What wasps can tell us about sex

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Whether an individual parasitoid wasp reproduces sexually or asexually is determined by a single gene. This new finding, reported by an Evolutionary Ecology research group from Eawag, the ETH and Zurich University, could help to answer a central question of evolutionary biology – and could also be of interest for biological pest control.

Why does sex exist? Evolutionary biologists have yet to find a satisfactory answer to this simple question. Asexual reproduction would be more "economical" because, with separate sexes reproducing sexually, only some organisms will produce offspring. Yet, in the course of evolution, sexual reproduction has become the predominant mode. Various theories have sought to explain why this is so, but they all have to contend with the problem that they are difficult to test empirically. It is true that certain animal species reproduce both sexually and asexually; however, in these species, individuals of sexual origin generally also differ in other respects[J1] from those of asexual origin, so that only limited conclusions can be drawn from direct comparisons.

Christoph Vorburger, SNSF Professor of Evolutionary Ecology at the ETH in Zurich and at Eawag in Dübendorf, and Christoph Sandrock, a doctoral student at Zurich University, have now discovered that a particular species of parasitoid wasp is ideally suited for reproduction studies. The two researchers investigated the aphid parasitoid Lysiphlebus fabarum, which has long been known to be capable of reproducing both sexually and asexually. Vorburger and Sandrock showed that there is virtually no difference between asexual and sexual individuals of this species – apart, that is, from their different modes of reproduction. In other words, the genetic differences between individuals are not greater than would typically be expected within a population.

Laws of inheritance apply

In sexual populations of these wasps, females develop from fertilized eggs and males from unfertilized eggs. In asexual populations, females only produce daughters without fertilization. Vorburger and Sandrock aimed to identify the genetic factors which determine whether a wasp will reproduce sexually or asexually. Surprisingly, it turned out that this fundamental difference is controlled by a single gene. Using crossing experiments, the researchers also demonstrated that the trait is inherited recessively. Exactly 12.5% of the third-generation females were found to reproduce asexually – the precise proportion predicted by Mendel's laws of inheritance for a recessive trait.

Vorburger and Sandrock do not yet know which gene determines the mode of reproduction. Vorburger explains: "We've only been able to show that the trait behaves like a single genetic factor, but we've already identified a microsatellite – a genetic marker – which is located close to the responsible gene. We'll now be carrying out a further study to answer this question."

More effective method of pest control?

However, these findings are not only of interest to evolutionary biologists: parasitoid wasps such as Lysiphlebus fabarum are used for biological pest control, as they deposit their eggs in aphids, which are then killed by the developing larvae. With sexual populations, only half of the individuals – i.e. the egg-laying females – actually contribute to pest control; this means that the effectiveness of the method could possibly be improved if asexual populations were used. But, as Vorburger points out, "It's also possible that the method would only be more effective in the short term – specifically, if the wasps can't

adapt to environmental changes." Asexual reproduction yields genetically uniform lines, and because there is no genetic mixing, adaptation to changing conditions is difficult. Ultimately – many evolutionary biologists believe – it is precisely the ability to adapt which explains why sexual reproduction predominates in nature, even though it appears at first glance to be less economical.

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https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/what-wasps-can-tell-us-about-sex