Towards sustainable agriculture: study identifies biodiversity-friendly alternatives to conventional wheat crop management, Germany

As intensive agriculture is associated with large-scale impacts on biodiversity, ecosystem services, food security and human health, it is important to shift to more sustainable, yet highly productive, farming practices. A study now assesses such practices in wheat, evaluating agricultural-management strategies at the field and landscape scales. The findings suggest that biodiversity-enhancing practices can support natural pest predation without use of agrochemicals — and that controlling pests and weeds by agrochemical means is less relevant than expected for final crop productivity.

Biodiversity provides a range of benefits for agriculture, including biological pest control, nutrient cycling and pollination. However, intensive agriculture can threaten the biodiversity and the ecological function of an ecosystem, impacting productivity. To address food security risks, farmers are encouraged to adopt a more environmentally sustainable and ecology-focused approach to agriculture via EU programmes and policies such as the Common Agricultural Policy. But which practices are suitable for this purpose, and how do they affect agricultural yield when compared to conventional intensive methods?

A study explores this question for winter wheat (*Triticum aestivum*) fields in Germany\(^1\). It considers non-adaptable drivers (e.g. soil characteristics) and common intensive farming practices (e.g. agrochemical use) to identify local and landscape-scale management options that can reduce the negative environmental impacts of agriculture, and feasibly be applied to real agroecosystems.

**Source:**

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The researchers studied 14 pairs of winter wheat fields near Würzburg, Bavaria (selected in 2014). In each field, a randomised experiment with pyrethroid insecticide and mineral fertiliser was implemented in four adjacent treatment plots, with the type and amount of substance and the timing of application following regional practices. Fertiliser (total 190 kilograms per hectare (kg/ha)) was applied at three growth stages and compared well to fertilisation levels of surrounding conventional wheat fields. Insecticide (300 millilitres of beta-cyfluthrin per hectare (ml/ha)) was sprayed once after the first of three biodiversity surveys, to test for the temporal effects of application on pests and predators.

The researchers considered a total of 34 variables as potential direct or indirect drivers of wheat yield, separated into soil, crop management, landscape and biotic (organism-driven) factors and sampled at different spatial scales. Crop-management data was derived from the experimental set-up (fertiliser and insecticide treatment) and from farmer surveys performed in autumn 2014.

The results showed plant biomass and grain yield to be strongly correlated and to increase with fertiliser application (by 26% and 30% respectively), but found no direct links between yield and insecticide application, pH or soil organic carbon content. There were no direct relationships between extensive crop management and yield quantity, but yield quality was greater in fields with high crop-rotation diversity or no-till methods of soil preparation.

The main drivers of pest abundance were resource availability and agrochemical application, with various pest species responding differently to the variables considered. Unexpectedly, landscape aspects played a minor role in predator (spiders, beetles and active flyers) abundance, with two exceptions: ground-hunting spiders were more active in landscapes with small crop fields, but less so in those with high ‘edge density’ (a landscape metric used as a measure of habitat network); and active flyers were less abundant in landscapes with high edge density. Predators in landscapes with small fields benefit from easy access to field-boundary habitat and on-field prey, the researchers suggest.
Microplastic pollution has soared in Spanish seagrass habitats over the last 40 years (continued)

Although agrochemical inputs had the strongest influence on yield quantity, the results indicate that reduced pesticide application may increase yield quality without significantly increasing pest pressure, and that biodiversity-enhancing management options such as no-till soil preparation and high crop-rotation diversity can enhance natural predation. As the effects of soil, management and landscape factors may be exaggerated by future climate change, the researchers highlight, such biodiversity-enhancing measures may also help strengthen the resilience of cropping systems to future global change (such as new pests, diseases or extreme weather events).

While the data covered only one year and one region, additional studies would improve understanding of these findings over longer time periods and wider geographic scales.