Pollination Aware

Persimmon

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 persimmon (*Diospyros kaki* L.) is a deciduous fruit tree native to China that can grow up to 14m in height. Most commercial development of the crop has occurred in Japan where it is regarded as the national fruit, however, smaller but expanding industries have been established in Brazil, Italy, California, Israel, New Zealand and Australia. Interest in the crop has occurred as a result of the availability of new cultivars and increasing awareness of the wide environmental adaptability, high yield potential and excellent post-harvest storage life of the fruit (McGregor 1976).

Persimmon fruit can be consumed fresh, dried or used as a sweetening agent in various cuisine and confectionary products. Persimmon oil can also be used for various other purposes in the industrial and mechanical industry, pharmaceutical industry, for cosmetics and for beverages (Wilson 2009). There are two distinct forms of persimmon, non-astringent and astringent. The non-astringent persimmon is also known as a sweet persimmon. Sweet persimmons are the main variety available in Australia, forming the majority of the Australian persimmon crop. Astringent persimmons need to be harvested when fully matured and are ready for eating when the flesh is soft, jelly-like and very sweet. This variety is better known to older generations and is not as common in Australia as the sweet persimmon (PAI 2009).

Persimmon production in Australia

There are approximately 350,000 persimmon trees in Australia with an estimated current production of 450,000 trays per annum and individual orchards on average containing around 400 trees. The gross value of the industry is estimated to be around $8 million. Australia is small in comparison to other markets, contributing less than 1% of total world production (QLD.DPI 2009). Persimmons are grown in most states of Australia, with the major regions in south-east and subtropical Queensland, New South Wales, Shepparton and Mildura in Victoria, the South Australian Riverland, as well as Harvey in the south-west of Western Australia (PAI 2009). A survey conducted in 2000 by Nissen et al. (2000) determined the average yield per hectare for each state (Table 1). Total Australian production in this year was estimated to be 2,100 tonnes.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Average persimmon yield in Australia per hectare for each state based on 2000 survey results (Nissen et al. 2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qld</td>
</tr>
<tr>
<td>Average yield (tonnes per hectare)</td>
<td>20.4</td>
</tr>
<tr>
<td>Average area of persimmon (ha)</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Persimmons have been grown in Australia for many years although local demand has been limited and most people are familiar with the astringent varieties often found in backyards. However, it is the non-astringent varieties of persimmon that have the greatest international interest and market potential. Persimmon varieties more recently introduced to Australia can be eaten when firm and crisp, and can be grown in the Atherton Tablelands in the north, and south-east of Queensland, as well as in New South Wales, Victoria, South Australia and Western Australia (Wilson 2009).

Australian persimmons and their products are presently exported to Singapore, Taiwan, Korea, Malaysia, Thailand and Japan. As most northern hemisphere producers only grow for the domestic market and there is only limited supply of persimmons in the southern hemisphere, great potential exists for Australia to supply these markets out of season.

Pollination in persimmons

McGregor (1976) conducted a review and found that there was little consistency in the pollination requirements for various cultivars of persimmon. In general, there is a consensus that persimmons require pollen transfer by an outside agent and that this may be achieved through an insect vector (McGregor 1976).

Most commercial persimmon cultivars in Australia are pistillate (female) constant (not self-compatible), therefore pollen-producing cultivars may need to be inter-planted with the main cultivar. Many important polliniser cultivars are monoecious and bear inferior fruit, therefore pollinisers have been selected to provide for specific pistillate cultivars or for their adaptation to local conditions (George et al. 1997). Pollination mediation is thus required to produce fruit on pistillate constant cultivars. McGregor (1976) stated that honey bees and bumble bees visit persimmon blossoms freely for nectar and pollen and appear dependable agents in the transfer of pollen.

Pollination in Queensland has been insect mediated with the European honey bee (Apis mellifera) or other bee species such as native Australian bees (Trigona spp) (George et al. 1997). George et al. (1993) observed that under Australian conditions honey bees were more attracted to flowers of the polliniser trees due to the greater abundance of flowers and/or pollen and nectar in the flowers. Reports by Fukae et al. (1987) suggest that at least 20 honey bee visits per flower to visit
Pollination management for persimmon 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:** Planting distances for persimmon trees vary depending on cultivar, rootstock, soil type and tree canopy management used. As a guide, dwarf cultivars can be planted at 5 x 2.5m (800 trees/ha), semi-dwarf cultivars ('Fuyu') at 5 x 3m (660 trees/ha) and vigorous cultivars ('Flat Seedless') at 6 x 4.5m (370 trees/ha). The amount of flowers on any one tree will depend on the management practices of the grower.

- **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

Some varieties of persimmon, such as 'Fuyu', can set fruit and grow to a good size without cross-pollination, particularly in the drier southern states. However, research in Queensland indicates that pollinisers improve fruit set, size and shape and reduce the risk of fruit drop. In high rainfall areas with lower light levels, a ratio of one polliniser to eight trees is recommended. In other areas, a slightly lower frequency may be used. Alternatively, some growers now graft pollinisers onto one limb of every three to five trees (QLD.DPI 2009). This appears to increase fruit set. 'Gailey' and 'Dai Dai Maru' are recommended pollinisers, however, 'Dai Dai Maru' requires more regular and harder pruning (QLD.DPI 2009).

Density of bees

Recommendations made by the Western Australian Department of Agriculture and Food and by the New South Wales Department of Agriculture are for 2–3 hives per hectare (DAF 2005; Ullio 2003). As noted above, reports by Fukae et al. (1987) suggest that at least 20 honey bee visits per flower were required for adequate pollination; therefore, depending on the growers pruning practices the number of hives may vary between orchards.

Arrangement of hives

It has been shown that bees prefer to forage within 100m of their hives. Therefore hives should be placed evenly throughout the orchard no more than 150m apart from each other. In order to encourage bees to take full advantage of the morning bloom time it is important to place hives in the sunlight. Hives can also be placed on stands and should always be placed above the ground to avoid low-lying areas where moisture will settle. Good hive site selection will ultimately increase flight and ensure greater foraging activity in marginal weather conditions.

Timing

In warm subtropical regions, flowering normally occurs about 35 days after bud break and in cool temperatures may not commence until 70 days after bud break. Flowering usually occurs over a seven to ten day period but under cooler conditions this may be less. Field observations by George et al. (1994) found that the period between bud break and flowering and duration of the flowering period were increased three fold with decreasing day/night temperatures (range 32/27°C to 17/12°C) (George et al. 1997). As flowering times between cultivars can differ by 1–2 weeks it is important that suitable flowering polliniser cultivars are planted to ensure adequate fruit set. To maximise the likelihood that bees will forage the persimmon flowers, hives should be brought in when 5–10% of flowers are in blossom. Such a delay will ensure that bees will target the persimmon flowers rather than other sources that may occur in the area.
Attractiveness, nutritional value of pollen and nectar

Honey bees collect nectar and pollen from persimmon blossom. The amount of pollen and nectar varies between cultivars so honey bees will show preference to some cultivars over others. In attractive cultivars, flowers are said to produce nectar sufficient for bees to produce honey. In the USA, persimmon produces large surpluses of honey and persimmon is said to be one of the major honey producing plants in the state of Oklahoma, giving a water-white colour to the honey.

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.

Alternatives

Australian native bees (Trigona spp) are seen as common visitors to persimmon flowers in Queensland and appear to be dependable agents for pollination (QLD.DPI 2009). The use of native hives for pollination of persimmon crops is a possible alternative for the European honey bee; however, this opportunity requires more research.
Optimal use of managed pollination services in all persimmon orchards in Australia would require a service capacity as indicated in Table 2 below.

### Table 2: Potential pollination service requirement for persimmon in Australia

<table>
<thead>
<tr>
<th>Australia</th>
<th>Peak month</th>
<th>Area (ha) total</th>
<th>Average hive density (h/ha)*</th>
<th>Estimated number of hives required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>October</td>
<td>438</td>
<td>2.5</td>
<td>1,095</td>
</tr>
</tbody>
</table>

Notes: ABS data was not available on persimmon production and orchard area per state. Therefore the average orchard area for persimmon in Australia was generated from the estimated 350,000 persimmon trees in Australia given by QLD.DPI (2009) and average tree density of 798 trees/ha taken from Nissen et al. (2000). Hive density and flowering time taken from DAF (2005) and Ullio (2003).
References


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.
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.

RIRDC funds for the program are provided by the Honeybee Research and Development Program, with industry levies matched by funds provided by the Australian Government. Funding from HAL for the program is from the apple and pear, almond, avocado, cherry, vegetable and summerfruit levies and voluntary contributions from the dried prune and melon industries, with matched funds from the Australian Government.