Peaches and nectarines

This case study is the primary source of information on potential pollination services for the industry. It is based on data provided by industry, the ABS and other relevant sources. Therefore, information in this case study on potential hive requirements may differ to the tables in the Pollination Aware report (RIRDC Pub. No. 10/081) which are based on ABS (2008) *Agricultural Commodities Small Area Data, Australia 2005-06.*

Introduction

The peach (*Prunus persica)* is a deciduous tree that grows from 4m to 10m tall and belongs to the subfamily Prunoideae of the family Rosaceae. The tree produces an edible juicy fruit and is believed to be native to China with evidence of its origins there as far back as 2000 BC. The nectarine (*P. persica* var. *nectarine*) is a cultivar of the same species as the peach. The major difference between the two is that the nectarine has smooth skin and the peach has needle-like, hairy or fuzzy skin (McGregor 1976). Within the peach and nectarine cultivars there are hundreds of subvarieties which are grown to suit local climatic and market conditions and can be divided into two categories, freestones and clingstones (Slingerland and Miles 2009). In the freestone types, the flesh separates readily from the pit whilst in the clingstone type the flesh clings tightly to the pit. The flesh may be either yellow or white and freestone types are usually preferred for eating fresh or for freezing, while clingstone types are used primarily for canning.

Globally, China is by far the largest producer of peaches and nectarines accounting for approximately 50% of world production, followed by Italy (10%), Spain (7%) and the USA (6%) (FAO 2009). The world's largest peach and nectarine exporting countries in 2003 were Spain, Italy, France and the USA in that descending order whilst the largest importing nations were Germany, France, Italy and the USA (Boriss and Brunke 2006).

Peaches and nectarines come in varieties that are both self-fertile and self-sterile. Regardless of the variety, however, there is strong evidence suggesting that a satisfactory commercial crop cannot be obtained unless adequate numbers of pollinating insects are working a crop when flowers are in bloom (McGregor 1976). The value of honey bees as efficient pollinators of peaches and nectarines in both glasshouse and open-field orchard has been recognised overseas (McGregor 1976) and in Australia (Langridge et al. 1977).

Peach and nectarine production in Australia

Peaches and nectarines are grown in the majority of Australian states excluding the Northern Territory and the Australian Capital Territory (Figure 1). Victoria is the major producer, accounting for around 70% of the total production of nectarines and around 80% of peaches. Victoria has many advantages in both production and processing including its natural assets in climate and soils which are ideal for peach and nectarine growth and are unfavourable for the development of major pest outbreaks and diseases (AAG 2002). New South Wales is the next highest producer accounting for around 14% and 12% of nectarine and peach production respectively with the remainder of national production in the states of Western Australia, South Australia, Tasmania and Queensland (Figure 2) (ABS 2008).

Peaches and nectarines are part of the Australian Stone Fruit Industry which includes peaches, apricots, nectarines, cherries and plums. Stone fruit is grown for both the processing and the fresh fruit market with the majority of fresh stone fruit consumed domestically and a large proportion of the processed fruit being exported.
Australia is a small player on the world stage and produces less than 1% of the world production of stone fruit (AAG 2002).

Average yields per hectare for peaches and nectarines in Australia are below world averages; however, total production has increased by 50% over the last decade. The increased production has been attributed to new peach and nectarine varieties (white fleshed/high sugar content) and effective marketing which have contributed to sales growth and driven production (AAG 2002).
Most fresh peach and nectarine produce is sold domestically with only relatively small volumes exported to destinations such as Taiwan, Hong Kong, Singapore, and the United Arab Emirates. More than 50% of processed fruit, however, is exported to destinations including Canada, Japan and Europe. Key export opportunities for Australia have been identified in Hong Kong due to an absence of quarantine restrictions, a comparative advantage as a counter-seasonal producer, and a reputation for good quality produce in the stone fruit market (AAG 2002).

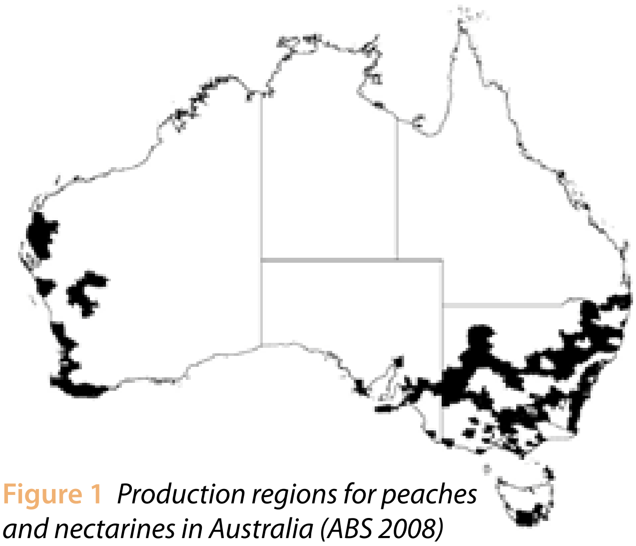


Figure 1 *Production regions for peaches and nectarines in Australia (ABS 2008)*

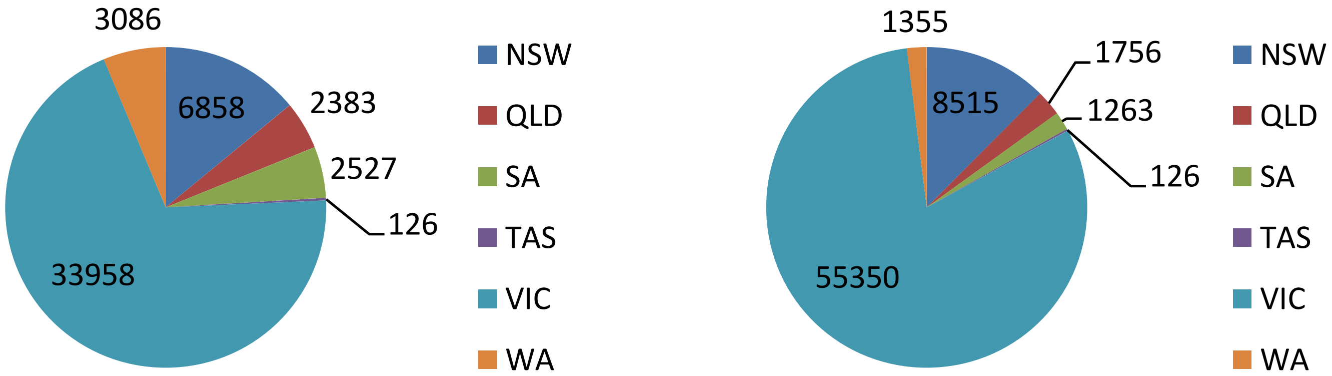


Figure 2 *Production per state in tonnes for nectarines (left) and peaches (right) (ABS 2008)*



Pollination in peaches and nectarines

The process of pollination is relatively simplified in peaches and nectarines in that only one ovule must be fertilized in order to set fruit as compared to hundreds of ovules in many other fruit species such as melons or papayas (McGregor 1976). Most varieties of peaches and nectarines are self-fertile, meaning that fruit will form when a plant's flowers are pollinated by its own pollen or pollen from another plant of the same variety. There are, however, many varieties that are self-sterile, that is they do not set fruit unless they are cross-pollinated, meaning pollen from another variety is needed for successful fertilisation of the ovule (DAF 2005). Whether the variety is self-fertile or self-sterile, a satisfactory fruit crop cannot be obtained if adequate numbers of pollinating insects are not working the peach or nectarine orchard at the time when the trees are in bloom (McGregor 1976).

A review of the pollination requirements of peaches and nectarines conducted by McGregor (1976) makes numerous references to research conducted in the mid-1900s describing the benefit of having honey bees in both glasshouses and open orchards. More recent research has also acknowledged the value of honey bees and other pollinating insects in the pollination of peaches and nectarines (Mattu et al. 1994; Szabo et al. 1998; Nyeki and Szabo 1996). Additionally, an Australian study by Langridge et al. (1977) showed the benefits of having bees within a peach orchard by comparing fruit set between caged and open trees of the cultivar 'Crawford'. Trees open to honey bee pollination had a 290% increase in the percentage of flowers that set fruit and a 260% increase in the weight of fruit harvested as compared to the trees that were caged to exclude bees (Table 1). There was also an evident decrease in fruit mutations in the open tree treatment (Langridge et al. 1977).

Table 1 A study of pollination of dessert peaches cv 'Crawford' (after Langridge et al. 1977, as cited in DAF 2005

Attribute	Caged trees	Open trees	Statistical significant difference
% fruit set	9.5	27.6	P<0.01
Harvested fruit	18.2kg	46.6kg	P<0.05
Fruit with split stones (%)	23.4	18.6	Not significant
Stones without kernels	53	32.8	Not significant



Pollination management for peaches and nectarines in Australia

There are a number of factors within the orchard which have a direct bearing on the pollination efficiency of honey bees:

Orchard layout

- *Tree and blossom density*: Orchard layouts may be either designed to a traditional open-vase system or a high-density planting system. The open-vase system usually has a density of around 299 trees per hectare, each trained into a cone shape, with ample spacing between trees of around 7m. The high-density design, on the other hand, may have tree densities of between 919 and 1196 trees/ha and tree spacing reduced to around 3m (Day et al. 2005). The higher blossom density associated with these high-density plantings have been shown to increase yields and give better returns to the grower when prices are good. Under circumstances of higher tree and blossom density, the density and condition of hives would also need to be increased relatively to ensure optimal pollination (DAF 2005).
- *Access*: From a beekeeper's point of view, all-weather truck access is highly desirable. Limited access may lead to an increased workload for the beekeeper, uneven placement of hives and thus inefficient pollination. Ensuring the beekeeper has good access will aid in placement of hives and be mutually beneficial to the grower (increased pollination efficiency) and the beekeeper (decreased labour effort).

Pollinisers

Most cultivars are self-fertile however some require pollen from another cultivar to successfully set fruit (DAF 2005). Further, yields and fruit quality have been shown to be improved with cross-pollination regardless of whether a cultivar is self-fertile or self-sterile and fruit set can range from 22 to 84%. Mattu et al. (1994) showed that if flowers of market-sold peaches, canning peaches and nectarines were isolated from each other then the fruit sets for the three types were 20.9%, 21.7% and 15.7% respectively. However if the three types were open-pollinated, the fruit set increased to 34.2%, 34% and 26.5%; an average increase in fruit set of 63% (DAF 2005).

Density of bees

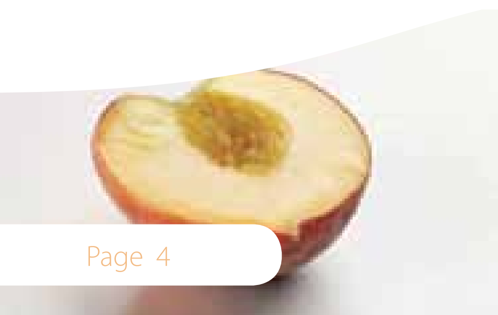
The Department of Agriculture and Food West Australia (2005) recommends to 2hives/ha for young trees and 2.5hives/ha in older orchards (DAF 2005). An issue worth noting is that most peach and nectarine growers will need to use thinning practices in years when trees bear a crop that is too heavy, which can cause limb breakage and a reduction in fruit size and quality. Some growers consider thinning of a heavy set of fruit to be a greater problem than pollination, however, it should be recognised that thinning the fruit after flowering is easier than getting fruit to set if the flowers are gone and fruit set is inadequate (McGregor 1976).

Timing

Most cultivars produce pollen at the same time that the stigma is receptive (McGregor 1976). Randhawa et al. (1963, cited in McGregor 1976) found that the flowers of peaches were fully closed at 6am, but most of them were open by 10am, and all were open by noon. They did not close at night; and stayed open with the stigma receptive for three days.

Attractiveness, nutritional value of pollen and nectar

Peaches and nectarines blossom in the spring with many different attractive pink and reddish blossoms. A notable quantity of nectar is produced in peaches and nectarines, ranging from 5 to 45mg/flower with a sugar content of between 30 and 50% (DAF 2005). The nectar is secreted at the base of the corolla and



is highly attractive to honey bees and other pollinating insects (McGregor 1976). Bees do not appear to target pollen but rather pollen is transferred from flower to flower while the bee is foraging for nectar (DAF 2005).

Risks

Pesticides: One of the biggest drawbacks of placing bees near any agricultural crop is the possibility of colonies or field bees being affected by pesticides. Pesticides should be kept to a minimum while hives remain on the property. Most poisoning occurs when pesticides are applied to flowering crops, pastures and weeds.

It is strongly recommended that growers take the following steps to prevent or reduce bee losses:

- follow the warnings on pesticide container labels
- select the least harmful insecticide for bees and spray late in the afternoon or at night
- do not spray in conditions where spray might drift onto adjacent fields supporting foraging bees
- dispose of waste chemical or used containers correctly
- always warn nearby beekeepers of your intention to spray in time for steps to be taken to protect the bees; give at least two days' notice
- always advise nearby farmers.

Weather

Temperature and rainfall have a marked effect on honey bee activity. Bee activity is very limited below temperatures of 13ºC, with activity increasing up to around 19ºC, above which activity tends to remain at a relatively high level. Decreases in both numbers of bees visiting blossoms and the distance from the hive at which bees forage occur with a decrease in temperature. If the weather is clear and mild, the bees will visit the flowers throughout much of the day; however, if the weather is cold or wet, bees may be absent (McGregor 1976).

Opportunities for improvement

The application of modern technologies: Recent research by West Australian honey bee expert Rob Manning has shown the benefits of a honey bee pollination system developed for high-density orchard plantings. Beetubes are a smaller, disposable and frameless beehive that can be inserted into high-density crops without interfering with machinery access and avoid the problem of having to place hives around an orchard instead of within it (Manning 2002). The beetube works by a process called enpollination which is the dispersal of hand or machine collected pollen on to bees. The use of pre-collected pollen, dried and powdered and placed in a specially designed system attached to the front entrance of beehives, allows the bees to be dusted with this pollen while passing through the device to forage (DAF 2005). The use of beetubes is important in high-density peach and nectarine orchards when dormancy breaking and thinning chemicals are used; dormancy breaking chemicals bring most flowers out in a short period, therefore high bee density is required to set fruit over a very short flowering period before chemical thinning is required (DAF 2005).

Potential pollination service requirement for peaches and nectarines in Australia

There is no information available to suggest what proportion of peach and nectarine crops are planted in high-density and open-vase systems. Because of the superior yields produced by high-density orchards, the estimation below assumes all land under peach and nectarine production is high density. Given this assumption, the estimation for the optimal use of managed pollination services in all peach and nectarine orchards in Australia would require a service capacity as indicated in Tables 2 and 3 below.

Table 2 Potential pollination service requirement for peaches in Australia

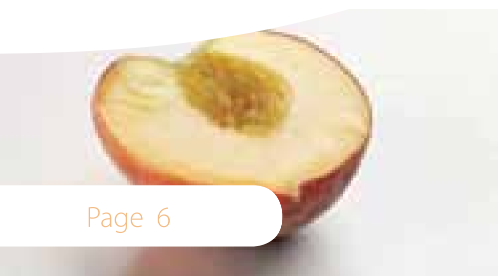
State	Peak month	Area (ha) total	Average hive density (h/ha)*	Estimated number of hives required
VIC	August	1,868	2	3,736
NSW	August	553	2	1,106
QLD	August	232	2	464
WA	August	154	2	308
TAS	August	11	2	22
SA	August	61	2	122
Total		**2,879**		**5,758**

Notes: Area under production estimated from number of trees per state (ABS 2008) divided by average tree density in high density plantings (DAF 2005), * average hive density and flowering sourced from DAF (2005).

Table 3 Potential pollination service requirement for nectarines in Australia

State	Peak month	Area (ha) total	Average hive density (h/ha)*	Estimated number of hives required
Vic	August	1,635	2	3,270
NSW	August	557	2	1,114
QLD	August	242	2	484
WA	August	316	2	634
Tas	August	12	2	24
SA	August	176	2	352
Total		**2,938**		**5,878**

Notes: Area under production estimated from number of trees per state (ABS 2008) divided by average tree density in high density plantings (DAF 2005), * average hive density and flowering sourced from DAF (2005).



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This case study was prepared as part of *Pollination Aware – The Real Value of Pollination in Australia*, by RC Keogh, APW Robinson and IJ Mullins, which consolidates the available information on pollination in Australia at a number of different levels: commodity/industry; regional/state; and national. Pollination Aware and the accompanying case studies provide a base for more detailed decision making on the management of pollination across a broad range of commodities.

The full report and 35 individual case studies are available at www.rirdc.gov.au.

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This project is part of the Pollination Program – a jointly funded partnership with the Rural Industries Research and Development Corporation (RIRDC), Horticulture Australia Limited (HAL) and the Australian Government Department of Agriculture, Fisheries and Forestry. The Pollination Program is managed by RIRDC and aims to secure the pollination of Australia's horticultural and agricultural crops into the future on a sustainable and profitable basis. Research and development in this program is conducted to raise awareness that will help protect pollination in Australia.

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