Bio-bites!

Will GM mosquitoes be released in Florida?

Oxitec is a UK-based biotech company that has used advanced genetics to insert a self-limiting gene into mosquitoes of the *Aedes aegypti* strain. *Ae. aegypti* is known to transmit potentially debilitating human viral diseases, including Zika, dengue, yellow fever, and chikungunya.

Oxitec has produced a genetically engineered line of the mosquito *Ae. aegypti* (OX513A) with the intent of suppressing the wild-type mosquito population at the release site(s).

Males, which do not bite or transmit disease, are released to mate with wild females. The offspring of such matings die before becoming adults. With repeated releases of sufficient numbers of these self-limiting males, reduction in the wild population of more than 90% have been achieved in 5 efficacy trials, in Brazil, Panama, and the Cayman Islands.

Because of public opposition to a planned field trial in the community of Key Haven, Florida, 2 non-binding referendums were held in November 2016, one in Key Haven, and one in Monroe County, in its entirety. While Monroe County residents support the release of GM mosquitoes (57% voted in favor of the trial), the majority of Key Haven residents, the community where the trial is planned to be conducted, voted against the release (65% of 643 residents who voted).

Increased photosynthetic efficiency leads to higher crop yields

Crop leaves in full sunlight dissipate damaging excess absorbed light energy as heat in a process called non-photochemical quenching (NPQ). When sunlit leaves are shaded by clouds or other leaves, this protective dissipation continues for many minutes and reduces photosynthesis.

In a recent study Kromdijk *et al* describe the bioengineering of an accelerated response to natural shading events in *Nicotiana* (tobacco), resulting in increased leaf carbon dioxide uptake and plant dry matter productivity by about 15% in fluctuating light.

Ostrov N, Landon M, Guell M, Kuznetsov G, Teramoto J, Cervantes N, Zhou M, Singh K, Napolitano MG, Moosburner M, et al. Design, synthesis, and testing toward a 57-codon genome. Science 2016; 353(6301):819-22; PMID:27540174; http://dx.doi.org/10.1126/science.aaf3639

Dutchen S. How and why researchers revised the genetic recipe for *E. coli*. 2016. UK: Omicron Technology Limited. http://phys.org/news/2016-10-genetic-recipe-coli.html

**tRNA code rewritten in entire E. coli genome**

An international team of researchers working at Harvard University have systematically replaced 7 codons with synonymous alternatives for all protein-coding genes in the *Escherichia coli* genome. In a publication in *Science*, Ostrov *et al* report computational design, synthesis, and progress toward assembly of a 3.97-mega-base, 57-codon Escherichia coli genome, in which all 62,214 instances of 7 codons were replaced with synonymous alternatives across all protein-coding genes. The researchers have validated 63% of recoded genes by individually testing 55 segments of 50 kgbases each; 91% of tested essential genes retained functionality with limited fitness effect. The team anticipates that codon reduction will confer virus resistance, as the use of non-standard codons is likely to have an impact on the viral life cycle. Also, the synonymous codons that were replaced in the genome could be used for incorporation of non-standard amino acids for industrially relevant proteins, or could be used for bio-containment measures.

Ostrov N, Landon M, Guell M, Kuznetsov G, Teramoto J, Cervantes N, Zhou M, Singh K, Napolitano MG, Moosburner M, et al. Design, synthesis, and testing toward a 57-codon genome. Science 2016; 353(6301):819-22; PMID:27540174; http://dx.doi.org/10.1126/science.aaf3639
To do this, they overexpressed the 3 main genes controlling NPQ in tobacco plants: 2 encoding the enzymes violaxanthin de-epoxidase and zeaxanthin epoxidase, and one encoding the protein PsbS—a subunit of the photosystem II antenna complex.

Because the photoprotective mechanism that has been altered is common to all flowering plants and crops, the findings provide proof of concept for a route to obtaining a sustainable increase in productivity for food crops.

Kromdijk J, Głowacka K, Leonelli L, Gabilly ST, Iwai M, Niyogi KK, Long SP. Improving photosynthesis and crop productivity by accelerating recovery from photoprotection. Science 2016; 354(6314):857-61; PMID:27856901; http://dx.doi.org/10.1126/science.aai8878

Williams R. Genetic Modification Improves Photosynthetic Efficiency. 2016: The Scientist. http://www.the-scientist.com/?articles.view/articleNo/47544/title/Genetic-Modification-Improves-Photosynthetic-Efficiency/andutm_campaign=NEWSLETTER_TS_The-Scientist-Daily_2016 andutm_source=Dhs_emailandutm_medium=emailandutm_content=37876522and_hsmi=p2ANqtz-_lpeR3SbCCwcac7MXTev_sybWzuvcpwVQ1Hl4oLi7t02avQZcch3DUNJVUS3b5lj4mnevqMffAba-aGn282VGstXOfQand_hsmi=37876522

**Carbon-silicon bond formation by bioengineered enzymes**

Molecules with silicon-carbon, or organosilicon, compounds are found in pharmaceuticals as well as in many other products, including agricultural chemicals, paints, semiconductors, and computer and TV screens. Currently, these products are made synthetically, since the silicon-carbon bonds are not found in nature. In a recent study, researchers at Caltech, California, used a method called directed evolution, pioneered by F Arnold, corresponding author of the present study, in the early 1990s, in which new and better enzymes are created in laboratories by artificial selection. In 3 rounds of successive mutation and selection, the team enhanced the catalytic function of cytochrome c from *Rhodothermus marinus* to achieve more than 15-fold higher turnover than state-of-the-art synthetic catalysts. This carbon–silicon bond-forming biocatalyst offers an environmentally friendly and highly efficient route to producing enantiopure organosilicon molecules.

Kan SB, Lewis RD, Chen K, Arnold FH. Directed evolution of cytochrome c for carbon-silicon bond formation: Bringing silicon to life. Science 2016; 354 (6315):1048-51; PMID:27885032; http://dx.doi.org/10.1126/science.aah6219

Clavin, W. Bringing Silicon to Life. 2016: Caltech Press Release. https://www.caltech.edu/news/bringing-silicon-life-53049

**Antisense Oligonucleotide Therapy against Spinal Muscular Dystrophy approved**

The US. Food and Drug Administration (FDA) approved Biogen’s SPINRAZATM (nusinersen) under Priority Review for the treatment of spinal muscular atrophy in pediatric and adult patients. SPINRAZA is the first and only treatment approved in the US for SMA, a leading genetic cause of death in infants and toddlers that is marked by progressive, debilitating muscle weakness. SPINRAZA is an antisense oligonucleotide (ASO) that is designed to treat SMA caused by mutations in the chromosome 5q that leads to SMN protein deficiency. SPINRAZA alters the splicing of SMN2 pre-mRNA to increase production of full-length SMN protein. ASOs are short synthetic strings of nucleotides designed to selectively bind to target RNA and regulate gene expression. Through use of this technology, SPINRAZA has the potential to increase the amount of full-length SMN protein in patients with SMA.

Biogen. U.S. FDA Approves Biogen’s SPINRAZATM (nusinersen), The First Treatment for Spinal Muscular Atrophy. Press Release, December 23rd, 2016.