



NSW Agriculture

Honeybees in faba bean pollination

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INTRODUCTION

Inadequate pollination is a major constraint to the potential yields of faba bean (*Vicia faba*) crops. Faba beans are a broad bean originating from the Middle East. They are an important human food crop in China, the Middle East, the Mediterranean and in African countries. Faba beans have been used extensively in Australia for livestock nutrition but an emerging export market may, in future, be more important.

Faba beans are a winter legume crop, gaining increasing levels of interest from farmers as a rotation crop for cereals. Faba beans conserve soil nitrogen and assist in breaking disease and weed cycles. They fix more than 80% of their own nitrogen needs under a wide range of conditions.

PLANT GROWTH CYCLE

A well-grown faba bean plant can grow to 1 m tall. Sowing usually takes place in May, although this can extend into June if conditions are favourable. Flowering extends for 5–6 weeks, depending on moisture and air temperature. Flowering occurs from late July to mid October, depending on the time of sowing, moisture, climatic factors and geographic location. Flowering is prolific, but only 10–20% of flowers produce pods. Flowers cross-pollinate and honeybees are the main agents for this to occur.

CONSTRAINTS TO YIELD

Although this Agnote is about the value of honeybees in pollinating faba beans (thus increasing the potential yield), other constraints to yield do have a major impact. Sometimes these factors override the benefits derived from having honey

bees on the crop. Some of these constraints include sowing time, moisture stress, pest pressure, plant population and harvesting efficiency.

- Sowing time is critical to yield potential. The later the sowing after early May, the greater the decrease in relative yield.
- Any plant that is water stressed during its growth or reproductive phase will not achieve its full potential.
- Insect pests such as heliothis caterpillars, aphids and thrips have been known to have an impact on faba beans.
- Chocolate spot is a fungal disease that is a major concern to growers of the Fiord variety. Chocolate spot has been responsible for major yield losses of this crop.
- Plant population has been reported to have a direct effect on potential yield. With the Fiord variety, a plant population of 25–30 plants/m² is recommended.
- A delayed harvest, particularly during wet weather, may result in increased pod drop and shattering. The author has seen up to 25% of one crop left behind after unsatisfactory harvesting methods.

POLLINATION EFFICIENCY

The presence of honeybees is said to accelerate the rate of set of bean pods and this has been supported by a number of studies. It has also been observed that plants with access to bees set more pods on the lower nodes and ripen earlier with significantly more seeds per pod.

For the purposes of collecting nectar from faba bean blossom, it has been established overseas that the bean flower is more adapted to insects with longer tongues than honeybees.

Although this may be the case it has also been shown that use of honeybees has the potential to increase yields of faba beans by 19–52%. In one case honeybees doubled the yield. A trial conducted in the Riverina in 1993 supports these findings with a yield increase of 25% with the use of honeybees.

Nectar secretion is highest in the early morning and late evening and the scent is very attractive to bees. Honeybees that enter the flowers probably obtain only pollen on many of their visits, although they may attempt to obtain nectar as well. Faba bean plants have extra floral nectaries located on the undersides of the stipules. Honeybees can visit these for the purpose of collecting some nectar. Bees visiting extra-floral nectaries are more numerous at midday while those visiting the flowers, especially for pollen, are more numerous from 2 pm to 4 pm.

Although bean pollen is presented from 10 am to 5 pm, some 91% of it is presented in the peak period which occurs from noon to 3 pm. All new flower buds open in the afternoon, 74% between noon and 2 pm.

There is little evidence that faba bean blossom provides any significant source of nectar to honeybees. Faba beans are mainly pollinated by pollen-gathering bees.

HIVE PLACEMENT

Temperature is very important to bee activity. Hive placement will dictate the level of activity of the colony. Where possible, hives should be located in an elevated position in a warm sunny area protected from prevailing winds. This will ensure maximum bee activity. In wet and cold conditions bees only forage short distances from their hives.

From a beekeeper's viewpoint, all-weather truck access is necessary. Hives should not be placed within 100 m of gates, lanes, stock troughs and sheds due to the amount of flight activity from those hives and the comfort of people and livestock.

Hives should not be placed in long rows, for example along a fence line. This leads to increased drifting and non-uniform colony strength. Irregular layout patterns are best with hives spaced apart and facing different directions.

Hives should be placed in minimum lots of 20 to 30. If the area is small then one or two placements may be necessary. If bees have to fly further than 500 m they should be split up and placed in appropriately spaced intervals.

Consider the main reason that bees are attracted to the crop: for its pollen. Pollen-gathering honeybees are said to fly shorter distances than nectar gatherers.

TIMING

In general, hives should be introduced when approximately 5% of the blossom is already in evidence to encourage bees to commence working right away. Once foraging begins, bees show a marked fidelity to the chosen species and may stay on the blossom for a long time.

BEE ACTIVITY AND CLIMATE

Temperature and rainfall have a marked effect on honeybee activity. At temperatures below 13°C honeybee flight activity will virtually cease. Between 13°C and 19°C activity increases sharply. Above 19°C it tends to reach a relatively constant high level.

With rainfall, flight activity ceases. Under rainy conditions bees fly between showers but only for very short distances — up to about 150 m. Wind, particularly strong wind, tends to reduce the ground speed of bees and hence reduce the number of flights per day.

STOCKING RATES AND CONDITIONS OF HIVES

A stocking rate of 2 hives/ha has been stated as adequate for pollinating faba beans. Relying on feral populations of bees to do the pollination is a lottery: its success depends on crop size, population levels and the health of the feral colonies closest to those areas to be sown to faba beans.

For a hive to be able to adequately pollinate faba bean blossom, the colony must be above a certain minimum strength. Hives require constant management to achieve this.

An ideal pollination unit is approximately six frames of brood and bees. With an expanding brood nest, the bees have greater need for pollen to feed their larvae. Therefore, they show far more enthusiasm in flying even during less than ideal conditions.

The number of combs of brood and bees should be agreed on before hiring bees. Generally, a very strong single hive or a colony expanding into a double hive is considered the minimum standard as a pollination unit.

SPRAY AND PESTICIDES

One of the biggest drawbacks of placing bees near any agricultural crop is the possibility of colonies or field bees being sprayed by pesticides. Pesticides should be kept to a minimum while hives remain on your 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 chemicals 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 and also advise nearby farmers.

IMPACT ON BEES

Faba beans provide very little nectar, if any, to honeybees. It is desirable, therefore, to provide or ensure there is stored honey in the hive before the bees go onto the crop; or alternatively, provide the bees with sugar syrup early in the flowering period to stimulate the colony into breeding and thus increase its demand for pollen.

The more pollen gatherers there are, the greater the chance of achieving maximum pollination.

Bees have been reported to collect reasonable quantities of pollen from faba beans for use within the hive. This does not detract from the amount of pollen available to be able to cross-pollinate faba bean flowers.

Pollen collected by the bees has a crude protein level of 22–24% with all the essential amino acids necessary for honeybee nutrition. This crop therefore provides breeding opportunities for the colony. The limiting factor is nectar, which, combined with the time of year, may cause significant swarming problems towards the end of the flowering or soon after the bees are moved off the crop.

Considerable time will be required to reduce the problems faced by this potential increase in the colony's desire to swarm, reducing the potential of colonies weakened by swarming to gather surplus honey crops following the bees foraging on faba bean flowers. Other floral sources may be more desirable for beekeepers to work their bees to provide better sources of nectar and pollen.

RESEARCH TRIAL

A research trial conducted in 1993 by the author in the Riverina supported previous information on the pollination of faba beans. The area of crop from which the measurements were taken was 32.5 ha.

The crop was subjected to four treatments, replicated five times.

- Treatment 1: Random plot in crop (control).
- Treatment 2: Cage with bees enclosed.
- Treatment 3: Cage without bees (no bee access).
- Treatment 4: Cage with shade effect only, sides open to honeybees.

Bees were placed in the crop at approximately 5% flower. This included thirty-two 10-frame strong double hives placed alongside the crop and five nucleus colonies placed inside five designated cages. These nucleus colonies were given a water source for the duration of the trial.

The nucleus colonies had sufficient honey and at least three frames of bees to enable it to be sustained for the duration of the trial.

Sixteen hives were regularly sampled. Samples of adult bees were removed from the same 16 hives on four occasions. These represented a gap of three weeks between sampling. The area of brood in the 16 sampled hives was also measured on the same days.

RESULTS

The results of this trial support the use of managed honeybees in the pollination of faba beans. The results indicate a 25% increase in yield. This was measured by excluding bees from five cages and introducing bees into five cages.

The trial data reveals a much higher yield in the open pollinated plots, indicating that the effect of cages on potential yield was considerable.

Table 1. Mean yield of faba beans from 2 m x 1 m plots (kg)

Random plot	1.8
Cages with bees	1.5
Cages with no bees	1.2
Shade only, access to field bees	1.7

Previous research suggests that the detrimental effect of the cages is unavoidable and that the beneficial effect of bee pollination is probably greater than results implied.

The area of brood increased over the trial period, indicating favourable nutritional conditions for honeybees as the adult crude protein levels remained constant over the trial period to maintain a productive colony.

CONCLUSION OF PROJECT

Provision of sufficient numbers of managed honeybee colonies should be considered to ensure that adequate pollination of faba beans is achieved. The colonies of bees placed on faba beans should contain sufficient honey stored for the duration of the pollination period.

Consideration of the pesticide spray program related to this crop should be carefully analysed to determine the risk of direct loss of bees from

spray and the possible long-term contamination of beehives to pesticide contaminants. Bees that come off faba beans should be in good nutritional condition to work a heavy honey flow or go onto another pollination contract — if the swarming tendency can be managed.

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The information contained in this publication is based on knowledge and understanding at the time of writing (March 2002). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user's independent adviser.