Searching for Sources of Pickleworm Resistance in the USDA-ARS Cucumber Germplasm Collection

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Pickleworm

Pickleworm, *Diaphania nitidalis*

- A migratory insect - “Tracking resources through space and time”
- Migration – reproductive biology – host plants
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- A migratory insect - “Tracking resources through space and time”
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Pickleworm

Pickleworm, *Diaphania nitidalis*

- Hosts include many wild and cultivated cucurbits, especially cucumbers
- Eggs are laid on developing tissue
- Larvae consume young flowers, leaves and **fruit**
- Pest in the USA since late 1800s
Pickleworm Management

- Damage threshold near zero limits management strategies
- Calendar-based application of insecticides
Pickleworm Management

• Damage threshold near zero limits management strategies
• Calendar-based application of insecticides

But... host plant resistance has potential – exploiting resistance to a pest that may be present in existing germplasm
Pickleworm Management

But... host plant resistance has potential – exploiting resistance to a pest that may be present in existing germplasm

- Host plant resistance is also important in disease management in cucumbers
- We took the opportunity to screen for downy mildew resistance
Downy Mildew, *Pseudoperonospora cubensis*

- Host range includes most Cucurbitaceae (cucumber, squash, melon, watermelon)

Angular yellow lesions restricted by veins *on top surface* of leaves
Downy Mildew, *Pseudoperonospora cubensis*

- Host range includes most Cucurbitaceae (cucumber, squash, melon, watermelon)

Sporangia and sporangiophores *on under surface* of leaves
Host Plant Resistance - Pickleworm

3-year field evaluation of cucumber for sources of resistance to pickleworm

- Plant introductions from the USDA-ARS Cucumber Germplasm Collection
- Flats were seeded in May in the greenhouse
Host Plant Resistance - Pickleworm

3-year field evaluation of cucumber for sources of resistance to pickleworm

- Plant introductions from the USDA-ARS Cucumber Germplasm Collection
- Flats were seeded in May in the greenhouse
- Flats were transferred to an outdoor trailer in June
Host Plant Resistance - Pickleworm

3-year field evaluation of cucumber for sources of resistance to pickleworm

- Plant introductions from the USDA-ARS Cucumber Germplasm Collection
- Seedlings transplanted to field in 3rd week of June
- ~2 acre fields, raised beds with plastic mulch
- 4 replicates, Randomized Complete Block Design
Host Plant Resistance - Pickleworm

3-year field evaluation of cucumber for sources of resistance to pickleworm

- Assessed pickleworm damage to fruit (number and depth of holes in ≤4” long fruit)
2016 Host Plant Resistance - Pickleworm

- 200 PIs planted
- 166 PIs produced <10 fruit
- 34 PIs produced ≥10 fruit and used for analysis (includes yellow squash control)

- 4 PIs had ≤10% damage
- 29 PIs had 10-20% damage
2016 Host Plant Resistance - Pickleworm

Plant introduction lines with ≤20%

- 4 PIs (12.1%)
- 29 PIs (87.9%)

Pickleworm damage:
- 0%
- 1-9%
- 10-20%

- Yellow squash ~83%
2017 Host Plant Resistance - Pickleworm

- 532 PIs planted
- 100 PIs did not produce fruit
- 218 PIs produced 1-5 fruit
- 124 PIs produced 6-9 fruit
- 96 PIs produced ≥10 fruit and used for analysis (includes yellow squash control and 5 CVs)

- 1 PI had ≤10% damage
- 4 PIs had 10-20% damage
2017 Host Plant Resistance - Pickleworm

Plant introduction lines with ≤20%

- 4 PIs
- 1 PI

Pickleworm damage
- 0%
- 1-9%
- 10-20%

• Yellow squash ~40%
2017 Host Plant Resistance - Pickleworm

5 Commercial Cultivars with ≤20%

- Logan
- Puccini
- Arabian 5479
- Citadel

- Yellow squash ~40%

Pickleworm damage

- 0%
- 1-9%
- 10-20%
2017 Downy Mildew Incidence and Severity

• 532 PIs planted
• 180 PIs screened using visual damage rating scale (0-10)
• 23 PIs (resistant and susceptible) were re-screened in autumn 2017
2017 Downy Mildew Incidence and Severity

6 PIs were tolerant and 2 PIs showed higher resistance than Peacemaker (resistant check)
2018 Host Plant Resistance - Pickleworm

- 231 PIs planted
- 27 PIs did not produce fruit
- 26 PIs produced 1-5 fruit
- 33 PIs produced 6-9 fruit
- 151 PIs produced ≥10 fruit and used for analysis (includes yellow squash control and 9 CVs)

- 86 PIs had ≤10% damage
- 34 PIs had 10-20% damage
2018 Host Plant Resistance - Pickleworm

- Yellow squash ~92%

Plant introduction lines with ≤20%

- 34 PIs
- 40 PIs
- 46 PIs

Pickleworm damage

- 0%
- 1-9%
- 10-20%
2018 Host Plant Resistance - Pickleworm

9 Commercial Cultivars with \( \leq 20\%

- Citadel 5479
- SMR58
- Peacemaker
- Arabian Logan Expedition
- Puccini Calypso

Yellow squash \( \sim 92\%

Pickleworm damage:
- Green: 0%
- Blue: 1-9%
- Light Blue: 10-20%
2018 Downy Mildew Incidence and Severity

- 231 PIs planted
- 55 PIs showed tolerance or resistance (≤4 on rating scale)
2016-2018 Summary

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• ~175 PI lines with ≤20% pickleworm damage have been identified and thus have promise for further characterization in 2019
• 61 PI lines showed resistance to downy mildew
• Determine pickleworm x downy mildew cross resistance
• Link geographic origin of PIs to reproductive growth and pickleworm and disease susceptibility