

# Performance of new Californian strawberry cultivars in Auckland

W. T. Bussell<sup>1</sup>, I. L. Ennis<sup>1</sup>, C. M. Triggs<sup>2</sup> and G. J Pringle<sup>3</sup>

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

<sup>2</sup>Department of Statistics, University of Auckland, Private Bag 92019, Auckland

<sup>3</sup>Graduate School, Unitec New Zealand, Private Bag 92025, Auckland

## Abstract

The Californian strawberry cultivars Camarosa (short day), Gaviota (short day) and Diamante (day neutral), released in New Zealand in the past five years, were compared in the 2002-03 season with the older Californian cultivar Pajaro (short day), the most widely grown cultivar in the Auckland region for many years. All of the recently released Californian cultivars above produced significantly greater yields than Pajaro. Gaviota produced a similar percentage of saleable fruit to Camarosa, but a significantly lower yield. Diamante produced a lower percentage of saleable fruit than Camarosa, particularly during periods of wet weather, and a significantly lower yield. Yield in all short day cultivars was lower in plants from the low altitude Katikati nursery than the high altitude Ohakune nursery. There was no consistent relationship of yield and planting time. Yield peaked in mid-December following a cold spring.

**Additional keywords:** Camarosa, Gaviota, Pajaro, Diamante, short day cultivars, chilling.

## Introduction

The continual introduction of new cultivars has contributed to increasing yield in commercial strawberry (*Fragaria x ananassa* Duch.) production in New Zealand (Pringle *et al.* 2002). Short day cultivars bred by the University of California strawberry breeding programme have been introduced to the northern New Zealand strawberry industry with success in the past (Lewthwaite and Clarke, 1977; Pringle, 1998) indicating that the breeding stock used in this programme is also suitable for the conditions in northern New Zealand. The evaluation of production characteristics in northern New Zealand conditions of cultivars bred for different environments is advisable before an investment is made in plant material. Assessment of the optimal agronomic approach in our environment may also increase the value gained from new overseas bred cultivars by growers. The research in this paper investigates yield and agronomic responses of

cvs Camarosa, Gaviota and Diamante in northern New Zealand.

## Materials and Methods

The widely grown older short day cultivar Pajaro, the newer short day cultivars Camarosa and Gaviota and, for comparison, the new day-neutral cultivar Diamante were used in this study conducted in the 2002-03 season. Runner plants were grown either at the usual low (c. 30 m) altitude nursery area at Katikati (37°30'S, 175°55'E) or at a high (c. 600 m) altitude nursery area at Ohakune (39°25'S, 175°25'E). They were dug on four occasions in autumn 2002 - 27 April, 5, 17 and 30 May - and were planted within 24 hours of digging in a commercial garden at Massey, Auckland (36°49'S, 174°36'E).

Cultural practices related to bed preparation and planting, fertiliser application, irrigation, and pest and disease control followed standard commercial practice at the garden. The black polythene mulched fruiting

beds were formed at 1.6 m centres and with a 1.2 m wide top on methyl bromide:chloropicrin-fumigated soil. Plants were staggered in adjacent rows and were planted in four rows 0.25 m apart with plants 0.36 m apart in each row on a bed, giving a density of 69,444 plants/ha, about half the standard commercial planting density for Pajaro in the Auckland region. Plots had 12 plants, with four replicates of each cultivar in a randomised block design.

Plants were deblossomed about a month before harvesting was planned to start in these trials. Deblossoming has normally been used on most cultivars grown to date in the Auckland region to remove poor quality fruit set in winter and to induce more crown branches to flower (Money, 1969; Lewthwaite and Clarke, 1977; Hawes, 1996). Fruit was harvested once weekly for 17 weeks from 25 September 2002 to 21 January 2003. At each harvest the number and weight of total and unmarketable (diseased, rain damaged, bird eaten, or < 10 g weight) ripe fruit was recorded. Data were adjusted for the small number of missing plants in the trials.

Daily air temperatures for March to May 2002 were obtained from Katikati and Ruapehu College, Ohakune (the nearest meteorological stations to Katikati and Ohakune nurseries) and hourly temperatures for March to May 2002 were obtained from Tauranga Airport and Waiouru (the nearest stations to Katikati and Ohakune nurseries recording hourly temperatures). From these records we estimated how much runner plants were chilled in the nursery by temperatures at or below 7.2 °C, the temperature fulfilling the chilling requirement of strawberry runners (Voth and Bringhurst, 1990). Daily air temperature records for May 2002 to January 2003 and long term averages for May to January were obtained from Henderson, the nearest meteorological stations to the trial site.

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

Smooth curves were fitted to scatterplots using the loess function, (Cleveland, 1992).

## Results and Discussion

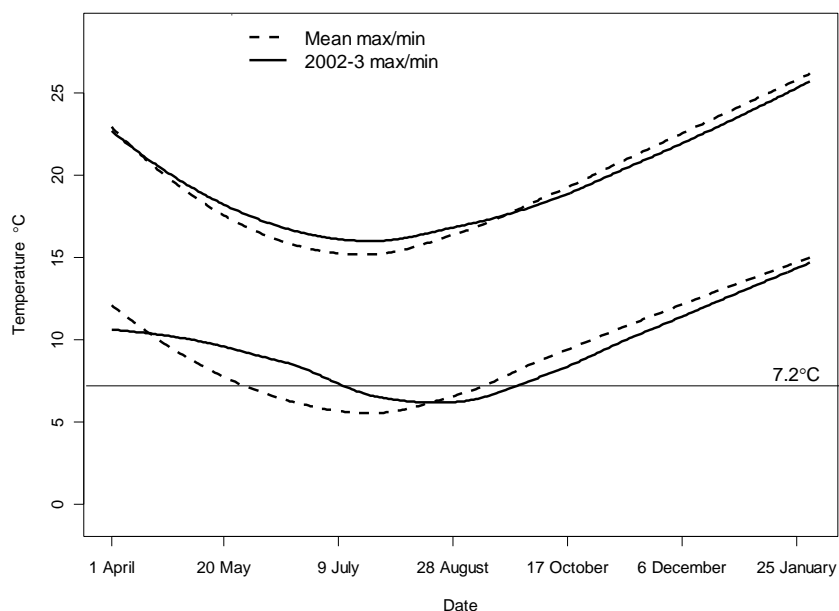
The minimum air temperature was 7.2 °C or below on 19 days at Katikati and 56 days at Ohakune before planting was completed in autumn 2002. Based on hours below 7.2 °C recorded at Tauranga airport and Waiouru, we estimated that by the last digging date in May there were fewer than 50 hours of chilling at Katikati and c 430 hours of chilling at Ohakune. Chilling temperatures in the fruiting bed occurred mostly in late winter (Figure 1) after higher than normal maximum and minimum temperatures from planting to mid-winter.

Total yields of all cultivars were significantly different with Camarosa the highest, followed by Gaviota, Diamante and Pajaro (Table 1). In other Auckland region trials in the 2002-03 and 2003-04 seasons, Camarosa has consistently yielded highest, but Gaviota was higher than Pajaro in only one season (Langford and Snelling, 2004). Except for Diamante, plants from Ohakune nursery had higher total yields than plants from Katikati nursery (Table 1). The difference was significant for Camarosa and for the mean yield of all cultivars. Significantly higher yields from Ohakune plants due to adequate nursery chilling and timely fruiting bed chilling have not been obtained consistently in recent years (Bussell *et al.*, 2005). Fruiting bed chilling appears to be most effective if most chilling has occurred by mid-winter. Thus lateness, rather than the amount, of winter fruiting bed chilling may have reduced its effect in this season. Differences in total yield for each cultivar at each planting time were not consistent, a similar finding to other years for Pajaro and Camarosa (Bussell *et al.*, 2005).

Yields were low from the start of the season in late September until late November, reached a peak in the third week of December and decreased rapidly during January (Figure 2). This yield pattern reflected seasonal

temperatures. In this fruiting season minimum temperatures were much cooler than normal and maximum temperatures slightly lower than normal in October and November (Figure 1). The yield pattern was similar for each cultivar and for each planting time in all cultivars. The

percentage of unsaleable fruit (damaged, diseased, misshapen or < 10g) from each cultivar varied, with Diamante producing 43% unsaleable, significantly more than Camarosa (30.5%) and Pajaro (29.5%) which produced



**Figure 1: Fitted curves to long term and 2002-03 season daily maximum and minimum air temperatures at Henderson meteorological station**

**Table 1: Yield (g/plant and mean of 4 planting times) of four cultivars from Katikati and Ohakune nurseries in 2002-03 season.**

| Cultivar           | Katikati                     | Ohakune | Mean           |
|--------------------|------------------------------|---------|----------------|
| Camarosa           | 1103                         | 1246    | 1175           |
| Gaviota            | 908                          | 986     | 947            |
| Diamante           | 755                          | 744     | 750            |
| Pajaro             | 666                          | 704     | 685            |
| <b>Mean</b>        | 858                          | 920     |                |
| Nursery            | LSD <sub>0.05</sub> (df=117) | 40      | p value 0.003  |
| Cultivar           | LSD <sub>0.05</sub> (df=117) | 57      | p value <0.001 |
| Cultivar x Nursery | LSD <sub>0.05</sub> (df=117) | 81      | p value 0.059  |

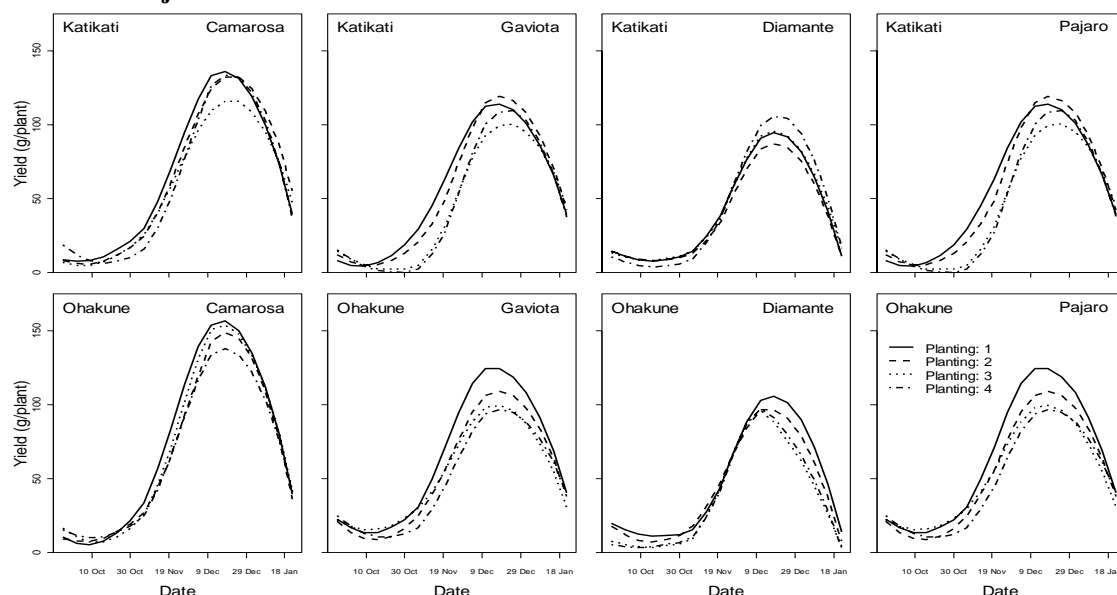
significantly more unsaleable fruit than Gaviota (24.4%). Camarosa had more unsaleable fruit in this season than in previous seasons in the Auckland region (Ennis *et al.*, 2001), possibly due to low spring temperatures (Figure 1) causing poor pollen quality and fruit set. Diamante had the most unsaleable fruit in this trial, and elsewhere (Langford and Snelling, 2001), at harvests following rain, making it an unsuitable cultivar for wetter parts of New Zealand.

Fruit number was highest in Camarosa, significantly less in Gaviota and significantly less still in Diamante and Pajaro (Table 2).

Fruit weight was significantly higher in Diamante than in Camarosa, Gaviota or Pajaro (Table 3). It has been reported that Gaviota produces larger fruit than Camarosa or Pajaro early in the season in the Auckland region (Langford and Snelling, 2002), but Gaviota did not produce larger early season fruit in this trial.

The results of this trial have reinforced those of other recent Auckland region trials showing the good performance of Camarosa, which has now replaced Pajaro as the industry standard cultivar (Langford and Braithwaite, 2005).

**Figure 2: Fitted curves to yield of each harvest in the 2002-03 season for cvs Camarosa, Gaviota, Pajaro and Diamante from Katikati and Ohakune nurseries.**



**Table 2: Fruit number (no/plant and mean of 4 planting times) of four cultivars from Katikati and Ohakune nurseries in 2002-03 season.**

| Cultivar           | Katikati                     | Ohakune | Mean           |
|--------------------|------------------------------|---------|----------------|
| Camarosa           | 55                           | 64      | 59             |
| Gaviota            | 46                           | 59      | 53             |
| Diamante           | 31                           | 33      | 32             |
| Pajaro             | 34                           | 35      | 35             |
| <b>Mean</b>        | 41                           | 45      |                |
| Nursery            | LSD <sub>0.05</sub> (df=117) | 2.0     | p value <0.001 |
| Cultivar           | LSD <sub>0.05</sub> (df=117) | 2.8     | p value <0.001 |
| Cultivar x Nursery | LSD <sub>0.05</sub> (df=117) | 4.0     | p value 0.035  |

**Table 3: Fruit weight (g and mean of 4 planting times) of four cultivars from Katikati and Ohakune nurseries in 2002-03 season.**

| Cultivar           | Katikati                     | Ohakune | Mean           |
|--------------------|------------------------------|---------|----------------|
| Camarosa           | 20.4                         | 19.5    | 19.9           |
| Gaviota            | 19.8                         | 20.3    | 20.1           |
| Diamante           | 25.1                         | 22.6    | 23.9           |
| Pajaro             | 19.7                         | 19.9    | 19.8           |
| <b>Mean</b>        | 21.3                         | 20.6    |                |
| Nursery            | LSD <sub>0.05</sub> (df=117) | 0.49    | p value <0.001 |
| Cultivar           | LSD <sub>0.05</sub> (df=117) | 0.70    | p value 0.008  |
| Cultivar x Nursery | LSD <sub>0.05</sub> (df=117) | 0.99    | p value <0.001 |

### Acknowledgments

We thank Strawberry Growers NZ for funding, John Garelja for caring for the trial on his property and Bruce Rapley and Michael Shanley for providing runner plants.

### References

- Bussell, W.T., Ennis, I.L., Triggs, C.M.; Pringle, G.J. 2005: A study on improving strawberry production in northern New Zealand. *New Zealand Journal of Crop and Horticultural Science* **33** (in press).
- Cleveland, W.S, Grosse, E., Shyu, W.M. (1992): Local Regression Models, in *Statistical Models in S*, Ed. J.M. Chambers, T.J. Hastie, Wadsworth and Brooks, Pacific Grove, California, pp 309-366.
- Ennis, I.L.; Bussell, W.T.; Pringle, G.J; Perry, F. 2001: Camarosa: a strawberry cultivar with potential. *New Zealand Commercial Grower* **56**: 47-48.
- Hawes, L. 1996: Strawberries - varieties and culture for commercial production. <http://www.hortnet.co.nz/publications/hortfacts/hf058001.htm>.
- Langford, G; Snelling, C. 2001: Berry Notes – Strawberry Varieties. *NZ Commercial Grower* **56**: 49.
- Langford, G; Snelling, C. 2002: Berry Notes – Strawberry Fertilisers. *NZ Commercial Grower* **57**: 42-43.
- Langford, G; Snelling, C. 2004: Berry Notes – Variety Review. *NZ Commercial Grower* **59**: 51-52.
- Langford, G; Braithwaite, B. 2005: Berry Notes - Variety Review. *NZ Commercial Grower* **60**: 40.
- Lewthwaite, J. R; Clarke, A. D. 1977: Strawberries: varieties and culture for commercial production. Ministry of Agriculture and Fisheries Aglink HPP 55 Wellington.
- Money, S. P. 1969: Growing strawberries for market. *Bulletin 321, New Zealand Department of Agriculture*. 24pp.
- Payne, R.W. (ed) 2002: *GenStat® Release 6.1. GenStat Committee*, VSN International, Oxford.
- Pringle, G. J. 1998: Altering production systems to increase strawberry yield. *Report for The Auckland Berryfruit Growers Association Inc*. 44pp.
- Pringle, G.J.; Bussell, W.T.; Ennis, I.L.; Perry, F. 2002: Strawberry growth and yield in response to the environment: introducing new production systems. *Acta Horticulturae* **567**: 423-426.
- Voth, V; Bringhurst, R. S. 1990: Culture and physiological manipulation of California strawberries. *HortScience* **25**: 889.