ALMOND BOARD OF AUSTRALIA

HONEY BEE BEST MANAGEMENT PRACTICES FOR AUSTRALIAN ALMONDS

ADAPTED FROM THE ALMOND BOARD OF CALIFORNIA PUBLICATION

A GUIDE FOR GROWERS AND POLLINATION STAKEHOLDERS

australian almonds
ALMOND BOARD OF AUSTRALIA

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ACKNOWLEDGEMENTS

The Almond Board of Australia (ABA) would like to thank the Almond Board of California for allowing us to modify their *Honey bee Best Management Practice Guide for Californian Almonds (2018)* to suit Australian conditions.

The ABA would like to acknowledge the contribution of the ABA Pollination Committee members including:

Robert Wheatley, Pollination Committee Chair, AustOn Group, Aroona Farms
Ian Zadow, Apiarist, IM & MJ Zadow Trust
Dr. Doug Somerville, Chair of the AgriFutures Honey Bee and Pollination Research Panel and former Technical Specialist, Honey Bees NSW Department of Primary Industries
Ben Brown, Almond producer, Select Harvest Ltd
Peter Cavallaro, Almond producer, Walker Flat Almonds
Pierre Janse van Rensburg, Almond producer, Olam Orchards Australia Pty Ltd
Drew Martin, Almond producer, Omega Orchards
Neale Bennett, Almond producer and former Chair of the Pollination Committee.

Feedback from the following is also gratefully acknowledged:

Australian Honey Bee Industry Council (AHBIC) and state honey bee associations
State government honey bee biosecurity departments
State Bee Biosecurity Officers (BBO)
Plant Health Australia
Debbie McMahon, Almond Board of Australia
Melina Mueller, Walker Flat Almonds.

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Hort Innovation Strategic levy investment | ALMOND FUND

This project has been funded by Hort Innovation using the almond research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

HOW TO USE THIS GUIDE

The following pages outline the Almond Board of Australia's (ABAs) honey bee best management practices (BMPs) that growers and other stakeholders involved in the pollination process can follow to promote the health of honey bees and protect them from environmental factors for their short stay in Australian almond orchards. While many of these practices are generally applicable across all crops, the focus of this publication is specifically on almonds, addressing issues primarily from a grower's perspective.

Four key areas are described in this guide where growers and beekeepers can work together to maximise the benefits from honey bee pollination while preserving the health of honey bees in almond orchards including:

1. hive standards, agreements and audits
2. reducing pest and disease risks and the National Bee Biosecurity Program
3. caring for honey bees while in the orchard through hive placement, gradual introduction and removal of hives and providing supplementary resources.
4. chemical use in and around the orchard.

The document provides a roadmap and links to further information and training available within Australia. Key supporting documents to this BMP guide include:

- a honey bee BMP Quick Guide for growers – summarising the key points within this document
- a honey bee BMP Quick Guide for spray operators – summarising the key points specific to what spray operators need to know and do
- pollination agreement template
- pollination register.

Australian Sustainable Almonds Program (ASAP) grower self-assessment

Growers can check how ready they are to preserve bee health during pollination by undertaking the Australian sustainable almonds program (ASAP) grower self-assessment.

Please refer to the ABA website industry.australianalmonds.com.au or contact the ABA for further information.

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Far right: Honey bees provide an essential service in fertilising almond flowers with pollen while collecting nectar. A good harvest starts with good pollination.

Image credit: Anna Petersen, Fremtiden Family Trust.

KEEPING HONEY BEES HEALTHY

European honey bees (*Apis mellifera)*, referred to as honey bees, are essential for successful pollination of almond flowers and the long-term sustainability of the Australian almond industry. Honey bees have long been recognised as the most efficient and effective pollinator for agricultural crops compared with other insects (including moths, flies and native bees) with their hairy legs and coat readily attracting and moving pollen from one flower to the next.

Why should almond growers - and all parties involved in almond pollination - care about bee health?

Almond growers recognise that healthy honey bees are likely to forage more actively and this provides greater pollination efficiency and nut set. Honey bees provide a valuable resource to almond production.

Almonds are one of the first crops for the honey bee season and the time they spend in almonds may impact hive health throughout the rest of the year, from the time they leave almond orchards until they return the next season. In Australia, the pollination industry has relied on public lands and native flora to build a strong hive out of season balancing the needs of agricultural pollination with native foraging for honey.

It is important that almond growers provide an environment in and around the orchard that nurtures honey bees and maintains hive health both during almond pollination and for the crops that follows.

It is hoped that by doing so growers and beekeepers will both benefit from a rewarding and mutually beneficial relationship, with more beekeepers encouraged to provide hives managed for crop pollination, and growers confident they are doing all they can to be good honey bee guardians.

Each almond flower is only viable for pollination for five days. Temperatures between 18 – 27 degrees are most conducive for pollen to be released. This typically occurs in early August.

Image credit: Peter Cavallaro, Walker Flat Almonds.

1. THE COMMUNICATION CHAIN

The most important tool that beekeepers and farmers can use to ensure a long-term, hassle free and mutually beneficial business relationship is communication!

Establishing a clear communication chain among all parties involved in pollination and pest management will help ensure that responsibilities are known, expectations are met, and important information is effectively conveyed.

The acting parties may simply be a beekeeper and a grower but depending on the scale of the operation, those involved in the almond pollination process may also include a bee broker, auditor, agronomist and spray operator. The state government departments are also a vital link in the communication chain.

Grower - beekeeper communication prior to almond bloom

Communication is the first step toward a successful almond pollination season as it ensures expectations between the beekeeper and grower are fully understood. In Australia, almonds are the first crop to be pollinated at the end of winter. Beekeepers will start preparing their hives as early as January to ensure hives are in good condition and fit for the job. It is important that growers notify beekeepers of their pollination requirements and expectations early to allow beekeepers to put in place specific practices over autumn to meet grower needs.

Topics for discussion are outlined on pages 8-9 and are encouraged to be documented in a pollination agreement (page 10).

At the end of each pollination season growers and beekeepers should review and document any issues that need to be addressed or any improvements that could be made for the next year. Communicate these as soon as possible (before Christmas) to facilitate discussion and avoid last minute problems.

Growers who do not have an established relationship with a beekeeper can contact the ABA or refer to ABA's pollination directory for a database that includes both beekeepers, auditors and bee brokers.

BeeConnected

BeeConnected is a free nation-wide smart-phone app that enables collaboration between beekeepers, farmers and spray service contractors to facilitate best practice honey bee protection. Through BeeConnected, registered farmers and contractors will receive notifications when a registered beekeeper places their bee hives near a farm or where crop protection products may be applied. Registered beekeepers also receive an alert when a farmer or contractor intends to use a product to protect their crop. The tool enables instant messaging between beekeepers, farmers and contractors, whilst maintaining privacy using a restricted in-app messaging service.

THE COMMUNI

Beekeeper and bee broker should discuss:

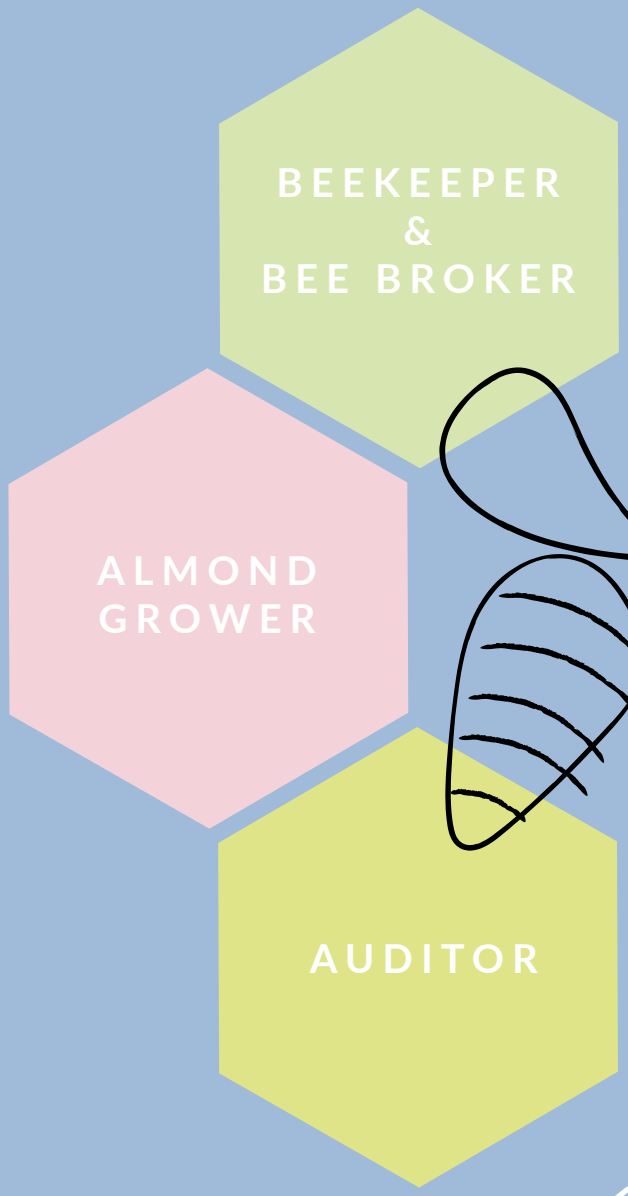
- **POLLINATION AGREEMENTS** using contracts with growers.
- **REGISTRATION** of beehives with the relevant state government.
- **BEE SECURITY REQUIREMENTS** for the relevant state including hive branding (bee registration number)
- **HIVE HEALTH RELATED INCIDENTS** e.g. suspected pesticide impact, notifiable pest and diseases (American Foul brood (AFB) etc. reported to the grower and state government agency.
- **SUSPECT EXOTIC PEST INCURSION** or notifiable pest and diseases e.g. Varroa mite and AFB etc. to be reported to the Exoctic Plant Pest Hotline 1800 084 881.

Almond grower should discuss:

- **POLLINATION NEEDS** as early as January to allow beekeepers to prepare for pollination.
- **POLLINATION AGREEMENTS** using contracts with beekeepers/bee brokers.
- **COMPLIANCE** with the National Bee Biosecurity Code of Practice with beekeepers by obtaining their Certificate of Compliance.
- **ENGAGEMENT** with independent third-party hive health auditor.
- **SPECIFICATIONS** of pollination agreements with other stakeholders involved in the chain (i.e. auditor /agronomist/ spray operator).
- **WHEN** hives will be in the orchard with neighbours.
- **WHEN SPRAYING** insecticides when hives are located in neighbouring properties.
- **PESTICIDE PLANS** with beekeepers, agronomists and agricultural suppliers.
- **MANDATORY ADVANCED WARNING** of a minimum of 48 hours to beekeepers when using fungicide products with the statement "dangerous or toxic to bees" on the label.
- **DETAILS OF THE PESTICIDE PLAN** with spray operators using the honey bee BMP Quick guide for spray operators and products recommended for use.
- **HIVE HEALTH RELATED INCIDENTS** e.g. suspected pesticide impact, notifiable disease, reported to the beekeeper and state government agency.

State government department should discuss:

- **HIVE REGISTRATION** and biosecurity risk assessment during pollination season with beekeepers.
- **BEEKEEPER REQUIREMENTS AND RESPONSIBILITIES** under the National Bee Biosecurity Program and Code of Practice to reduce the biosecurity risk.
- **ASSISTANCE AVAILABLE** to growers in contacting beekeepers.
- **INVESTIGATION REQUIREMENTS** during suspected pest and disease related bee incidents with growers, beekeepers and auditors (as appropriate).
- **RESULTS** of pest and disease surveillance and compliance monitoring activities with growers and beekeepers (as appropriate).



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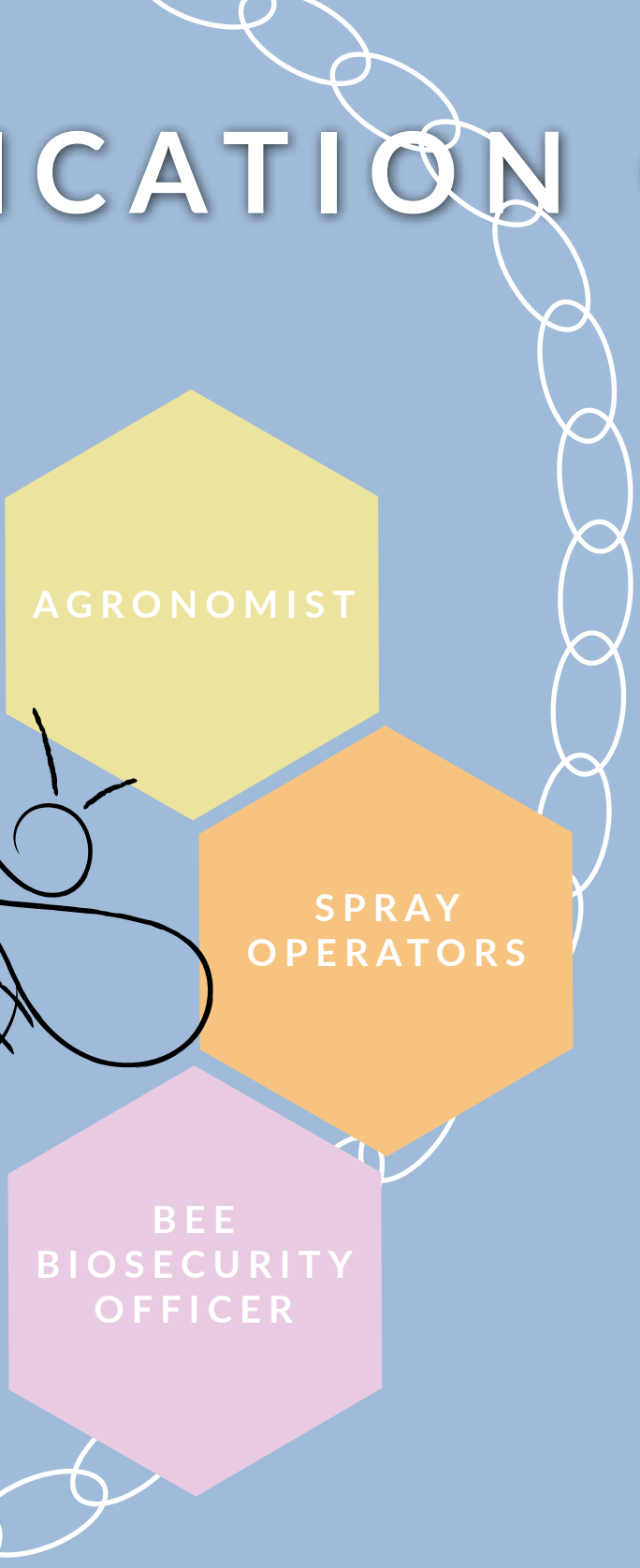


Agronomist should discuss:

- **SPRAY OPTIONS** with growers that provide effective control while avoiding harm to bees and promote biological approaches to maintain the natural balance within the orchard.
- **PESTICIDE PLANS** in consultation with growers, beekeeper and spray operator, including specific application recommendations and products to avoid.
- **CONTACTING BEEKEEPERS** before pesticide application with the grower. This includes beekeepers with hives located in neighbouring properties using the BeeConnected app. Advanced warning of a minimum of 48 hours is mandatory for fungicide products with the statement "dangerous or toxic to bees".
- **HIVE HEALTH RELATED INCIDENTS** e.g. suspected pesticide impact, with the grower.

Spray operators should discuss:

- **PRACTICES** in the honey bee BMP quick guide for spray operators with the grower.
- **SPECIFICATIONS** within the pesticide plan and notify the grower of any proposed changes.
- **CHEMICAL LABELS** and directions for use with the grower, agronomist and chemical provider.
- **ROUTINE MAINTENANCE AND REPAIRS** of chemical plant and thorough cleaning of tanks and equipment to avoid pesticide contamination with grower.
- **SPRAY TIMING** of fungicides during bloom after dusk to avoid foraging.
- **MAINTAINING SPRAY DIARY RECORDS** capturing the weather conditions.
- **HIVE LOCATIONS** and duration on or near the orchard with the grower.
- **CONTACTING BEEKEEPERS** before pesticide application with the grower. This includes beekeepers with hives located in neighbouring properties using the BeeConnected app. Advanced warning of a minimum of 48 hours is mandatory for fungicide products with a statement “dangerous or toxic to bees”.
- **HIVE HEALTH RELATED INCIDENTS** e.g. suspected pesticide impact, with the grower.

Auditor should discuss:

- **HIVE HEALTH ASSESSMENT TIMING** and approach to determine colony strength (i.e. the size of the cluster) and parameters agreed in the pollination agreement with growers.
- **HANDLING OF HIVES WITH BEEKEEPERS** on behalf of growers to ensure minimal disruption to the hive during the assessment.

Far right: Hives should be assessed by an independent auditor within seven days of arriving in the orchard. A hive assessment includes an evaluation of colony strength and agreed frame numbers.

Image credit: Melina Mueller, Walker Flat Almonds.

2. HIVE STANDARDS

Hive standards are a critical component for maintaining bee health and ensuring grower satisfaction. Growers and beekeepers should discuss and mutually agree on their expectations for each other to avoid misunderstandings.

The ABA recommended standard for each hive is to contain:

- an average of eight standard frames of bees per hive: full depth frames
- six frames minimum
- each frame three quarters covered by bees at 15C
- two full standard frames or four frames 50% full of brood (developing eggs, larvae or pupae) in all stages (depending on seasonal conditions)
- at least three full-depth frames of honey (10kg of honey) for pollination period
- an active laying queen (not drone laying queen)
- sufficient room for colony expansion
- no American foulbrood (AFB) as per hive inspections in autumn.

For further information refer to NSW DPI Ag Guide on Pollination using honey bees – Chapter 11 Pollination Standards (NSW 2018).

Once the hive standard is met, the stocking rate can vary depending on the number of flowers in the orchard. For pollination in mature almond orchards, it is common practice to place an average of six to seven hives per hectare when using an average of eight frames of bees. Higher standards may be negotiated to minimise potential localised stress event.

Pollination agreements

Pollination agreements are useful to clarify what a grower is hiring and what the beekeeper needs to supply. It is important that growers and beekeepers specify, and agree upon, each other's responsibilities and expectations in the following areas prior to bloom:

- the number of hives and hive standard
- location of hive placement in the orchard
- accessibility of hives to beekeeper and potential site hazards
- timing to commence gradual introduction of hives into the orchard
- details regarding hive inspection including date, ambient temperature and time of day , number of hives to be inspected and who will be involved e.g. independent auditor
- proposed pesticide plan and spray diary records of materials used
- supply and maintenance of a clean water source especially for sandy soils
- when to notify the beekeeper of signs of dead bees
- removal and replacement of dead or weak hives
- timing to gradually remove all hives from the orchard
- payment terms, including the deposit, progress payment and final payment
- contact details and ABN for each party
- evidence of appropriate insurances including public liability (including third party to cover accidental damages) for all parties.

A sample of an almond pollination agreement is provided in Appendix A for growers and beekeepers to customise to meet individual needs and requirements.

Agreeing on price

The establishment of a price is determined between the grower and the beekeeper depending on the conditions of the agreement and level of service.

The price is generally driven by grower demand and the beekeeper's ability to supply. In seasons where there is a shortage of floral resources (i.e. seen during droughts or fires) supplementary feeding may be required. Increasingly beekeepers are practising supplementary feeding in autumn to ensure best possible chance of almond pollination standards being met in August. Care must be taken by all parties involved in negotiations to ensure the price delivers all the growers' expectations.

It is also worth noting that different crop types pay different prices for hives. When comparing crop prices consideration needs to be given about the service being provided. Almonds generally consume honey during pollination whereas avocadoes and macadamias, for example, provide a honey crop (honey is made) while bees are pollinating flowers so hives may cost less. Beekeepers may call for a higher price if providing services above the standard agreement.

Hive audit and colony strength assessment

Hives arriving on the orchard should be audited by an experienced and agreed independent auditor. These audits assess colony strength (i.e. the size of the cluster) and parameters agreed in the pollination agreement such as number of frames. An audit assessment will determine if the terms stated in the pollination agreement have been met (refer pollination agreement section). Note: it is important that there is minimal disruption to the hive in this process and some parameters, for example queen presence, may not be able to be assessed at this stage. The pollination agreement should describe arrangements for audit assessment.
Hives should be assessed within an agreed time of delivery. It is best to let the hives acclimatise to the orchard landscape before conducting the inspection. Ideally the audit should be done within seven days of the hives being delivered. Typically, only a representative sample of hives will be inspected – about 10% of hives delivered is recommended.

Growers do not have automatic right to access or move hives as they remain the private property of beekeepers even though they are located in the orchard. Assessing hives to ensure they meet the contractual arrangements requires skill and understanding of honey bee biology and behaviour. There are also safety risks associated with handling bees, so it is vital that audits are undertaken by experienced broker or auditors and beekeepers are available to assist in handling the hives. The grower should also be present and observe the inspection.

Refer to NSW DPI AgGuide Pollination using honey bees – Chapter 10 for a comprehensive guide on how to assess hive strength and what to look for (NSW 2018).

Growers can further monitor colony strength by walking orchards daily during bee flight hours to observe activity levels. In addition, growers should record hives that appear weak (i.e. relatively few bees coming and going at the hive entrance) or inactive, and then report those hives to the beekeeper. This is also an opportunity to observe whether pollination is taking place. If the foraging bees are not collecting and carrying pollen on their legs, there is little to no pollination taking place.

The National Bee Biosecurity Code of Practice ensures only clean and healthy hives are delivered to almond properties reducing the risk of pest and disease spread.

Image credit: Melina Mueller, Walker Flat Almonds.

3. MANAGING PESTS AND DISEASE

Australia is fortunate in that it does not have any serious exotic parasites, such as Varroa, tracheal and tropilaelaps mites. However, there are a variety of established pests that can affect the hive health and productivity if not properly managed. Beekeepers will be familiar with these pests and how to control them e.g. American foulbrood (AFB), European foulbrood (EFB), Chalkbrood, Nosema, Small hive beetle (SHB), Wax moths, European wasps and even some ants.

More information about honey bee pests can be found on the BeeAware website.

Biosecurity risk

In large orchards there may be multiple beekeepers engaged to achieve the required hive density. The movement of hives within Australia to meet the demand for almond pollination together with the robbing habit of honey bees means the spread of pest and disease can be difficult to prevent or contain discouraging beekeepers from providing pollination services.

For example, AFB is an established bacterial disease of the brood (developing eggs, larvae or pupae) which forms spores that may be viable for decades and readily spread when hives infected with AFB are robbed. Robbing occurs when field bees from healthy hives remove honey from infected and weakened hives. In this process, contaminated honey is transported back to healthy hives. The risk increases if infected hives are left for extended periods after flowering as the availability of nectar declines and the tendency to rob hives increases. If AFB is present in an orchard, then all hives within three to four kilometres are at risk of infection.

The National Bee Biosecurity Program

Over the last three years the Australian Honey Bee Industry Council (AHBIC) and Plant Health Australia (PHA) have worked with beekeepers to develop a National Bee Biosecurity Program. The program is underpinned by a Bee Biosecurity Code of Practice (the 'Code') which provides a framework for Australian beekeepers to use biosecurity measures in day-to-day practice. Compliance with the 'Code' will reduce the risk of disease and benefit the whole beekeeping industry and horticultural operations that rely on honey bee pollination ensuring only clean and healthy hives are delivered to almond properties.

The 'Code' has been developed to incorporate fundamental biosecurity principles into the practices of all Australian beekeepers including:

- training and planning
- reducing exposure of bees to pests and diseases
- controlling pests and diseases
- controlling the spread of undetected disease in an apiary
- keeping accurate records, and
- hive and equipment maintenance.

Some sections of the 'Code' are mandated under state legislation. State governments have primacy in enforcing the 'Code' and investigating pest or disease incidents.

All beekeepers are required to complete an annual Certificate of Compliance. In the future, almond growers may request a copy of the Certificate of Compliance each year from their beekeepers to ensure disease spread is avoided during pollination.

Beekeepers meeting the 'Code'

Beekeepers have embraced the 'Code' as it provides assurance that only clean and healthy hives will be brought to almond orchards. The following checklist helps show that beekeepers have prepared for the almond pollination in line with their responsibilities under the 'Code'. Growers will know if beekeepers are compliant if:

1. registration details are current and branding (including name and registration number) is clearly marked on all hives
2. all hives are structurally sound, have intact external surfaces, and only have openings designed specifically for bee access
3. broods have been inspected regularly for pests and diseases. Diseased or substandard hives have been removed from the load before arriving at the orchard
4. hives have been tested for exotic parasites (such as Varroa mite) via drone uncapping and either the sugar shake or alcohol wash methods
5. beekeepers have provided available hive numbers and their quality
6. records are available detailing inspections, tests, observations and actions (such as movement) as they relate to each hive
7. a honey culture test is conducted annually (mandatory for beekeepers with 50 or more hives)
8. a completed and signed 'Certification of Compliance' document is available to demonstrate compliance with the Code.

An online training course 'Biosecurity for Beekeepers' has been developed for beekeepers to care for honey bees in accordance with the new Australian HoneyBee Industry Biosecurity Code of Practice.

The 'Bee Biosecurity Awareness' course is available to anyone and provides an overview of biosecurity best practice, keeping honey bees healthy, hive inspections and reporting suspect pests or diseases.

The 'Pests and Diseases of Honeybees' course helps identify and manage the major established pests and diseases of honey bees to minimise their impact, whilst promoting awareness and surveillance for the exotic pests and diseases threatening the Australian honey bee industry. It is offered online through Tocal College, a Registered Training Organization, and is aligned to national units of competency, awarded on successful completion of the assessment tasks.

Under the "Code of Practice" every beekeeper needs to be registered and their brand clearly marked on hives. Bee keepers may provide a 'Certificate of Compliance' outlining their practice to maintain hive health in-line with the "Code".

Image credit: Almond Board of Australia.

Biosecurity inspection/ investigation

Each year, beekeepers are required under legislation to register their hives and keep records of subsequent movements within and between states. This enables early contact of beekeepers and location of hives that may require inspection or treatment to prevent the spread of unwanted pests and diseases.

It is the role of a state biosecurity inspector to quickly ascertain whether hives delivered to an orchard pose a biosecurity threat and direct suitable action to destroy hives immediately to prevent spread.

Under the relevant state legislation, state government officers have the 'right to enter' a property to undertake disease surveillance and compliance monitoring activities which may include physical hive inspections to detect and contain any disease present.

Movement of vehicles, machinery and equipment

The almond pollination season involves the transportation of over 300,000 hives and millions of bees. Vehicles and apiary equipment (including forklifts, trucks, hand tools, hive components and appliances), are brought in by commercial apiarists from southern Queensland, New South Wales, Victoria and South Australia. It is possible that pests and diseases and weed seeds can be brought into orchards via contaminated soil, apiary equipment, vehicles, clothing, boots and bees which can then spread, or be introduced to other properties.

Growers should work with beekeepers to reduce the threat from pests, diseases and weeds by:

- adopting a 'come clean, go clean' policy wherever possible
- inspecting all incoming vehicles and equipment for signs of contaminated soil or plant material, honey, wax and associated colony debris
- consider using high pressure washdown facilities, with a tarmac pad, for cleaning vehicles and equipment with treatment and disposal of effluent away from plants and irrigation sources
- dispose of debris or farm waste away from growing or production areas
- limiting the movement of vehicles within the orchard to well-formed roads with appropriate capacity for heavy vehicles
- regularly cleaning and sterilising all tools and equipment, including hive tools, gloves, pallets, boxes and any other equipment and machinery
- erecting biosecurity signs at the property entrance which outline basic requirements for visitors including sign in procedures
- implementing a monitoring and pest management program
- keep hive sites clean of weeds over the full year to control weed seeds especially spiny weeds seed such as Three Corner Jack, Caltrop and Gentle Annie.

While inspecting and cleaning machinery can seem onerous, it is easier and cheaper than dealing with a new pest or disease outbreak.

Honey sacs on the legs of honey bees are a sign that bees are actively foraging and that pollination is taking place.

Image credit: Beephotos_Buzz honey

4. CARING FOR HONEYBEES IN THE ORCHARD

A good harvest starts with good pollination. There are several simple and practical things growers can do in the orchard to create an environment which keeps honey bees healthy and encourages them to forage and pollinate more almond flowers.

Environmental factors affecting hive health

There are many conditions that affect bee behaviour and health and measures need to be put in place to minimise or eliminate the impact of the following:

- cold weather in early spring means the outer edges of the brood are left unprotected and become chilled. The minimum standard of six frames per hive ensures the core temperature is maintained
- insufficient nectar and pollen occurring if hives are brought in too early (without supplementary resources) and left in too late after flowering, resulting in adult worker bees removing or feeding on larvae and pupae
- overheating in extremely hot weather, or during transport if confined to their hives, when field bees cannot manage to collect enough water to keep the hive cool
- failing or absent queen where hives without a healthy and fertile queen stop producing a healthy brood
- pesticide poisoning with pesticides applied when bees are foraging or collecting nectar or pollen contaminated with systemic insecticide and return to the hive affecting the colony. Bees sprayed directly with spray (even if not toxic) will not be able to fly with the weight of spray droplets on their wings. When pesticide drifts onto bees, flowering plants, hives or the bees' water source. ***Refer to section 5. Honey bees and pesticides.***

Selecting a suitable location for bee hive placement

Many Australian almond orchards were designed to maximise the planted area which means the areas assigned for hive placement were generally not suitable for growing almond trees. Unfortunately, many of these locations are also less than desirable for bee hive placement. Depending on elevation and exposure to the sun the difference in micro-climate temperatures in an orchard can be 10 degrees Celsius or greater (Somerville and Frost 2019). Pollination in late winter is very sensitive to the impact of temperature, bee flight and behaviour that need to be considered when placing hives. There are also practical considerations in the placement of hives to reduce health and safety risks and assist general orchard operations.

Hives should be placed:

- ✓ where they are accessible and convenient at all hours for servicing and removal
- ✓ near flowering forage before and after bloom if possible.
- ✓ with northern and eastern exposures for hive openings to encourage honey bee flight
- ✓ away from areas prone to shade, flooding or frost
- ✓ away from abandoned hives that may harbour disease
- ✓ where they can be accessed via roads that are well maintained to enable access during wet conditions and free of obstructions
- ✓ where they have appropriate buffers between pesticide-treated areas and colonies
- ✓ away from busy, high traffic areas frequented by field workers who may be stung
- ✓ in areas actively managed for weed seeds to prevent spread to subsequent locations.

Place hives where they are easily accessed via well maintained roads and in an area free of prickles.

Image credit: Melina Mueller, Walker Flat Almonds.

Maintain clean water close to hives with floats or landings allowing bees to rest or drink. Water sources should be covered during chemical control treatment, or clean water supplied immediately after a treatment.

Image credit: Almond Board of Australia.

Gradual introduction of hives, commencing at 5-10 percent flowering, will ensure enough flowers are available to support bees and reduce bee stress.

Image credit: Bee photos_Buzz honey.

Providing fresh drinking water

Water is important in maintaining the temperature of active hives. The grower and beekeeper should determine who will be responsible for maintaining fresh water for bees to drink during pollination that is free from contamination. The source should be close to the hives (i.e. 50-100m or closer) to ensure bees spend more time pollinating the crop than searching for water and safeguards against bees using water further afield that may be contaminated with pesticides. Water should be checked and replenished throughout the bees' time in the orchard.

Landings such as hessian, screens or floats make water accessible and prevent bee drowning. The responsible party should also either cover or remove water sources before a pesticide treatment and supply clean water after a treatment is made.

Timing of hive placement

The timing of moving hives in and out of the orchard is important to maximise pollination and minimise bee stress. If all the bees required for pollination were introduced at the start of flowering, there are not enough floral resources available to sustain all the bees. Staging the movement of hives in and out of the orchard, in relation to the amount of flower, can help reduce the stress on the bees.

Ideally hives should enter the crop when flowering is at about 5-10% flowering to ensure field bees immediately initiate pollination as they orientate to collect the nectar and or pollen. However sometimes there are delays in delivery caused by rain, truck delays, poor road conditions, and the high number of hives needing to be delivered at the same time. For these reasons it is better to start hive delivery when flowering is close to starting.

Monitor the flowering process across the orchard and keep the beekeeper informed of signs of bud swell and green tip so that hive delivery can be timed (Appendix B).

Warm weather may bring forward bud swell, and flowering may happen more quickly with the primary blossom out in flower in less than two weeks. Similarly, cold weather may delay flowering and reduce bee foraging activity.

ABA Interactive flowering graph for different varieties

ABA flowering observation tool – long term flowering records.

The flowering process

The flowering period for almonds is typically in early August and is nearly always finished by the end of August. However, each flower is only viable for pollination for five days.

The temperature must reach at least 13C before buds swell to flowering. Pollen is released when anthers split open, or dehisce, with an optimum range between 18 – 27C. Most pollen is removed from each flower each day if the field bee numbers are adequate and the foraging conditions favourable. The stigma is most receptive to pollen on the first day of blossoming and this diminishes each day until the fifth and last day. The flowering process happens progressively; the anthers do not open all at once.

On a typical day in bloom, the bees have collected the pollen that was released by mid-afternoon. The blossom's pollen-receiving structure, the stigma surface, is receptive to fertilisation for about five days after the flower opens. However, fertilisation is most successful when pollination occurs during the first few days that a flower is open. Bees, both pollen and nectar collectors, concentrate on newly opened blossoms. One study found about 90% of all bee visitations were confined to flowers that have pollen. With adequate weather and bee activity, essentially all pollen will be collected from individual flowers within about four days after they have opened. In fact, past studies show that during favourable pollination weather, blossoms remain receptive to cross-pollination up to four-to-five days after opening. Cooler weather will lengthen the period of pollen collection and flower receptivity and will delay petal fall.

Petals normally remain on flowers past the receptive period for cross-pollination, but once the pollen is depleted bee visitation to flowers drops off substantially and the remaining few visitors concentrate on collecting nectar. Nectar collectors are not efficient pollinators. These bees typically descend on the petals, probe for nectar at the base of flowers, and rarely pick up or transfer pollen. In contrast, pollen-collecting bees descend on the top of anthers and transfer pollen to the stigma surface, which is necessary for fertilisation.

Determining if flowers have pollen and are receptive to cross-pollination is fairly simple. In newly opened flowers, most, if not all, anthers have not yet opened and are plump; yellow, but not fuzzy. Anthers with pollen appear yellow and fuzzy, and for about four days there will be a mixture of opened (dehisced) and unopened anthers. Older anthers without pollen are dry and light brown, and in older flowers when none of the anthers have pollen, the style (the tube below the stigma surface) turns from green to brown, and the stigma and style are no longer receptive to pollination.

It is best to check for pollen in the morning before honey bees finish foraging for all the pollen available that day.

Supplementary feeding

Increasingly, beekeepers are relying on supplementary feeding to maintain hive health and pollination efficiency rather than relying solely on the environment. Drought conditions and bush fires in National Parks have depleted the amount and selection of native floral resources historically used to build up hive strength and produce honey. This together with the expansion of beekeeping operations means supplementary feeding has become more necessary.

Supplementary feeding is when sugar syrup and protein supplements are made available to the hive. There are different types of feeding to encourage brood rearing or to increase hive stores. Open feeding is not acceptable while hives are present in the orchard.

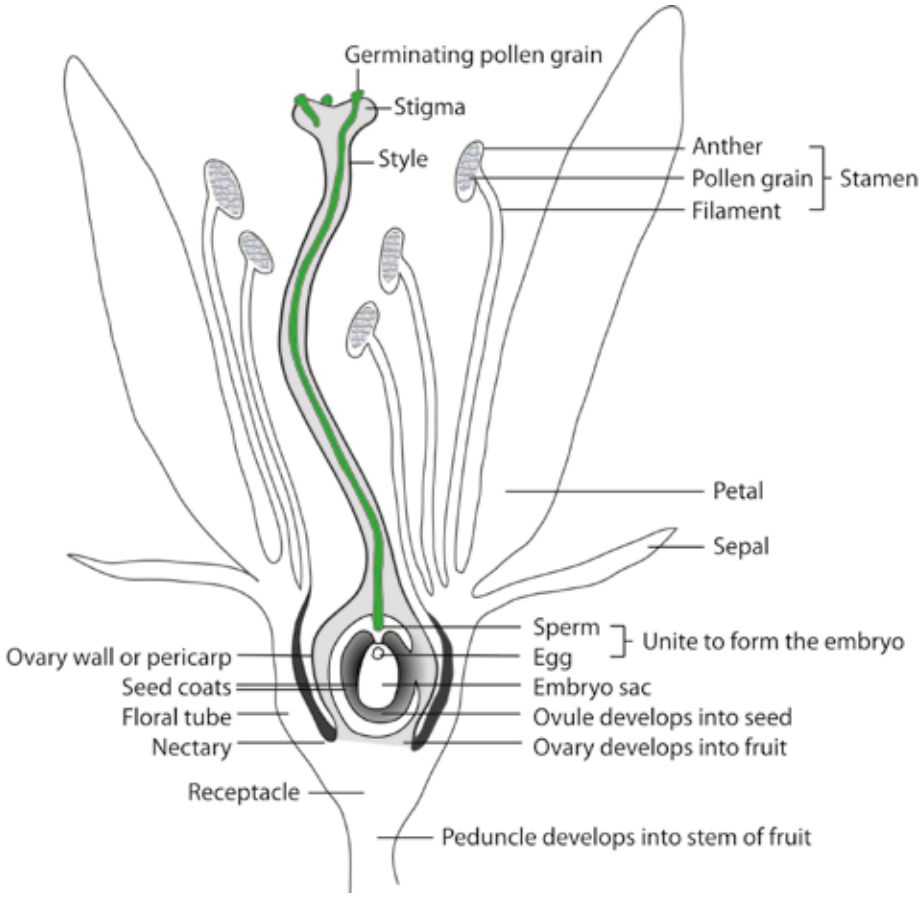


Figure 1:
For fertilisation to be initiated, pollen from the anthers must be transferred to the stigma surface. When no anthers have pollen, the style turns from green to brown and the stigma and style are no longer receptive to pollination, and thus fertilisation (Wirthensohn, 2018, All About Almonds: Breeding for self-fertlity in almonds).

Supplementary feeding may stimulate the colonies to enhance pollination activity and provide protein supplements to ensure the colony remains in good health despite any nutritional deficiencies associated with the almond pollen.

***Consider the following causes and effects** NSW DPI AgGuide (NSW 2018) Pollination using honey bees – Chapter 13:*

- The area of brood in a hive is determined by the availability of nectar in the field. No fresh nectar leads to diminished brood rearing.
- Increasing supplies of nectar stimulate the colony to increase brood rearing.
- The presence of brood sends a signal to the bees that pollen is required.
- Stimulating nectar results in greater brood area and hence increased foraging for pollen.
- Pollen gathering bees are more efficient at pollinating than nectar gathering bees (8-10 times more efficient).
- The size of brood response to the amount of the nectar and pollen foraged depends on the number of bees in the colony and age of the queen; younger queens respond more quickly to the nectar stimulus.
- Hive conditions can be manipulated and potentially produce a more efficient pollination unit (hive). Clearly there is a cost to this extra work but the bees and the crop can benefit.

Supplementary feeding is theoretically a good strategy. However, if hives are constantly opened and closed to provide supplements any beneficial effects may be outweighed by the presence of Nosema; a disease of adult bees. Interfering with hives during early spring and in cool, inclement conditions, may cause Nosema levels to rise and premature death of adult bees.

A green style and yellow, fuzzy anthers with pollen indicate the flower is receptive to being cross-fertilised. Pollen is best checked in the morning while honey bees are foraging.

Image credit: Drew Martin, Omega Orchards.

Establishing cover crops between rows including a mix of brassicas, mustards, vetch or weeds such as wild turnip provide added nutrition before and after bloom when there may be a shortage of floral resources. Orchards with floral cover crops that flower at the same time as almonds tend to have higher nut set.

Image credit: Almond Board of Australia.

Hives are progressively removed from the orchard when the latest flowering variety reaches 90 percent bloom. Bees are collected in the afternoon and bee keepers should make every effort to minimise the number of bees left behind.

Image credit: Robert Wheatley.

Alternative floral resources

Research in Australia and California showed that alternative floral resources e.g. flowering cover crops, provide honeybees with better nutrition and a longer period of foraging — and healthy honeybees means better pollination.

Research showed that alternative floral resources do not compete with almond blooms but can assist by increasing colony strength by extending the foraging period and providing bees with natural nutrition before and after bloom, when there is a shortage of pollen. In general, orchards with floral cover crops tend to have higher nut set than those without.

Alternative floral resources can be planted within rows as a cover crop or adjacent to orchards e.g. buffer zones. Even weeds with flowering times similar to almonds such as brassicas, mustards, daikon radish, turnip weed and clovers can be beneficial during this time. If possible, avoid spraying these weeds post-harvest but allow them to continue to grow and flower until after pollination.

In addition to providing robust food resources for honey bees, floral cover crops within orchards may provide other benefits including:

- increased organic material, nitrogen fixing and soil fertility,
- improved water infiltration and soil moisture conservation, and
- improved soil stabilisation and erosion control.

Growers should note that planting cover crops in, or around, orchards will require attention to pesticide use and consideration of bees while foraging. Growers can reference the Honey Bee BMP Quick guide for spray operators on how to protect bees while spraying.

Planting cover crops in late March ensures the maximum use of rainfall, though some available seed mixtures have a low moisture requirement. When seeds are sown, they should germinate with normal rainfall in autumn and early winter, providing forage blossoms in time for honey bee colonies when they arrive for almond bloom. Some orchards have installed dual irrigation system (low-level sprinkler and drip) to supplement rainfall and encourage cover crop growth.

Timing of hive removal

The ABA recommends bee removal from orchards when 90% of the flowers on the latest blooming variety are at petal fall. Pollination does not take place beyond that point, and when bees forage for alternate food sources and water outside the orchard — bees can fly up to 6.5 kilometres beyond the orchard — they will be at a higher risk of coming in contact with insecticide or fungicide-treated crops from neighbouring properties.

Another option is to provide supplemental forage for bees, particularly before and after bloom (page 20). However, even if bee removal timing may be included in the pollination agreement between the grower and beekeeper, both parties should keep in mind that beekeepers can't always be available, or don't have an alternative location to move the bees.

Unlike bee hive delivery (done in the night) bee hive pick up is done in the afternoon when hives are loaded onto the truck and secured while the beekeeper waits until all the field bees return to the hives on the truck before driving away. This creates a logistical challenge when hives are scattered throughout the orchard and it is likely that many field bees will be left behind. These bees may become a problem to the people who work in the orchard. Beekeepers must make every effort to minimise the number of bees that are left behind to minimise the risk to orchard staff.

Bees actively flying in and out of hives are a good indication that the hives are healthy.

Image credit: Bee photos_Buzz honey.

5. HONEY BEES AND PESTICIDES

While not all chemicals are harmful to honey bees, some pesticides are extremely toxic while others may have delayed effect on the health of the colony. Understanding what chemicals to avoid and how to use chemicals wisely will ensure the safety of honey bees before, during and after pollination.

Insecticides - systemic versus contact

Most of the pesticides that are toxic to honey bees are insecticides and should not be used during almond bloom when bees are in the orchard. Insecticides generally work in one of two ways. Contact insecticides are designed to kill unwanted insect pests upon contact, whereas systemic pesticides are designed to be taken-up through plant tissue, so that pest insects will ingest the poison as they eat the plant. Systemic insecticides can potentially be carried back to the hive in nectar, pollen and water collected by bees, after the application occurred. If insecticide residues are attached to pollen brought back to the hive and fed to the bee brood, it may result in deformed wingless bees that fail to emerge from the hive. Because the length of a brood's lifecycle is about 21 days, problems affecting the brood may not appear until after almond bloom. Deformed wingless bees are pulled from their comb cells by other bees and are commonly found in front of the hive entrance, leaving those comb cells empty.

Some people believe that contact insecticides pose less risk to bees than systemic insecticides, provided that the bees don't come into contact with wet pesticide solution. However, it must be considered that contact insecticides may remain active for several days and may be re-dissolved in dew, which bees may subsequently come into contact with or drink.

Fungicides

Fungicide applications are needed in many situations as disease protection during almond bloom is vital. However, fungicides may negatively impact pollination. For example, spraying while bees are foraging weakens the floral-scents that draw the bees to the blossom. Research shows some fungicides, while fairly safe for use around adult honey bees, may contribute to brood losses in larval and pupal stages. While most fungicides do not cause harm when used on their own, mixing with other fungicides, insect growth regulators, herbicides or insecticides can result in toxic combinations with harmful effects.

Further research is being done in this area in Australia and overseas. A literature review by the University of Adelaide has found that most fungicides are relatively harmless when used on their own. However, some fungicides weaken the bees' immune system and can increase the toxicity of insecticides. Until the impacts are fully understood fungicide(s) should only be applied if deemed necessary, applied as a separate application (not mixed with other chemicals) and only applied late afternoon or evening when foraging bees and pollen are not present.

Further information on the findings of the literature review on fungicides and bees in almonds can be found here https://www.agrifutures.com.au/product/fungicides-and-bees-in-almonds/.

Some insecticides are known to result in greater than additive toxicity when combined with certain fungicides such that when the insecticide and fungicide are tank-mixed, the combination can be more toxic to bees than either chemical used alone. Until more is known, avoid tank-mixing insecticides with fungicides during the almond pollination season, the only exception being mixing ***Bacillus thuringiensis*** (Bt) with a fungicide as Bt is documented to be safe for both adult and immature bees.

Growers should notify beekeepers if they see anything unusual, inactive hives or signs of dead bees (more than a cup) in front or around hives .

Image credit: Almond Board of Australia

Do not use insecticides in the 10 days prior to hives being moved on to the property or while hives are in the orchard. Thoroughly clean spray tanks to avoid remnant insecticide contaminating fungicide sprays.

Image credit: Almond Board of Australia.

Fungicides should only be applied if deemed necessary, applied as a separate applications (not mixed with other chemicals) and only applied late afternoon or evening when foraging bees are not present.

Image credit: Almond Board of Australia.

Honey bees use an enzyme called P450 to detoxify chemicals, and if this enzyme is being used to detoxify one chemical, it may not be available to detoxify the other, resulting in poisoning. It is difficult for beekeepers and farmers to ascertain which products will pose a threat when applied together. The simple "jar test" practised by many farmers, only provides an indication of whether or not the combination of chemicals can be applied without solidifying and damaging equipment – it does not provide any indication of its efficacy or impact on bees. In the absence of expert advice, the most responsible approach is for beekeepers and farmers to assume that chemical combinations are toxic, and to avoid this practice in situations where honey bees may be affected. Alternatively, beekeepers should consider relocating their hives before spraying to avoid the risk.

Surfactants

Pesticides are sometimes required to be mixed with an additional product known as a surfactant, which is designed to ensure that a pesticide penetrates the target plant or insect. Some evidence suggests that some surfactants, designed to penetrate woody plants for example, may also penetrate the waxy cuticle or exoskeleton of the honey bee, its first line of defence against such hazards. In Australia surfactants and other adjuvants are regarded by the Australian Pesticides and Veterinary Medicines Authority (APVMA) as pesticides in their own right, and are subject to the same assessment, registration and labelling requirements.

Pesticide label warnings

All new agricultural chemicals are assessed and registered by the APVMA with many pesticides used in horticulture and broadacre farming known to be toxic or dangerous to honey bees. Pesticide labels provide bee related warnings. However, it is important to note that the absence of a honey bee related warning does not mean that the product is entirely safe for honey bees as many herbicides, fungicides and adjuvants do not contain a bee related warning. Label language will continue to evolve as more information becomes available on the effects of pesticides on bee brood.

In 2012 Rural Industries Research and Development Corporation (RIRDC) published a list of 349 broadacre and horticultural pesticides known to be toxic to honey bees in Australia 'Honey bee pesticide poisoning: a risk management tool for Australian farmers and beekeepers', Appendix 1 and 2.

Growers can find currently registered chemical products by registered name or active constituent via the APVMA Public Chemical Registration Information System Search (PUBCRIS).

Integrated pest and disease management

Monitoring for pests and disease is a key component in knowing when and what pests and diseases are present to target control treatments. Integrated pest and disease management (IPM and IDM) programs will enhance pest control, protect water and air quality, and minimise exposure of bees and pollen to pesticide sprays. IPM and IDM provide an environmentally sensitive way of managing pests and diseases using a combination of practices (managing inputs and good orchard hygiene) and control methods with the aim of preventing problems from occurring and reducing the need for pesticide intensive activities. Sources of information on developing and implementing an IPM and IDM programs in almonds can be located on the ABA website.

Best practices chemical use to protect honey bees

Growers and spray operators can follow these precautions to help protect honey bees from pesticide applications:

- ✓ Always read the label and follow directions for use.
- ✓ Discuss your pesticide plan with your beekeeper and agronomist well before the start of the season to select chemicals that are safe for bees while still achieving effective pest and disease control.
- ✓ Before bloom, avoid applying insecticides with extended residual toxicity or systemic insecticides.
- ✓ Before, when spray applications are imminent, establish clear lines of communication with all involved in pollination and spraying so that each party is informed in advance of this busy season.
- ✓ During bloom, do not use pesticides with cautions on the label that read “dangerous to bees”, “highly toxic to bees,” “toxic to bees,” “residual times” or “extended residual toxicity.” Residual toxicity to bees varies significantly between pesticides and pesticide products, and their impact can last anywhere from hours to a week, or more.
- ✓ During bloom, spray fungicides only if essential and only at mid afternoon/ night, when the bees aren’t active allowing time for the chemical application to dry. Do not spray so late that the fungicide does not have time to dry before bees begin foraging the next day. Avoid tank-mixing insecticides with fungicides (unless mixing with Bt).
- ✓ Thoroughly clean spray tanks to avoid remnant insecticide contaminating fungicide sprays.
- ✓ Surfactants (adjuvants) should not be added to fungicides during bloom, unless stated otherwise on the label. Most fungicides are formulated with adjuvants including wetting agents, spreaders and stickers.
- ✓ Advanced warning is mandatory for pesticide products with the statement “dangerous or toxic to bees” on the label. Give beekeepers at least 48 hours but more time is preferable. Bees can only be moved at night and under suitable environmental conditions.

- ✓ See the sections on "the flowering process" for guidelines on how to determine whether exposed pollen is present in flowers.
- ✓ Ensure bees have access to clean water and cover or remove water sources before spraying and replace with clean water immediately after chemical use.
- ✓ Do not spray hives directly with any pesticide. Ensure that the spray-rig driver turns off nozzles when near hives.
- ✓ Ensure bees are not foraging in the area to be sprayed and do not hit flying bees with spray applications as the weight of spray droplets on their wings will mean they can't fly.
- ✓ Be sure to avoid pesticide application or spray drift to blooming weeds in or adjacent to the orchard when honey bees are present.
- ✓ Notify neighbours when bees will be in the orchard and provide your contact details so they can provide notice before intended sprays.
- ✓ After bloom, and once the hives have been removed, it is recommended to check the locations where the hives were kept for bees that may still be foraging.
- ✓ Before making insecticide applications outside of the pollination season register each spray event through the BeeConnected App to check for hives in the area and automatically alert beekeepers.

Remember to keep all parties informed of agricultural sprays according to the communication chain agreed upon so that beekeepers are always aware of impending applications and spray operators are fully informed of the parameters regarding materials, timing, location, climate conditions and method of application.

Registered farmers and contractors will receive notifications through BeeConnected when a beekeeper places their bee hives near an orchard. Registered beekeepers also receive an alert when a farmer or contractor intends to use a product to protect their crop. More information on pesticide toxicity is available on the BeeAware website.

Identifying suspected pesticide – related honey bee losses

It is important to understand how to recognise and respond to a pesticide-related incident if it does occur. Growers should regularly monitor hives in the orchard and check for possible signs of a pesticide-related incident which may including:

- excessive numbers of dead and dying adult honey bees in front of hives
- in severe cases, dead adult bees will be found inside the hives as well and brood will die from starvation, overheating or chilling (due to inability of adult bees to feed brood and regulate hive temperature). This may be observed when a beekeeper/third party auditor undertakes a hive health assessment in response to dead and dying bees
- lack of foraging bees leaving the hive on a normally attractive blooming crop
- bees that are lethargic (i.e., dazed, unconscious) or immobile, and are unable to leave flowers
- bees that are demonstrating jerky, wobbly or rapid movements; spinning on their backs; or are excessively grooming
- disorientation and reduced efficiency of foraging bees
- bees that are unable to fly and are crawling slowly, as if chilled
- most or all hives in an area may be affected
- dead adult bees often have their wings unhooked and at odd angles to their body, their proboscis fully extended, and their hind legs outstretched behind them
- remaining bees may behave aggressively.

What should you do?

Contact the beekeeper immediately if any of the symptoms above are observed. Remember that bees can fly over 6.5 kilmetres and spray drift under the wrong weather conditions can travel up to 10 kilometres so the poisoning event may not have occurred on the orchard, it could be a neighbour for example who does not know there are bees in the area. If a beekeeper decides to report the incident a proper investigation is important to ensure growers who have done the right thing are not unfairly blamed.

In reporting a suspected incident to the state government department the grower may be required to provide information describing the time, date, location(s) and number of bees killed. If a recent chemical has been sprayed, describe the previous health of the colony, prevailing wind at the time of spraying, registration number from the suspected pesticide label, name of the suspected pesticide and how the bees may have been exposed to the pesticide. Photos or videos of the incident can also be included.

Beekeepers should also report pesticide treatments applied to the hives and pertinent details related to the health of the bees leading up to the incident.

Immediately freezing at least 60 grams of adult bees, brood, pollen, honey, nectar or wax in labelled, clean containers will preserve the evidence of an incident and may be helpful if the incident warrants laboratory analysis.

Do not disturb the hives or site when an investigation is pending.

More information about responding to a poisoning event can be found on the BeeAware website.

For a summary of the information to include and what symptoms to record, download the Pesticide poisoning report. This report is an extract from Honeybee pesticide poisoning: a risk management tool for Australian farmers and beekeepers, published by the Rural Industries Research and Development Corporation (2012).

Report a suspected pesticide-related event

Anyone with a concern, or knowledge of a spray drift incident or pesticide misuse in their local area should report it to the EPA or state government:

New South Wales
Environment Protection Agency (EPA)
www.epa.nsw.gov.au
Environment Line - 131 555

South Australia
Department of Primary Industries and Resources, Senior Apiary Inspector
www.pir.sa.gov.au
Phone: 08 8207 7975

Victoria
Agriculture Victoria,
http://agriculture.vic.gov.au/agriculture/farm-management/chemicals/report-an-issue
Customer Service Centre – 136 186

Western Australia
Department of Agriculture and Food, Plant Biosecurity
www.agric.wa.gov.au
Phone: 08 9368 3535

These reports should be submitted as soon as possible after an incident occurs to help ensure the details are documented as accurately as possible.

Reporting an adverse pesticide experience- Australian Pesticides and Veterinary Medicines Authority (APVMA)

If growers have experienced an unintended or unexpected outcome associated with the registered use of a product when used according to the approved label instructions this is called an adverse experience and should be reported to the APVMA. This includes impacts on honey bees.

An adverse experience report can be made online providing as much detail as possible (including details of vets, doctors and/or agronomists reports, pathology and post-mortem reports etc., where appropriate). Please note that the information supplied should be accurate and correct.

The APVMA will evaluate all the adverse experience reports it receives involving registered agricultural chemical products in Australia.

The APVMA adverse experience reporting program can be contacted by phoning 1800 700 588 or visiting https://portal.apvma.gov.au/aerpexternal/welcome.htm.

These reports should be submitted as soon as possible after an incident occurs to help ensure the details are documented as accurately as possible.

Falling petals indicate the end of another pollination season and a job well done by honey bees.

Image credit: Bee photos_ Buzz honey.

6. HONEY BEES AND SELF-COMPATIBLE ALMOND VARIETIES

Although self-compatible (or self-fertile) varieties will reduce the reliance on bees it will not eliminate them or the need for pollination. Self-fertile varieties still require bees for pollination of a self-compatible flower and between flowers on the same tree. A number of factors - genetic, environmental and even the individual flowers - determine self-pollination and set. Even with self-compatible varieties, honey bees can ensure maximum set because bees consistently transfer pollen within the same flower from the anthers to the stigma of the pistil, where fertilisation is initiated (see Figure 1). However, with self-compatible varieties, because pollen no longer needs to be transferred between different varieties, the number of bee hives needed will be reduced.

7. KEEPING EVERYONE SAFE DURING POLLINATION

There are common hazards associated with having bees on-site and growers need to be aware of these to make sure all parties involved in pollination are working safely as well as visitors.

Bee stings

Honey bees may sting as a natural defence when the hives are handled or in response to a potential threat. People react differently to stings from a small local reaction (pain, redness, itching and swelling) for a short time to a hypersensitive reaction that may be life threatening.

As part of a farm safety system growers should at a minimum:

- erect signs at the property entrance to advise visitors, staff and contractors when beehives are located on the property
- provide staff and contractors with a hive location map and schedule activities away from hives ad foraging bees to avoid exposure
- ask all visitors and new staff if they are allergic/anaphylactic to bee stings
- maintain a first-aid kit with EpiPen
- ensure only beekeepers or agreed auditors open or move hives using appropriate personal protective equipment including: hat and veil; protective gloves; safety boots and protective suits; smokers etc
- inform staff, if stung, to calmly and quickly walk away from the hive, or forage area, towards a shady area or into a car or building
- have staff trained in first aid procedures and emergency response to bee stings.

Manual handling

Beekeepers are well trained in handling beehives. If assisting a beekeeper in the process of unloading, loading or moving hives avoid manual handing injuries by:

- handling smaller loads
- use a machine if possible (trolley, forklift, mechanical hive loader)
- employ additional labour to assist
- practice good body positioning to reduce bending, twisting and reaching movements
- allow adequate time to prevent muscle fatigue and strain.

Heavy vehicle safety – growers' chain of responsibility

Growers play an important role in supporting safe, reliable road transport for the benefit of all road users. Heavy vehicles (vehicle mass of more than 4.5 tonnes) are often used to brings hives to the orchard and growers have a shared responsibility to ensure all parties in the heavy vehicle supply chain always use safe practices within their control.

For more information on the national heavy vehicle regulator go to www.nhvr.gov.au/sms or https://www.nhvr.gov.au/files/201802-0755-cor-primary-producers.pdf.

Growers responsibilities when heavy vehicles are owned and operated:

- What and how much is loaded onto the vehicle, how the weight is distributed and how the load is restrained.
- Vehicles are fit for purpose, mechanically safe and legally able to be used on a road.
- Drivers are not fatigued or tired and don't work longer than they are allowed by law.
- Safety risks of the activity are understood as related to the transport task, including packing goods for transport, scheduling travel and delivery times, and the impacts of delays in loading and unloading trucks.
- Avoid requests, instructions, requirements or demands that may influence the driver to speed or drive while fatigued.

Growers responsibilities when heavy vehicles are contracted via another operator:

- Avoid requests, instructions, requirements or demands that may influence the driver to speed or drive while fatigued.
- Ensure stock or loads are ready to load on time so that a driver is not unduly delayed and pressured to speed or exceed fatigue hours.
- Ensure safe access, while on your property, for the heavy vehicles and advise drivers of any relevant local knowledge.
- Ensure you consult with your transporter and other parties in the chain when setting timeframes for pickup and delivery.
- Use operators that provide safe and compliant transport activities. Consult your provider to ensure any safety risks are understood and steps are taken to mitigate those risks.

Far right: Heavy vehicles are often used to bring hives to the orchard and growers have a shared responsibility to ensure everyone uses safe practices within their control.

Image credit: Almond Board of Australia.

Best management practice for the transportation of open entrance beehives

In the interests of public safety, the Australian Honey Bee Industry Council Inc. (AHBIC) recommends that the following guidelines are followed, except in the case of emergency, e.g. fire or flood:

- ✓ Where possible, only transport open entrance beehives between sunset and sunrise.
- ✓ When securing beehives, equipment or machinery onto transport vehicle ensure LOAD RESTRAINT GUIDES as set down by the National Transport Commission of Australia are adhered to.
- ✓ After completion of loading of beehives, wait until most bees have stopped flying before departing site.
- ✓ Even in cooler weather, travel through built up areas and road works should be avoided during daylight hours.
- ✓ Ensure adequate fuel is carried on the vehicle to complete the journey without the need to enter a refuelling depot when transporting open entrance beehives.
- ✓ If absolutely necessary that a break in the journey has to occur, then ensure vehicle is located far enough away from lights as not to attract bees.

If the above guidelines cannot be met, AHBIC advises beehives should be screened, netted or closed entrance to prevent escape of bees from transport vehicles. Further information can be found on the AHBIC website.

All hives should be structurally sound with sufficient room for colony expansion.

Image credit: Melinda Mueller, Walker Flat Almonds.

8. REFERENCES AND USEFUL RESOURCES

- Almond Board of California 2018. Honeybee best management practices for California almonds. A guide for pollination stakeholders. Published by the Almond Board of California. Pp19.
- BeeAware website:
  https://beeaware.org.au/pollination/
  https://beeaware.org.au/industry/education-and-resources/
- Dr Mark Goodwin, Pollination of crops in Australia and New Zealand.
- Daryl Connelly (2012) Honey bee pesticide poisoning – a risk management tool for Australian farmers and beekeepers, Rural Industries Research and Development Corporation Publication 12/043.
- Connelly, D (2012). Honey bee pesticide poisoning – a risk management tool for Australian farmers and beekeepers, Rural Industries Research and Development Corporation Publication 12/043.
- Goodwin, M (2012). Pollination of crops in Australia and New Zealand, Agrifutures Australia. Pp 136.
- NSW DPI (2014) Healthy Bees Managing Pests, Diseases and Other Disorders of the Honey Bee AgGuide A Practical Handbook by Jennifer Laffan https://books.apple.com/au/book/healthy-bees/id904874707
- NSW DPI (2016) Healthy bees AgGuide A Practical Handbook https://www.tocal.nsw.edu.au/publications/bees/agguide-healthy-bees
- NSW DPI (2018) Pollination using honey bees AgGuide A Practical Handbook, by Doug Sommerville and Elizabeth Frost Pp. 309 https://www.tocal.nsw.edu.au/publications/bees/pollination-using-honey-bees.
- NSW DPI (2019) Honey and pollen flora of South Eastern Australia – by Doug Sommerville https://www.tocal.nsw.edu.au/publications/bees/Honey-and-pollen-flora-of-south-eastern-Australia
- Plant Health Australia 2016. Biosecurity manual for Beekeepers. Version 1.1
- Thomas, D (2018). Phenology standard for almonds. South Australian Research and Development Institute. Pp7.
- Wirthensohn, M (2018), All About Almonds: Breeding for self-fertility in almonds, Almond Board of Australia.

APPENDIX A: POLLINATION AGREEMENT TEMPLATE

This agreement is made on the_____(date)

BETWEEN_____

(Grower's name) hereinafter called the "Grower"

AND _____

(Beekeeper's name) hereinafter called the "Beekeeper"

TERM OF AGREEMENT
The term of this agreement shall be for the _____(season) growing season, covering _____ (date) to_____(date).

(Other agreed provisions should be added or deleted if required at the time of signing, and initialed by both parties.)

SECTION A: RESPONSIBILITIES OF THE BEEKEEPER

Beekeeper Agrees:

1. Supply proof of current beekeeper registration with relevant state government department (e.g. Victorian Department of Environment and Primary Industries, Primary Industries and Resources SA, NSW Department of Primary Industries).
2. To supply the Grower with hives of European honey bees as stipulated in the following table:

HIVE DELIVERY TABLE

Hive Number	Description of the hive set-down location	Timing of introduction
		At % of flowering
		At % of flowering
		At % of flowering

(Grower to advise Beekeeper of delivery dates as per clause 5)

3. Deliver hives each containing a minimum of (higher standards may be negotiated, especially on isolated or problem crops):

   a. Six, with an average of eight standard frames well-covered with bees (three quarters covered at 15 degrees Celsius)
   b. two full standard frames or four frames 50% full of brood in all stages
   c. at least three full-depth frames of honey (10kg of honey)
   d. active laying queen (not drone laying queen)
   e. sufficient room for colony expansion

4. To deliver hives that have been inspected for symptoms of American foulbrood, European foulbrood, Chalkbrood, and small hive beetle in the previous autumn, and demonstrate compliance with the National Australian Honey Bee Industry Bee Biosecurity Code of Practice, by providing the grower with a copy of beekeeper 'Certification of Compliance' document completed and signed.
5. To deliver each instalment of hives to the property within____days of first signs of green tip (bloom stage of almonds) or by_____(date).
6. To place hives in positions decided in previous consultation with the Grower in group sizes of no more than____(number) hives.
7. Within and agreed timeframe (___days) of notice from the Grower to open and demonstrate bee colony strength of any hives specified by the Grower (such request not to be made unreasonably).
8. To provide permission for an auditor nominated by the Grower to audit the strength and health of the colonies if requested by the Grower within seven days of arrival.
9. To supply within an agreed timeframe (____days) an additional hive(s) to compensate for any hive found to be below the minimum standard, at no extra cost to the Grower.
10. To remove the hives within an agreed timeframe (_____days) of being notified by the Grower that they are no longer required.
11. To take all reasonable measures to reduce the number of field bees left behind in the Grower's property when hives are removed.
12. To collect any bee swarms in the property during the flowering period within an agreed timeframe (_____days) as requested by the Grower.
13. To carry appropriate insurance e.g. public liability insurance (including third party for accidental damage) and workers compensation insurance.
14. To abide by orchard policies, including but not limited to: personal and professional conduct policies; biosecurity and occupational health, safety and welfare policies.
15. To inspect the property and any site hazards identified by the Grower under Section B, clause 8, such inspection to be in daylight before delivery of hives.
16. Carry out any sanitation of vehicles, hives and associated equipment of all debris, plant or soil material prior to arrival and before departure as outlined in the Biosecurity manual for beekeepers (section 26) and as requested by the Grower.
17. To fulfill all heavy vehicle safety obligations under the National Heavy Vehicle Regulator Chain of Responsibilities (www.nhvr.gov.au).

SECTION B: GROWER RESPONSIBILITIES

Grower Agrees:

1. To pay a rental sum of $_____per hive for a total of_____hives. GST is to be added to all payments.
2. The total rental is $_____. This is payable as to $_____on or by_____(date) and a final payment of $_____by the_____(date) of the month following removal of hives from the property.
3. To pay_____% (insert) per month (or part thereof) interest on amounts unpaid after due dates.
4. To liaise with the Beekeeper well in advance of hive delivery and allow Beekeeper prior inspection of the property in daylight.
5. To provide a suitable place to locate hives. This site must provide all weather access to a truck or other vehicles used in handling and servicing the colonies and be in a sheltered, sunny position.
6. To provide the Beekeeper with a map of the property well before delivery of hives showing the positions in which hives are to be placed, and the number of hives to be placed at each location.

The positions will be as agreed under Section A, clause 6.

7. To be present, or nominate an appropriate person to be present, when the hives are inspected under Section A, clause 8, and when hives are delivered and removed (to assist with locating sites).
8. To advise the Beekeeper in writing of any property hazards including drains, orchard wires, fences, ditches, irrigation pipes, and any other hazard, and to clearly identify the location and nature of such hazards.
9. To allow the Beekeeper entry onto the property at a reasonable time whenever necessary to service the bees
10. To give the Beekeeper at least hours first notice and hours final notice that hives are required to be placed in the property.
11. Not to shift, examine, or disrupt bee access to or from hives without the Beekeeper's approval.
12. To provide and maintain a clean water source while bees are on-site.
13. To give the Beekeeper at least____hours notice to remove hives from the property.
14. To abide by the appropriate federal and/or state pesticide legislation.
15. To comply with bee toxicity warnings on agrichemical labels.
16. Not to spray any bee-toxic chemical while the hives are on the property, and in so far as is reasonably practicable, to avoid spraying any insecticide in the ten days prior to hives being shifted into the property.
17. To provide the Beekeeper a copy of the orchard spray diary with the spray activities that occurred whilst the hives were on the orchard, thereby facilitating a Maximum Residue Limit (MRL) audit of honey.
18. To avoid spraying any agrichemicals between 08:00 and 17:00 hours when large numbers of bees are foraging, in so far as is reasonably practicable.
19. To provide the Beekeeper with at least_____hours notice if anything is to be sprayed on the property while hives are present and to flush any insecticide or other bee-toxic chemical from tanks and spraying equipment before spraying while hives are on the property.
20. To dispose of any insecticide-contaminated liquid or other bee-toxic material so that bees cannot contact or drink.
21. To give adjoining land owners notice of intent to bring in hives at least ten days before the hives are moved into the property and notice of the full period that the hives may be present.
22. To advise the Beekeeper within 12 hours if a significant number (one cup or more) of dead bees are seen near the entrance of any hive.
23. To carry appropriate insurance e.g. public liability (including third party for accidental damage) insurance and workers compensation insurance.
24. To fulfill all heavy vehicle safety obligations under the National Heavy Vehicle Regulator Chain of Responsibilities (www.nhvr.gov.au).

PERFORMANCE

Neither party shall be responsible for failure to comply with the terms of this agreement where such failure to comply results from causes beyond the reasonable control of that party, provided however that this shall not relieve the Grower from liability to make payment for services performed.

ARBITRATION

If the Grower is dissatisfied with the quality of hives suppled his/her first recourse shall be to the Beekeeper. Such complaints shall be lodged as soon as possible and in no case after the hives are removed from the property.

In the event of any unsettled dispute between the Beekeeper and Grower both parties agree to abide by the decision of a mutually agreed upon independent arbitrator.

ASSIGNMENT OR TRANSFER

This agreement is not assignable or transferable by either party, except that the terms hereof shall be binding upon a successor by operation of law to the interest of either party.

IN WITNESS THEREOF, the parties hereto have executed this agreement the day and year above.

Signature:_____

Grower: _____
ABN: _____

Address:
(Correspondence) _____
(Delivery) _____

Contact details:
(Site Manager)_____ (Mobile) _____

Signature: _____

Beekeeper: _____
ABN: _____

Address:
(Correspondence) _____
(Delivery) _____

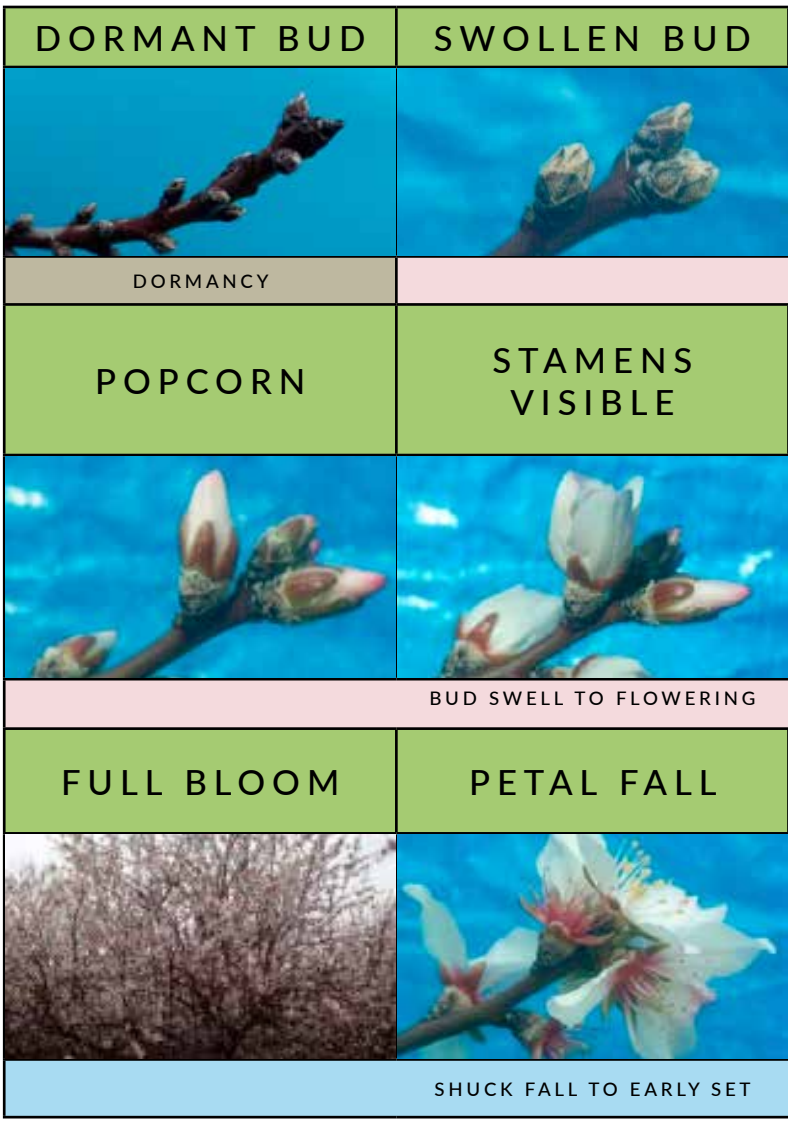
Contact details:
Name: _____ (Mobile) _____

(One signed copy each to be retained by the Grower and by the Beekeeper).

APPENDIX B: PHENOLOGY STANDARD FOR ALMONDS

Thomas, D (2018). Phenology standard for almonds. South Australian Research and Development Institute. Pp7.

For complete explanation of stages download the information booklet from:
https://2q1ee4456oc52trll42uctl1-wpengine.netdna-ssl.com/wp- content/uploads/2018/08/Phenology-standard-for-Almonds-27June-2018.pdf



BUD BURST	GREEN TIP	PINK BUD
		
BUD SWELL TO FLOWERING		
FLOWERING	BEGINNING OF FLOWERING (10% OF FLOWERS OPEN)	FULL FLOWERING (50% OF FLOWERS OPEN)
		
	SHUCK FALL TO EARLY SET	
FRUIT SET	JACKET STAGE	EARLY PIT HARDENING
		
	FRUIT GROWTH TO EARLY PIT HARDENING	

ALMOND BOARD OF AUSTRALIA

P. (08) 8584 7053

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