



TECHNICAL BULLETIN 007

**A BEST PRACTICE GUIDE
TO
BEE POLLINATION IN PIPFRUIT ORCHARDS**

July 2005



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**PIPFRUIT
NEW ZEALAND**

SUMMARY

This bulletin was written as a 'best practice' guide for pipfruit orchardists and beekeepers supplying hives for pipfruit pollination.

It describes the responsibilities of orchardists and beekeepers and suggests minimum inclusions in hive supply contracts to protect both orchardists and beekeepers.

How best to position hives within the orchard, minimum hive quality or strength are also described.

A summary of the legal requirements as to bee toxicity warnings and plant pest and disease product labels is included.

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1.0 Introduction

Honey bees are essential to pollination of many domesticated plants.

Unfortunately they are also susceptible to some of the plant protection products used on crops. This susceptibility and its ramifications (dead bees, contaminated honey and reduced pollination) have prompted the regulatory bodies in NZ and elsewhere to place 'bee toxicity' warnings on agrichemical containers of those products known to detrimentally affect bees.

It is not only the active ingredients that can be toxic but also the surfactants in the formulations or that are added to the tank to increase the efficacy of the products.

Honey bees introduced into orchard areas for pollination are also in a potentially hostile environment especially if several crop types have overlapping flowering periods and fruit thinning in any of the crops is chemically based.

Orchardists need to ensure significant pollination of their crop so that accurate crop loads can be manipulated at fruit set. Honey bees are probably responsible for up to 90%+ of pipfruit pollination with flies, bumble and native bees and other flower visiting species responsible for the remainder. If you consider 90% of the crop results from honey bee pollination then 90% of the orchardists (your) income is directly due to honey bees – it is well worth looking after them.

2.0 Bees and Pollination

Honey bees are important commercial pollinators because the hives are mobile, easily managed and bees are available in large numbers to fly whenever the weather enables them to do so. Honey bees fly readily at temperatures above 10°C but work better at temperatures of 15°C – 25°C and wind speeds of less than 25-30kph. The high numbers of bees in a hive and the proportion foraging on a regular basis result in honey bees being the dominant species found in most flowering crops including pipfruit.

Honey bees will forage continually while conditions and food sources are available and visit high numbers of flowers when doing so. They store excess nectar and pollen in cells for 'lean periods' such as bad, wet weather and winter when they 'subsist' on the stores they have built up.

Typically 1-4 hives/ha have been used for apple pollination but lower bee numbers in some hives due to *Varroa* mite may necessitate an increase in this number or at least looking to the higher end of this range. The HB Pollination group recommends 4 hives / ha. (*Varroa* mite is only found in the North Island as at the time of preparation of this bulletin).

Beekeepers try to provide hives that are increasing in brood numbers to ensure there is a demand for pollen, thereby encouraging the foragers to visit flowers. Often the trick is to get them visiting the 'correct' flowers. Kiwifruit, for example, are poor nectar producers and therefore bees prefer to forage flowers that produce both pollen and nectar (such as apple, pear and white clover). Likewise the apple orchardist has to ensure conflicting pollen and nectar sources are unavailable to the bees (by mowing the orchard floor and removing clover and weed flowers).

3.0 Grower Responsibilities

- To discuss pollination requirements with your beekeeper well before the hives are needed
- Allow access to your orchard at any time for beekeepers to service their hives (much of this may be done at night when bees are resident in the hives)
- Provide suitable places to position hives. Clear areas in warm, sunny, sheltered positions that allow good vehicle access
- Provide a clear timetable of when hives are required and keep in close touch with beekeepers at flowering time
- Clearly state a final date you require the hives out of the orchard by (Section 11.0)
- Be available when hives are delivered to assist placement and location
- Notify any orchard hazards to the beekeeper in line with OSH requirements
- Do not touch or move the hives once placed by the beekeeper – if they prove to be in an unsatisfactory place call the beekeeper back to move them
- Give a copy of your spray plan over bloom to the beekeeper
- Before any spraying notify the beekeeper and check for hives within 3km
- Observe bee toxicity warnings on product labels – these are legal requirements
- Notify the beekeeper if you notice anything abnormal about the hives or bee activity
- Agree on a pollination auditor with the beekeeper and who will pay for audit
- Carry adequate public liability insurance
- Have a sound contract with the beekeeper

4.0 Beekeeper responsibilities

- Determine hive numbers early to help with build up planning
- Ensure minimum hive strengths as defined in Section 8
- Survey the orchard prior to signing a contract to identify hive locations suitable for the bees and suitable to the pollination task – identify areas of competing bloom
- Agree with the grower about hive location
- Have the orchardists point out any orchard hazards in line with OSH requirements
- Obtain for the grower a spray plan for the bloom period
- Identify with the grower any concerns you have with the spray plan and resolve them before agreeing to supply hives
- Deliver hives at about 10% bloom of early flowering varieties
- Demonstrate to the grower the hives meet the minimum strengths agreed
- Identify a date when hives need to be removed from the orchard and remove the hives within the 3 days leading to the agreed final date
- Do not leave large numbers of bees foraging when you remove the hives
- Agree to remove any swarms if they arise
- Carry adequate public liability insurance
- Agree on a pollination auditor with the orchardist and who will pay for audit
- Have a sound contract with the orchardist

5.0 Contract to supply hives

The agreed and signed contract should include at a minimum, information that will act to protect both beekeeper and orchardists. Such information could include:

- Orchard RPIN
- Orchard contact name, address and phone number (landline and mobile)
- Orchard address including RAPID number
- The number of hives required
- The minimum quality or strength of the hives required
- The location of the hives in the orchard – an orchard map with location site identified can be appended to the contract
- The required notice to deliver the hives
- Details if replacement hives are required after a period of time
- The final date for removal of the hives, If the orchardists insists on retaining hives beyond the suggested last date for each region then consider an additional fee calculated from that regional date that recognises the higher risk to the hives over the additional time they are required (e.g., a daily rental fee)
- Fees and terms of payment
- A statement as to hive management practice including AFB and *Varroa* management plans
- A requirement and mechanism for the orchardists to contact the beekeeper before any spraying
- A requirement for the orchardists to supply the beekeeper with a spray plan for over bloom
- A disputes resolution mechanism
- Recourse to an independent hive auditor/arbitrator
- Responsibilities for remedial action

6.0 Placement of hives

Some orchardists prefer to space hives out around the orchard perimeter, others have the hives delivered on a pallet and placed in one corner – the best place to ensure the bees you are paying for pollinate your crop is to place them in a central clear area so they forage out into your trees.

Hives should be placed in an easily accessible, sunny area, sheltered from rain, irrigator sprinklers and cold winds. Hives in the shade take longer to warm up each day and therefore do less foraging. There should be no risk of damage to the hives by machinery (tractors, mowers, sprayers, trailers, hydaladders, trucks etc).

Bees collecting pollen (the optimum group to aim for during pollination) tend to have smaller foraging areas than those looking for nectar or pollen and nectar. By placing the hives centrally in your orchard optimises the pollination of your orchard because the bees are foraging in your trees all around the hive.

By placing them around the perimeter or in one corner they can fly in all directions to forage but only one of those may be to your trees (Fig. 1A, B, C). Only 1B indicates optimal placement for your orchard.

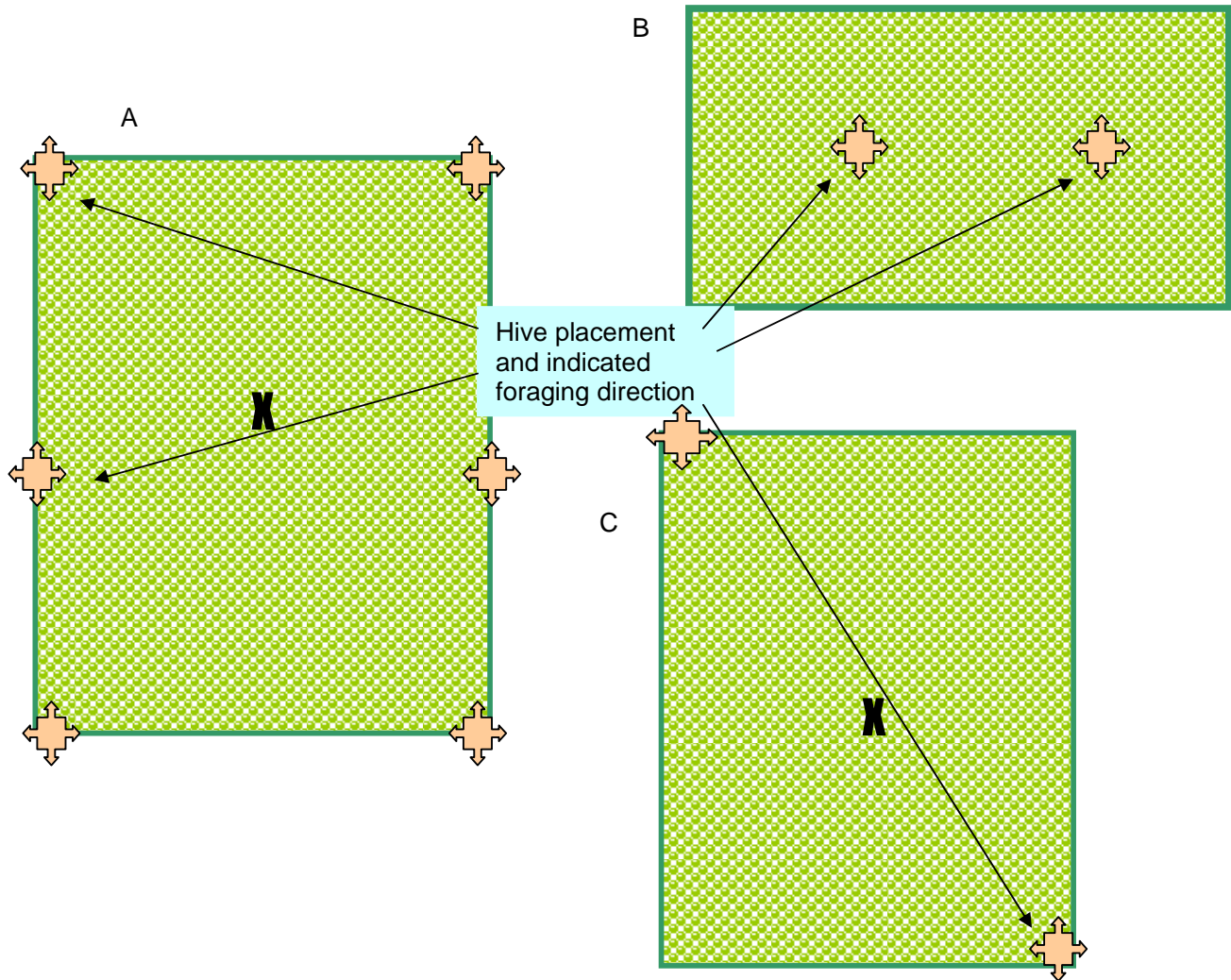


Figure 1: A – perimeter placement and limited foraging in the placement orchard
 B – central placement and optimal foraging in the placement orchard
 C - Corner placement and limited foraging in the placement orchard

7.0 Introduction of hives

Hives should not be brought into the orchard until flowering is well underway – around 10% of blooms of early flowering varieties and pollinators are out otherwise the bees will move off site seeking alternative food sources and if pollinators are not in flower those varieties requiring cross pollination (Braeburn) will set a poor crop.

Tell the beekeeper if you have used PGRs, bloom compressers, dormancy breakers or any products designed to change flowering times. If you require hives early you may be charged for the privilege.

8.0 Hive quality or strength

Growers need to define what it is they require as a minimum for leased hives and this should be stated in the contract you have with the beekeeper.

Hive strength is usually defined by the following parameters:

- Amount of brood
- Age of brood
- Position of brood
- Bee numbers
- Empty comb
- Honey reserves

At beginning of flowering each hive needs a minimum strength to do the job for the pollination period. This can be defined in the above terms and by the standards MAF would audit the pollination hives to;

A two storey hive containing:

- Appropriate level of (three standard frames of) brood at all stages
- Nine standard frames covered with bees (approx. 22,500 bees)
- At least one full depth frame of honey
- A good laying queen
- Room for expansion
- Free of disease (American Foul Brood or AFB)
- Have a *Varroa* management programme

9.0 Care of hives in the orchard

If you run fertiliser through your irrigation lines your water may be unsuitable for the bees to drink. Always have a ready supply of clean drinking water for the bees – discuss this with your beekeeper.

As stated in the introduction inappropriate use of plant pest control products are the largest threats to bee / hive welfare in an orchard.

The label on an agrichemical container is a legal document in NZ. This is the location of specific information you need as an agrichemical user to use the product according to recommendations. Some agrichemical labels contain **bee toxicity warnings** which advise the user it is illegal to treat plants that may be visited by bees with the product in question. It can be successfully argued that this also means plants affected by overspray or drip (ie neighbouring blocks or the orchard floor).

These requirements are reinforced in **NZS8409:2004 Management of Agrichemicals** which was recently reviewed in light of the new HSNO legislation. This document states in the various sections indicated:

NZS8409:2004 2.4.3 Non target organisms

Users shall not apply agrichemicals that are ecotoxic to non target organisms, except in accordance with the relevant ERMA approvals and the conditions of registration (or exemptions from registration) imposed

under the ACVM Act. This includes any area where bees are foraging, or where any plant or flower, likely to be visited by bees, is in flower or likely to flower within the period specified on the label (see F5).

NZS8409:2004 **5.3.1.2** *Bees*

Where agrichemical application is likely to directly affect bee keeping or plants in flower, prior notification **shall** be given to any party likely to be affected (see 2.4.3).....

NOTE – Refer to specific product labels for details.

NZS8409:2004 *F5.2 Bees and other pollinators*

By taking the following precautions users can reduce the chances of bee poisoning or movement of chemical into the food chain through pollen transport:

- Do not apply products that are toxic to bees during flowering, including shade trees and weeds. Mow cover crops and weeds to remove the flowers prior to spraying;
- Select the product which is least harmful to foraging bees. Check product labels for information specific to bee toxicity;
- Select the safest formulation. Dusts are more hazardous to bees than are sprays. Wettable powders are usually more hazardous to bees than either emulsifiable concentrates or water-soluble formulations. Granular insecticide formulations are generally the least hazardous to bees. The hazard increases, however, when insecticides are micro-encapsulated as the minute capsules can be carried back to the hive in much the same manner as pollen;
- Minimize drift during application;
- Time the application carefully. Evening applications are less hazardous than early morning; both are safer than midday applications;
- Do not spray near hives. Bees may need to be moved or covered before using agrichemicals near colonies;
- Co-operate with beekeepers. Fostering co-operation among beekeepers, growers and agrichemical users can reduce bee poisoning.

The best way to avoid injury to beneficial insects and micro-organisms is by careful and correct use of agrichemicals. Target-specific products should be used where possible and applied only when necessary as part of a total pest management programme.

Most of the incidents that implicate pipfruit orchardists being responsible for bee kills centres around the application of carbaryl as a fruitlet thinner.

If at all possible use something other than carbaryl – there is a strong chance it will not be available for too much longer. BA products and BA combined with oils, ANA and several other options give reasonable results in the warmer areas. In these areas carbaryl is used because of cost and habit.

The cooler southern areas are more problematic with respect to the loss of carbaryl as the alternative products do not seem to perform as reliably.

One must not forget that growers took some time to learn how to use carbaryl as a thinner, other products will also take time for growers to familiarise themselves with the idiosyncrasies of alternative products and orchard trials should not be overlooked by the orchardists to see what works in their situation. Also refer to Technical Bulletin #002 April 2002 *Crop Loading and Thinning: A Guide for NZ Orchardists* prepared for Pipfruit NZ Inc by John Wilton, AgFirst Consultants.

The use of bud breakers and bloom compressors exacerbates the problem because they are not used on all varieties and therefore the length of time hives are required in an orchard is extended by around two weeks.

Early flowering varieties could be receiving thinning sprays while late flowering varieties are still in flower. Growers should consider burning off late flower with ATS to discourage bee foraging – the fruit from these flowers will invariably be thinned off so save the trouble.

Regions with multiple crops are most at risk of bee kill incidents and Hawke's Bay is a good example with summerfruit, pipfruit, (grapes, although these are wind pollinated bees also visit the ground cover flowers) gold and later, green kiwifruit and berries flowering, the 'pollination' period extends from mid August to December. This makes removal of hives from a district difficult due to overlapping pollination requirements.

10.0 Symptoms of hive poisonings and bee kills

Numbers of dead or lethargic bees around the hive are an obvious indication all is not well but there are more subtle signs also: low numbers of foraging bees from a hive or group of hives, white, cream, brown or black grubs (larvae that look like large fat maggots) being brought to the hive entrance from inside the hive – basically workers expelling dead or dying larvae are all signs that if noticed you should notify your beekeeper immediately.



Figure 10.1: Dead bees around a hive, sick bees clinging to hive boards

11.0 Can beekeepers help the situation?

Beekeepers can help by participating in a regionally based pollination hive register which is updated regularly with hive locations so growers know where hives are and who to contact when they need to spray.

Beekeepers can also help by ensuring their hives are out of orcharding areas between flowering and thinning. Their contract to supply hives should incorporate a 'hives out by' date clause.

This should be set in consultation with the local fruit growers as 'hive out' dates will be regionally dependent on flowering but as a guide:

Region	Approximate 'hives out' dates
Waikato	5 November
Gisborne	20 October
Hawkes Bay	25 October
CHB and Lower NI	1 November
Nelson/Marlborough	5 November
Canterbury/Central Otago	10 November

12.0 Use of a pollination hive register by growers

If such a system is operated in your region by beekeepers advising the register of the location of pollination hives (GPS or RAPID street addresses) please use the service. The register will be held on a web based and/or centrally on a pc based database map reference. Such a system enables growers to locate hives within 3-5km of their orchard. Once they are aware of hive location they will be better informed of the risks of spraying with products detrimental to bee health.

Appendix 1 List of pipfruit IFP and organically permissible products that contain a bee toxicity warning in their label as at June 2005

PRODUCT AI (and TRADE NAMES)	comments
Abermectin (Avid®; Apostle®)	Use after flowering but mow ground cover
Carbaryl (Carbaryl; Sevin® Flo)	Used for thinning - remove all flowers first, watch overspray into neighbouring blocks and mow groundcover first
Diazinon (Basudin®®, Diazinon)	Spot treatments for ALCM and WAA remove all flowers if treating non bearing trees and mow ground cover first
Garlic and Pyrethrum	Use after flowering but mow ground cover
Hydrogem cyanamide (Hicane, HiBreak®)	Use before flowering but mow ground cover
Lufenuron (Match®)	Avoid spraying active bees, apply at non-foraging periods and allow to dry before bees are active
Milbemectin (Mit-E-Mec®)	Mid season use, mow ground cover
Pirimicarb (Pirimor®)	Use before flowering but mow ground cover
Spinosad (Success®, Entrust®)	Use after flowering but mow ground cover
Tebufenozide (Mimic®)	Avoid spraying active bees, apply at non-foraging periods and allow to dry before bees are active

SURFACTANTS, ADJUVANTS AND WETTING AGENTS

Please note all surfactants will kill bees by increasing susceptibility to the accompanying active ingredient(s); enhancing desiccation; blocking spiracles and/or drowning.

Most products contain some incorporated surfactants.

USE ALL PEST AND DISEASE MANAGEMENT PRODUCTS WITH 'BEE CAUTION' – ALWAYS MOW FLOWERING GROUND COVERS AND BURN OFF LATE FLOWERS ON YOUR TREES BEFORE APPLYING ANY OF THE ABOVE PRODUCTS

ORGANIC PRODUCTION

Organic growers should note that Lime sulphur sprayed of flowers can act as a temporary deterrent to bees visiting sprayed flowers. Garlic and pyrethrum concentrate® and Entrust® also carry bee toxicity warnings.