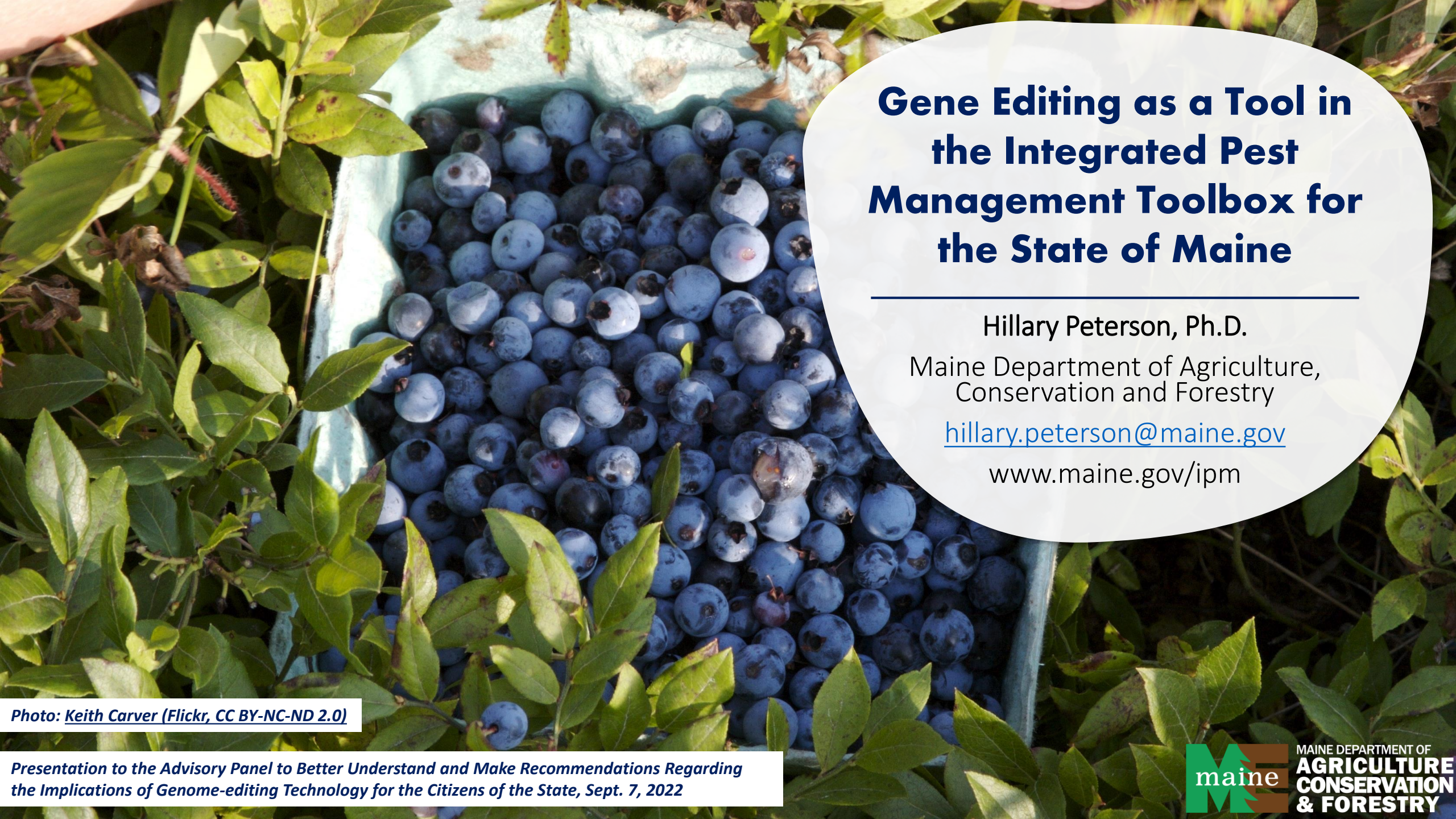

Gene Editing as a Tool in the Integrated Pest Management Toolbox for the State of Maine

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www.maine.gov/ipm

Photo: Keith Carver (Flickr, CC BY-NC-ND 2.0)

Presentation to the Advisory Panel to Better Understand and Make Recommendations Regarding the Implications of Genome-editing Technology for the Citizens of the State, Sept. 7, 2022

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Integrated Pest Management (IPM)

Integrated Pest Management

Gene editing can fit within the many pieces of an integrated pest management program, which aids in the reduction of pesticide use

There is no set policy or position within ME DACF.

What is Integrated Pest Management (IPM)

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Maine Wild Blueberries

- Predictable Pests, Pathogens & Weeds
- Invasive Species

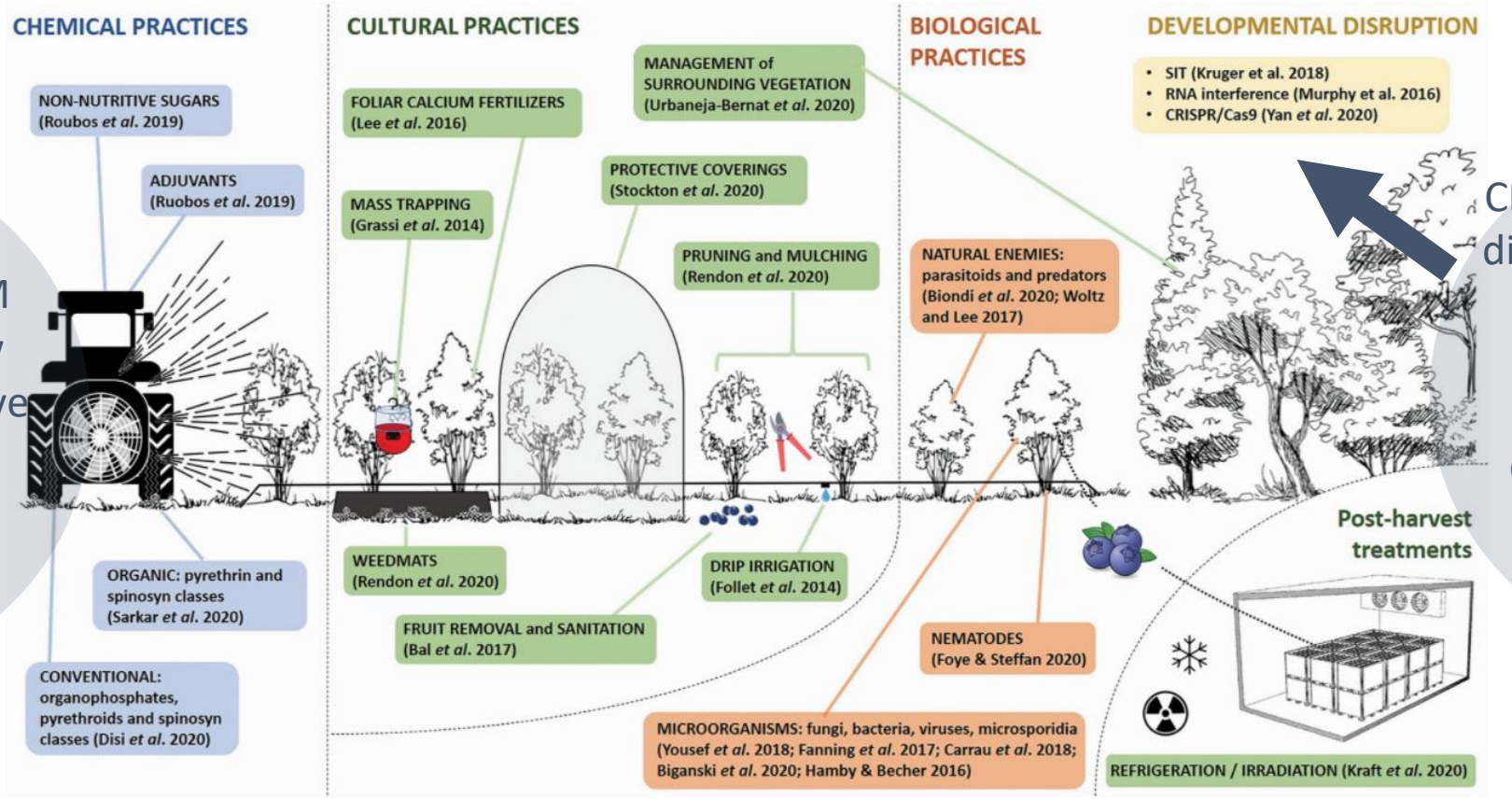
- Growth Conditions
- Pollination
- Pruning
- Harvest & Sanitation

Integrated Pest Management

A system that combines several methods to prevent and mitigate pest related problems in an integrated and biologically based manner.

Gene editing fits within the many pieces of an integrated pest management program

Recent drafted IPM plan from a review paper on the invasive spotted winged drosophila



CRISPR/Cas9 mediated disruption of the white gene leads to pigmentation deficiency and copulation failure in *Drosophila suzukii*

Figure: Tait et al. 2021 (Open Access Review Paper)

The IPM Toolbox

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1. Set plants up for success with ideal growth conditions

   Traditionally – soil conditions, plant cultivars, moisture, pH, pruning, sanitation, mulching, irrigation

2. Monitor for pests and disease and keep records

   Traditionally – visual scouting, photos, notebooks or spreadsheets, calendars

3. Properly identify pests and disease before treating

   Traditionally – trapping and using guides, working with taxonomists and extension experts, pest control companies

4. Mitigate pesticide use through other means

   Traditionally – biological control, natural enemies, mass trapping, repelling, physical barriers; preventing with step #1

How can gene editing fit into the IPM toolbox?

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1. Set plants up for success with ideal growth conditions
2. Monitor for pests and disease and keep records
3. Properly identify pests and disease before treating
4. Mitigate pesticide use through other means

Gene Editing & Plant Growth Conditions

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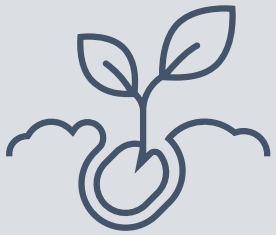

Set plants up for success with ideal growth conditions

Traditionally:
soil conditions, plant cultivars, moisture, pH, pruning, sanitation, mulching, irrigation

INCREASING YIELDS ... COMMENTS

Photosynthesis hack boosts soybean yield 20%

RIPE researchers prove bioengineering better photosynthesis in
for the first time ever

PUBLISHED ON AUGUST 25, 2022

CRISPR–Cas9-based genetic engineering for crop improvement under drought stress

Abdul Sami, Zhao Xue, Saheera Tazein, Ayesha Arshad, Zong He Zhu, Ya Ping Chen, Yue Hong, Xiao Tian Zhu & Ke Jin Zhou

Application of Gene Editing for Climate Change in Agriculture

Nicholas G. Karavolias[1,2], Wilson Horner[1,3], Modes
Sarah N. Evanega[5*]

Review Article | Open Access | Published: 15 June 2019

CRISPR technology is revolutionizing the improvement of tomato and other fruit crops

Tian Wang, Hongyan Zhang & Hongliang Zhu

Horticulture Research **6**, Article number: 77 (2019) | Cite this article

The Cold-Regulated Genes of Blueberry and Their Response to Overexpression of *VcDDF1* in Several Tissues

Aaron Walworth and Guo-qing Song*

▸ Author information ▸ Article notes ▸ Copyright and License information Disclaimer

Genome Editing in Potato with CRISPR/Cas9

Satya Swathi Nadakuduti [1], Colby G Starker [2], Daniel F Voytas [2], C Robin Buell [3 4 5], David S Douches [6 4]

Gene Editing & Mitigating Pests

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Mitigate pesticide use through other means

Traditionally: biological control, natural enemies, mass trapping, repelling, physical barriers

CRISPR/Cas9 mediated genome engineering in Drosophila

Andrew Bassett [1], Ji-Long Liu [2]

CRISPR/Cas9 mediated disruption of the *white* gene leads to pigmentation deficiency and copulation failure in *Drosophila suzukii*

Ying Yan [a, b], Judith Ziemek [a], Marc F. Schetelig [a, b]

Temperature-dependent sex-reversal by a *transformer-2* gene-edited mutation in the spotted wing drosophila, *Drosophila suzukii*

Jianwei Li & Alfred M. Handler

RESEARCH ARTICLE | Open Access

Resilin* is needed for wing posture in *Drosophila suzukii

Steven Lerch, Yang Yang, Justin Flaven-Pouchon, Nicole Gehring, Bernard Moussian

Oral RNAi to control *Drosophila suzukii*: laboratory testing against larval and adult stages

Clauvis Nji Tizi Taning, Olivier Christiaens, Nick Berkvens, Hans Casteels, Martine Maes & Guy Smagghe

(not just CRISPR!)

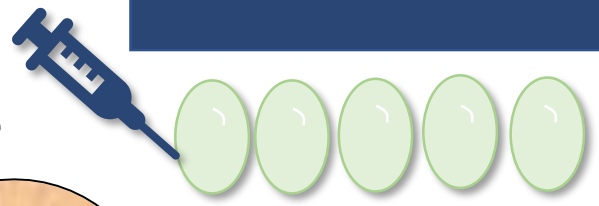
Gene editing can fit within the many pieces of an integrated pest management program…

…including collaboration and ease of initial proof of concept testing within species…

A brief adventure back to my Ph.D. work...

Embryo Injections

ReMOT Control
P2C-Cas9 Results



"Pink" Phenotype

"Mosaic" Phenotype

Wild-Type Nymph

Effort efficiency (EEF)

$$\frac{n\ edited}{n\ injected}$$

EEF = 2.9%

EEF = 4.5%

G_0 gene-editing efficiency (GEF)

$$\frac{n\ edited}{n\ hatched}$$

GEF = 7.2%

6 edited individuals (208 eggs injected)

GEF = 2.1%

4 edited individuals (88 adult females injected)

"Mosaic" Phenotype

How can Maine prepare?

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Remember gene-editing technology remains **one** piece of the toolbox

Support research in agriculture

Increase awareness and education while respecting many perspectives

Questions?

Photo: Keith Carver (Flickr, CC BY-NC-ND 2.0)

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