The relationship between yield and strawberry runner characteristics

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- The productivity of strawberry is dependent on the supply of high-quality nursery plants
- The effect of runner characteristics on the yields of plants in south-east Queensland was investigated. Yields were best with a planting from mid- to late March for '*Festival*' and from early to mid-April for '*Fortuna*'
- Research in north America suggests that the best yields occur when the runners are exposed to significant chilling in the nurseries. Experiments are required to determine if the temperature models developed in America can predict yield and runner quality in Australia

Horticulture production around the globe is dependent on the supply of quality nursery plants. Plants of inferior quality can fail to establish or produce enough fruit to cover the costs of planting, growing, and harvesting. In strawberry, runner performance can be related to several factors including the size of the plants, the amount of carbohydrate they have stored in reserves, and the level of flowering initiated in the nursery before planting.

This article reports on the relationship between yield and runner characteristics seen in Queensland strawberries, including the effect of planting time on yield and the relationship between yield and carbohydrate reserves. Temperature models developed in north America to predict runner performance and yield are also discussed.

Optimum planting time in south-east Queensland

Two experiments were conducted to examine the effect of planting time and runner source on the performance of strawberry crops.

In the first experiment, '*Festival*' runners were obtained from Stanthorpe in southern Queensland, a warm-growing environment, and from Toolangi in Victoria and Kempton in Tasmania, two cool-growing environments. Runners were planted from early March to late April/early May at Nambour over three consecutive years.

Across the three years, yields were best with a mid-March planting, with lower yields recorded for plantings at the other times (Table 1). Plants from Stanthorpe were as productive as those from Toolangi or Kempton, indicating that the differences in climatic conditions amongst the locations were not large enough to influence productivity. Gross returns per plant shown in Table 1 were calculated using the yields (grams per plant) from each treatment for each month from June to October multiplied by the average price received for strawberry in the Brisbane Markets for each of the months.

In the second experiment, '*Festival*' and '*Fortuna*' runners from Stanthorpe were planted from late March/early April to late April/early May over two consecutive years. The early planting for each cultivar corresponded with the time when the runners were first available from the nurseries. In this experiment, yields were greater with a planting in late March/early April (Table 2). Average yields were lower in '*Fortuna*' than in '*Festival*'. Gross returns from the different planting times reflected yield, with a strong linear relationship between returns and yields.

Table 1. Effect of time of planting on yield and gross returns in '*Festival*' strawberry at Nambour.

Time of planting	Yield (g per plant)	Gross return ($ per plant)
Early March	711 ± 183	4.25 ± 1.17
Mid-March	**1013 ± 86**	**6.24 ± 0.51**
Late March/early April	765 ± 38	4.56 ± 0.18
Mid-April	671 ± 37	3.94 ± 0.24
Late April/early May	542 ± 16	3.15 ± 0.08

Data are the means (± standard error) of four or five replicates, pooled over three years. Source: Menzel and Smith (2011).

Table 2. Effect of time of planting on yield in '*Festival*' and '*Fortuna*' strawberry at Nambour.

Time of planting	Yield (g per plant)			
	Festival in Year 1	*Festival* in Year 2	*Fortuna* in Year 1	*Fortuna* in Year 2
Late March/early April	**875**	**966**	**827**	**823**
Mid-April	689	668	518	749
Late April/early May	643	740	478	643

Data are the means of eight replicates. Source: Menzel and Smith (2012b).

Relationship between yield and carbohydrate reserves in Queensland

Research overseas has suggested that runners with high carbohydrate reserves have higher yields than those with low reserves. Carbohydrates typically accumulate over the growing season, especially under cool conditions.

Experiments were conducted to study the relationship between productivity and carbohydrate reserves using '*Festival*' runners obtained from Stanthorpe and Toolangi.

In the first experiment, there was a comparison of runners dug at different times at Stanthorpe and planted in Nambour (Table 3). The weight of non-structural carbohydrates per plant increased as digging was delayed. Plants dug on 17 March had more non-structural carbohydrates and higher fruit yields than those dug on 3 March. Plants dug on 1 and 13 April had even higher carbohydrate reserves than those dug on 17 March but had lower fruit yields. Only the variations in fruit yields between the plants dug on 3 or 17 March reflected the differences in carbohydrates.

In the second experiment, there was a comparison of plants dug in early April from Stanthorpe and Toolangi (Table 4). Information was collected on the concentrations of carbohydrates in the plants and on fruit yields after planting in Nambour. Runners from Stanthorpe had greater carbohydrate reserves than those from Toolangi, but similar yields over the growing season.

It was concluded that carbohydrate reserves in runners only partially reflect their productivity. Productivity may have been more closely related to the level of flowering.

Runners with flowers initiated in the nursery have earlier production than those that initiate flowers after planting.

Table 3. Effect of runner harvest timing on plant weight, the weight of non-structural carbohydrates and fruit yield to the end of July for '*Festival*' runners sourced from Stanthorpe.

Time of runner harvest	Plant dry weight (g)	Weight of non-structural carbohydrates (mg per plant)	Yield (g per plant) at Nambour
Early March	2.2	210	250
Mid-March/late March	**3.8**	**401**	**382**
Early April	4.0	487	219
Mid-April/late April	4.1	547	181

Data are the means of eight replicates. Source: Menzel and Smith (2012a).

Table 4. Comparison of plant weight, weight of non-structural carbohydrates and total yield of '*Festival*' runners dug in early April and planted in Nambour.

Source nursery	Plant dry weight (g)	Weight of non-structural carbohydrates (mg per plant)	Total yield (g per plant)
Stanthorpe	4.0	478	723
Toolangi	3.0	324	756

Data are the means of eight replicates. Source: Menzel and Smith (2012a).

Variations in strawberry transplant (runner) quality. Photo credit: Christopher Menzel

Relationship between yield and temperature in north America

Research in Florida showed that plants from northern or mid-latitude nurseries in Canada, Massachusetts, Oregon, California or North Carolina out-yielded those from southern nurseries in Alabama or Florida in about half the cases (Menzel and Smith, 2011). The temperatures in these northern areas are up to 10°C lower than those in Florida during the 6 to 8 weeks before the plants are dug.

Tanino and Wang (2008) also investigated the relationship between yield and temperature in north America. '*Camarosa*' runners grown in nurseries in California and Canada under different weather conditions were planted in Oxnard and Irvine in California and information was collected on yield. Yields from these nurseries were related to the yields of runners from two standard control nurseries at Redding in California, a warm growing area.

There was a strong relationship between yield and the accumulated difference between day and night temperatures in the nurseries (Figure 1). The greater the difference in diurnal temperatures, the higher the subsequent yield. In other words, **nursery sites with warm days and cool nights gave the best production**. Accumulation of 180 degree-days gave 30% higher yields in the plants from a cool nursery location in Canada over those from a warm location in California. **Warm days and cool nights favour strong crown and root growth and possibly good flowering in the nursery.**

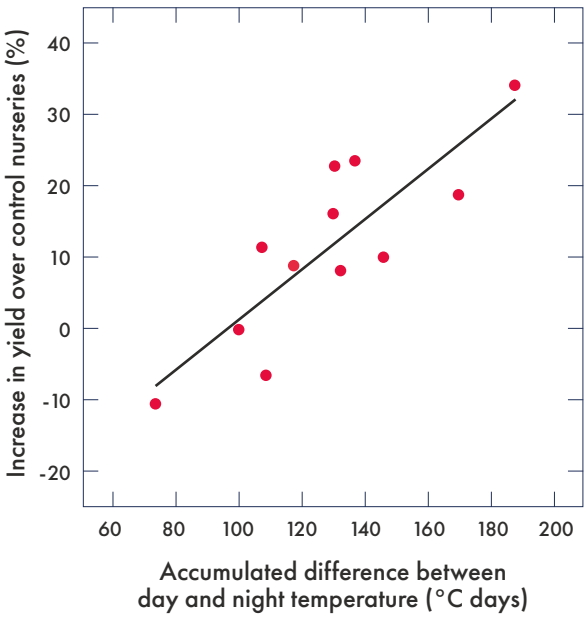

Figure 1. Relationship between yield and nursery temperature in *'Camarosa'* runners grown in Californian and Canadian nurseries.
Source: Tanino and Wang (2008).

Implications for commercial production

The optimum time of planting in southern Queensland varies with the cultivar and growing location. Runners dug early can be too small for successful establishment.

In contrast, runners dug late only begin to crop in July and have low total production. There are also issues for the commercial viability of the nurseries.

It is not practical or cost-effective to supply runners before mid- to late March most seasons in southern Queensland. Yields are best with a planting from mid- to late March for '*Festival*' and from early to mid-April for '*Fortuna*'. Carbohydrate reserves in runners only partially reflected their productivity in Queensland.

In contrast, there was a good relationship between yield and temperatures in the nurseries in north America. Research is required to determine if the temperature models developed in north America can predict yield and runner quality in Australia.

Please note: 'Transplant' is the universal term used to describe a new nursery plant. The term 'runner' only appears in the Australian literature. When looking for information on this topic be sure to use both terms in your search.

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