

# The impact of planting timing on yield in south-east Queensland

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Global warming will decrease the yields of many crops. These lower yields can be mitigated in some annual species by planting the crops early or late to avoid extremes of weather. We were interested in determining whether this strategy would work for strawberries in Queensland.

We showed that when the nursery plants were planted early, the bulk of the crop was produced before the weather warmed up. We conclude that planting the crop early would reduce some of the impacts of global warming on the yields of strawberries in south-east Queensland.

The main scenarios for global climate change include an increase in the concentration of carbon dioxide (CO<sub>2</sub>) and an increase in average temperatures. Researchers in China found that the average yields of wheat, rice and maize across the country decreased by 2.58% for each 1°C increase in average daily mean temperature. These results demonstrate that many species are sensitive to small changes in temperature under global warming.

New cultivars and changes in plant agronomy can reduce some of the impacts of global warming on the yields of crops. These include the use of better-adapted cultivars, the use of wild relatives, protected cropping and changes to the date of sowing or planting.

Hijmans (2003) investigated the benefits of different times of planting and different cultivars on the productivity of potato under various climate change scenarios. He found that average global yields decreased by 18 to

32% without better cultivars or times of planting with a 1.0°C to 1.4°C increase in temperature. Hunt et al. (2019) indicated that early sowing could increase national wheat yields in Australia by an average of 0.54 t/ha under climate change. We conducted experiments to determine whether early plantings could mitigate some of the impacts of global warming on the yield of strawberries on the Sunshine Coast. The average daily mean temperature from April to September in this area has increased by 2.0°C over the past fifty years. The rate of warming has been greater in August and September than in April and May. The rate of warming has also been greater during the night than during the day.

## What we did

We planted transplants of 'Festival' and 'Fortuna' at three different times over two years at Nambour in south-east Queensland.

In the first year, 'Festival' was planted on 31 March, 14 April or on 28 April, while 'Fortuna' was planted on 7 April, 21 April or on 5 May. In the second year, 'Festival' was planted on 30 March, 13 April or on 27 April, while 'Fortuna' was planted on 6 April, 20 April or on 4 May. We harvested fruit every week for an assessment of marketable yield (fresh weight).

In year one, the first fruit were harvested on 9 June and the last fruit harvested on 13 October. In year two, the first fruit were harvested on 22 June and the last fruit harvested on 12 October. Mature fruit were harvested and were classified as those that were at least three-quartered coloured. Fruit that were smaller than 6 g or affected by rain or grey mould or misshapen, or that had other defects (mainly other disease, surface bronzing or bird damage) were considered non-marketable.

We also collected weather data at the site from the Bureau of Meteorology.



**Planting new transplants in a time of planting experiment at Nambour**

Photo credit: Chris Menzel

## What we found

- Average monthly maximum temperatures ranged from 21°C to 25°C over the two seasons, while average monthly minimum temperatures ranged from 9.0°C to 15.0°C.
- Temperatures were lower from June to August than from September to October.
- Average maximum/minimum temperatures were 21.4°C/10.7°C from June to August and 24.7°C/14.4°C from September to October.
- The long-term averages for these two periods are 22.2°C/11.0°C and 26.0°C/14.4°C respectively.
- The temperatures from June to August were suitable for leaf, flower and fruit growth.
- In contrast, the temperatures from September to October were above the optimum for fruit growth.

There was a strong effect of cultivar, time of planting and season on the productivity of the strawberries (Tables 1 and 2). Average total yields to mid-October were higher in 'Festival' ( $791 \pm 14$  g/plant) than in 'Fortuna' ( $673 \pm 37$  g/plant), and higher with the first time of planting ( $873 \pm 29$  g/plant) than with the second ( $656 \pm 43$  g/plant) or the third ( $626 \pm 47$  g/plant) (Table 1).

Average yields were higher in the second year ( $765 \pm 13$  g/plant) than in the first year ( $672 \pm 33$  g/plant). Acceptable commercial marketable yields for strawberries on the Sunshine Coast range from 750 to 1000 g/plant.

Early yields to the end of August reflected total yields to mid-October (Table 2). Early yields were higher with the first times of planting than with the second or third. Between 37 to 61% of the total crop was produced to the end of August, and the proportion was higher with the first times of planting than with the second or third (Table 2).

**Table 1. Effect of cultivar & time of planting on the marketable yield of strawberries to the mid-October in QLD.**

YEAR & CULTIVAR	YIELD TO MID-OCTOBER (G/PLANT)		
	First planting	Second planting	Third planting
<b>Festival in year one</b>	875 ± 43	689 ± 44	643 ± 40
<b>Fortuna in year one</b>	827 ± 42	518 ± 31	478 ± 27
<b>Festival in year two</b>	966 ± 39	668 ± 18	740 ± 43
<b>Fortuna in year two</b>	823 ± 50	749 ± 16	643 ± 19

**Table 2. Effect of cultivar and time of planting on the marketable yield of strawberries to the end of August in Queensland. Data in parenthesis show the percentage of total yield that was harvested by the end of August. Data are the means (± standard errors or SEs) of four replicates per treatment.**

YEAR & CULTIVAR	YIELD TO THE END OF AUGUST (G/PLANT)		
	First planting	Second planting	Third planting
<b>Festival in year one</b>	534 ± 43 (61%)	323 ± 25 (47%)	240 ± 27 (37%)
<b>Fortuna in year one</b>	477 ± 32 (58%)	228 ± 30 (44%)	198 ± 20 (41%)
<b>Festival in year two</b>	577 ± 23 (60%)	370 ± 19 (55%)	362 ± 36 (49%)
<b>Fortuna in year two</b>	515 ± 37 (63%)	369 ± 15 (49%)	242 ± 21 (38%)

### Implications for commercial strawberry production

Time of planting affected the cropping of strawberries in Queensland. Planting the nursery material in late March or early April resulted in heavy crops from June to August before the weather warmed up in September and October. These results suggest that early times of plantings would reduce some of the impacts of global warming on the yields of strawberries in Queensland.

There was a wide variation in the productivity of the strawberries depending on the time of planting. The total yields of the nursery material planted in late March or early April were on average 36% higher than the nursery material planted later. Early yields were on average 82% higher in the early plantings than in the later plantings. There have been several studies reporting on the effect of time of planting on the productivity of strawberries in Florida, which has a similar production system to Queensland.

Early and total yields were generally higher with a planting in early to mid-October, and lower with earlier or later plantings.

The average daily mean temperature was 16.0°C from June to August and 19.5°C from September to October. The long-term averages for these two periods are 16.6°C and 20.2°C, respectively.

Higher temperatures decrease fruit size and soluble solids content in strawberries, decreasing marketable yields and fruit quality.

Planting the crops in late March or early April resulted in heavy crops before the weather warmed up.

Higher temperatures under global warming will decrease the yields of strawberries in many locations. Planting the crops early would offset some of these impacts on productivity.

## Conclusions

Strawberries planted in late March or early April had higher yields to the end of August than those planted later.

More than 60% of the total crop was produced from June to August when average maximum/minimum temperatures were 21.4°C/10.7°C.

The rest of the crop was produced from September to October when average maximum/minimum temperatures were 24.7°C/14.4°C.

We concluded that planting the crop early would reduce some of the impacts of global warming on the yields of strawberries in south-east Queensland.

There is not likely to be an issue with frost in most of the growing areas along the coast.



**Strawberry farm in south east Queensland.**

Photo credit: Chris Menzel

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