2 Apple I

Where: Ballroom D
MI re-certification credits: 2 (1C, COMM CORE, PRIV CORE)
OH re-certification credits: 1 (presentations as marked)
CCA Credits: CM (1.5) SW (0.5)
Moderator: Brett Anderson, MSHS Board, Sparta, MI

2:00 PM **Apple Replant Project Update**
- Julianna Wilson, Michigan State University

2:30 PM **Avoiding a Rotten Harvest: Management of Summer Diseases in Apples (OH 2B, 1 hr)**
- Sara Villani, North Carolina State University

3:00 PM **Codling Moth Sterile Insect Release Program Update**
- Chris Adams,

3:30 PM **Climatic Trends and Potential Implications for Disease Management**
- Jeff Andresen, Michigan State University

3:45 PM **Multi-leader and Fruiting Walls for High Density Apple Plantings**
- Phil Schwallier, Michigan State University

4:00 PM **Session Ends**

APPLE (*Malus* x *domestica* 'Empire', 'Jonagold')
Glomerella leaf spot and bitter rot;
Colletotrichum gloeosporioides-complex

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MHCREC, NCSU
Mills River, NC 28759

Evaluation of fungicide programs for the management of Glomerella leaf spot and bitter rot on 'Gala' apple in NC, 2018.

A trial was conducted at the Mountain Horticultural Crops Research and Extension Center in Mills River, NC to evaluate the effectiveness of fungicide programs for the management of Glomerella leaf spot and an associated bitter rot on apple. The orchard site is a planting of 21-yr-old 'Tenroy Gala' trees on M.7 rootstocks. Treatments were applied on 7 to 14 day intervals, dilute to runoff, using a gas powered backpack sprayer (200 PSI) at the following timings: Pink (Pk, 3 Apr), bloom (Bl, 18 Apr), petal fall (PF, 27 Apr), 1st cover (1C, 8 May), 2nd cover (2C, 17 May), 3rd cover (3C, 25 May), 4th cover (4C, 1 Jun), 5th cover (5C, 8 Jun), 6th cover (6C, 15 Jun), 7th cover (7C, 22 Jun), 8th cover (8C, 29 Jun), 9th cover (9C, 9 Jul), 10th cover (10C, 20 Jul), 11th cover (11C, 27 Jul), 12th cover (12C, 6 Aug), and 13th cover (17 Aug). Total precipitation in Mar, Apr, May, Jun, Jul and Aug (up to date of harvest on 21 Aug) was 3.4, 4.7, 15.3, 3.6, 7.0, and 10.3 inches, respectively.

The incidence of Glomerella leaf spot (GLS) on leaves was first assessed on 11 Jun, approximately 2.5 weeks after the emergence of symptoms on 26 May. Additional disease incidence ratings occurred on 18 Jun, 25 Jun, 2 Jul, 17 Jul, 25 Jul, and 9 Aug. Disease severity, expressed as the percentage of defoliation resulting from GLS was evaluated on the same dates. To evaluate the incidence of GLS and defoliation, eight mid-shoot leaves on twenty terminal shoots per treatment replicate were designated for evaluation prior to the onset of symptoms. For each evaluation, the incidence of GLS was expressed as the number of leaves with GLS out of 8 leaves with twenty shoot assessments for 4 replicate trees per treatment. Defoliation due to GLS was expressed as the number defoliated leaves out of 8 originally designated leaves with twenty shoot assessments for 4 replicate trees per treatment. The same leaves were evaluated for each foliar rating. The incidence of Glomerella-associated rots ("bitter rot) at harvest were evaluated on 20 Aug. Fruit spot + rot incidence was expressed as the number of fruit with Glomerella-associated rot symptoms out of 5 fruit, with 10 collections assessed per 4 replicate trees per treatment. On the date of harvest (21 Aug) 25 fruit were collected from each treatment replicate and evaluated for russet. To assess the severity of russeting, fruit were evaluated individually and assigned to one of six categories; 0 = <1% russet, 1 = 1-10% russet, 2 = 11-20% russet, 3 = 21-40% russet, 4 = 41-60% russet, and 5 = 61-100% russet. Russet data were then quantified using the 0-5 scale as well as the following russet index equation: $RI = (N_{cat0}/N_t * 0) + (N_{cat1}/N_t * 5.5) + (N_{cat2}/N_t * 15.5) + (N_{cat3}/N_t * 30.5) + (N_{cat4}/N_t * 50.5) + (N_{cat5}/N_t * 80.5)$; where N_{cat0}, N_{cat1}, N_{cat2}, N_{cat3}, N_{cat4} and N_{cat5} represent the number of fruits in each russet category (Holb et al, Ann. Appl. Biol. 2003, 142:225-233). Disease incidence, defoliation data, and russet index (RI) were subjected to analysis of variance (ANOVA) for a randomized block design using accepted statistical procedures and software (i.e. Generalized Linear Mixed Models (GLIMMIX)) procedure of SAS (version 9.4; SAS Institute Inc., Cary, NC). All percentage data were subjected to arcsine square root transformation prior to analysis.

Across all treatments, the incidence of GLS symptoms on leaves, expressed as relative area under the disease progress curve (rAUDPC), ranged from 6.8 to 65.6, with the non-rotational Captan 80WDG (5 lb/a) program (Trt 21) providing the highest level of efficacy against the disease. The non-rotational programs of Sercadis (Trt 19), failed to provide a level of control against Glomerella leaf spot that was significantly different from the untreated program (Trt 1). Alternatively, the most efficacious program in this trial was Captan 80WDG at a rate of 5 lb/A (trt 21). Defoliation of shoots due to GLS, presented as both rAUDPC and percent defoliation at harvest, ranged from 0.1 to 21.3 and from 0.6 to 84.9%, respectively. With the exception of the Sercadis (Trt 19) and sulfur + ProPhyt (trt 8) program, all fungicide programs significantly reduced defoliation due to GLS compared to the untreated program..

The incidence of Glomerella fruit spot and bitter rot, caused by *Colletotrichum fructicola,* at harvest ranged from 0.5 to 100% and 0.0 to 82.7%, respectively. The non-rotational Captan 80WDG program (5 lb/A; Trt 21) again provided the highest level of efficacy against fruit spot. In regards to bitter rot, Fontelis provided a statistically equivalent level of control as the non-rotational Captan program (Trt 21). Fairly low rates of russeting were observed across all programs.

	Treatment programs (amt./A)	Timing[z]	Mean rAUDPC foliar GLS[y]	Mean rAUDPC shoot defoliation[x]	Mean shoot defoliation at harvest
1	Untreated	na.	58.9 ± 2.8 a	16.8 ± 2.9 b	78.8 ± 7.2 a
2	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80 WDG 2.5 lb + Koverall 3 lb Captan 80WDG 2.5 lb + Ziram 76DF 3	Pk,Bl PF, 1C 2C 3C-13C	13.3 ± 1.1 ghij	0.3 ± 0.1 d	2.2 ± 0.5 bc
3	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80 WDG 3.75 lb + ProPhyt 4 pt Ziram 76DF 4 lb + ProPhyt 4 pt	Pk,Bl,2C PF,1C,13C 3C,5C,7C,9C,11C 4C,6C,8C,10C,12C	23.0 ± 3.0 def	1.5 ± 0.7 d	11.4 ± 4.9 b
4	Koverall 3 lb + ProPhyt 4 pt Captan 80 WDG 2.5 lb + Koverall 3 lb Merivon 5.5 fl oz Captan 80WDG 2.5 lb + Ziram 76DF 3	Pk,Bl PF 1C,2C 3C-13C	15.0 ± 2.3 fghi	0.7 ± 0.3 d	3.1 ± 1.3 bc
5	Koverall 3 lb + ProPhyt 4 pt Fontelis 20 fl oz Fontelis 20 fl oz + Ziram 76DF 3 lb Captan 80WDG 2.5 lb + ProPhyt 4 pt + Indar 2F 8 oz Captan 80WDG 3.75 lb + ProPhyt 4 pt	Pk,Bl,2C PF,1C, 3C,6C 4C,5C 7C-13C	27.5 ± 2.4 de	0.5 ± 0.2 d	2.3 ± 1.2 bc
6	Koverall 3 lb + ProPhyt 4 pt Captan 4L 4 pt + ProPhyt 2.86 pt + Bond Max (0.05%)	Pk-1C 2C-13C	11.1 ± 1.9 ij	0.3 ± 0.07 d	2.2 ± 0.8 bc
7	Koverall 3 lb + ProPhyt 4 pt Captan 4L 6 pt + ProPhyt 3.81 pt + Bond Max (0.05%)	Pk-1C 2C-13C	16.3 ± 5.3 fghi	0.6 ± 0.3 d	2.8 ± 1.1 bc
8	Koverall 3 lb + ProPhyt 4 pt Microthiol Disperss 2 lb + ProPhyt 1 pt	Pk-1C 2C-13C	49.2 ± 2.6 b	13.4 ± 3.1 c	78.1 ± 7.5 a
13	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt + Bond Max (0.05%)	Pk,Bl PF-13C	13.5 ± 1.2 ghij	0.4 ± 0.1 d	3.7 ± 1.3 bc
14	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt + LI-700 (0.05%) Merivon 5.5 fl oz Oso 6.5 fl oz	Pk,Bl PF 1C-3C 4C-11C 12C,13C	20.2 ± 5.1 efg	0.7 ± 0.3 d	4.1 ± 1.8 bc
15	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80WDG 3.75 lb + ProPhyt 4 pt Microthiol Disperss 2 lb + ProPhyt 3 pt Oso 6.5 fl oz	Pk,Bl PF-2C 3C,5C,7C,9C,11C 4C,6C,8C,10C 12C,13C	18.8 ± 2.5 fgh	0.3 ± 0.2 d	2.7 ± 1.7 bc
16	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80WDG 3.75 lb + ProPhyt 4 pt Oso 6.5 fl oz	Pk,Bl PF-2C 3C-12C 13C	22.9 ± 3.2 def	1.0 ± 0.5 d	5.2 ± 1.5 bc
17	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt	Pk,Bl PF-13C	18.0 ± 2.3 fghi	0.7 ± 0.3 d	2.8 ± 1.3 bc
18	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz	Pk,Bl PF-13C	12.6 ± 1.0 ghij	0.7 ± 0.2 d	3.3 ± 0.8 bc
19	Koverall 3 lb + ProPhyt 4 pt Sercadis 3.3 fl oz	Pk,Bl PF-13C	65.6 ± 3.5 a	21.3 ± 3.0 a	84.9 ± 4.2 a
20	Koverall 3 lb + ProPhyt 4 pt Cabrio EG 9.2 oz	Pk,Bl PF-13C	18.9 ± 1.0 fgh	0.1 ± 0.07 d	0.6 ± 0.4 c
21	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 5 lb	Pk,Bl PF-13C	6.8 ± 2.1 j	0.1 ± 0.02 d	1.0 ± 0.2 bc
22	Koverall 3 lb + ProPhyt 4 pt Aprovia 7 fl oz	Pk,Bl PF-13C	30.0 ± 6.1 cd	2.1 ± 1.2 d	15.9 ± 8.1 b
23	Koverall 3 lb + ProPhyt 4 pt Aprovia 7 fl oz + Bond Max (0.05%)	Pk,Bl PF-13C	30.5 ± 1.4 cd	1.0 ± 0.2 d	4.9 ± 0.6 bc
24	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80 WDG 2.5 lb + Koverall 3 lb Captan 80WDG 2.5 lb + Ziram 76DF 3	Pk,Bl PF 1C,2C 3C-13C	11.6 ± 0.5 hij	0.4 ± 0.2 d	1.7 ± 1.2 bc
27	Koverall 3 lb + ProPhyt 4 pt Thiophanate-Methyl 85WDG 0.8 lb	Pk,Bl PF-13C	37.2 ± 1.6 c	2.3 ± 0.2 d	16.7 ± 2.9 b

[z]Applications timing were made on 7 to 14 day intervals: Pink (Pk) through 13th cover (13C).

[y]The relative area under the disease progress curve (rAUDPC) was calculated for each treatment. All values are disease incidence and the means and standard errors of 20 terminal shoots across four replicate trees. Values within columns followed by the same letter are not significantly different ($P \leq 0.05$) according to LSMEANS procedure in SAS 9.4 with an adjustment for Tukey's HSD to control for family-wise error. Incidence of GLS evaluated on both dates was calculated from the number of 8 randomly selected leaves with GLS lesions out of eight fully expanded leaves. For each of four treatment replications, 20 shoots were assessed. The same leaves were evaluated on each date.

[x] The relative area under the disease progress curve (rAUDPC) was calculated for each treatment. Values are incidence of defoliated leaves and the means and standard errors of 20 terminal shoots assessed across four replicate trees. Values within columns followed by the same letter are not significantly different ($P \leq 0.05$) according to LSMEANS procedure in SAS 9.4 with an adjustment for Tukey's HSD to control for family-wise error. Percentage of defoliated leaves from scaffolds was calculated from the percentage of scaffold/branch defoliation of 20 branches from 4 replicate trees per treatment.

	Treatment programs (amt./A)	Timing[z]	Incidence of fruit spots (%) (harvest) [y]	Incidence of bitter rot (%) (harvest)	Russet Index[x]
1	Untreated	na.	100.0 ± 0.0 a	75.5 ± 11.2 a	1.8 ± 0.4 c
2	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80 WDG 2.5 lb + Koverall 3 lb Captan 80WDG 2.5 lb + Ziram 76DF 3	Pk,Bl PF, 1C 2C 3C-13C	13.0 ± 5.3 efg	1.0 ± 0.6 d	3.3 ± 0.8 bc
3	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80 WDG 3.75 lb + ProPhyt 4 pt Ziram 76DF 4 lb + ProPhyt 4 pt	Pk,Bl,2C PF,1C,13C 3C,5C,7C,9C,11C 4C,6C,8C,10C,12C	53.0 ± 16.9 bc	16.5 ± 6.3 bc	2.6 ± 0.7 c
4	Koverall 3 lb + ProPhyt 4 pt Captan 80 WDG 2.5 lb + Koverall 3 lb Merivon 5.5 fl oz Captan 80WDG 2.5 lb + Ziram 76DF 3	Pk,Bl PF 1C,2C 3C-13C	12.5 ± 7.1 efg	2.0 ± 1.2 d	2.4 ± 0.4 c
5	Koverall 3 lb + ProPhyt 4 pt Fontelis 20 fl oz Fontelis 20 fl oz + Ziram 76DF 3 lb Captan 80WDG 2.5 lb + ProPhyt 4 pt + Indar 2F 8 oz Captan 80WDG 3.75 lb + ProPhyt 4 pt	Pk,Bl,2C PF,1C, 3C,6C 4C,5C 7C-13C	30.5 ± 12.3 de	2.5 ± 1.0 d	3.9 ± 0.9 abc
6	Koverall 3 lb + ProPhyt 4 pt Captan 4L 4 pt + ProPhyt 2.86 pt + Bond Max (0.05%)	Pk-1C 2C-13C	11.0 ± 2.9 efg	0.0 ± 0.0 d	3.9 ± 0.8 abc
7	Koverall 3 lb + ProPhyt 4 pt Captan 4L 6 pt + ProPhyt 3.81 pt + Bond Max (0.05%)	Pk-1C 2C-13C	6.0 ± 3.6 g	0.5 ± 0.5 d	3.6 ± 0.4 bc
8	Koverall 3 lb + ProPhyt 4 pt Microthiol Disperss 2 lb + ProPhyt 1 pt	Pk-1C 2C-13C	100.0 ± 0.0 a	80.5 ± 5.0 a	6.3 ± 1.4 ab
13	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt + Bond Max (0.05%)	Pk,Bl PF-13C	7.0 ± 5.1 fg	0.0 ± 0.0 d	4.0 ± 0.4 abc
14	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt + LI-700 (0.05%) Merivon 5.5 fl oz Oso 6.5 fl oz	Pk,Bl PF 1C-3C 4C-11C 12C,13C	36.0 ± 15.0 cd	4.5 ± 3.2 cd	4.0 ± 0.2 abc
15	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80WDG 3.75 lb + ProPhyt 4 pt Microthiol Disperss 2 lb + ProPhyt 3 pt Oso 6.5 fl oz	Pk,Bl PF-2C 3C,5C,7C,9C,11C 4C,6C,8C,10C 12C,13C	28.7 ± 15.2 def	2.7 ± 2.7 cd	3.5 ± 0.7 bc
16	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80WDG 3.75 lb + ProPhyt 4 pt Oso 6.5 fl oz	Pk,Bl PF-2C 3C-12C 13C	52.5 ± 16.0 bc	5.0 ± 3.8 cd	3.2 ± 0.4 c
17	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 3.75 lb + ProPhyt 4 pt	Pk,Bl PF-13C	8.5 ± 4.4 fg	0.5 ± 0.5 d	2.9 ± 0.7 c
18	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz	Pk,Bl PF-13C	14.0 ± 3.3 efg	0.5 ± 0.5 d	2.9 ± 0.5 c
19	Koverall 3 lb + ProPhyt 4 pt Sercadis 3.3 fl oz	Pk,Bl PF-13C	100.0 ± 0.0 a	82.7 ± 2.9 a	3.1 ± 0.6 bc
20	Koverall 3 lb + ProPhyt 4 pt Cabrio EG 9.2 oz	Pk,Bl PF-13C	13.5 ± 6.1 efg	1.5 ± 1.0 d	2.9 ± 0.8 c
21	Koverall 3 lb + ProPhyt 4 pt Captan 80WDG 5 lb	Pk,Bl PF-13C	0.5 ± 0.5 g	0.0 ± 0.0 d	6.7 ± 2.5 a

22	Koverall 3 lb + ProPhyt 4 pt Aprovia 7 fl oz	Pk,Bl PF-13C	64.4 ± 12.9 b	12.8 ± 7.8 bcd	4.2 ± 0.5 abc
23	Koverall 3 lb + ProPhyt 4 pt Aprovia 7 fl oz + Bond Max (0.05%)	Pk,Bl PF-13C	67.1 ± 2.0 b	5.1 ± 2.6 cd	2.9 ± 0.3 c
24	Koverall 3 lb + ProPhyt 4 pt Merivon 5.5 fl oz Captan 80 WDG 2.5 lb + Koverall 3 lb Captan 80WDG 2.5 lb + Ziram 76DF 3	Pk,Bl PF 1C,2C 3C-13C	15.3 ± 10.3 efg	2.0 ± 1.2 d	2.0 ± 0.3 c
27	Koverall 3 lb + ProPhyt 4 pt Thiophanate-Methyl 85WDG 0.8 lb	Pk,Bl PF-13C	95.0 ± 2.4 a	19.5 ± 6.4 b	2.3 ± 0.2 c

[z]Applications timing were made on 7 to 14 day intervals: Pink (Pk) through 13th cover (13C).

[y]All values are disease incidence of 10 fruit collections across four replicate trees. Values within columns followed by the same letter are not significantly different (P<0.05) according to LSMEANS procedure in SAS 9.4 with an adjustment for Tukey's HSD to control for family-wise error.

[x]Russet data were quantified using the 0-5 scale as well as the following russet index equation: $RI = (N_{cat0}/N_t * 0) + (N_{cat1}/N_t * 5.5) + (N_{cat2}/N_t * 15.5) + (N_{cat3}/N_t * 30.5) + (N_{cat4}/N_t * 50.5) + (N_{cat5}/N_t * 80.5)$; where N_{cat0}, N_{cat1}, N_{cat2}, N_{cat3}, N_{cat4} and N_{cat5} represent the number of fruits in each russet category (Holb et al, Ann. Appl. Biol. 2003, 142:225-233). Values within columns followed by the same letter are not significantly different (P<0.05) according to LSMEANS procedure in SAS 9.4 with an adjustment for Tukey's HSD to control for family-wise error.

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Sterile Insect Release; a New Tool for Codling Moth Control in Michigan

Christopher Adams and Larry Gut
Michigan State University

Great Lakes Expo, 2018. Grand Rapids, MI

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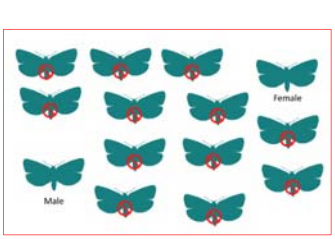
Sterile Insect Release



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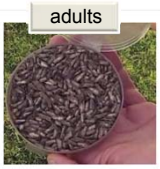
Sterile Moths from OKSIR in British Colombia

SIR

eggs

adults



larvae

release

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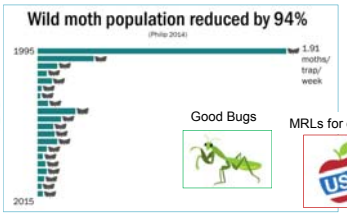
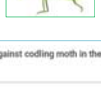
Benefits of SIR



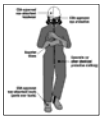
Good Bugs

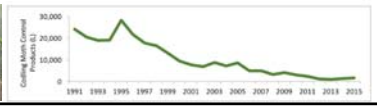


MRLs for exports

Pesticide resistance

Pesticide exposure





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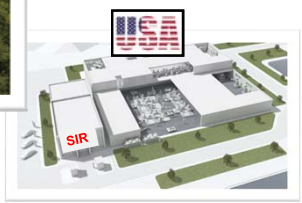
Future Trends

Aerial Releases



US Rearing Facility

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Objectives

Reduce

Cost

Optimize

Release Pattern

Understand

Release Quantity

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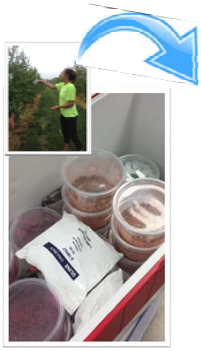
Reduced Number of Release Points : Even, Center, Corners



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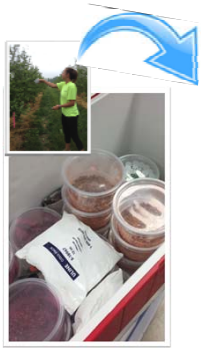
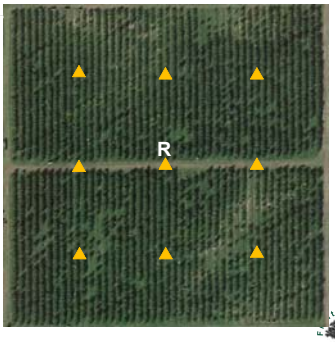
Reduced Number of Release Points : Even, Center, Corners





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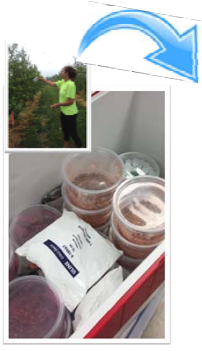
Reduced Number of Release Points : Even, Center, Corners



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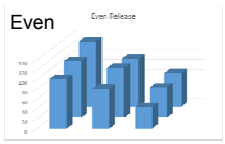
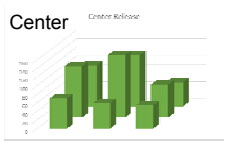
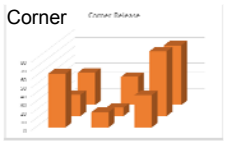
Reduced Number of Release Points : Even, Center, Corners







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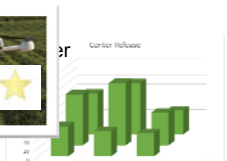
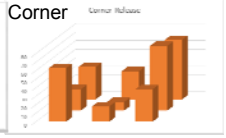
Reduced Number of Release Points : Even, Center, Corners





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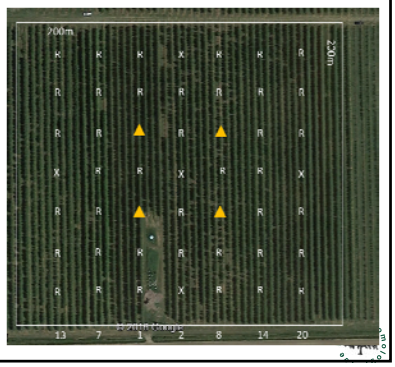
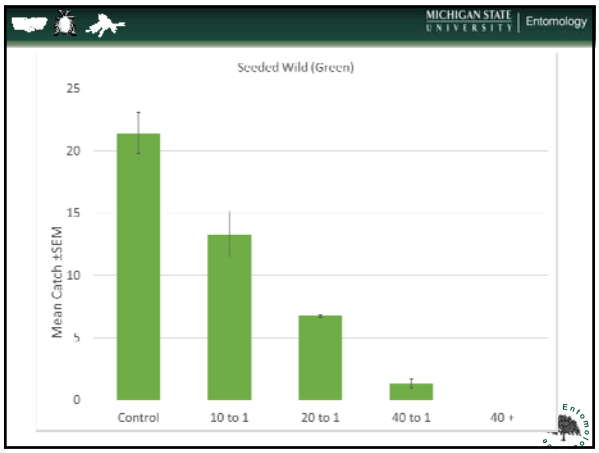
Release Ratio needed for suppression? : 10to1, 20to1, 40to1

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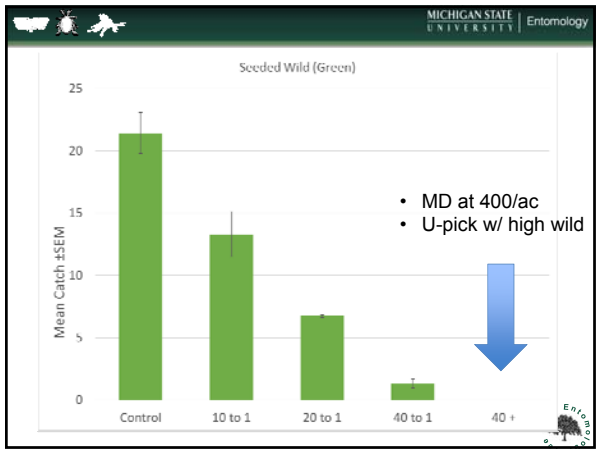
Seeded Wild (Green)
Mean Catch ±SEM
25
20
15
10
5
0
Control
10 to 1
20 to 1
40 to 1
40 +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Seeded Wild (Green)
Mean Catch ±SEM
25
20
15
10
5
0
Control
10 to 1
20 to 1
40 to 1
40 +
• MD at 400/ac
• U-pick w/ high wild


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• Research is on going . . .
Thanks to Project GREEEN
and the Canadian SIR program
Project GREEEN


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• Looking for grower partners for the 2019 field season !
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