Optimising spatial distribution of mass-flowering patches at the landscape scale to increase crop pollination

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Abstract

The addition of floral resources is often recommended to improve entomophilous crop pollination. However, implanting new plots of mass-flowering resources in landscapes can have both positive and negative effects on pollinator visitation rates to crops.

We investigated the effects of plot characteristics (size and nesting quantities) on the best places to locate new co-flowering plots to optimise crop pollination. First, we parameterised and validated an existing pollination model with field data. We set up experiments to simulate the conversion of random plots into new sunflower fields vs wildflower plots (intended to provide more nesting sites than sunflower fields and co-flowering with sunflower) and quantified the change in pollinator visitation rates to existing target sunflower fields.

We predicted a decrease in visitation rates (competition) when floral plots were established next to target fields and an increase in visitation rates (facilitation) when floral plots were established farther away. We identified the competition-facilitation transition distance (/CF distance/), and the distance at which facilitation was maximal (/Fmax distance/). We interpreted competition effects as a dilution of pollinators among the floral resources and facilitation

effects as an increase in habitat quality, thus supporting bigger pollinator populations. Implanting floral resources that provide more nesting sites, such as wildflower plots vs new sunflower fields, significantly increased facilitation and reduced /CF distance/ (1,241 m vs 713 m) and /Fmax distance/ (1,788 m vs 1,138 m). The size of the converted plot did not affect /CF/ or /Fmax distance/.

We predicted a benefit in isolating rather than aggregating multiple sunflower fields in terms of global crop pollination.

/Synthesis and applications/. Our findings highlight the opportunity to optimise the spatial distribution of mass-flowering resources at the landscape scale to enhance crop pollination. We also suggest preserving or introducing nesting sites as a priority in areas with high-density mass flowering resources to compensate for the negative consequences of pollinator dilution.

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