Pesticide Action Network UK

What could farmers do to rely less on neonicotinoids?

Bee Declines & Pesticides factsheet 6

This fact sheet discusses issues around reducing use of neonicotinoids. Many farmers have become over-reliant on neonicotinoids as an 'insurance policy' – a tactic which goes against the key Integrated Pest Management principle of only using chemicals based on actual need. Promising developments in reducing pesticide reliance in general in arable cropping systems are described, before looking at potential alternatives to neonicotinoids in oilseed rape. Challenges in reducing neonicotinoid reliance are identified, along with the need for farmer advisory support and policy measures.

Credit: Graham White

A wide range of pests are targeted with neonicotinoid applications in different cropping systems in Europe and the US. Seed treatments in maize, sunflower and oilseed rape (OSR) are used to protect seed and young plants from wireworms ,cutworms, western corn rootworm, aphids and leafhoppers[1].

In the UK neonicotinoids are used for various soil-dwelling insect pests in wheat, maize and other cereals, in sugarbeet and OSR. Neonicotinoids may be sprayed against aphids and other sucking pests in UK apple and pear orchards and vegetables and fruits grown in greenhouses. They are also used as soil treatments in

turf and lawns. Neonicotinoids are widely used in ornamentals and pot plants and many products exist for the amateur gardener (see PAN UK's bees webpages for a list). Not all of these uses will result in direct pollinator exposure and the main concerns are for crops which produce flowers attractive to pollinators and in which neonicotinoid residues may be present. However, even in greenhouses, environmental contamination may take place and residues can end up in water sources used by pollinators. Soil treatments may remain active for years and could affect invertebrates, which are food items for birds and other wildlife.

Over-reliance on insecticide treatments as 'insurance policy'

In the last few years, a significant increase in reliance on insecticides used as preventative pest control has triggered alarm bells in the US and Europe. In the US Midwest maize and soya belt, recent high prices for these crops have lead many growers to overuse pesticides and to grow more of the most profitable crops in order to maximise their yields[2,3]. A noticeable trend back to older habits of blanket insecticide applications, including neonicotinoid seed treatments, as an 'insurance policy' style of pest control, has been criticised by entomologists[4,5]. Routine, calendar-based treatments are contrary to the philosophy of Integrated Pest Management (IPM). Under IPM principles, field-based crop monitoring is essential to see whether key pests are indeed present in a particular field or season or at levels that will lead to economic losses. Instead, many US farmers are using insecticides before their need is demonstrated and this can disrupt natural biological control by harming beneficial insects[6]. Since 2002 US maize cultivation has undergone a ten-fold average increase in insecticide use and a shift away from IPM practices, linked partly to the spread of genetically modified crop varieties and the marketing of seeds treated with increased doses of neonicotinoids[7,8].

Italian maize cultivation witnessed a similar trend to 'insurance' seed treatment, which recent research has proved to be largely unnecessary, as well as harmful to bee populations[9] (see factsheet 5). APENET researchers have established that treating seeds with systemic insecticides does not increase maize yields. Their national monitoring shows that visible pest attack is low (below 10% of plants observed) and where it does occur, it has no impact on

"In many instances pesticides are applied without scouting fields to see if they are needed, violating a bedrock principle of integrated pest management. The result is a biological diversity desert in many corn and soybean fields in the agricultural Midwest, and signs that the surviving insects are becoming resistant to several key bug-fighting tools now available to farmers."

Diana Yates, University of Illinois, USA

Credit: CARI, Belgium

overall crop yield. The researchers conclude that the best way to reduce harm to bees from pesticide exposure is by implementing suitable IPM cropping practices, such as wider crop rotations, to reduce the spread of soil-dwelling maize pests. Pesticides (including in treated seeds) should only be used in case of real need[10].

Pesticide reduction through IPM and cropping systems redesign is feasible

Moving to pest management strategies which are safer and more sustainable, while remaining profitable and productive, is feasible, given the right support. As part of the French National Pesticide Action Plan which aims for a 50% reduction in pesticide use by 2018, several years of on-farm trials with farmers have generated useful experiences in rethinking arable cropping systems. Late autumn sowing of wheat, for example, is effective in reducing aphid attacks and can eliminate the need for foliar insecticide applications while reducing nitrogen fertiliser inputs helps lower aphid numbers[11]. Sowing an earlier strip of wheat can form a reservoir of predatory insects to feed on these pests. UK research has looked at how pesticide use could be reduced in winter-sown arable crops (Box 1).

The National Agriculture Research Institute (INRA) has calculated that France can achieve a 30% reduction in pesticide use on arable crops without harm to yields or farm income by a stepwise progression to more sustainable systems[12]. Between the extremes of current high pesticide-input intensive agriculture and organic agriculture, intermediate approaches aim to reduce pesticide and fertiliser inputs and combine these with non-chemical methods of adapted crop rotations and husbandry practices that help prevent damaging levels of pest, disease and weed attack.

Participatory trials with farmers in France's Eure river basin to reduce water pollution by pesticides and fertilisers demonstrate how re-designing arable cropping systems can work in practice. Current conventional

Box 1. Potential pesticide reduction levels in UK arable systems

Research by Rothamsted has looked at options for more environmentally sustainable arable cropping than current practice - dominated by a narrow three year rotation of wheat-wheat-OSR. They concluded that a 30% overall reduction in pesticide use could be achieved by changing crop rotations to include more spring-sown crops and a wider variety (e.g. beans, spring barley and fallows). These reductions would mainly be in herbicide and fungicide use. However, wider uptake of available technologies could achieve a further 20% pesticide reduction, including some reduction of insecticides, through better forecasting and decision support, practical measures to encourage more biological control and greater use of resistant varieties. Further reductions could come through in-row insecticide targeting in oilseed rape and trap cropping for key pests.

Source: Ferguson & Evans, 2010[14]

practice tends to grow a narrow rotation of OSR>wheat>wheat>winter barley and relies on regular application of pesticides and fertilisers, frequent field operations and cultural controls mainly using cereal varieties tolerant of leaf and stem diseases. This conventional practice is facing not only water pollution issues but also crop husbandry and economic problems due to low yields in the second wheat crop in the rotation, increasing weed problems and wheat stem diseases. The solution needs to be a rethinking of the entire system[13].

The first step is to include peas before OSR and grow sunflower between wheat years. Subsequent steps integrate methods including:

- more suitable crop varieties
- pesticide applications based on careful monitoring
- field plot size reduced to improve biological control
- reducing seeding density and nitrogen inputs
- shifting sowing dates
- sowing varietal mixtures
- alternating winter and spring cropping
- use of stale seedbeds and green manure cover crops.

Data show that overall pesticide treatment frequency can be reduced by 58% under a systems approach, with reductions also in nitrate leaching, energy consumption, greenhouse gas emissions and a 42% saving on input costs, with net income maintained or very slightly increased.

"Understanding the fundamental differences between prevention-based biointensive IPM and treatment-oriented systemic approaches to pest management is a necessary first step to moving away from today's high cost, high-risk, and unsustainable pest management technologies".

Chuck Benbrook, Rachel Carson Memorial Lecturer, 2008

While these on-farm trials do not specifically address neonicotinoid use, both the French and UK cases show the potential to achieve pesticide reductions by rethinking approaches and building in new techniques. The French nationwide network of demonstration farms and participating farmers is now looking at methods to avoid using treated seed in cereals, OSR and sunflower[15].

Support for change

Changes to cropping systems and reducing reliance on unsustainable agrochemical inputs will not happen without concerted support in practical, farm-based research, farmer training and advice and appropriate policy measures. Groups of French arable farmers have achieved impressive results as part of continued close collaboration with IPM agronomists and researchers in ecologically-based pest and crop management since 2006, by trying out different combinations of rotations and cultivation measures and recording the performance in economic and pollution reduction terms[16]. Policy measures that governments could take to help farmers shift to lower input farming include: targetted grants; pesticide taxes; better delivery of advice and training; and more research into agro-ecological methods[17].

Options for reducing reliance on neonicotinoids in oilseed rape

Oilseed rape is one of the largest British uses of neonicotinoid seed treatments in a crop frequently visited by bees. Treated

seed is commonly used by farmers as a broad-spectrum control of OSR pests including flea, leaf and cabbage stem beetles and several aphid species. The conventional view is that preventative treatment at autumn sowing is needed to target leaf, stem and root-feeding insects that can damage young plants and it may help to control viral diseases transmitted via aphids, which can reduce yields the following spring. Pyrethroid insecticides or neonicotinoids may also be sprayed versus aphids, flea and pollen beetles. Seed treatments are not always fully protective, however, for example, farmers often need follow-up foliar sprays in spring to maximise flea beetle control and to reduce aphid transmission of viruses[18,19]. Seed treatments do not appear effective against rape winter stem weevil.

Under an IPM or organic pest management strategy, the first question would be to ask if farmers really need to control these pests in all seasons and on all fields? British farmers tend to rely on 'insurance' treatments if they have experienced problems in the past and the cost of insecticide application is a very small proportion of overall production costs so there are few economic incentives to try a different approach. However, it is unlikely that treatment is necessary for all OSR pests on such a regular basis, for example, there are indications that not all stem-boring OSR pests in Scotland warrant control interventions[20].

Better decision making: Improved pest monitoring, along with more use of decision support systems for predicting levels of pest or viral disease attack, would help farmers make better decisions based on actual need. For pollen beetle control, monitoring traps and on-line forecasting can help focus efforts and reduce unnecessary 'insurance' foliar sprays against pollen beetles in spring[21]. Careful observation for all stem-boring pests in autumn, including looking for cabbage stem beetles in stores and monitoring for damage in emerging seedlings, is recommended. The Scottish Agricultural College monitors for rape winter stem weevil migration into crops and growers can receive information for accurate spray timings[22].

Diversifying crop rotations: Narrow crop rotations, commonly with OSR one year and two years of winter wheat, can exacerbate pest problems in oilseed rape. OSR acreage has been rising since the end of "set-aside" and as demand for biofuels grows. French experience in reducing agrochemical inputs shows convincingly that widening and diversifying crop rotations is a key principle in moving to less polluting systems, while maintaining farmer incomes. While organic OSR is hardly grown in the UK, in other countries organic production systems only include it one year in every five or six, as part of effective pest management by organic farmers who clearly have no recourse to use of seed treatments or foliar sprays (Ulrich Schmutz, personal communication). The more diversified crop rotations required of organic systems tend to deliver higher biodiversity than conventional farming and increase foraging resources for pollinators (see factsheet 7).

Appropriate crop varieties: Using OSR varieties more tolerant or resistant to key pests and aphid-vectored diseases might be a further option for reducing use of neonicotinoids.

More use of biological control: Maximising control by natural enemies is another option. There are well-documented field management practices shown to encourage more predation of aphids in cereal crops, such as 'beetle bank' grass strips which help predatory insects move into large fields, and sowing of floral strips to attract nectar-feeding hoverflies (the larvae of which feed on aphids). Increasing habitat refuges and resources for natural enemies can contribute to improved pest management in arable rotations[23] especially if fewer pesticide applications, which often harm natural enemies, are made.

Biocontrol and other IPM options exist for reducing or eliminating use of foliar sprays against pollen beetle in UK OSR[24]. Good natural control is provided by three species of parasitic wasp, which are able to kill 25-50% beetle larvae on unsprayed crops. Trap cropping with turnip rape can attract more parasitic wasps into fields and often reduce pollen beetle numbers below the decision threshold for spray action.

Taking pest resistance into consideration: Avoiding the development of insect pest resistance to neonicotinoids and other insecticides is a further consideration for achieving longer term sustainable pest management. Some populations of peach potato aphids in Europe seem to have developed resistance to neonicotinoids and there are concerns that this resistance could spread to UK populations[25]. Pollen beetles have developed resistance to pyrethroid insecticides in Europe and the first resistant individuals were recorded in the UK in 2006[26]. For this particular OSR pest, UK advisory services strongly warn farmers not to be tempted to apply insecticides for insurance purposes and note that pollen beetles are rarely numerous enough to warrant treatment in most fields.

Preliminary experiences in reducing reliance on neonicotinoids

To date there is little experience developed on how farmers could reduce reliance on neonicotinoids or even avoid their use entirely. The Italian maize story shows that in some crops and regions, farmers can easily cope without using treated seed and do not suffer economic consequences.

A few supermarkets have recently started to consider restricting use of neonicotinoids in their supply chains. The Co-operative is the first UK retailer to have taken action on neonicotinoids, with restrictions on their use as foliar sprays in relevant flowering crops attractive to bees in place since 2009[27]. The Co-operative's pesticide policy states that use of these compounds should be avoided where possible. If not, growers must request permission to use neonicotinoid sprays, provide justification for use and adhere to strict requirements on application timing and methods to minimise potential bee exposure. Preliminary feedback from their suppliers (Simon Press, personal communication) indicates that a number of suppliers have moved away from neonicotinoid use where there are readily available alternatives. The Co-operative's policy has certainly drawn the attention of their growers and suppliers to the issue of neonicotinoids and their potential to harm bees. Growers have been

encouraged to place greater emphasis on pest assessment, applying insecticides only once there is a proven risk that needs to be managed.

Regulatory or supply chain restrictions on neonicotinoids need to avoid unintended negative consequences, such as farmers replacing these with older insecticides that are harmful in other ways. Reducing reliance on neonicotinoids will require:

- participatory field trials with farmers to develop and fine-tune methods
- exploring how certain organic practices could be adapted by conventional farmers
- advisory services and policy measures to help more farmers adopt ecologically-informed IPM strategies
- investing in longer term cropping system redesign
- support and motivation for change in the different links in food supply chains

Key points

- Routine, 'insurance policy' treatments are common but run counter to IPM principles, where decision making should be based on actual need.
- At least 30% reduction in pesticides is feasible in arable systems without negative effects on farm income or yields, given proper advice and other support to farmers.
- In oilseed rape, do farmers really need to control pests in all seasons and in every field? Improved monitoring could reduce the perceived need for neonicotinoid use.
- Diversifying crop rotations, using varieties more tolerant of pests and encouraging natural enemies can help farmers reduce their reliance on neonicotinoids.
- More research into alternatives and investment in farmer training is needed, along with policy measures to encourage change.

In this series

If you would like to find out more about the relationship between pesticides and pollinator declines, all of these leaflets and other info are available via PAN UK's bee webpages at: **http://bees.pan-uk.org**

Bee Declines and the Link with Pesticides. Summary leaflet.

Fact sheets:

1. Different routes of pesticide exposure
2. Sub-lethal and chronic effects of neonicotinoids on bees and other pollinators
3. Serious shortcomings in assessing risks to pollinators
4. Different regulatory positions on neonicotinoids across Europe
5. Can restrictions on systemic insecticides help restore bee health?
6. **What could farmers do to rely less on neonicotinoids?**
7. Opportunities for improving and expanding pollinator habitats
8. Action on neonicotinoid and other bee-toxic pesticides

References

1. Marzaro, M, Vivian, L and Targa, A. (2011) Lethal Aerial Powdering of Honey Bees with Neonicotinoids. Bulletin of Insectology 64 119-126

2. Yates, D. (2012) Pesticide overuse reaps insect resistance and diversity desert. Press release, University of Illinois, 5th March 2012. Via:

3. PANNA (2012) GE corn and sick honey bees- what's the link? Groundtruths, 19 April 2012. Pesticide Action Network North America. Via: http://www.panna.org/blog/bee-kills-corn-belt-whats-ge-got-do-it

4. Gray, ME. (2011) Relevance of Traditional Integrated Pest Management (IPM) Strategies for Commercial Corn Producers in a Transgenic Agroecosystem: A Bygone Era? J. Agric. Food Chem 59 5852-5858

5. Eureka Alert (2012) Researcher tracks agricultural overuse of bug-killing technology. Eureka Alert, Feb. 2012. Via: http://www.eurekalert.org/pub_releases/2012-02/uoia-rta022912.php

6. Hopwood, J, Vaughan, M, Shepherd, M, Biddinger, D, Mader, E, Hoffman Black, S and Mazzacano, C. (2012) Are neonicotinoids killing bees? A review of research into the effects of neonicotinoid insecticides on bees, with recommendations for action. Xerces Society for Invertebrate Conservation, USA. www.xerces.org

7. Benbrook, C. (2008) Prevention, not profit, should drive pest management. Pesticides News 82 12-17. Via: http://www.pan-uk.org/pestnews/Issue/pn82/PN82_p12-17.pdf

8. PANNA, op.cit.3

9. APENET (2011a) UNAAPI's synthesis and highlighting of the Report on activities and results of the APENET Project "Effects of coated maize seed on honey bees" Year 2011. National Union of Italian Beekeeper Associations UNAAPI. Original APENET report in Italian available via: http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/860

10. APENET (2011b) Letter to the Agriculture Committee of the European Parliament, 30 Sept 2011. Prof. Stefano Maini, APENET, Bologna University, Italy.

11. Williamson, S. (2010) French farmers and Integrated Production of wheat. Pesticides News 90 16-17.

12. Farming Online (2012) French scientists: 30 per cent pesticide reduction possible without affecting yields. Friday 02 March 2012, Farming Online. Via: http://www.farming.co.uk/

13. Denis, E and Lallier, S. (2012) Shifting from conventional to economic farming in three years. Presentation (in French) to Sustainable Agriculture Network seminar on arable cropping systems held in Paris, 13 February 2012.

14. Ferguson, A and Evans, N. (2010) Reducing pesticide inputs in winter cropping systems in the UK. Winter Crops Based Cropping Systems Case Study Guide no. 3. ENDURE network for diversifying crop protection. Via: www.endure-network.eu

15. Denis & Lallier, op.cit.13

16. Williamson, op.cit.11

17. Farming Online, op.cit.12

18. SAC (2007) Winter oilseed rape pests and diseases. Technical Note TN 620. Scottish Agricultural College, Edinburgh.

19. SAC (2009) Stem boring pests of winter oilseed rape. Technical Note TN 584. Scottish Agricultural College, Edinburgh.

20. SAC, op.cit.18

21. HGCA (20120) Controlling pollen beetle and combating insecticide resistance in oilseed rape. Info sheet 13/Spring 2012 , HGCA, Agriculture & Horticulture Development Board, UK. Via: www.hgca.com

22. SAC, op.cit.18

23. Ferguson & Evans, op.cit.14

24. Cook, SM and Denholm, I. (2008) Ecological approaches to the control of pollen beetles in oilseed rape. EPPO Bulletin 38 110-113.

25. Farmers Guardian (2012) Monitoring aphid resistance to neonicotinoids in-field. Farmers Guardian, 21 April 2012. Via: http://www.farmersguardian.com/home/arable/arable-news/monitoring-aphid-resistance-to-neonicotinoids-in-field/46358.article

26. HGCA, op.cit.21

27. Co-op (2009) The Co-operative prohibits eight pesticides as part of radical new 'Plan Bee'. Press release, The Co-operative Group today. 30 January 2009

PAN UK's vital work in the UK and in developing countries

Pesticide Action Network UK is a registered charity dedicated to:-

- Eliminating the most hazardous pesticides,
- Reducing dependence on chemical pesticides,
- Promoting sustainable and equitable food systems and increasing the use of alternatives to chemical pest control in agriculture, urban areas, public health and homes and gardens

In the UK, we campaign for tighter regulatory controls on pesticides and encourage retailers to tackle pesticide problems in their supply chains. We provide advice on alternative ways to control pests and work with local communities to reduce public exposure to pesticides. In the developing world, we raise awareness about pesticide hazards and train farmers in organic and low input agricultural techniques to help them to make a decent living without putting their own health, their families or their environment at risk.

Populations of bees and other insect pollinators have fallen dramatically in recent years. The reasons for these declines are complex and wide ranging, but there is little doubt that pesticides are playing a key part. PAN UK has prepared these fact sheets to cut through the confusion and provide an up-to date and balanced explanation of the role of pesticides in pollinator declines. To find out more and what you can do, please visit http:\\bees.pan-uk.org

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