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The Relationship Between Temperature and Bloom-to-ripening Period in Low-chill Peach[1]

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Abstract

Fruit development period (FDP) of 22 low-chill peach cultivars was related to mean monthly temperatures during the fruit growing season at 13 locations in Australia that represented the range of peach growing climates. A regression of FDP on mean fruit growing season (August through November) temperatures at 13 locations showed a 5 day delay in FDP for each 1°C reduction. Temperatures during the 2 months following bloom were the most important in determining FDP. The regression equation may be used for predicting the relative FDP at various locations.

Additional word index: degree days, thermal time, fruit development period

Introduction

Low-chill, early ripening peaches, introduced into Australia mainly from the U.S. and South Africa, have mostly been grown in the low-chill zones, but have been tested and are grown to a lesser extent in high-chill zones where spring frosts are not a hazard (3). Time of ripening in peach depends on time of bloom and length of the FDP. Time of bloom is regulated by the chilling requirement of the cultivar and heat unit accumulation after chilling is satisfied, whereas the FDP, though varying with the cultivar, is regulated by heat accumulation from blossom to ripening (4). Ripening of low-chill cultivars in high-chill zones is more delayed than one would expect based on time of bloom. Blake (1) stated that April and May temperatures affect the length of the peach FDP in New Jersey and Weinberger (6) found that maximum temperatures for the 50 days following bloom were the most reliable in predicting length of FDP for 'Elberta' peach at Fort Valley, Georgia. This study relates the mean fruit growing season temperature at various locations in Australia to the mean length of FDP over 22 cultivars. This permits an estimate of length of FDP in one location relative to another.

Materials and Methods

The 15 sites from which data were obtained represent a diverse array of climatic conditions (Table 1) and geographic locations (Figure 1). The monthly mean temperature for each of the 15 sites is an average of 10 or more years. Mean temperatures of the coldest month (July) at the 15 sites corresponds to annual chill unit accumulation ranging from about 200 to over 1000 chill units (5). Low-chill peaches can be fruited in high-chill climates only where spring frost hazards are small as occurs in many locations in Australia.

The 22 low-chill peach and nectarine cultivars used in this study (Table 1) ranged from 100 ('Flordabelle') to 550 ('Flordaqueen') chill units (2). Full bloom (50% open flowers) and first harvest dates were recorded for each cultivar at all sites except Evelyn and Loxton where full bloom was not recorded and were not used in calculating the regression line. These 2 sites are included in Table 1 to show variability in growing season temperatures and harvest dates. The dates were

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based on 3 or more years from all sites except Medina (1 year), Swan Hill (1 year), Loxton (1 year), and Nambour (2 years). The FDP was calculated as the number of days from 50% bloom to first commercial harvest in each cultivar. Bloom and fruit harvest site means were calculated by least squares analysis because the data set was nonorthogonal (not all 22 cultivars at each site).

Results and Discussion

Mean date of estimated 50% bloom for all cultivars collectively at each location was about the same (Table 1). For example, only 15 days (day 220 to 235) separated most locations with Kingaroy (day 212) earlier and Bathurst (day 246) later. In fact, bloom time became progressively later with reduced temperature for locations with a July mean below 10°C. Similar bloom dates at all locations is only possible because the low-chill cultivars received adequate chilling and were not delayed in bloom in the lowest chill areas where the coldest month (July) mean was above 13°C and because chilling was accomplished in early winter in high-chill areas where coldest month mean was below 10°C so that heat accumulation toward bloom could begin in mid-winter (4). The delayed bloom date at Bathurst is explained by the coldest growing season temperature means of all locations (Table 1).

Mean date of first commercial harvest for all cultivars at each location (58 day differences) was much more varied than bloom date (32 day dif-

Table 1. Mean temperatures for dormancy and during fruit growth, blossom and harvest dates, and number of days in the fruit development period (FDP) for low-chill clones at 15 test sites in Australia (unequal representation of clones adjusted for in bloom and harvest by least squares).

Site	Mean temperature (°C)					Bloom[x] (50%)	First[x] harvest	FDP[y] (days)	Clones[z] (no.)
	July	Aug.	Sept.	Oct.	Nov.				
Carnarvon	17.0	18.1	20.2	22.1	23.4	225	295	70	7
Rockhampton	15.8	17.7	20.2	23.1	25.3	232	307	75	5
Evelyn	15.5	16.4	17.5	20.9	22.4	—	302	—	7
Nambour	14.6	14.6	17.9	18.6	21.6	230	317	87	22
Alstonville	13.8	15.2	17.1	19.0	20.9	227	320	93	18
Medina	12.8	13.0	13.8	16.1	18.6	234	323	89	13
Alice Springs	11.8	14.2	18.2	22.6	25.5	230	325	95	15
Stoneville	11.3	10.8	12.6	15.2	18.3	228	336	108	20
Arcadia	11.2	13.1	14.8	17.5	19.5	220	331	111	18
Kingaroy	10.9	12.0	15.3	17.7	21.1	212	313	101	17
Loxton	10.3	11.0	13.4	15.7	18.4	—	353	—	7
Swan Hill	9.4	10.8	13.5	16.8	18.9	226	345	119	15
Knoxfield	9.4	9.9	11.1	13.6	15.4	232	360	128	22
Applethorpe	7.5	9.1	12.2	14.7	17.5	235	348	113	22
Bathurst	5.8	7.8	10.5	12.7	17.6	246	364	118	19

[x]Julian date.
[y]FDP = Fruit Development Period (days from 50% bloom till first commercial harvest).
[z]Number of clones from the low-chill group of Albatros, China Flat, Culemborg, Earlibelle, Flordabelle, Flordagold, Flordaking, Flordaprince, Flordaqueen, Flordared, Flordasun, Maravilha, Orion, Sherman's Early, and Sherman's Red peaches and Fla. 3-4N, Fla. 5-13N, Fla. 5-14N, Sundowner, Sunlite, Sunred, and Sunripe nectarines.

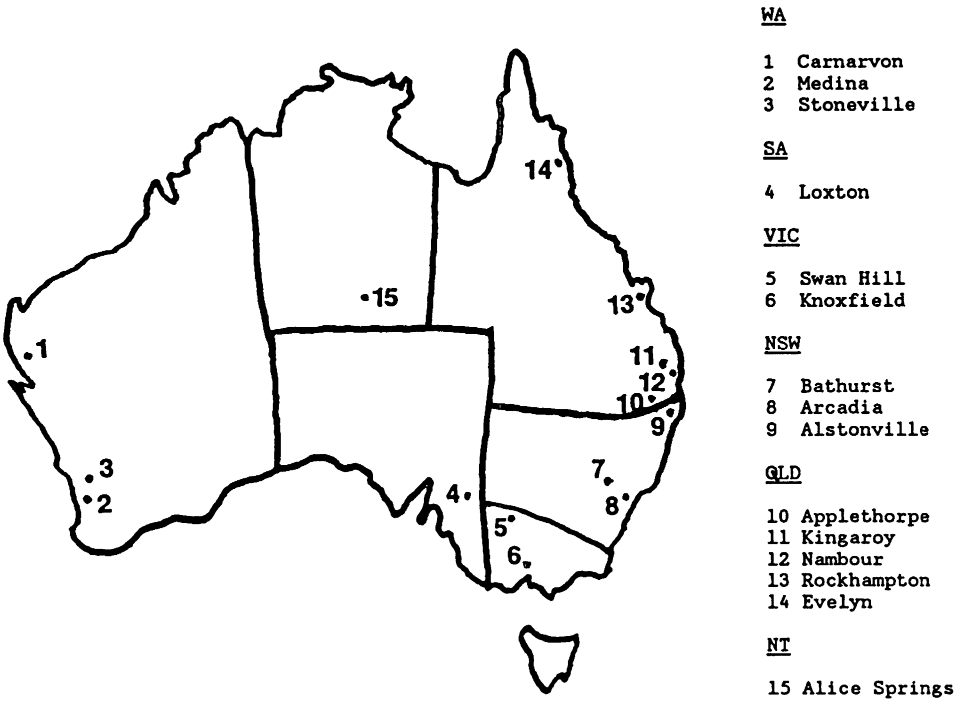

Figure 1. Geographic location of test.

ferences) due mainly to temperature differences during fruit growth. In fact, correlation coefficients (r values) of FDP with monthly mean temperatures at each location were August (-0.91**), September (-0.89**), October (-0.82**), and November (-0.80**), and -0.88** for the 4 months combined. Higher r values were found in the months closer to and including the month of bloom. This trend and actual r values indicate that temperatures during the first 2 months following bloom vary the most and thus are the most important in determining the length of the FDP as reported by Blake (1) and Weinberger (6). This data is based on cultivars with a relatively short FDP and may not predict as accurately a similar performance in cultivars with a long FDP. All 13 locations from which FDP was determined are plotted in Figure 2 with the mean temperature for August to November of the growing season. A regression line was fitted to show a 5 day increase in FDP for each 1°C reduction in mean temperature. A similar 5 day increase in FDP was expected and found, based on above r values, when FDP were regressed on individual monthly mean temperatures during the growing seasons. Weinberger (6), working with smaller temperature and FDP ranges, reported about 3½ days increase in FDP for each 1°C for 'Elberta' peach based on 10 springs at Fort Valley, Georgia.

Four locations had FDP's that were much further off the regression line than expected. For example, Swan Hill (119 day FDP) and Medina (89 day FDP) had observations for only one year and at Medina it was the first crop on young trees. Knoxfield had a FDP of about 8 days longer than expected and also had the lowest mean temperatures for the last 3 months of

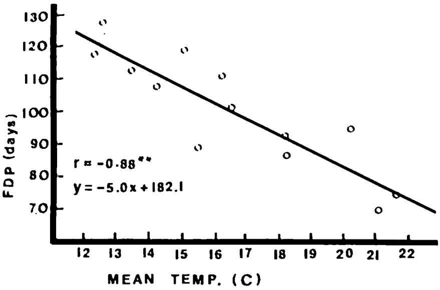

Figure 2. Relationship between mean temperature during and number of days in the fruit development period (FDP) based on 13 locations in Australia.

the fruit growing season. Alice Springs had a FDP of 12 days longer than expected and also had the highest temperatures for the last 2 months of the growing season. Minimum night temperatures at Knoxfield and maximum day temperatures at Alice Springs may have been low and high enough, respectively, to slow fruit growth, thereby extending FDP.

A more accurate model to predict FDP at locations should be possible if all cultivars were in all locations at the same tree age with the same person recording all blossom and harvest dates, and if these dates were related to degree days or monthly mean temperatures for each cultivar from bloom to harvest. Nevertheless, we feel that our high r values and regression equation present a generally sound estimate for predicting the relative FDP (time of ripening) at various locations. In addition, if the date of ripening and bloom time for a cultivar is known at one location, the average date of ripening can be predicted for another location where the mean growing season monthly temperatures are known.

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