Protecting Bees, Beekeepers and Honey from Contamination in Wales

Briefing from GM Freeze, GM Free Cymru and Friends of the Earth Cymru

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Introduction

The growing of GM crops brings with it the risk of contamination of neighbouring crops and wild plants through cross pollination. The EU wants Members States to develop rules that allow GM and non-GM crops (including organic) to "coexist". However containing GM pollen and seeds within the field where they are grown and prevention of mixing of GM and non-GM seeds and crops pre- and post-harvest has been proven to be impossible. Hence coexistence is EU "speak" for legalised contamination. This briefing looks at the risks GM pose for honeybees, beekeepers and honey.

Pollination

Honeybees and other insect pollinators (such as bumblebees, moths and beetles) are vital to the survival of plant species. Without these vital ecosystem services the human food supply would be hugely reduced and the survival of human beings would be in doubt. Pollination in some crops is mainly by wind borne pollen (eg, maize and beet), while other crops are largely self fertile within each plant (eg, soya). However, for some crops (eg, many legumes and apples) insect pollination is essential. These plants have evolved to attract insects to their flowers to collect nectar or pollen and therefore carry pollen between flowers and plants allowing cross pollination to take place.

Large-scale honeybee losses could adversely affect the pollination of strawberries, apples, pears and other crops and reduce yields in others (eg, oilseed rape). In the UK as a whole, pollination services and honey production are estimated to be worth around £200 million a year[i]. Even when the plant is not dependent on insects for pollination, bees may still visit plants to collect pollen as a source of protein.

Honeybees are very efficient pollinators, and farmers and growers pay beekeepers to bring hives into their crops. Pollination occurs because bees collect pollen grains as they visit plants to collect food, and they transfer these grains to other flowers where they brush off on stamen and fertilise the plant's ovum to start the development of seeds and fruit. Each bee can carry up to 60,000 pollen grains on its body hair[ii]. Other wild pollinating insects work in a similar way.

Research in Canada has shown that profits are highest if 30% of land is uncultivated within 750 metres of the edge of oilseed rape crops. This uncultivated land provides wildflowers for nectar and pollen when the crop is not in flower and also provides nesting sites for wild bees and host plants for other pollinators. Other studies have shown the importance of honeybees and other large pollinators for increasing yields. A trial in Australia where bees and other large pollinating insects were excluded from one part of the oilseed rape crop found that seed yield was 58% increased and seed weight increased by 46% when pollinators had access to the crop[iii].

Cross Pollination

If bees visit GM flowers and then non-GM crops of the same species, gene transfer is guaranteed to take place. Bees returning to the hive from a GM crop laden with pollen can brush against bees feeding on a different non-GM crops and pollen can be transferred between the two as the foraging bees return to gather more nectar and pollen. This is another way for cross pollination between GM and non-GM crops to take place[iv].

How Far do Bees Travel?

If there is a reliable and large source of pollen, honeybees are willing to travel long distances. Researchers collected pollen from honeybees returning to the hive around a GM spring oilseed rape crop in Oxfordshire in 1999. Bees were found to be travelling at least 4.5km (3 miles) to the field to collect pollen. Other researchers have found bees foraging on abundant sources of pollen over 9.5km away from the hive[v]. Bumblebees are also important pollinators, and research has shown they range up to 2km from their nest sites[vi], but usually stay closer.

Other insects may move pollen further. Research in Scotland using male sterile bait plants found that GM pollen had transferred 26km. On this occasion it was speculated that the vector was a pollen beetle (a pest of oilseed rape).

Importance of Pollen to Honey Bees

Honeybees collect pollen to provide protein for young bees and larvae. Pollen is also an integral part of honey influencing its texture and flavour.

GM and Bees

There are 250,000 colonies of honeybees in England and Wales[vii], and a further 20,000 beekeepers may be unknown to bee inspectors. Inspectors check on the heath of bees because of the major disease and parasite problems that have hit bee colonies across the world. Mapping of apiaries is carried out by the bee inspectors, and the map for England and Wales shows an even distribution throughout the lowlands[viii].

The British Beekeepers Association issued a policy statement on GM crops in January 2008[ix]:

> *"The British Beekeepers' Association, at its October 9th Forum meeting of members, deplored the situation that has arisen regarding the widespread introduction of GM trial sites without due consideration being given to the ethical and environmental impact that could arise through these trials."*

They also recommended a minimum separration distance between hives and GM crops:

> "The only short term advice that can be given is for beekeepers to move their colonies away from trial sites. A probable safe distance is in excess of six miles."

Recent monitoring of GM pollen in honey in Germany found that only 3 out of 21 samples were "very good", with 6 being were "unsatisfactory". Almost half the honey the samples contained GM pollen. Many of the samples from South America contained GM soya pollen despite the fact that soya not a very good source of nectar[x].

Honeybees Crop by Crop

This section examines whether crops likely to be genetically modified are visited by honey bees and the implications of this for GM contamination of other crops and wild relatives.

Beet (Sugar and Fodder)

These are the same species and behave in a similar way. Beet is a biennal and produces a very large tap root in its first year. This is what is normally harvested at the end of the growing season either for fodder or sugar extraction. If left in the ground, the plant would flower and produce seed in the second growing season. The flowers produce nectar and pollen that attract honey bees and other pollinators. Around 1% of plants flower[xi] in the first year (bolting). Similarly, small roots if not harvested in the first season can flower the following year. If bolted beet is not controlled, by hand pulling or using herbicides, seeds will be produced, and these will germinate in following crops as weed beet. This is a major problem for beet growers, with two thirds of beet fields infested (reported to be getting worse)[xii]. Fodder and sugar beets cross readily with its seaside relative Sea beet (*Beta vulgaris ssp maritima*). Beet pollen has been found to travel at least three kilometres[xiii], meaning that a GM beet crop allowed to bolt could spread GM traits over a very wide area, and honeybees could collect GM pollen from weed beet and sea beet in seasons to follow. Weed beet seeds can lay dormant in soils for many years after GM crops and produce flowers if not controlled.

Maize

Maize is a wind pollinated plant, and honeybees play no part in the fertilisation. However, maize pollen is an important source of pollen for foraging honeybees[xiv, xv and xvi] . An illustration of the serious problems that could arise as a result of bees foraging on GM maize came in Bavaria, where a beekeeper found his honey contained pollen from the GM maize Mon810 (insect resistant). The level of contamination was reported to be 7% of the pollen present, and the courts have prevented it from being sold[xvii].

Recent research has shown that one Bt toxin produced by GM maize plants and present in pollen found potential behaviour and feeding impacts on honey bees including possible disorientation. The authors called for more research[xviii].

Thus honeybees will collect pollen from GM maize plants especially if there is a shortage of other pollen sources, as may be case in areas of intensive arable production.

Oilseed Rape
Honeybees are strongly attracted to oilseed rape to collect nectar and pollen. Crop yields are increased by the presence of bee hives nearby. Research carried out for Friends of the Earth in 1999 at a GM spring oilseed rape crop, which was part of the Farm Scale Evaluations, found that honeybees travelled 4.5km to collect pollen from the GM field. Honey sold in the area was found to contain GM pollen.

Honeybees can also collect pollen from GM volunteer oilseed rape, which can appear in fields for at least 15 years[xix] after a GM crop has been harvested due to the longevity of seed dormancy. Feral rape plants also survive in the wild, and these, along with wild relatives, could be a source of GM pollen for bees to collect. Wild relatives of oilseed rape which are known to cross and therefore pick up GM traits are wild turnip (*Brassica rapus*), hoary mustard (*Hirschfeldia incana*), wild radish (*Raphanus raphanistrum*), white mustard (*Sinapsis alba*) and wild cabbage (*Brasssica oleracaea*).

Research on hybridization during the Farm Scale Evaluations even found that GM rape had hybridised with the arable weed charlock (*Sinapis arvensis),* which was previously believed to be an impossible cross in the wild[xx].

Thus GM traits in oilseed rape crops have the potential to spread into many other plants that honeybees visit for pollen and nectar. The extent to which this will occur is still unclear, but one research team estimated that for wild turnip in the UK about 32,000 hybrids appear annually in wild riverside populations, and a further 17,000 arise in arable weed populations across the UK (mainly found in Humberside at present)[xxi]. The development of populations of herbicide tolerant wild turnips and other related weeds in arable fields as a result of crossing with GM oilseed cannot be ruled out. Such plants could acquire genes giving tolerance to several herbicides over time, which could result in much higher populations if conditions favoured their survival, increasing the chances of bees collecting GM pollen.

Beekeepers and Coexistence
Beekeepers in Wales need to be very wary of GM crops being grown. Experience in Germany suggests that honey can easily become contaminated with GM pollen as result of normal foraging behaviour by bees. The most recent consumer poll in the UK found that nearly two thirds of regular honey purchasers wanted a GM-free product[xxii]. The impacts of GM insect resistant crops are still not fully understood. Herbicide tolerant GM crops were found in the Farm Scale Evaluations in the UK from 1999 to 2003 to reduce the numbers of weeds in fields of oilseed rape and beet[xxiii]. Fewer flowering weeds will reduce the wild sources of nectar and pollen available to foraging honeybees when farm crops are not in flower.

Farmers and Honey Bees
Many fruit, vegetable and arable crops depend on honeybees to pollinate them to produce a crop. Other crop yields increase as a result of the pollination services provided by beekeepers and their hives. Wild bees also contribute to pollination. Bees are already under threat from a variety of diseases, parasites and conditions some of which have not been fully explained. GM crops can contaminate honey, which could affect sales and therefore impact on the viability of beekeepers and their ability to continue to provide pollination services to farmers and growers.

Action to Protect Honey and Bees
The Welsh Assemby Government has a policy "*to maximise restrictions on GM crops in Wales*"[xxiv], including "*significant isolation distances between GM and non-GM crops and buffer zones, incorporating pollen barriers or traps*". In her statement in February 2009, Minister for Rural Affairs Elin Jones made no mention of the need to protect bees and honey from GM contamination.

Wales should follow the lead of the British Beekeepers Association and demand that rules governing the growing of GM crops in Wales require:

- a six mile exclusion zone around each hive or colony of honey bees.

In addition:

- Biotechnology companies supplying GM seeds should be strictly liable for any economic harm to beekeepers and damge to bees and bee colonies.
- If GM crops are ever grown in Wales, an independent monitoring system for bees and honey should be established that should be required to produce a health status report before the first crops are planted to provide a baseline for Wales.

Further Information

For further information on GM issues visit our websites:

www.gmfreecymru.org.uk/index.htm
www.foe.co.uk/cymru/english/campaigns/real_food_index.html
www.foe.co.uk/cymru/cymraeg/index.html
www.gmfreeze.org/

or email info@gmfreeze.org or phone us on 0845 217 8992.

Notes

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[i] National Audit Office, 2009. DEFRA: *The health of livestock and honeybees in England Executive Summary.*
[ii] Ramsay, G, et al, 1999. "Honeybees as vectors of GM oilseed rape pollen". *Gene Flow and agriculture: relevance for transgenic crops BCPC Symposium Proceedings No 72 pp 209-214.*
[iii] Langridge DF and Goodwin RD 1975. "A study on pollination of oilseed rape (*Brassica campestris*)". *Australian Journal of Experimental Agriculture and Animal Husbandry* 15(73) 285 – 288.
[iv] Ramsey G et al, 1999. op cit.
[v] Beekman M and Ratnieks F. "Long-range foraging by the honey-bee, *Apis mellifera* L". *Functional Ecology* Volume 14, Number 4, August 2000 , pp. 490-496(7).
[vi] Alford, D. V. (1975). *Bumblebees*. Davis-Poynter Ltd.
[vii] National Audit Office,2009 op cit.
[viii] See https://secure.csl.gov.uk/beebase/maps/map.cfm
[ix] See www.britishbee.org.uk/news/statements/policy-statement-on-genetically-modified-crops-gmo.shtml
[x] See www.oekotest.de/cgi/ot/otgs.cgi?doc=28602http://www.oekotest.de/cgi/ot/otgs.cgi?doc=28602
[xi] Eastham K and Sweet J, 2002. *Genetically Modified Organisms (GMOs): The significance of gene flow through pollen transfer.* European Environment Agency.
[xii] Farmers Weekly. "Battle to beat weed beet". *Farmers Weekly*, February 13-19 2004, page 54.
[xiii] Department of the Environment. *Genetically Modified Crops and Their Wild Relatives - A UK Perspective.* Research Report No 1. DOE, London 1994.
[xiv] Keller I, Fluri P and Imdorf A (2005). "Pollen nutrition and colony development in honey bees: part I". *Bee World*, **86:** 3-10.
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[xvii] See www.spiegel.de/international/germany/0,1518,611582,00.html
[xviii] Ramirez-Romaro R et al. (2008). "Does Cry1Ab protein affect learning performances of the honey bee Apis mellifera L. (Hymenoptera, Apidae)?" *Ecotoxicology and Environmental Safety **70**: 327–333*
[xix] .Lutman PJW et al. "Persistence of seeds from crops of conventional and herbicide tolerant oilseed rape (Brassica napus)". Proc.R.Soc B (2005) 272, 1909-1915, 22 September 2005.
[xx] Daniels R et al , 2005. *The Potential For Dispersal Of Herbicide Tolerance Genes From Genetically-Modified, Herbicide-Tolerant Oilseed Rape Crops To Wild Relatives* Contract reference EPG 1/5/151 available at www.defra.gov.uk/environment/gm/research/epg-1-5-151.htm .
[xxi] Wilkinson M et al. "Hybridization between Brassica napa and B. rapa on a national scale in the United Kingdom". *Science*, 9 October 2003 (10.1127/Science.1088200).
[xxii] NOP World survey, 30 August – 1 September 2002.
[xxiii] See reports at http://webarchive.nationalarchives.gov.uk/20080306073937/http://www.defra.gov.uk/environment/gm/fse/
[xxiv] http://cymru.gov.uk/about/cabinet/cabinetstatements/2009/gm/?lang=en .

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