Ferns communicate to decide their sexes

Older generations release pheromones to balance the sex ratio in youngsters.

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Japanese climbing ferns can influence each other's growth.

Humans have it easy. For ferns, reproduction is much more involved.

In many animals, the sex of offspring is, biologically speaking, decided between the parents. But for Japanese climbing ferns (*Lygodium japonicum*), it depends on the entire community communicating across generations, researchers report in *Science*[1].

Older fernlings secrete pheromones that determine the sex of the younger ones — maintaining a balanced ratio so that they can all reproduce faster, the study shows.

It is the most intimate look yet at the sex lives of ferns, which spawn not from seeds, but from spores. They mature into full plants known as gametophytes, which can be male, female, or hermaphroditic. If there are no other gametophytes around, they will remain hermaphroditic and self-fertilise — reproducing but at the risk of inbreeding.

Six of one, half a dozen of the other

But in the Japanese climbing fern, a team led by Makoto Matsuoka, a molecular biologist at Nagoya University in Japan, found that the older gametophytes influence the sex of nearby younger ones. The two-step process involves a pheromone called gibberellin, which causes the plants to grow male sex organs.

Maturing female ferns express some genes that begin the production of gibberellin, but add a methyl ester chemical group to the precursor molecule before secreting it into the wet forest floor. This modification helps younger ferns to take up the substance; these nascent plants then express the genes necessary to complete the production of gibberellin, turning them male.

This allows the older ferns to be female while raising the number of males — thus balancing the sexes, eliminating the need for self-fertilisation, and maintaining genetic diversity.

“We know much more about sex in animals than we do in plants,” says Jody Banks, a plant geneticist at Purdue University in West Lafayette, Indiana. When it comes to the pheromones that determine sex selection, “This is really the first study to put a molecular face to it,” she says.

Sex and growth

Gibberellin had a key role in the Green Revolution after the Second World War, when farming and breeding technologies caused wheat and rice yields to soar worldwide. In these crops, gibberellin acts as a growth hormone, and the development of new crop varieties with reduced sensitivity to it allowed farmers to grow shorter and more weather-resistant stalks. Tai-ping Sun, a plant molecular biologist at Duke University in Durham, North Carolina, says that one day, a better understanding of the hormone might allow us to breed more-efficient strains of crops.

There could also be ecological implications. Matsuoka notes that the Japanese climbing fern has become an invasive species in the swampy southeastern United States, and that fungicides that target gibberellin could be used to combat the spread of the ferns.

He adds that it is difficult to say whether intergenerational cooperation is common among other ferns.

Banks may find out: she works with a different species of fern and is attempting to identify which of its genes affect sex selection. “This is really useful because now we have some candidate genes to target,” says Banks.

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References

1. Tanaka, J. *et al*. *Science* **346**, 469–473 (2014).