Nature's harvest

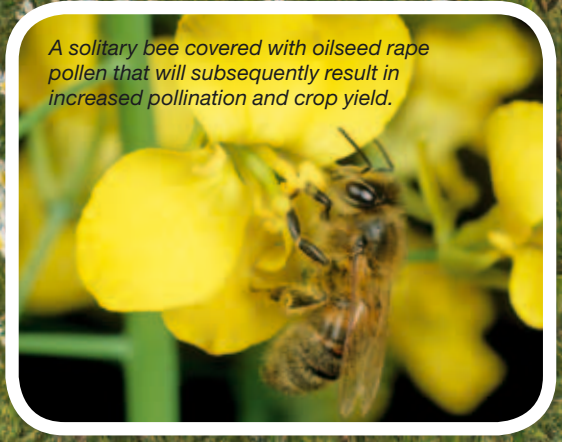
We live in a hungry world, and this will only increase. By the middle of the century, scientists estimate that global crop yields need to rise by 70 per cent. How can we do this in a way that's environmentally and socially sustainable but also economically viable? Richard Pywell and Ben Woodcock argue that supporting native wildlife on farms is part of the answer.

Population growth and changes in diets mean we urgently need to produce more food. The farming methods we already rely on may not be able to achieve this. The UK has signed the Convention on Biological Diversity, which requires that 'by 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity'.

But many native species have the potential to increase crop yields, so supporting biodiversity on farmland has more to offer farmers than simply beautifying the countryside. For example, bees pollinate crops, predatory beetles eat pest aphids, and wildflowers mean there's more and better grass for livestock without the need for environmentally-damaging nitrogen fertilizers. Yet for biodiversity to benefit agriculture, our native plants and animals need careful husbandry within farmed landscapes.

Farmers have always been in a running battle with pests. We estimate that in 2010, UK crops worth £715 million were lost to insect pests. Pesticides are crucial to controlling them, but the development of pest resistance, key products being withdrawn from sale and fears about human and environmental health mean that alternative methods are increasingly important. One solution is to promote native biodiversity that will kill pests within crops.

A flower-rich field margin. The flowers provide food and shelter for bees and butterflies, as well as other insects such as spiders, predatory ground beetles and parasitic wasps that are involved in natural pest control.



A solitary bee covered with oilseed rape pollen that will subsequently result in increased pollination and crop yield.

Ben Woodcock

A predatory orb-web-building spider that will benefit from habitats created by sowing field margins next to arable crops.

NATIVE SPECIES CAN INCREASE CROP YIELDS, SO SUPPORTING BIODIVERSITY HAS MORE TO OFFER FARMERS THAN SIMPLY BEAUTIFYING THE COUNTRYSIDE.

So-called 'natural pest control' can cut crop losses by 65 per cent, and is worth an estimated £1.3 billion a year to UK farmers. £432 million of this comes from invertebrates like parasitic wasps or predatory ground beetles. Invertebrate communities that control pests are diverse in the UK – for example, we have identified nearly 60 species of predatory ground beetles that feed on pests in wheat, barley and oilseed rape.

However, most invertebrates that help control pests cannot remain in fields throughout the year – ploughing and harvesting will kill them. To keep large numbers of predatory invertebrates in the fields, we need to sow new habitats where they can shelter before moving back into the crops. One of the best ways of doing this is by managing field margins for biodiversity. This involves sowing seed mixtures that provide crucial habitats for pest-eating invertebrates in thin strips around the field edges.

For example, sowing tussock-forming grasses like cocksfoot will benefit beetles and spiders that hide and overwinter in them. Creating these habitats is an important part of European agri-environmental schemes, of which field margins represent one of the most widely-implemented approaches. The principle behind these field margins is simple, but how they are established and managed will determine what predators are present, how common they are and how well they can move into the centre of fields to feed on pests.

A helping hand

Insects play other roles in food production by pollinating flowering crops like oilseed rape and soft fruits. In the UK this is worth an estimated £400 million a year, and worldwide its value could be as high as £150 billion. Yet we know very little about the role our native bee species play in this pollination. In recent surveys we were surprised to find that as well as the well-known honeybee (*Apis mellifera*), more than 30 species of native bees were pollinating oilseed rape crops. Native bees can account for at least as many flower visits as honeybees, so they are crucial in crop pollination, particularly where colony collapse disorder means there are no longer enough honeybee hives.

Observations we are making suggest that native solitary bees may be particularly efficient in pollinating crops as they don't clean pollen off their bodies to the same extent that bumblebees and honeybees do. By being messy eaters, the solitary bees are more likely to transfer pollen to the female reproductive part of the flower (the stigma).

It is by gaining a more detailed understanding of which insects are pollinating crops that we can map their UK distribution using data collected by the volunteers of the Bees, Wasps and Ants Recording Scheme and the Biological Records Centre. This let us identify crop-growing regions that support limited numbers of native bee species. This kind of information is likely to be increasingly important in the future for policy-makers who need to target land management to promote beneficial insect pollinators – for example, by sowing wildflowers on unproductive field edges and awkward field corners to support large numbers of these helpful insects.

Farm-management techniques that enhance biodiversity need to develop in a way that is compatible with real-world agriculture, and increasingly must deliver a wide range of benefits including pollination, pest control, water protection and even locking up greenhouse gases in the soil. The most successful approaches rely on communication between scientists, farmers, the agricultural industry and the government.

For example, a partnership with the agro-chemical company Syngenta helped create wide-reaching benefits for bees under the 'Operation Pollinator' programme by planting field margins rich in flowers that helped support greater abundances of pollinating bees. Future increases in crop yields will almost certainly not be achieved in isolation from consideration of the role played by ecosystem services that are provided by native biodiversity. This means management that promotes biodiversity to benefit crop production will be vital to the UK's long-term food security.

MORE INFORMATION

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Operation Pollinator farmland biodiversity programme – www.operationpollinator.com

Bees, Wasps and Ants Recording Scheme www.bwars.com

Biological Records Centre – www.brc.ac.uk