Rubus

Introduction

Rubus is a large genus of flowering plants from the Rosaceae family, subfamily Rosoideae, of which there are believed to be hundreds if not thousands of species as well as hybrid species created both in nature and artificially. Most of these plants have woody stems with prickles, spines, bristles and gland-tipped hairs which are often referred to as brambles. Bramble fruit are generally separated into two groups, raspberries (Rubus idaeus L.), and cultivated blackberries (Rubus subgenus Eubatus) (DPI. VIC 2002) and have a number of culinary uses ranging from fresh fruit, to being processed into jams, yogurt flavouring or pie fillings.

Cultivated blackberries come in a number of different varieties which vary in growth characteristics, fruit size and shape and include but are not limited to varieties such as blackberries, boysenberries, youngberries and loganberries (DPI.VIC 2002). On the other hand, most commercial raspberry varieties are of European origin but some have been developed from hybridisation with native North American varieties (Rubus strigosus) (McGregor 1976).

Raspberry and blackberry cultivars range from completely self-fruitful to completely self-unfruitful with most erect blackberries being fruitful yet prostrate growing cultivars often requiring cross-pollination (McGregor 1976). Because rubus berries are made up of an aggregate of druplets (each druplet only forms after its pistal has received pollen) yield and fruit quality can be significantly improved from honey bee pollination (Chagnon et al. 1991; DAF 2005; Langridge and Goodman 1985; McGregor 1976).

Rubus production in Australia

The Australian rubus industry includes the production of raspberries, blackberries, and the hybrid brambles boysenberry, loganberry and youngberry. There are approximately 120 growers producing rubus crops across all states except the Northern Territory with negligible amounts in Western Australia. The major production states are Victoria, around the Dandenong Ranges and Gippsland, and throughout Tasmania (ARGA 2005) (Figure 1). Production regions for raspberries are shown in Figure 2.

Three markets exist for bramble fruit growers in Australia including the fresh fruit market, the supply to jam and confectionary companies, and lastly the ‘pick your own’ enterprises where the customer comes and picks their own berries (DPI.VIC 2002).

Estimated total annual production in 2003/04 of rubus fruit in Australia was 800 tonnes, with a gross value of approximately $10 million. Imported rubus fruit during the same period totalled 2,400 tonnes with an estimated value of $9 million.
Actual production in 2007/08 (ABS 2008) was reduced to 723 tonnes which may have been as result of field plantings that were impacted by phytophthora and drought after 2004 (ARGA 2005). Exports occur on a small scale and there is potential for large growth in fresh fruit sales as the price is steady, demand is reliable and cultivars that suit export are available. Processed fruit is a limited market due to competition from imports and an inability on both sides to establish long-term, large-volume contracts (ARGA 2005).

Pollination in rubus

Raspberries and cultivated blackberries are an aggregate fruit which means the flowers consist of a number of separate pistals, each of which must be pollinated for the formation of each druplet. Raspberry and blackberry cultivars range from completely self-fruitful to completely self-unfruitful with most erect blackberries being fruitful and prostrate growing cultivars often requiring cross-pollination. However, it has been found that even in self-fruitful cultivars, providing insect pollination greatly enhances the yield and fruit quality of crops (Chagnon et al. 1991; DAF 2005; Langridge and Goodman 1985). Numerous studies have shown increases in yield and fruit quality when bees are brought into a berry crop during flowering. Chagnon et al. (1991) found the number of druplets and berry weight of raspberries on flowers openly pollinated by honey bees were both significantly higher than those from the bagged control (Table 1). There were also strong positive correlations between the number of honey bee flower visits and druplet numbers, thus honey bee visits were also strongly correlated to average berry weight (1991).

In Knoxfield, Victoria, Langridge and Goodman (1985) studied the role of honey bees in the pollination of loganberries by comparing yield and fruit quality from caged and open-
pollinated plants. No difference in the total number and weight of fruit harvested was observed although significant improvements in berry quality were seen. Numbers of reject fruit resulting from honey bee pollination was 8% compared with 50% for control plants. This corresponded to a farm gate value of roughly double for the honey-bee-pollinated fruit compared to the non-honey-bee-pollinated fruits. After deducting the cost of hiring the bees, it was calculated the net extra return to the grower from open-pollinated fruit was $1,876 per hectare (Langridge and Goodman 1985).

### Pollination management for rubus in Australia

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

#### Crop layout

- **Plant and blossom density**: Raspberries are usually grown on a hedgerow system with 2.5–3.5m row spacing and plants are grown 0.6–1.0m apart giving a density of 2,860–6,670 plants per hectare (Paulin 2005).

  Cultivated blackberries are grown on trellises with a plant spacing of 1.5–2.0m giving a density of 1,430–2,670 plants per hectare (Paulin 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).

#### Density of bees

Recommendations for the number of hives required for cultivated blackberries vary. The Department of Agriculture and Food, Western Australia (DAF 2005) recommend that between two to ten hives are necessary, with some at higher rates of seven to ten hives per hectare. Garces and Morales (1995) found that the average visitation to blackberry flowers was eight seconds with honey bees most active between the hours of 10am and 4:30pm and recommended that two hives per hectare was needed for adequate pollination.

For raspberries recommendations from the USSR include 1–7 hives per hectare and 0.5–2 hives per hectare are required for optimal pollination. In Tasmania, there have been reports of $25 per hive being charged by apiarists for raspberry pollination (DAF 2005).

#### Arrangement of hives

Hive placement in an orchard is very important and will dictate the level of bee-foraging activity and thus degree of pollination achieved. Bees will tend to work along rather than across

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**Table 1** Honey bee foraging and raspberry pollination (Chagnon et al. 1991)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Open pollinated</th>
<th>Bagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of druplets per berry</td>
<td>78.7</td>
<td>50.4**</td>
</tr>
<tr>
<td>Berry weight (g)</td>
<td>3.16</td>
<td>2.04**</td>
</tr>
</tbody>
</table>

**Significant reduction P<0.01**
the rows (DPI.NSW 2000) which may lead to non-uniform pollination of the berry crop especially in hedgerow raspberry orchards. Hives should therefore be placed evenly and in greater numbers along rows rather than between them.

Timing

Flowering is initiated after the winter frost (around September to November) and can persist for between three and six weeks (DAF 2005). A study by Szklanowska (1991) of six different raspberry cultivars showed that the quantity of pollen supplied by the flowers was greatly influenced by weather conditions. Pollen quantity of flowers was also high at the start of flowering and during full bloom and declined towards the end of flowering (Szklanowska 1991). Bees should therefore be introduced at the onset of flowering to maximise the transfer of pollen and maximise yield.

Attractiveness, nutritional value of pollen and nectar

In general, the nectar and pollen from cultivated blackberries is produced in quantity (DAF 2005), however, variations occur between cultivars and different environmental conditions (Karp et al. 2004). Both nectar and pollen are attractive to pollinating insects, and the plants have been shown to be a source of surplus honey that is light amber in colour with good flavour (McGregor 1976).

Raspberry nectar is also highly attractive to pollinating insects because of the abundance with which it is produced (16–20mg per flower have been reported) and its high sugar content (sucrose content of 47–49%) with honey yields for two varieties in Bulgaria equal to 116 and 59kg per hectare (DAF 2005). Raspberry pollen is also a strong pollinator attractant (Chagnon et al. 1991).

Availability of bees for pollination

Both cultivated blackberries and raspberries are attractive to honey bees in terms of the quantity and quality of nectar and pollen they produce, and both are known to yield surplus honey after bees have serviced an orchard (DAF 2005). Apliarists would therefore be more inclined to supply hives to growers of bramble berries than to growers of less attractive crops (such as almonds).

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 of flowering 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.
Potential pollination service requirement for rubus in Australia

Optimal use of managed pollination services in all rubus plantations in Australia would require a service capacity as indicated in Table 2 below.

<table>
<thead>
<tr>
<th>State</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>VIC</td>
<td>November</td>
<td>386</td>
<td>4.5</td>
<td>1,737.0</td>
</tr>
<tr>
<td>NSW</td>
<td>November</td>
<td>84</td>
<td>4.5</td>
<td>378.0</td>
</tr>
<tr>
<td>QLD</td>
<td>November</td>
<td>31</td>
<td>4.5</td>
<td>139.5</td>
</tr>
<tr>
<td>SA</td>
<td>November</td>
<td>16</td>
<td>4.5</td>
<td>72.0</td>
</tr>
<tr>
<td>TAS</td>
<td>November</td>
<td>96</td>
<td>4.5</td>
<td>432.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>613</td>
<td>2.75</td>
<td>2,758.5</td>
</tr>
</tbody>
</table>

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.

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