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Field performance of engineered male mosquitoes

Various approaches involving genetically modified (GM) mosquitoes have been proposed to help control the spread of diseases[1]. However, the ability of these engineered male mosquitoes to effectively compete with wild males in terms of finding and mating with wild females, which is vital to the success of these strategies, has remained untested. We report data from the first field trial involving GM mosquitoes.

We demonstrated that GM male mosquitoes mated successfully with wild females and fertilised their eggs. These findings suggest that this technology could help to control diseases.

Laboratory test

We first tested mating competitiveness by placing ten wild female, 10 GM male mosquitoes and ten wild males in a laboratory cage and determining which type of male each female mated with.

From five repeats of the experiment, we obtained data from 31 females. 17 (55%) had mated with a GM male, indicating that no strong mating barrier exists between them, at least in this laboratory test.

We observed the offspring from the mating of the GM mosquitoes and female wild mosquitoes and found that the survivors were weak and short-lived (data not shown). This leads us to suspect that survival would be even lower in the wild.

Field test

GM males were released into a 10-hectare area in the Cayman Islands at an average release rate of 465 males per hectare per week for 4 weeks. There are several reasons why we released only males[2], one being that only female mosquitoes bite humans.

We monitored the mosquito population, comprising both GM and wild insects, using ovitraps, which mimic the natural sites in which females lay eggs. We hatched these eggs under laboratory conditions, and tested the resulting larvae for the presence of the lethal gene (**Table 1**). Larvae that had the gene came from GM fathers, whereas those without the gene came from wild fathers.

Table 1

Investigating mating outcomes by ovitrapping

Trap number	Larva with lethal gene	Total tested
1	0	10
2	1	2
3	0	9
4	0	11
5	0	136
6	0	168
7	0	50
8	43	44
9	0	1
10	0	9
11	12	42
12	64	139
13	0	69
14	0	4
15	0	9
16	0	4
17	6	28
18	0	23
19	0	49
20	0	22
21	0	13
22	0	29
23	0	29
24	0	34
25	0	253
26	0	129
Total	**126**	**1316**

Conclusions

These data allow us to estimate how many GM mosquitoes might need to be released in this area to suppress the wild population. Briefly, models indicate that the population needs to contain 13–57% of GM mosquitoes. Based on the proportion (9.6%) of offspring observed in the experiment, this would require around 1.4–12 times the release rate of the experiment described here.

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