Neonicotinoid insecticides:

The case for farmers to report the sowing of treated seed

Introduction

Readers of *BBKA News* will have seen recent articles discussing the effects of neonicotinoid insecticides on honey bees. My contribution about the SETAC 'Pesticide Risk Assessment for Pollinators' Workshop, appeared in the May issue. This was followed by an article by Dr Louise Westwood in June. In July, the front cover was given over to a report from the European Food Safety Authority (EFSA) and inside, correspondence between the BBKA and the Chemicals Regulation Directorate (CRD).

In my article, I called on Defra and Fera to implement a strategy that requires farmers to report the sowing of seed treated with systemic pesticides.[1] I wrote to Defra in May with this proposal, suggesting that Fera would be a suitable central point to collect and make this information available online. Defra have replied that: *There is no intention at this stage to introduce a mandatory reporting requirement*. Needless to say this was disappointing, but not unexpected. The aim of this article is to explain the reasons for my request.

Systemic insecticides: background

Systemic pesticides are applied to seed as a dressing, so that the active substance permeates the plant during the growing season and acts on any insect that feeds on the plant and so provides 'plant protection'. One-third of UK arable land in 2010 was sown with seed treated with systemic pesticide.[2]

The active substances in the majority of systemic products are neonicotinoids: clothianidin, thiamethoxam and imidacloprid. They are a neurotoxin to insects, the effect of which is virtually irreversible and cumulative.[3] Neonicotinoids are at least 5,000 times more toxic to bees than DDT and a lethal oral or contact dose for a honey bee is in the order of nanograms (billionths of a gram).[4] From this information and from dosing information[5] it can be deduced that the toxicity of a single maize or sweet corn seed coated with the Bayer product 'Poncho', contains the equivalent of over 100,000 lethal oral doses (LD50 24h).

Of course, it is not expected that bees will have direct contact with the seed, but they will be exposed to pesticide residues in pollen and nectar, as well as in soil and water. Foraging bees will also take pesticide residues back to the hive (Figure 1, re-illustrated from the figure on page 16 of the SETAC Workshop summary).[6] The use of systemic pesticides has radically changed the approach to pest management. Spray pesticides are applied at the first sign of a pest attack, i.e. reactively. Pesticides which are applied to the seed are used constantly, regardless of whether they are needed or not, i.e. prophylactically. There are many implications to wildlife and the environment by this approach to pest management. The following four points are my main concerns.

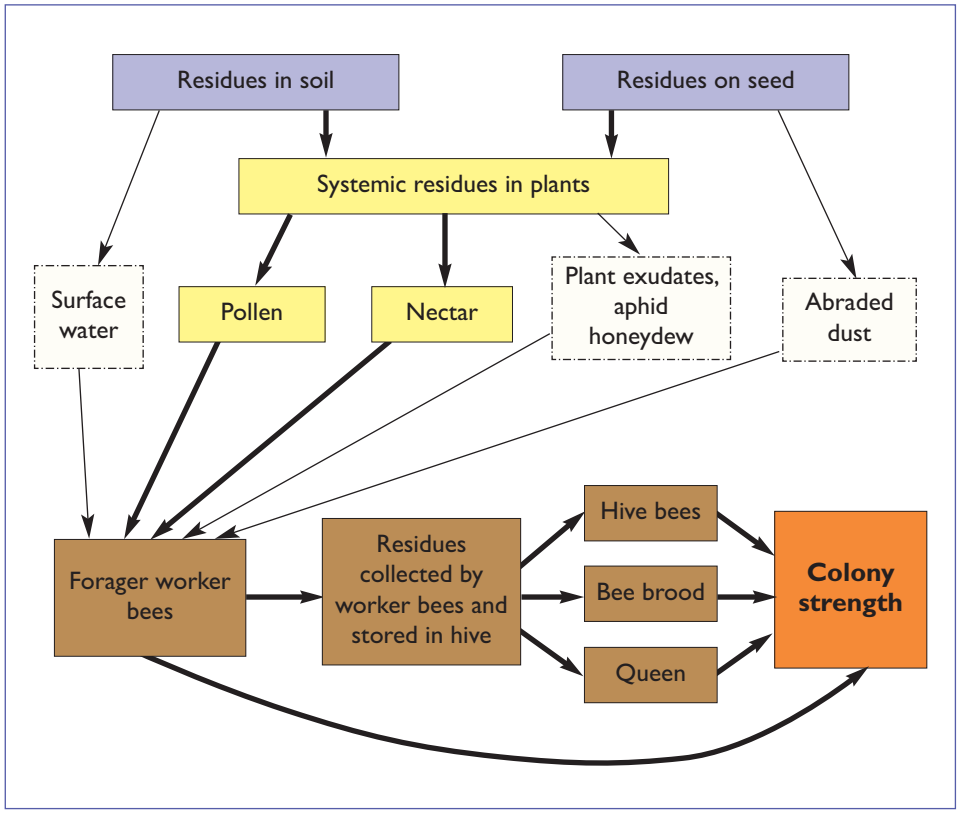

Figure 1. Stressor source, potential routes of exposure, receptors and attribute changes for a systemic pesticide applied to the soil or as a seed dressing (boxes with dashed lines represent secondary routes of exposure). Figure taken from Fischer and Moriarty, 2011.[6]

1. The pesticide risk-assessment for honey bees is incomplete

The SETAC 'Pesticide Risk Assessment for Pollinators' workshop stated (see pages 20–21) that harmonised toxicity tests (acute and chronic) are still to be developed for systemic insecticides.[6] The research recommendations, summarised from pages 39–41 in Table 1,[6] ought to have been identified and investigated much earlier. Clothianidin, for example, was approved for use as an active substance in 2002. The Advisory Committee on Pesticides (ACP) Annual Open Meeting in November 2011 made the same observations and said it might be another five years before a standardised test for chronic bee toxicity guideline will be developed.[7]

The European Food Safety Authority (EFSA) recently published an opinion on the science behind the development of a risk-assessment of plant protection products on bees. In the summary they identified a number of areas where the existing risk-assessment could be improved, including: the methods of field testing;

Table1. Summary of SETAC Workshop Research and Recommendations

Research item	Comments
1. Exposure nomogram for pesticide concentrations in pollen and nectar	To predict pesticide residues in pollen and nectar compared with pesticide application on seeds.
3. Likelihood & magnitude of pesticide exposure through guttation	To determine if plant guttation drops are a pesticide exposure route for bees.
4. Pesticide fate within the colony	To determine the movement, distribution and breakdown of pesticides in the colony and effects on the bee castes.
5. Modification and validation of larval test	A test for the effect of pesticides on bee larvae. A test has already been partly validated.
6. Standardized protocol for chronic feeding study	The need for a standard procedure for a chronic feeding study with adult bees.
7. Testing method to assess effects on foraging behaviour	Further research on methods to evaluate potential pesticide effects on bee foraging behaviour.
10. Improvements to monitoring efforts	Reporting schemes for better collection and analysis of field experiences, including incident reporting.
11. Research on effects of pesticides on community or landscape populations	To better understand the impact of pesticides on the environment. Does not specify, but should include soil & water.

Table 1. SETAC workshop research recommendations summarised. From Fischer and Moriarty, 2011, pp39–41.[6]

testing of the presence and fate of pesticide residues; gaps in knowledge of sub-lethal doses and long-term effects of pesticides on bees; the unsuitability of conventional regulatory tests based on acute toxicity for assessing risks of long-term exposure, and improvements to existing laboratory, semi-field and field testing.[8] These statements clearly indicate that the original risk-assessment that resulted in the approval of neonicotinoids as the active substance for insecticides was inadequate.

2. Conflicting opinions on the effect of neonicotinoids on bees

CRD's reply in the July issue of *BBKA News* did not explain their assessment of the fifteen papers they listed, simply stating: '*The body of evidence assessed so far supports the conclusion that neonicotinoids do not threaten honey bee populations.*' Some of these papers addressed the shortcomings identified in point 1 above, so why not take the opportunity to give an evaluation of these papers? *Pesticides and Honey Bees: State of the Science* reviews over twice as many papers.[9] The authors conclude that '*the weight of evidence demonstrates that pesticides are indeed key in explaining honey bee declines, both directly and in tandem with the other two leading factors, pathogens and poor nutrition*' (p1). What are beekeepers supposed to make of these conflicting views, if the CRD will not explain its side?

Why did the National Beekeepers' Association of New Zealand (NBKANZ) find it necessary to evaluate Dow Agro-Sciences (NZ) Ltd application to import the insecticide 'Transform'? This insecticide, with active substance 'Sulfoxaflor', is a liquid applied to soil, prior to sowing crops. It is systemic, neurotoxic, highly persistent in soil, soluble and mobile in water. NBKANZ assessed the documentation as inadequate due to the lack of data on the safety and health of bees. It commented: '*One has to ask … if Dow Agro Sciences has written this application to mislead or are just plainly incompetent in putting together a coherent application.*'[10] It should not be necessary for the NBKANZ, or any national beekeeping organisation, to have to check such applications.

3. EU regulation on plant protection products

European Regulation (EC) No. 1107/2009, lays down rules governing plant protection products and the active substances contained in these products.[11] Persistence in the environment is an important criterion and an active substance is defined as 'very persistent' if the half-life in soil exceeds 180 days, yet clothianidin, for example, has a half-life in soil of 545 days.[12] It is therefore surprising that the UK Environment Agency does not routinely test soil and water for neonicotinoids, especially in locations where treated seed is frequently planted.[13]

The Regulation also states that an active substance shall only be approved if it '*will result in a negligible exposure of honey bees, or has no unacceptable acute or chronic effects on colony survival and development, taking into account honeybee larvae and honeybee behaviour.*' As there are no internationally agreed test guidelines and the European Community risk-assessment methodology is incomplete in several respects, I contend that neonicotinoids have not been shown to meet these two conditions.

4. Risk managers take the final decision

The EFSA states that the final decision on protection goals needs to be taken by risk managers. EFSA says: '*There is a trade-off between plant protection and protecting the ecosystem services, pollination, hive products and biodiversity. From a farmer's point of view, plant protection may be more important than hive products.*' (p10).[8] In other words, there is a let-out clause in favour of economic factors.

But the SETAC Workshop summary also says that if '*the use of that product is considered efficacious and necessary [i.e. for plant protection], then the regulating authority may seek to manage the potential risk through mitigation.*' Risk-mitigation may take the form of label instructions.

For example, Bayer Provado® Ultimate Bug Killer (400ml aerosol spray can) contains 0.1 g Imidacloprid (0.25 g/l). The environmental protection label states 'HIGH RISK TO BEES. Do not apply when blooms are open. APPLY AWAY FROM BEES'. In case you are unfamiliar with the terminology, 'high risk' is worse than 'extremely dangerous'. This product contains enough active substance to kill two million bees (based on a lethal contact dose of 50 ng/bee (LD50 24h). So the risk manager decided in favour of ornamental plant protection and passed responsibility for the protection of bees to the public. This is hardly reassuring, yet there

is no mitigation for systemic products to protect bees.[7]

Discussion

Defra states: '*If such a [reporting] scheme were to be considered it would have to be demonstrated that it was a practical and effective risk mitigation measure*.' I do not think there are practical obstacles for farmers to report sowing of treated seed and for Defra to make this information available online. Farmers derive economic benefit from use of pesticides and a report would be relatively easy to make. They would need only to report once per season. The information required should include the name of the crop, the pesticide product, the location and area of the field, and the start and end dates of the growing period. Many farmers already submit information to Defra online.

The Rural Payments Agency (RPA) has a Rural Land Register (RLR) which holds details of all registered land parcels in a digital format. All land must be registered on the RLR for a farmer to be eligible to receive payments from, say, the Single Payment Scheme (SPS). Each field has a unique reference number (Ordnance Survey sheet number and the National Grid field number), usually the mid-point of the field and the size in hectares.[14] Such a scheme might be included in the existing agri-environment schemes administered by Natural England.[15] Defra and CRD state that '*Ministers take the success of bee populations very seriously*.' If they are reluctant to enforce such a reporting scheme, perhaps a financial incentive might encourage farmers to cooperate?

Knowledge of the location of seed-treated crops would allow beekeepers to take their own risk-mitigation measures in the siting or moving of colonies if they so wish. Of course in most cases it will not be practical or possible to do so, but without this information we do not even have that option. The value of knowing the location of these crops is similar to the availability of crime statistics maps (no pun intended). In addition, it would provide the opportunity for correlations between bee losses and seed-treated crops.[16]

Defra states:'*We will continue to encourage farmers and pesticide users to develop good relationships with their neighbours, including beekeepers*.' As spray liaison is more or less moribund in Hampshire and Cornwall, I doubt farmers will volunteer the whereabouts of seed-treated crops, unless they are required or encouraged to report. Until we know which crops are sown with treated seed, beekeepers will be forever arguing about systemic pesticides. Also, it does not help when an agrochemical company promotes its insecticide products as 'bee-friendly' (an oxymoron) or 'bee-safe' (not proven).[17]

The SETAC Workshop summary states: '*Growers and beekeepers engage in reciprocal endeavours: it is therefore to the advantage of each to anticipate the concerns of the other. Cooperation and understanding of one another's needs is essential*.' Until there is a comprehensive pesticide risk-assessment for bees, I still contend that we are entitled to know the location of crops sown from seed treated with systemic pesticides.

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