Disparate notes for project

Article: Pest control of aphids depends on landscape complexity and natural enemy interactions

**Abstract**

Aphids are a major concern in agricultural crops.

Complexity is known to influence natural enemies of pests; few studies measured the degree of pest control by different enemy guilds across gradients in landscape complexity

This study used natural enemy enclosures replicated in 18 fields across a gradient in landscape complexity to investigate:

1. The strength of natural pest control across landscape (difference in pest pressure when the natural enemies are present or absent)
2. The contribution of natural enemy guilds to pest control
3. Interaction effect between natural enemy guilds and landscape.

**Results of the research**

* They showed that natural pest control increased 6 times from simple to complex landscape.
* In the absence of pest control, aphid population growth was higher in complex than simple landscapes. But when natural enemies were present, aphid pop growth was reduced the same way across all landscape.
* The effects of enemy guilds were dependent on the landscape. In complex landscape, pest control was mainly done with flying insects and ground-dwellers. Birds had little control.
* Despite evidence of intraguild predation, the overall effect on aphid control was complementary.
* Our results suggest that, where aphids are the main pest of concern, interactions between natural enemies are largely complementary and lead to a strongly positive effect of landscape complexity on pest control.

**Important info**

* Usually, more natural enemies in complex or seminatural habits as opposed to simple habitats with monoculture. Especially true for enemies that depend on permanent habitat structures for nesting, overwintering or other food resources.
* There can be interacting effects between natural enemies: additive, synergistic or antagonist (intraguild predation or behavioral interference). Determined by niche complementarity, functional redundancy, intraguild predation.
* Natural enemies include parasitoid wasps, syrphid fly larvae, carabid and staphlinid beetles, birds (may disrupt the effect of other NE)

The study was done in south Korea in a field of Brassica oleracea.

Examined the effect of three main functional guilds of natural enemies on pest control:

1. Birds and other vertebrates larger than 1.5 cm
2. Flying insects
3. Ground dwellers

Specifically, they assessed:

1. The strength of pest control by all NE combined on aphid population, across a gradient in landscape complexity
2. Identify the separate contributions of NE to pest control across landscape
3. Evaluate the influence of local management on these effects.

Hypothesis:

Interactions of the natural E pool may change with landscape complexity. And that this had consequences for overall pest control strength.

**Materials and method**

* Region located at the head of a watershed, annual and perennial crops are cultivated in small fields separated by seminatural margin: high landscape heterogeneity
* 18 fields selected, 13 were managed organically and five conventionally.
* Seminatural habitat was defined in this region as including seminatural field margins, secondary regrowth and shrubs, 1 and 2-year old fallows, and forest edges.
* After an initial 20 days, six rows of four cabbages were randomly marked in each plot from which all herbivores were removed. Six natural enemy exclusion treatments were installed on these plants between day 20 and 21 and maintained until harvest after 60 days. 6 x 4 x 18 = 432
* Inoculated aphids in these treatments by placing on each treated cabbage the average number of aphids per plant.
* Made sure that the aphid density was the same at first.
* 10 days later 🡪 arthropods monitoring (NE).
* After 60 days, cabbage plants were harvested and weighed for fresh biomass.

Natural enemy exclusion treatments were cages designed to exclude combinations of 3 guilds of NE (not good enough to prevent external colonization by aphids). Another exclusion treatment was by using eco-friendly pesticide. Pitfall traps were also installed in all treatments soon after the beginning of the experiment.

**Dependent variables studied**: aphid pop growth, parasitism rate (the portion of aphids that has been parasitized), syrphid fraction (larvae of syrphid flies predate aphids) and final crop biomass.

Parasitism rates = the ratio of parasitized to all aphids

Syrphid fractions = the ratio of syrphids to total aphids + syrphids

**Results**

On average, daily aphid population growth was 4x higher in the absence of NE. Effect maintained across sampling dates.

The exclusion of birds from treatments with other enemy guilds did not significantly impact mean aphid population growth at any date

The combined effects of ground-dwellers and flying insects on aphid suppression were stronger than in isolation => complementary impact.

Without NE, aphid pop growth higher in complex landscape. Effect maintained combining multiple guilds (GB).

In complex landscapes, flying insect enemies reduced aphid growth 2 times more than ground-dwelling predators.

Rates of parasitism and syrphid fractions increased with landscape complexity mainly in treatments accessible to flying insects only.

Negative effect of bird and ground-dweller access on the effectiveness of flying insect enemies.

Aphid population growth was strongly negatively correlated with parasitism rate and syrphid fractions, confirming the impact of these enemies for reduction of aphid populations. Neither population growth nor cumulated aphid densities led to a significant decrease in final crop biomass.

**Discussion**

* This study shows that in the absence of pressure by natural enemies, aphid population growth was higher in complex than in simple landscapes.
* However, aphids were also strongly reduced by natural enemies, and this pest reduction increased with landscape complexity.

Overall, aphids were maintained at low levels in all landscapes, because higher aphid growth and colonization in complex landscapes was compensated by stronger pest control by natural enemies.

* Our results suggest that flying insect enemies had stronger impacts than ground-dwellers on aphid control. these effects appeared to increase in complex landscapes (more parasitism and syrphid fractions).

Control by ground-dwellers increased to a lesser extent with landscape complexity than control by flying insect enemies.

Only syrphids had a positive impact on crop biomass, the final measure of interest for assessment of pest control.

* Positive interactions effect of flying insects and ground-dwellers on aphid suppression.
* No disruptive intraguild predation:  pest control provided by the combination of three enemy guilds was higher than pest control by individual guilds