Canola

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

Canola is an oil seed plant belonging to the Cruciferae family (Brassicaceae) and resulting from the natural hybridisation of cabbage, *Brassica oleracea* L., and seed rape, *Brassica rapa* L. First cultivated by ancient civilisations in Asia and the Mediterranean, it has been recorded as early as 2000BC in India and has been grown in Europe since the thirteenth century, primarily for its use as oil for lamps. Canola was first grown commercially in Canada in 1942 to produce a lubricant for use in war ships. Canola was first grown commercially in Australia in 1969; the winter-growing oilseed crop is currently grown across wheat belt areas of temperate Australia.

Canola blossom is frequently one of the earliest floral species available to commercial honey bees in the southern areas of Australia, flowering from September to October. Canola can be of benefit in the management of honey bees, although honey obtained from canola crops tends to candy very rapidly, presenting the beekeeper with an un-extractable product.

Canola production in Australia

As the world's second largest exporter of canola seed, Australia's exports consistently exceed one million tonnes. Our canola crop has grown to a size and quality that meets the high expectations of exporters, domestic crushers and intensive livestock producers. A minor crop in the late 1980s, canola is now Australia's third-largest broadacre crop (after wheat and barley) (Table 1). Canola is widely grown across south-east Australia and in Western Australia (Figure 1). Australian growers have adapted to their unique climate and growing conditions, which vary over large areas.

In 1990, Australia hit the global stage as an exporter of canola seed, and rapid growth led to our exports exceeding two million tonnes in 1999/2000. Our annual exports have now stabilised at around one to 1.5 million tonnes, and our main export markets are Japan, China, Pakistan, Europe and Bangladesh. The Australian canola industry abounds with opportunity. The industry is increasingly moving towards higher value-added domestically produced oils and greater production. As well, the industry continues to develop improved oilseed varieties.

Table 1 Production area and quantities of canola (ABS 2008)

	NSW	VIC	QLD	SA	WA	TAS	Total
Production ('000 t)	314.2	272.5	0.7	213.3	616.6	1.3	**1,418.6**
Area ('000 ha)	194.3	190.9	0.9	147.4	437.1	0.8	**971.4**

Pollination in canola

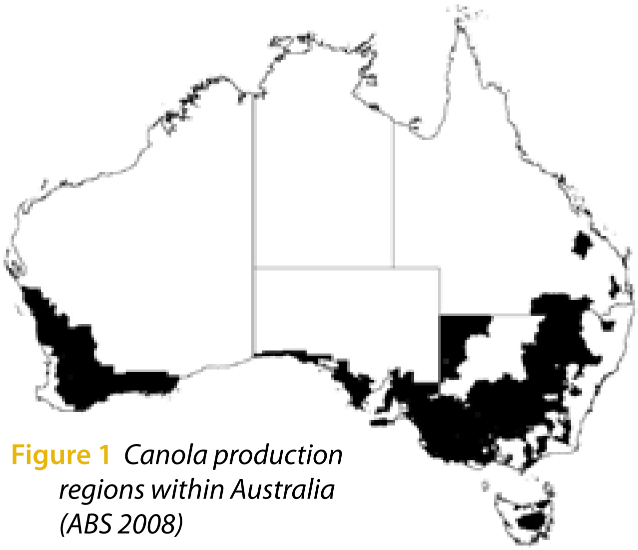


Figure 1 *Canola production regions within Australia (ABS 2008)*

Pollination is an essential step in the seed production of canola, *Brassica napus* L. It is achieved with the assistance of various pollen vectors, but particularly by the honey bee, *Apis mellifera* (Sabbahi et al. 2005). The canola flower has an entomophilic structure that attracts honey bees through copious supply of nectar and pollen, although the production of both depends much on the individual cultivar (Manning and Wallis 2005). Honey bees have remarkable qualities as pollinators when it comes to foraging flowers. First, they can easily adapt to different plant species, thus they can visit a large diversity of flowers throughout the season. However, when they locate an entomophilous plant, the bees develop fidelity towards it and the plant can benefit from good pollination (Sabbahi et al. 2006). Benefits to growers from insect pollination come principally from higher yields through more pods per plants, more seeds per pod and higher rates of germinability of resultant seed. Additional benefits may be increased set of early pods, leading to earlier ripening and easier harvesting (Manning and Wallis 2005). In spite of the attractiveness of its flowers to insects, canola might still have good seed yields without insect pollination, but this depends on environmental factors (Manning and Wallis 2005). Hence there is a degree of controversy over the need for insect pollination of canola.

Some reports claim that canola is largely self-pollinated and does not need honey bees, whereas others indicate greater seed yields when honey bees are present. Several authors have identified the presence of honey bees and the beneficial effects (Sabbahi et al. 2006; Langridge and Goodman 1975; Langridge and Goodman 1982; Manning and Wallis 2005) while others have reported honey bees gave no significant benefit to productions of canola

Improvement in seed yield of 46% in the presence of three honey bee hives per hectare, compared with the absence of hives was seen in a Canadian study (Sabbahi et al. 2005). The introduction of honey bees contributed to production and consequently, these pollinators represented a beneficial and important pollen vector for the optimal yield of canola.

Manning and Wallis (2005) tested three hypotheses in a Western Australian study: firstly, that deploying honey bees increases the yield of seed; secondly, that the benefits of honey bees decline the further plants are from an apiary; and thirdly, poorly pollinated plants should channel more resources into larger seeds, whereas plants benefiting from insect pollination should produce more but smaller seeds. The experiments confirmed all three hypotheses. Yield of seed increased by more than 20% and seed yield declined in plots located more than 200m from the apiary site (Table 2) (Manning and Wallis 2005).

Table 2 **Study example (Manning and Wallis 2005)**

Parameter	Site 1	Distance from apiary site 1 (m)			
		100	200	300	400
Pods/m2	4,818	5,118	5,235	4,332	4,588
Dry seed (g/m2)	204.5	228.0	219.0	180.0	191.0
Seed (t/ha)	2.04	2.28	2.19	1.8	1.91



Pollination management for canola in Australia

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

Crop layout

- *Pasture layout and blossom density*: Canola is a broadacre crop planted generally in large open paddocks.
- *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.

Density of bees

Results showed an improvement in seed yield of 46% in the presence of three honey bee hives per hectare, compared with the absence of hives(Sabbahi et al. 2005). Further information from Canada indicates the need for larger numbers of bees hives for the pollination of hybrid canola seed, where stocking rates of six hives per hectare have been reported (Somerville 2002). These higher stocking rates may reduce honey produced by as much as 75% as the main aim is to maximise seed production (Somerville 2002). A normal stocking rate for honey production was stated as 0.5 hives/hectare for non- hybrid canola varieties (Somerville 2002).

Arrangement of hives

Manning and Wallis (2005) found that the beneficial effects of honey bee foraging declined after a distance of 200m from an apiary site consisting of 100 hives. While Somerville (2002) suggests that honey bees will travel several kilometres to forage on canola.

Timing

Canola blossom is frequently one of the earliest floral species available to commercial honey bees in the southern areas of Australia, flowering from September to October, depending on the geographic location, time of sowing and general conditions of the crop (Somerville 2002).

Bee husbandry in the paddock

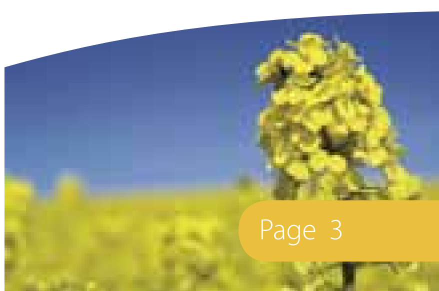
Moving hives into a crop during the night is less stressful on the bees, because they are not flying and the representatives are generally cooler. With a rapidly expanding population, swarming can be a problem with strong colonies. This is to be expected when working floral resources with surplus pollen and nectar resources, combined with the warming weather conditions associated with early spring (Somerville 2002). Rigorous activity by the beekeeper is often needed to minimise swarming(Somerville 2002).

Attractiveness, nutritional value of pollen and nectar

Canola is a major beekeeping floral resource, producing quantities of both nectar and pollen in the early spring period (Somerville 2002). The canola flower has an entomorphic structure that attracts honey bees through a copious supply of nectar and pollen (Manning and Wallis 2005). The blossom provides an abundant quantity of yellow-coloured pollen high in crude protein; levels of 22–27% which are normally sufficient to support an expanding colony (Somerville 2002).

A weak colony should benefit from being placed on canola blossom, the fresh nectar and pollen supply encourages the colony to breed and to expand the brood area. Particularly if the colony experienced a particularly harsh winter and or is suffering from Nosema disease, access to canola blossom could help the colony to overcome the diseases by enabling the bees to rapidly expand the population (Somerville 2002).

The condition of bees when they are first introduced onto a canola crop will have a significant impact on the appropriate management strategies to be considered by the beekeeper. The abundance of nectar and pollen combined with warmer spring conditions will lead to a rapid expansion of the brood area in strong colonies.



Availability of honey bees for pollination

Canola is a major beekeeping floral resource, producing quantities of both nectar and pollen in the early spring period. Canola is frequently one of the earliest floral species available to commercial honey bees in the southern areas of Australia flowering from September to October depending on the geographic location, time of sowing and general condition of the crop. Good nutritional value of canola pollen and nectar means that apiarist do not have to supplement bees diets to maintain strong working colonies. Fees for providing pollination services for canola were up to $60 hive in 1998 (Somerville 2002).

Feral bees

There is a degree of controversy over the need for insect pollination of canola. The majority of recent research in Australia identifies significant production benefits when introducing honey bees into canola crops. Canola growers 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 canola flowers bloom 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 seed production.

Risks

Pesticides: As with honey bees working any agricultural or horticultural crop, the risk of pesticide sprays is a serious threat to the health and well being of the honey bees. Bees find canola very attractive and will fly several kilometres to forage on the blossoms of canola crop(Somerville 2002). For growers it is often necessary to apply an insecticide to control pests during flowering when the bees are the most active but insecticides kill bees and serious losses have been experienced while hives have been working canola crops. It benefits both the grower and beekeeper to have bee hives on canola crops, so it's very important for growers and beekeepers maintain good communications.

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. Under rainy conditions bees fly between showers but only usually for very short distances. Wind, particularly strong wind, tends to reduce the groundspeed of bees and hence reduces the number of flights per day.

Colony strength will also have a direct bearing on the temperature at which honey bees will leave the hive. Only strong colonies will fly at lower temperatures. Bees need to keep their brood nests within their hives at a constant temperature of 37ºC. The cooler the external temperature, the more the bees are required within the hive to maintain that temperature. Hence if the colony is strong in numbers the surplus bees not required for maintaining hive temperature are available for foraging duties.

Environmental factors have a direct bearing on the amount of nectar secreted. It has also been found that nectar is the most concentrated in old flowers about to wither, but nectar concentration fluctuates widely in accordance with the relative humidity throughout the day (Manning and Wallis 2005). The number of honey bees that visit the blossom has been directly correlated with the amount and concentration of nectar produced.



Potential pollination service requirement for canola in Australia

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

Table 3 Potential pollination service requirement for canola in Australia (ABS 2008)

State	Month (flowering)	Area ('000 ha)	Average hive density (h/ha)*	Estimated number of hives required
NSW	September	194.3	0.5	97,150
VIC	October	190.9	0.5	95,450
QLD	September	0.9	0.5	450
SA	September	147.4	0.5	73,700
WA	September	437.1	0.5	218,550
TAS	October	0.8	0.5	400
Total		**971.4**		**485,700**

Notes: Area sourced from ABS (2008) flowering times and average hive density from Sommerville (2002)

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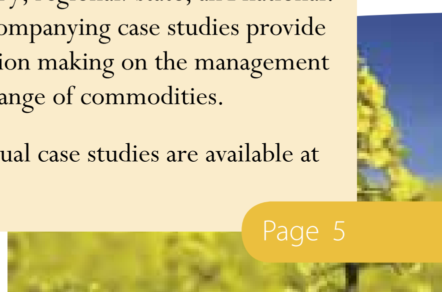
This case study was prepared as part of *Pollination Aware – The Real Value of Pollination in Australia*, by RC Keogh, APW Robinson and IJ Mullins, which consolidates the available information on pollination in Australia at a number of different levels: commodity/industry; regional/state; and national.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