EVALUATING THE USE OF GENE DRIVES FOR WASP CONTROL

Invasive social wasp (Vespula vulgaris)

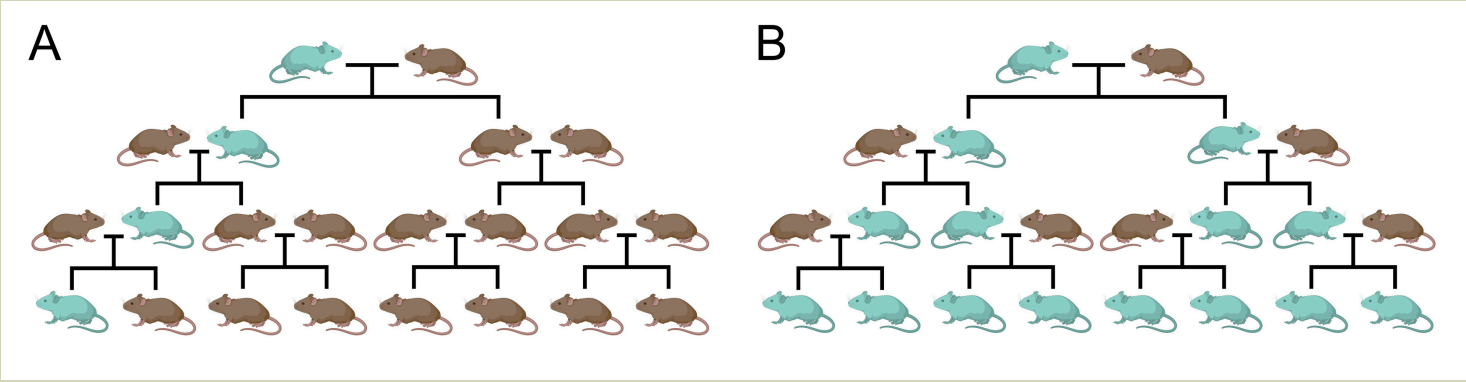
WHAT IS GENE DRIVE?

Gene drive technology is a form of genetic engineering that increases the likelihood that a particular gene variant is passed on in a population. For wasp control, the genome of individuals could be edited to reduce male fertility, and then the genetically modified individuals are released into the environment. Over time, the gene modification that reduces fertility is inherited by successive generations, effectively decreasing fertility and shrinking each subsequent generation (Fig 1.).

AT A GLANCE

Introduced wasps in Aotearoa New Zealand damage native ecosystems, harm human health, and threaten the beekeeping industry. Current pest control of wasps relies on spraying broad-spectrum insecticides across a landscape. However, gene drive technology is now recognised as a potentially revolutionary method for wasp control.

Fig 1. Shows (A) a typical inheritance pattern of an edited gene (blue rate) and (B) the enhanced inheritance pattern of an edited gene created by a gene drive, whereby all offspring inherit the edited gene.



MODELLING GENE DRIVES FOR WASP CONTROL

This research developed a model to investigate the efficacy of gene drives for control of the common wasp (*Vespula vulgaris*) in the northern South Island of Aotearoa. The model tested the impact genetically modified wasps would have in this environment. The model placed wild nests (with non-modified queens and males), genetically modified nests (genetically modified queens and non-modified males), and sterile nests (genetically modified queens and males) randomly in 1 km cells within a spatial grid that modelled the environment.

Research on natural and life history traits of the common wasp governed how the simulated wasp populations reproduced, dispersed, and interacted with one another over time.

The virtual wasp population was tracked for 200 years (which is also 200 wasp generations), and the numbers and types of wasp nests in each cell on the spatial grid were recorded each year. During each year, wasps were able to disperse and reproduce. Some scenarios tested the impact of ongoing release of the genetically modified wasps, so in these scenarios there was a release of additional genetically modified wasps each year.

MODEL FINDINGS

There were no significant impacts on wasp abundance in the first 15 years after the release of genetically modified wasps, but within 25 years the wasp population was typically suppressed to <90% of the starting population and continued to be suppressed until the end of the simulation. Increasing natural dispersal distance increased the years that it took to suppress the population, while human-aided wasp dispersal had much less influence. Though there were local extinctions of wasps within a particular area, complete extinction was not observed in any of the scenarios with only one release of genetically modified wasps.

Wasp populations would likely persist, but with much lower densities. The only simulations with 100% eradication success were those that released genetically modified wasps in every 1 km grid cell of the 48,000 km grid, every year for 20-30 years.

IMPLICATIONS

The results imply that very intensive release strategies would be required for reliable wasp eradication. The scale and intensity of such a release strategy makes it unrealistic to carry out in the real world and extinction seems unlikely. However, even in scenarios when genetically modified wasps were just released once, there was significant suppression of the population, although suppression might take some decades to be seen. This result means that while gene drives appear unlikely to cause a rapid and widespread extinction of wasps, it is a technology that could offer a long-term and cost-effective method of population suppression. More research on the ethics, social licence, and efficacy of molecular tools is ongoing.

Collecting wasps

FIND OUT MORE

https://bioheritage.nz/gene-drives-maybe-not-a-silver-bullet-but-a-bullet-nonetheless/

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References:

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