Apricot

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 apricot (*Prunus armeniaca*) is a fruit tree belonging to the Rosaceae family. The tree is usually around 8–12m tall, with a trunk of approximately 40cm in diameter and a dense, spreading canopy. The slightly tart fruit is very versatile and can be used in a number of culinary ways as well as eaten fresh right off the fruit stand. Fresh apricots are an excellent source of vitamins A, C and E, potassium, and iron, as well as being a great source of beta-carotene.

The native range is somewhat uncertain due to its extensive prehistoric cultivation, but is most likely from India, and in Armenia the apricot is considered native as it has been cultivated in the area for many hundreds of years and the species is named *armeniaca*. Today the cultivars have spread to all parts of the globe with climates that support cultivation of the tree and the resulting highly sought-after fruit. Cultivation is generally confined to cool frost-free sites, due to the early blooming but relatively high chilling requirement of the fruit, and fungal disease problems in humid climates.

Published data on the pollination requirements of apricots shows a considerable variation in results, which is summed up by McGregor (1976) stating that 'the literature on pollination of apricots is meagre and not in complete agreement'. Despite this, the value of using managed honey bee pollination services has been demonstrated by several authors and shows significant potential in Australia and abroad (Austin and Hewett 1996; Langridge and Goodman 1981).

Apricot production in Australia

All six mainland states in Australia have some production of apricots (Table 1). In Victoria, apricots are gown predominantly around the Goulburn Valley region, along the Murray River in Swan Hill and Mildurain; whilst in South Australia fruit is grown in the riverland region centred around the regional town of Mypolonga in the Lower Murray Region of the state (Figure 1).

Australian summer fruit (peaches, nectarines, apricots and plums) exports achieved a 20% value growth to $30.1 million in the 2008/09 season helped by a more favourable exchange rate, and a good supply of quality fruit. Major export markets were Hong Kong and the Middle East with over 320 tonnes of apricots being exported to these areas in 2008/09.

Dominant players in the world export market for apricots include France (US$47 million) and Spain (US$38 million) with the world export market worth some US$180 million (180,000Mt) (FAO 2002).

Table 1 Apricot production by state across Australia (ABS 2008)

	NSW	QLD	SA	TAS	VIC	WA	Total
Production (tonnes)	268	214	4,187	371	11,545	332	**16,917**
Area (ha)	78	57	371	129	702	68	1,405



Pollination in apricots

As discussed above, published data on the pollination requirements of apricots shows a considerable variation in results (Langridge and Goodman 1981; Alburquerque et al. 2004). Levels of self-compatibility vary greatly amongst cultivars although it is generally accepted that cross-pollination will ensure good levels of fruit set. Self-incompatibility can influence not only fruit set, but also the size and quality of fruit in those crops where seed numbers vary (McLaren and Fraser 1996). Several studies have shown increased fruit set and resultant production when using managed honey bee colonies for pollination services (Egea and Burgos 1992; Langridge and Goodman 1981; McLaren and Fraser 1996).

Apricots flower for a relatively short period of time and are often open for less than two days over each flowering period. Hence the effective pollination period (EPP) of apricots may be short and can result in poor fruit set. Honey bees *(Apis mellifera* L.) are major agents of pollination for deciduous fruit crops, including apricots (Langridge and Goodman 1981), thus introducing well-managed honey bee colonies into apricot orchards may alleviate problems associated with short effective pollination periods of the fruit. The time in which honey bees could achieve cross-pollination after in-hive exchange (pollen transferring from bee to bee in the hive) is short for apricots when compared to apple.

The EPP can be limited by several factors including the length of time that the stigma remains receptive, the suitability of the style tissue or the duration of ovule viability (Egea and Burgos 1992). Receptivity of flowers varies with cultivar. In New Zealand, the variety 'Sundrop' has a short period of receptivity whereas 'Moorpark' has one of the longest periods at eight days (Austin and Hewett 1996). Egae and Burgos (1992) found the EPP of apricots in the warm climatic conditions of the south Mediterranean to be extremely short, which was largely due to a short stigma receptivity period.

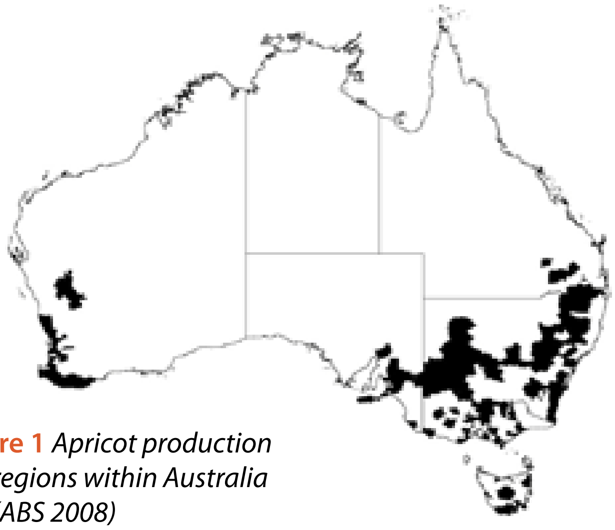


Figure 1 *Apricot production regions within Australia (ABS 2008)*

Table 2 **Effect of caging on fruit set in apricots (Langridge and Goodman 1981)**

Attribute	Caged trees	Open trees	Significance (<0.05)
Flower fruit set (%)	10.8	18.9	Yes
Weight of fruit harvested (kg)	66.9	99.0	Yes
Nº of fruit harvested /tree	1,480	2,945	No
Fruit with full kernels (%)	93.8	100.0	Yes

Langridge and Goodman (1981) demonstrated the value of having honey bee pollination by excluding honey bees using cages. Apricot trees openly pollinated by honey bees showed significantly higher fruit set, fruit weight and percentage fruit with full kernels (Table 2) (Langridge and Goodman 1981). Adverse weather conditions may restrict foraging activity since some apricot cultivars bloom very early in spring (typically mid August) in some growing areas, and honey bee activity is highly weather dependent (Austin and Hewett 1996). Reduced fruit set could therefore occur if foraging activity was limited by or inefficient for one or several reasons (Langridge and Goodman 1981).

Whilst this evidence demonstrates that adequate cross-pollination will help ensure adequate seed formation and reduce the incidence of deformed apricots, which in turn results in better outcomes for the grower, it has been suggested that management to ensure good pollination often may not be given sufficient attention, especially during the busy spring season.

Pollination management for apricots 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*: Most apricot blocks are planted on a reasonable scale and allow for tractor access between rows (4.5 to 5.0m). Within the rows, trees are usually spaced 3m apart which leads to a tree density of 600 to 800 tress per/ha. Final tree height is anywhere from 4 to 5m. Under circumstances of higher tree and blossom densities, the density and condition of hives must also increase to ensure optimal pollination.
- *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

As the majority of apricot cultivars require cross-pollination to some degree it is vital that pollinising varieties are placed throughout the orchard. Ensuring flowering times of fruit-ing varieties and pollen donating varieties coincide is also an important part of any well-managed orchard (Langridge and Goodman 1981).

Density of bees

Recommendations for density of honey bee hives for efficient pollination of apricots varies from two to six hives/ha. McLaren and Fraser (1996) suggested that adequate cross-pollination is feasible with hive densities of about five hives per hectare, within the range normally recommended for stone fruit crops. Recommendations from the Western Australian Department of Agriculture and Food (DAF 2005) suggest three hives/ha as adequate for sufficient pollination of apricots.

Arrangement of hives

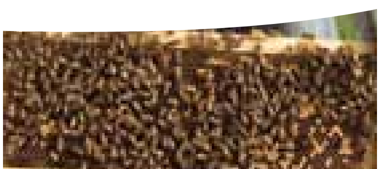
Hive placement within the orchard is a very important factor to consider. Bees have been observed to visit consecutive plants along a row more frequently than across rows, therefore it is recommended that the majority of hives be placed between rows rather than along them (DAF 2005). Hives should also be placed no more than100m away from each other, preferably in a sunny position in order to take advantage of morning blooms (Jay 1986; McGregor 1976).

Timing

Apricots flower for a shorter period than apples and often for less than two days over each flowering period. Therefore, the time in which honey bees could achieve cross-pollination after in-hive exchange (pollen transferring from bee to bee in the hive) is far shorter for apricot than apple. To maximise the likelihood that bees will forage on the apple flowers, and thus transfer pollen, hives should be in the orchard when roughly 5–10% of the apricot flowers have blossomed. Such a delay will encourage bees to focus on the target trees rather than learn to visit competing plants.

Attractiveness, nutritional value of pollen and nectar

Bees are attracted to flowers that are available in large numbers, that have readily accessible pollen and/or nectar, and that are rewarding in terms of energy. The quantity of nectar and the concentration and type of constituent sugars in floral nectars determine their attractiveness to bees (Jay 1986).
Very little information exists on the nutritional value of apricot nectar and pollen. Austin and Hewett (1996) found the apricot cultivar 'Sundrop' flowers held up to 20microlitres of nectar at an initial concentration of about 5% sugar, which is low for the nutritional needs of bees.


Availability of bees for pollination

The apricot flowering season occurs quite close to when beekeepers would be looking to build up the conditions of their hives for the spring and summer flows. Given that apricot nectar and pollen may not provide nutrition suitable to maintain and build a strong hive, it is likely that the beekeeper would have little incentive other than monetary in order to supply honey bees for pollination services within apricot orchards.

Feral bees

Orchardists relying on feral bees for part or all of their pollination services should be similarly aware first, that feral colonies are unlikely to be at full strength at the time that apricots flower and, second, that even if they were, foraging by these bees is unlikely to be sufficiently intense to achieve the level of pollination required for optimal production especially if there are alternative floral resources available to the bees in the same vicinity.

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 13°C, with activity increasing up to around 19°C, 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. Flight activity of bees measured as the number of bees leaving a hive per minute varied with ambient temperatures (Langridge and Goodman 1981). Little flight activity was seen at 13° C, but as temperatures rose towards 21° C, activity rose sharply to figures in excess of 200 bees per minute (Langridge and Goodman 1981). At temperatures around 13° C there was less than one bee per tree and above 19° C there were 20 or more bees per tree.

Weather conditions influence the fruiting process because pollination, stigma receptivity, ovule fertility, ovule longevity and fruit set are directly related (Ruiz and Egea 2008; Egea and Burgos 1992).

Potential pollination service requirement for apricots in Australia

Optimal use of managed pollination services in all apricot orchards in Australia would require a service capacity as indicated in Table 3 below.

Table 3 Potential pollination service requirement for apricots in Australia

State	Peak month	Area (ha)	Average hive density (h/ha)*	Estimated number of hives required
VIC	October	703	3	2,109
NSW	October	78	3	234
QLD	August	57	3	171
WA	October	70	3	210
TAS	September	129	3	387
SA	October	371	3	1,113
Total		**1,408**		**4,224**

Notes: Area sourced from ABS (2008), flowering times and average hive density from DAF (2005).

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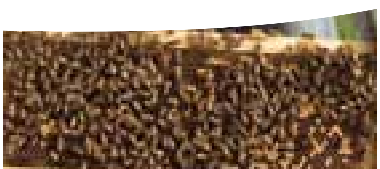
This case study was prepared as part of *Pollination Aware – The Real Value of Pollination in Australia*, by RC Keogh, APW Robinson and IJ Mullins, which consolidates the available information on pollination in Australia at a number of different levels: commodity/industry; regional/state; and national. 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.

Notes



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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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