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Applying fertilizer? Don't forget about pollination

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In this post Stijn van Gils discusses his paper with Wim van der Putten and David Kleijn. [‘Can above-ground ecosystem services compensate for reduced fertilizer input and soil organic matter in annual crops?’](#)

You can also [read this post in Dutch](#).

Farmers often try to increase yield directly through ploughing, and the addition of fertilizers and agro-chemicals. Yield, however, is also affected by ecological interactions, such as pollination and natural pest control. In a semi-field experiment with oilseed rape, Stijn van Gils and colleagues examined whether the effect of pollination and herbivory on yield changed under different soil conditions.

I look at my stopwatch, it shows that there are only a few seconds left of my 15 minute count. I check the oilseed rape plants one more time: nothing, no bees or hoverflies. I give the plants half a litre of extra water and move on to another field site. I have 15 sites in total, and altogether the sites form a gradient in pollinator visitation rate. While many studies have shown that more pollinator visits lead to more yield, at the moment this is not what I am monitoring. Instead I have another question— how does fertilizer interact with pollinations to affect yield?

The oilseed rape plants that I am monitoring were grown in soil with either high or low soil organic matter content and either with low or high mineral fertilizer. We are testing if better soil conditions (more soil organic matter, more fertilizer) may lead to plants that are more attractive to pollinators; meaning that at sites with fewer pollinators plants would still get sufficient pollination. If soil nutrients are linked to pollination then we would expect pollination to be especially important for plants grown under nutrient poor conditions. Taking that step further, we would also expect that yield losses due to less fertilizer supply could be compensated for by boosting pollination.



Plants were placed at different field sites, representing a gradient in pollinator visitation rate.

Surprising energy re-allocation effect

Back at the office of the Netherlands Institute of Ecology (NIOO-KNAW) we found some surprising outcomes in the number of flowers produced by each plant. Plants at sites with higher pollinator visitation rate also had more flowers and this effect increased with fertilizer supply. First we were puzzled by this result: Plants were grown in exactly the same conditions and only placed at the different sites when they started to flower, so we did not expect differences in flower number among sites. However, we realized that crucifers such as oilseed rape are flexible in growth allocation, meaning under certain conditions they can grow more flowers. Other studies have shown already that flower number is influenced by caterpillar egg deposition and hand pollination. In that sense, our surprising results indicate that soil conditions may also play an important role in influencing flower numbers.

As we found that plants at sites with higher pollinator visitation rate also had more flowers and that this effect increased with fertilizer supply, we would expect a similar interaction on yield. However, this was not the case. Indeed, both higher pollinator visitation rate and fertilizer supply led to more yield, but these two acted independently from each other. A high pollinator visitation rate related with a higher yield increase than that after applying fertilizer. This was surprising, because oilseed rape can also be wind-pollinated and does not require insects to get pollinated. Another surprise: although an increase in soil organic matter content did increase plant biomass, it did not increase seed yield at all.



A higher pollinator visitation seems more important for oilseed rape yield than applying fertilizer.

New way of thinking

Overall, our results suggest that yield losses due to less fertilizer supply could be compensated by boosting pollination and that highest yield will be obtained by maximizing both fertilizer and pollination. Our findings suggest pollination by wild insects to be an underestimated and underappreciated agricultural input. So, is mineral fertilizer the best way to increase yield? No. Maybe it is more effective to increase pollination.