end of harvest was higher in Camarosa (mean 4.4) than in Pajaro (mean 2.9) (p-value <0.001). Nearly 40% of Camarosa plants had 5 or more crowns while only 4% of Pajaro plants had 5 or more crowns (p-value <0.001). Ohakune sourced plants produced more crowns (4.1 per plant) than Katikati sourced plants (3.1 per plant) (p-value <0.001). Larger plants at planting have higher crown numbers at harvest (p < 0.001). This result is consistent in both cultivars (p-value for difference 0.52) and in plants from both nurseries (p-value for difference 0.06). For every 1 mm increase in initial crown diameter the number of crowns per plant increased by 1.025 (s.e. 0.0017).

The number of runners per plant at the end of harvest was higher in Camarosa (mean 4.4) than in Pajaro (mean 2.2) (p-value <0.001). The number of runners in plants from Katikati and Ohakune were similar, 3.4 and 3.5 per plant respectively. The number of runners per plant did not change with initial crown diameter.

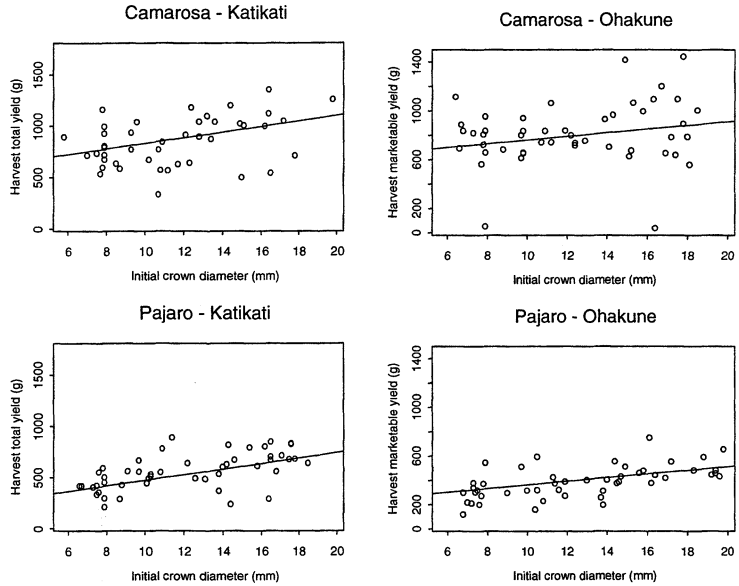

Figure 1. Total and marketable yields (g/plant) of strawberries plotted against crown diameter (mm) at planting for some treatments.

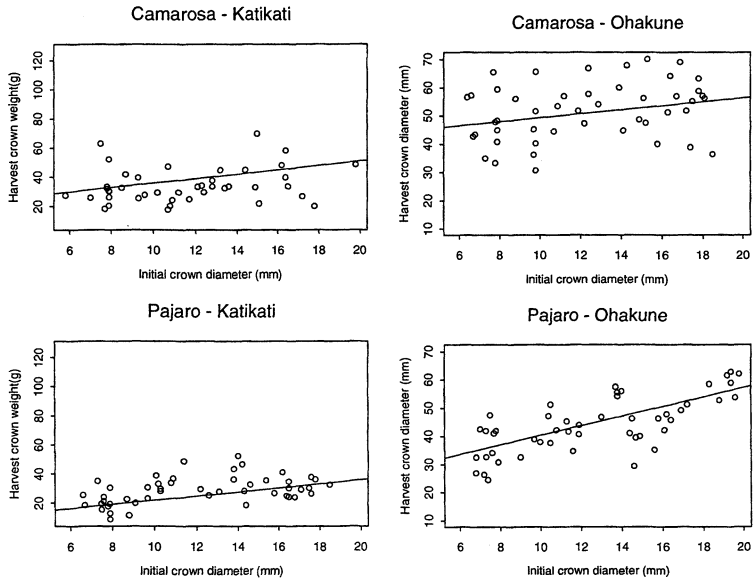

Figure 2. Crown fresh weight (g) and crown diameter (mm) of strawberries at the end of harvest plotted against crown diameter (mm) at planting for same treatments

The substantial changes in yield or plant growth by the end of harvest due to changes in initial crown diameter found in this trial may be quite specific for the region, since the details of the results here differed from other trials (e.g. Rice and Duna, 1986; Human ,1999). The results also suggest that while there is not an optimal runner crown size for strawberry fruit production in the Auckland region. However the linear relationship between initial crown diameter and yield suggests that nurserymen should aim to produce the largest possible runners for growers to plant in their fruiting beds. Further research might enable the industry to justify runner size grades and associated price differentials in order to improve economic efficiency in the industry.

Table 3. Calculated values for total and marketable yield (g/plant) and crown diameter (mm) and crown fresh weight (g) at the end of the season for strawberry plants with an initial diameter of 8mm or 18mm.

(a) Yield

Cultivar	Nursery	Total yield Initial crown diameter (mm)		Marketable yield Initial crown diameter (mm)	
		8	18	8	18
Camarosa	Katikati	780	1050	630	780
	Ohakune	900	1170	730	880
Pajaro	Katikati	420	690	240	390
	Ohakune	550	810	330	480

$LSD_{0.05}$ (df = 182) to compare total yield predictions = 85
$LSD_{0.05}$ (df = 182) to compare marketable yield predictions = 71

(b) Crown diameter and weight

Cultivar	Nursery	Final crown diameter (mm) Initial crown diameter (mm)		Crown fresh weight (g) Initial crown diameter (mm)	
		8	18	8	18
Camarosa	Katikati	40	46	33	48
	Ohakune	48	55	45	60
Pajaro	Katikati	28	45	19	33
	Ohakune	37	54	32	46

$LSD_{0.05}$ (df = 182) to compare final crown diameter predictions = 3.9
$LSD_{0.05}$ (df = 182) to compare final crown fresh weight predictions = 6.3

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