http://hydroponics.com.au/free-articles/where-have-all-the-ladybirds-gone

Where have all the ladybirds gone?

In this two-part article, the authors shine a spotlight on neonicotinoid pesticides against a backdrop of widespread use of this group and concerning reports of an alarming and increasing loss of biodiversity. While honey bees have been the focus of concern, other pollinators and invertebrates, birds and even the lowly earthworm are at risk.

Part I examines neonicotinoid uses in Australia and problems ascribed to their use overseas, particularly massive losses of honey bees. Are honey bees under threat from colony collapse disorder in Australia? Are we equipped to adequately address environmental pesticide management issues?

By Marilyn Steiner and Stephen Goodwin

In spring, 2010, we noticed that ladybird beetles were conspicuously absent from our garden. Not just down in numbers, but absent. There didn't seem to be any shortage of aphids, so where were they all? As summer progressed, we continued to look out for them. No shortage of plant-eating and fungus-eating ladybirds, but no insect and mite-eating species. In summer and again recently, we emailed colleagues in the bug management business. Had they noticed a decline in ladybirds? They reported major declines in the Sydney basin, southern Queensland and Adelaide Plains, but not in Western Australia or Victoria. Our neighbours grow organic stone fruit on one side and citrus on the other. Heavy rain washes fertiliser, and potentially pesticides, from the citrus farm into the creek we all share for irrigation. It's well known that run-off can leach some residual pesticides from soil into creeks and rivers, but we have no idea if this is the case and even less chance of proving it. The dots are a long way from being joined, because population fluctuations in insects are the norm. Perhaps the main question to ask is, if ladybirds did in fact disappear from the Australian fauna, would anybody care enough or have sufficient funds to launch an investigation?

You may think that disappearing ladybirds is not a particularly newsworthy item, nor worth the expenditure of valuable research dollars. The fact is, research dollars in Australia for environmental issues such as IPM have almost dried up in the last 2 years, and this in itself is a major concern. The proportion of projects which, relate to integrated pest management (IPM) that are funded through Horticulture Australia Ltd (HAL), particularly those involving national vegetable levy funds, has declined from 17% in 2007 to 8.7% in 2009. The proportion of projects going directly to AUSVEG is significant and has increased substantially in the same period, going from 6.25 to 12.5%. Is the money, which is collected through grower levies, voluntary contributors and the Federal Government, being well spent? How is it possible to assess this? HAL is being less than transparent about how funding is being allocated. We asked several times for information on the dollar value of individual projects, but met with refusal. Without this information, it is not possible to see how much is being assigned to specific program areas, and where the trends lie.

In *PH&G issue #118, May-June 2011*, we reported on a highly successful pilot project for IPM in capsicum, which was inexplicably refused further modest funding. Concerned IPM researchers met in Adelaide in July this year, and formed the Mitcham Sustainable Horticulture Group. All present expressed deep concern about the drying up of funding for research and development, and frustration at their inability to provide real input into the decision-making process. Also being queried is the commitment of AUSVEG management towards IPM. While ostensibly the agency is supportive, in line with strong support for IPM from growers, the disenfranchising of the research community and withdrawal of R&D funding is causing deep disquiet. Two years ago AUSVEG formed strategic partnerships with Bayer CropScience, Syngenta and Dupont. This raised a red flag at the time, for obvious reasons. While donations to the cause are no doubt welcome, such arrangements are seldom altruistic, and can create potential conflicts of interest. We were also refused information on the agreements within these partnerships. It appears that only the CEO and

the AUSVEG board are privy to them. At the AUSVEG Convention in April 2011, these three chemical companies all had invited speaker spots. Bayer CropScience brought in Dr Maria Teresa Almanza, Product Development Manager Insecticides, Beneficials and Pollinators for Bayer CropScience in Germany to deliver a presentation on Beneficials and Pollinators. This is an irony that will not escape many of our informed readers. The talk, which she entitled 'Bayer CropScience and Sustainable IPM Systems', conveniently did not actually mention pollinators, nor imidacloprid and other Bayer CropScience products, which have incurred the wrath of beekeepers and environmentalists world-wide. The audience was told that Bayer CropScience was very committed to IPM; its new pesticides Belt® (flubendiamine) and Movento® (spirotetramat) reflected this. Hold that thought, it's certainly a commendable sentiment, and a step in the right direction.

Honey bees can pick up neonicotinoids from flowers (Image Dan Papacek)

The lucky country

Australia has perhaps been sheltered from the long-running controversy engulfing the rest of the world about the role of pesticides in the decline of honey bees. Colony collapse disorder, a malady characterised by honey bees inexplicably disappearing from hives, has galvanised beekeepers in North America, Europe and much of the rest of the world since the 1990s. Annual losses have run to millions of hives annually and declines of over 40%, particularly in wintering colonies. A recent post in *The Australasian Beekeeper* by Jeffrey Gibbs, a beekeeper from NSW, threatens to bring this debate closer to home (http://theabk.com.au/article/neonicotinoids-australia). While authorities maintain that there is no colony collapse disorder in Australia, Jeff claims that there are half the number of bees that there used to be. This is quite possibly due to multiple causes, but he said that beekeepers

have learnt to stay away from some broadacre crops because of adverse experiences with bee losses. According to an APVMA spokesperson, Australia has a wide variety of food resources available to bees (i.e. honey bees), particularly flowering Eucalypts, so honey bees are less dependent on crops that might have been treated. Jeff gives a good summary of the problems encountered elsewhere with neonicotinoid insecticides, the major chemical group of concern. He also queries the cause of the huge fish kill in the Darling River at the agricultural town of Bourke in north-western New South Wales in March this year. Millions of fish and crayfish were killed following record rainfalls, which flooded surrounding areas. While officially recorded as a black water issue caused by low levels of dissolved oxygen in the river, the scuttlebutt is that pesticide residues from surrounding cotton and other crops, usually under dryland farming, are another possibility. While the APVMA, Australia's pesticide regulatory body, requests that Adverse Impact Reports should be sent in if there are any observed problems with pesticides, Jeff maintains that in his fraternity, beekeepers rely on word of mouth, and no-one is keen to fill out forms or get involved with officialdom. The fact that the APVMA has to date not received any Adverse Impact Reports regarding bee losses is therefore not a cause for complacency. Responsibility for collecting and collating problems with pesticides and wildlife is shared among several agencies.

Brief history of colony collapse disorder (CCD)

It is hardly possible to give a brief history of this problem, because it stretches back to the early 1990s and has engendered a huge amount of controversy. This has not abated today, far from it. The term 'colony collapse disorder' originated in the United States, but unusual bee losses were already evident in Europe. Declines of hives over winter of 10-20% are not unusual, but beekeepers were sustaining much greater losses than normal, and it was happening every year. An outwardly healthy colony rapidly deteriorated, but dead bees were hard to find. The bees just never made it back to the hive. The remaining bees were often infected with a large number of disease organisms.

In Europe, the impact on hives was sometimes less subtle. France lost a third of its commercial honey bees in 1999 following widespread use of the neonicotinoid imidacloprid as a seed dressing for sunflowers. France banned the product after outrage from beekeepers, and in 2003 banned the same product as a seed dressing on corn. Other uses remain though. Fipronil, a BASF phenylpyrazole product also very harmful to honey bees, and which acts in a very similar way to neonicotinoids, was allowed to step into the breach, with predictable results. Fipronil was also suspended in 2003 and since banned. In 2003 Bayer CropScience brought out clothianidin, which is yet another neonicotinoid even more toxic to bees than imidacloprid. France denied it registration, but Germany permitted it in 2006. In 2008, eight pesticide seed treatments containing imidacloprid, clothianidin, thiomethoxam and methiocarb were banned in Germany on canola and sweet corn after mass honey bee deaths (11,000 colonies) caused by clothianidin exposure. Bayer CropScience claimed misapplication of their product, but there appear to have been multiple deficiencies in the application process on corn.

Clothianidin was later reinstated on canola. Similar die-offs have been reported in other countries, including Italy, Spain, Hungary, Switzerland, Austria, Poland, Greece, Belgium, Brazil, Canada, The Netherlands, Japan, China, India and Slovenia. While little talked about in the Western press, Japanese ecologists are becoming increasingly concerned about the loss of bees and biodiversity and are pressuring their government to ban neonicotinoids (www.mieliditalia.it/index.php/archivio-notizie/85-english-bees-environment-agriculture-a-pesticid/80123-also-from-far-east-dmaning-evidence-about-neonicotinoids; http://devcompage.com/?p=121). There is also a recent book by Syunsuke Funase (2008) entitled *Neonicotinoids, Devilish Novel Pesticides. Silent Summer Without Bees,* unfortunately in Japanese only. Few lessons appear to have been learned since Rachel Carson's *Silent Spring* alerted the world to the environmental disaster unfolding from overuse of broad-spectrum, persistent pesticides.

Neonicotinoids in the spotlight

Neonicotinoids have been a subject of controversy since the early 1990s. This class of pesticides is derived from nicotine (sleep well, all you smokers). They are neurotoxins, active against a wide range of sucking and chewing insects, but relatively safe to mammals. They include imidacloprid (Bayer CropScience and others), acetamiprid (Bayer CropScience), thiamethoxam (Syngenta), thiacloprid (Bayer CropScience), and clothianidin (Bayer CropScience and others).

Imidacloprid is the largest selling and most widely used insecticide in the world, ever. It was first marketed by Bayer CropScience in 1991, and is exported to over 120 countries and used on more than 140 crops. Australia has nearly 150 registered products containing imidacloprid, including seed, foliar, veterinary, public health, turf and home garden uses. Formulations include sprays, seed dressings, drenches and tablets for use under trees. There is hardly an agricultural, horticultural, veterinary or domestic use not covered. It is ubiquitous in the environment. The most well-known products are Gaucho® seed dressing (cereals, beans, peas, lentils, lupins) and Confidor® (just about everything). The Gaucho label does not mention bees, but states that it is highly toxic to terrestrial and aquatic life. The Confidor label states, under 'Precautions for Livestock', that it is dangerous to bees. Bayer CropScience's patent protection for imidacloprid expired in 2003, so many companies now produce and market it. Bayer CropScience then marketed its successor, clothianidin. It is very persistent in the crop, has a high carry-over of residues and is very mobile. It is also far more toxic to bees than imidacloprid, and toxic to collembola and earthworms, which would seem to us to wave a red flag for soil applications.

In Australia, clothianidin was registered in 2007 and is marketed by Sumitomo under the trade names Shield® (cotton, bananas, sugar cane, Eucalypts), Samurai® (apples, pears, grapes, stone fruit) and Stealth® (turf). The label, again under 'Protection of Livestock',

warns about dangers to bees from foraging in treated crops, including that it may be toxic to bees for several days after application. Thiamethoxam is marketed in Australia as Cruiser® (cotton, corn, sorghum, sunflower) and Meridian® (turf). There is no warning on bees. Thiacloprid (Calypso®) is registered on stone and pome fruit, with claimed low toxicity to bees. Acetamiprid is produced and sold by many companies. In Australia it is registered by Certis on potatoes as Supreme®, by Dupont on cotton as Intruder®, and by Scotts on ornamentals as Crown® and Defender Maxguard®. The Crown label warns of adverse effects on transverse ladybirds, predatory mites, parasitic wasps and spiders, but not bees. The Defender Maxguard label recommends not spraying bees feeding in flowering plants. Otherwise there are no warnings regarding toxicity to bees. An EPA Pesticide Fact Sheet states that acetamiprid is moderately toxic to bees. It is moderately to highly mobile in most soils but degrades rapidly. Imidacloprid, thiamethoxam and acetamiprid have registered or permitted usage on some greenhouse crops in Australia. They may be used as a preventative treatment on seedlings before shipment to growers, making it next to impossible to use biocontrol agents during the life of the crop because of persistent residues.

These products are systemic. They are absorbed and carried into all parts of the plant, including flowers, pollen and nectar. Here they are available to be collected by bees and returned to hives for storage and feeding to other bees and progeny. Foragers are also exposed through direct contact with sprays, dust and residues on foliage. It doesn't end there, as if that wasn't enough. Neonicotinoids are very persistent in the environment, with a long half-life in soil, as many as years in heavy soils. They can be leached out by heavy rains into the ground water and thence into creeks, dams and river systems. Once applied, residues can persist and build up in soils so that they last from 1 year to the next and are available to be picked up by successive crops. A recently published book by Dr Henk Tennekes, a toxicologist in The Netherlands, paints a bleak picture of the current parlous state of European wildlife that can be directly related to neonicotinoid use (www.disasterinthemaking.com). Using imidacloprid as an example, he shows that it has leached into waterways over an extensive area with devastating results on aquatic and terrestrial invertebrates and therefore the wildlife dependent on them, particularly birds. Estimates of amounts applied worldwide are difficult to find, but Bayer CropScience reportedly earned a tidy US$830 million for global sales of imidacloprid and US$267 million dollars for clothianidin in 2010 alone.

Unlike some other countries, pesticide usage data is not collected in Australia. The APVMA authority extends only to the point of retail sale, though the organisation collects a levy based on dollar value of product sold (www.apvma.gov.au/about/reporting/product_sales.php). The scale of the potential problem in Australia is basically unknown unless the pesticide companies can be persuaded to release their sales volume data for individual pesticides, an unlikely prospect without a statutory requirement. The sales data for agricultural chemical products make interesting reading. Sales of insecticides and fungicides alone from 2004-2010 amounted to AU$500-$625 million per annum, with household insecticides making up more than a third of this total. Hopefully, the latter is a reflection of profit margin rather than volume applied, but it is still concerning.

In Part II the authors explore the evidence for neonicotinoid impacts on honey bees, the role of governments in regulating pesticides, and the changes required to adequately evaluate their environmental safety.

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Reference

Funase, S. 2008. *Neonicotinoids, Devilish Novel Pesticides. Silent Summer Without Bees.* Sangokan, Tokyo. 235pp.