Current developments in agricultural science
Possible implications for biological security

Christine Uhlenhaut

2nd Annual Global Forum on Scientific Advances Important to the Biological and Toxin Weapons Convention
Geneva, December 2, 2019
Surveillance / diagnostics

Simple, rapid diagnostic tests - moving away from centralized labs

- Immunoassays, e.g. lateral flow
- Molecular tests, e.g. mobile PCR
Surveillance / diagnostics

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Immunoassays, e.g. lateral flow
Molecular tests, e.g. mobile PCR
Applied research

Gene drive - possible applications

• Confer resistance to
  – Porcine reproductive and respiratory disease virus
  – African Swine Fever
  – Infectious pancreatic necrosis virus in Atlantic salmon
  – Targeted mutagenesis to prevent rice blast disease

• Create improved models, e.g. to study pathways, drug targets

• Produce more muscular animals

• Produce cows without horns

• Producing offspring of a single sex (e.g. milk, egg production)
On the market

- Bt crops (rDNA)
- Herbicide-resistant crops (rDNA)
- Pesticide-resistant crops (rDNA)
- Fluorescent zebrafish
- Transgenic laboratory animals
- Yeast-derived products (vanillin, stevia, egg whites, gelatin)
- V. natriegens platform

Fig. 1. Global adoption (in %) of GE crops (maize, cotton, soybean, eggplant) with insect resistance traits (either alone or stacked with HT traits) in 2017 (data source: ISAAA, 2017). Only countries are listed where the biotech crop was grown on > 1000 ha. Adoption levels > 80% are highlighted in bold. In the case of Vietnam and Spain, adoption levels were calculated based on data from the USDA Foreign Agricultural Service (www.fas.usda.gov).
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**Under development**

- Fragrant moss
- DIY glowing plants
- Genome-edited crops
- Genome-edited animals
- Plants as sentinels
- Increased photosynthesis plants
- Landmine detecting mice
- Revived animals extinct or nearly so
- Animals with gene drives for control of insects or invasive mammals
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**Proudfoot et al., 2015**
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Cattle with a precise, zygote-mediated deletion safely eliminate the major milk allergen beta-lactoglobulin

Jingwei Wei1, Stefan Wagner1,2, Paul Maclean1, Brigid Brophy1, Sally Cole1, Grant Smolenski1,2, Dan F. Carlson4, Scott C. Fahrenkrug5, David N. Wells5 & Götz Laible6

Proudfoot et al., 2015
Synthetic Biology

What is this: H$_2$O ?
Synthetic Biology

What is this: $H_2O$ ?
Synthetic Biology

What is this: $\text{H}_2\text{O}$? And this: $\text{C}_{332652}\text{H}_{492388}\text{N}_{98245}\text{O}_{131196}\text{P}_{7501}\text{S}_{2340}$?
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Poliovirus
Synthetic Biology

What is this: H₂O? And this: C₃₃₂₆₅₂H₄₉₂₃₈₈N₉₈₂₄₅O₁₃₁₁₉₆P₇₅₀₁S₂₃₄₀?
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Poliovirus

Did Pox Virus Research Put Potential Profits Ahead of Public Safety?

February 17, 2018 - 8:08 AM ET
Heard on Weekend Edition Saturday

PELLI GREENFIELDBOYCE
Vaccines
CEPI rapid response platforms portfolio

mRNA vaccine printer
Yellow Fever, Lassa, Rabies

self-amplifying RNA (saRNA)
Influenza, Rabies, Marburg

molecular clamp
RSV, Influenza, MERS
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RSV, Influenza, MERS

Imperial College
London

CureVac
the RNA people®

Food and Agriculture Organization of the United Nations
25% of the global pig population is expected to die in an epidemic of African swine fever.

Sources: CCTV Hebei, China

World Organisation for Animal Health
October 31, 2019
Drones

Agricultural drones are used for

• Crop spraying and spot spraying
• Soil and field analysis
• Seed planting
• Crop mapping and surveying
• Irrigation monitoring and management
• Real-time livestock monitoring
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Other issues

Counterfeit drugs & fake news
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Armed groups kill Ebola health workers in eastern DR Congo

**MMR uptake at 16 months and proportion of mothers believing in complete or almost complete safety of MMR vaccine**

- Crohn’s paper
- Autism paper
- Sustained negative media reportage

**% mothers confident**

**MMR uptake**

**Gangs in China Fake Outbreaks of African Swine Fever**

Jennifer Shike
July 12, 2019 10:21 AM
And there is so much more...

Thank you