**Controlling Codling Moth and Oriental Fruit Moth in Apples Using Isomate TT**

Deborah I. Breth, Cornell Cooperative Extension- Lake Ontario Fruit Program,
12690 NYS RT 31, Albion, NY 14411

Randall C. Paddock, Paddock Agricultural Services, 12420 Lake Shore Rd, Lyndonville, NY 14098

Elizabeth Tee, CCE-LOF, Program Assistant, 12690 NYS RT 31, Albion, NY 14411

**Materials & Methods:**

A demonstration of mating disruption (MD) using Isomate TT for codling moth and oriental fruit moth was conducted for three years in 2 orchards in western NY with a history of damage from CM and OFM at harvest. Kast Farms and Russell Farms were cooperators in the project with a 20-acre orchard on each site. A comparison block was chosen in the area for a grower standard (GS) comparison.

Isomate TT for codling moth and oriental fruit moth mating disruption were applied at Kast and Russell's MD plot before first flight at bloom, May 11-12 in 2006, May 8-9 in 2007 and April 29-30 in 2008. Twintubes were applied at a rate of 200 per acre, hung in the top third of the tree canopy using 10 ft poles. Eight workers finished the applications in 3 hours per 20 acres; it took approx. 1 hour per acre in trees that were 14 feet tall. In 2006 both orchards had Cyd-X applied to a 5-acre section of each orchard; Cyd-X was not used in 2007 and 2008.

Orchards were monitored using traps and pheromone lures, scouting, and harvest evaluations. Traps in the MD blocks for CM were hung in 4 locations on 10ft bamboo poles placed next to tree trunks, containing 10x lures & the OFM traps were hung in 4 locations in the trees at head height containing standard lures. The Grower Standard plots were monitored using traps and harvest evaluations. The traps in the Grower standard blocks were standard strength lures in Pherocon IIB traps, CM traps were hung on bamboo poles in the tree tops and OFM traps were hung at head height in the trees in two locations at each orchard. Traps and lures were changed on a 4 week schedule.

Degree day models were also maintained for each location using weather data for Albion for the Kast plot and Appleton South for Russell. The first sustained trap catch date collected in the grower standard traps were recorded for each site to initiate the accumulation of degree-days. Sprays for 1$^{st}$ generation CM were timed for 250 DD after first trap catch in the area and 10-14 days later. Subsequent sprays were timed according to high trap catches in the immediate area or in the MD plots.

Mid-season scouting for OFM damage consisted of on-tree evaluations of 20 fruit and 20 shoots per tree and 20 trees per plot, 10 each from the interior and exterior of the plot, in each of the disrupted plots. The plots were monitored after each generational flight of CM for fruit infestation.

Harvest Evaluations were conducted at the farm just before each block was harvested. The evaluations consisted of 1000 apple samples; 100 apples were harvested per tree randomly, 50 from the lower and mid-section of the tree and 50 from the top. The results for harvest evaluations are displayed in Table 1 for 2006, Table 2 for 2007 and 3 for 2008.

Spray records were collected from each grower for three years in the mating disruption blocks and the grower standards. Summaries of insecticide inputs and costs are shown in Tables 4 & 5.

**Results:**
The Figures 1-4 show the trap data for MD plots and Grower Standard (non-disrupted) plots. Trap catch in MD plots were suppressed well and never broke threshold for CM or OFM, while counts were higher in the Grower Standard plots. OFM peaked three to four times in 2006, 2007, and 2008 in non-disrupted orchards. CM peaked as many as 4 times exceeding the recommended trap threshold of 5 moths per trap often in the Growers Standard plots.

The harvest evaluation results show that Kast MD plot for all three seasons had no damage from internal leps compared to the grower standard plot with 3.4, 7.2, and 3.8% internal lep damage in 2006, 07, and 08, respectively. The Russell MD block had 0.1% internal lep damage in 2006, bu none in 2007-2008. There was no damage evident in the grower standards, although formal counts were not done.

Figures 7-12 show the accumulated DD base 50 F and Base 45 F which is used to determine the best spray timing for control of CM and OFM, respectively. The figures also show the rainfall for each location for 2006, 2007 & 2008. The CM DD model (developed by MSU) was used to time sprays for the first generation in 2006, 2007 & 2008, but trap data in the growers standard plots were taken into account for subsequent generations. The spray dates and costs are listed in the Appendix.

The insecticide applications from petal fall through harvest for control of CM and OFM are listed in Tables 4-5. Insecticides with marginal efficacy for CM and OFM, directed at obliquebanded leafroller are excluded from these tables. In Kast MD plots, the number of OP's was reduced from 5 in 2006 to one in 2008. In Russell MD plots, the number of OP's was reduced from 4 in 2006 to 2 in 2008. But in 2007, Russell's MD plot was not treated with OP's while substituting 2 Avaunt sprays at petal fall and 1 Assail for AM in August, resulting in increased costs in the MD plot but no difference in damage compared to the grower standard. In 2008, Russell's applied 2 OP in the MD plot compared to 3 in the grower standard but they were directed toward other pests. There were no special sprays applied for CM in 2008. In Kast's high pressure orchard, the total number of insecticides applied has decreased from 10 in 2006 to 3 in 2008 using a combination of Isomate CM/OFM TT and integrating new insecticides to replace OP's and pyrethroids which are losing control over these pests. In Russell's low pressure site, the total number of insecticides actually directed specifically to CM/OFM have been reduced to 1 application directed toward first generation of CM. Other sprays were directed at leafrollers, plum curculio, and apple maggot. However, it is important to note there has been an increase in the San Jose scale infestation in this orchard over the 3 year period and has reached a treatable level for 2009.

The cost of the spray program includes the cost of the Isomate product. The suggested retail of Isomate CM/OFM TT is $119 per acre. This increases the cost of the insect management program significantly over the non-disrupted acreage. But in the case of Kast GS, it would have certainly improved the control of internal lep pest. In 2008 however, the cost of the MD spray program is only $7 higher than the Grower standard spray program in the Kast plot but resulted in 3.6% internal lep damage in the non-disrupted standard.

In 2007, in the low pressure Russell site, MD allowed the removal of the latest insecticide compared to an additional spray in August required in the grower standard. The 3$^{rd}$ season in the high pressure kast Orchards allowed for safe removal of the special CM sprays in August and September. The only risk noted was the presence of 0.2% European corn borer and regular trap monitoring for apple maggot. The fruit from the Kast GS had sufficient larvae detected at the processing receiving station to be downgraded to juice, losing a potential 3-4 cents per pound each season. That loss would have more than paid for the cost of the pheromone.

Under a low pressure situation as in Russell's, if there is no impact on quality and grade of apples at harvest, it is difficult to document advantages other than managing insecticide resistance in the CM and OFM and reducing the human health risks associated with OP's. But it is clear that mating disruption is necessary to get control of CM/OFM under a high pressure situation as shown in the Kast blocks.

Figure 1. 2006 trap data for MD and Grower Standard – Kast.

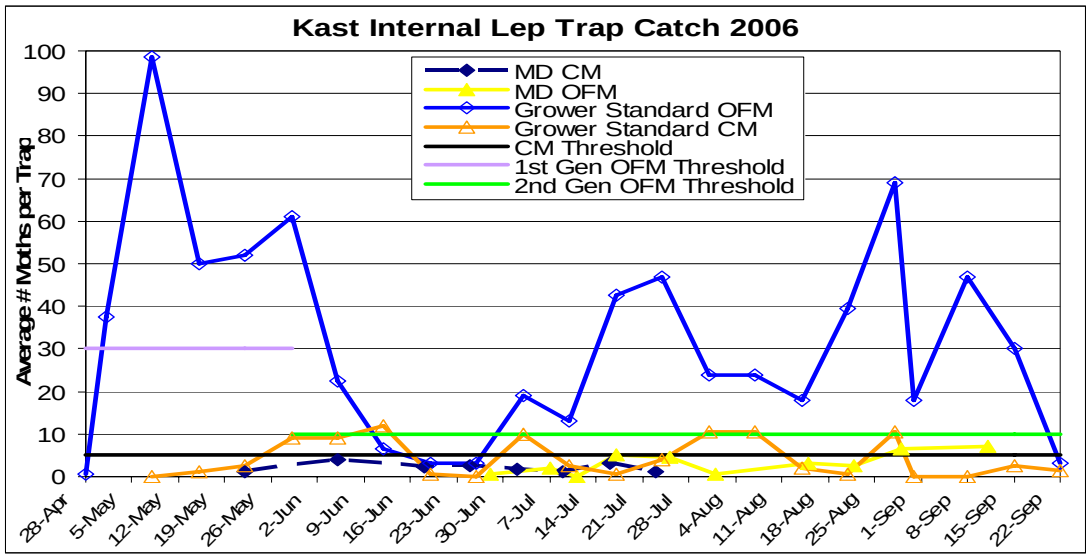



Figure 2. 2007 Trap data for MD and Grower Standard – Kast.

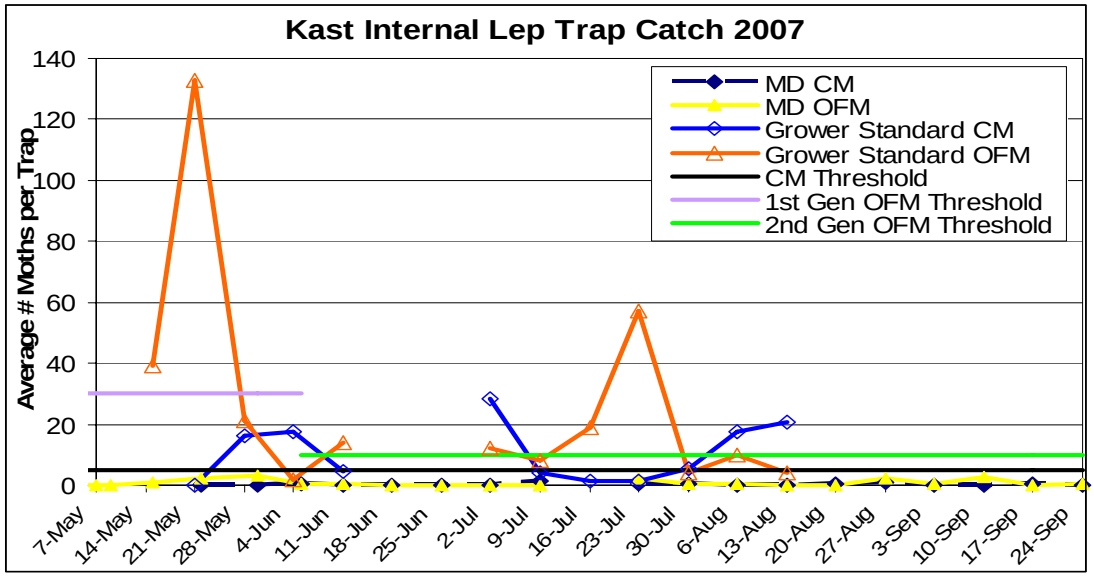



Figure 3. 2008 Trap data for MD and Grower Standard – Kast.

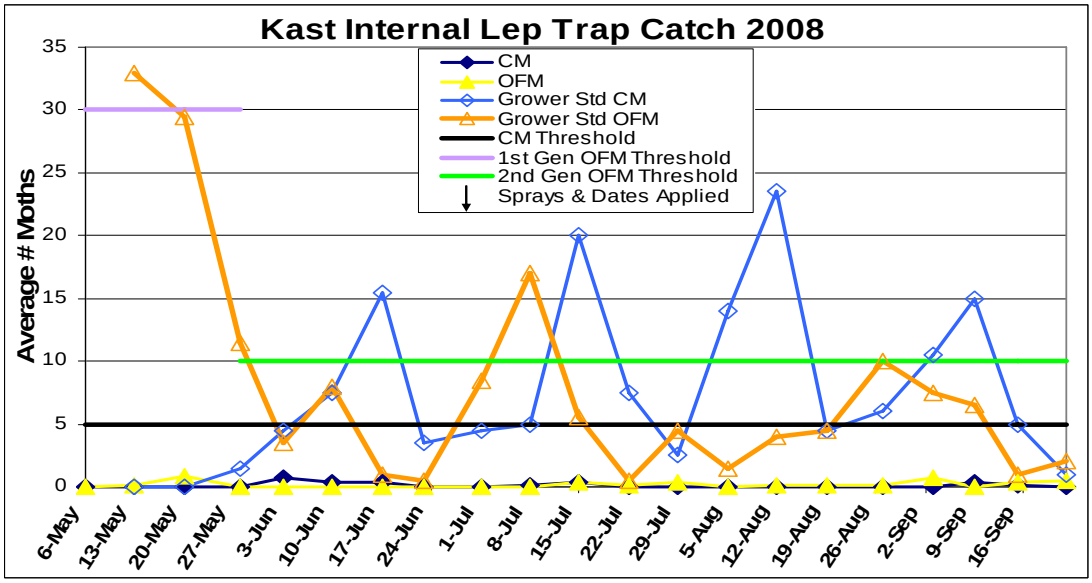


Figure 4. 2006 Trap data for MD and Grower Standard – Russell.

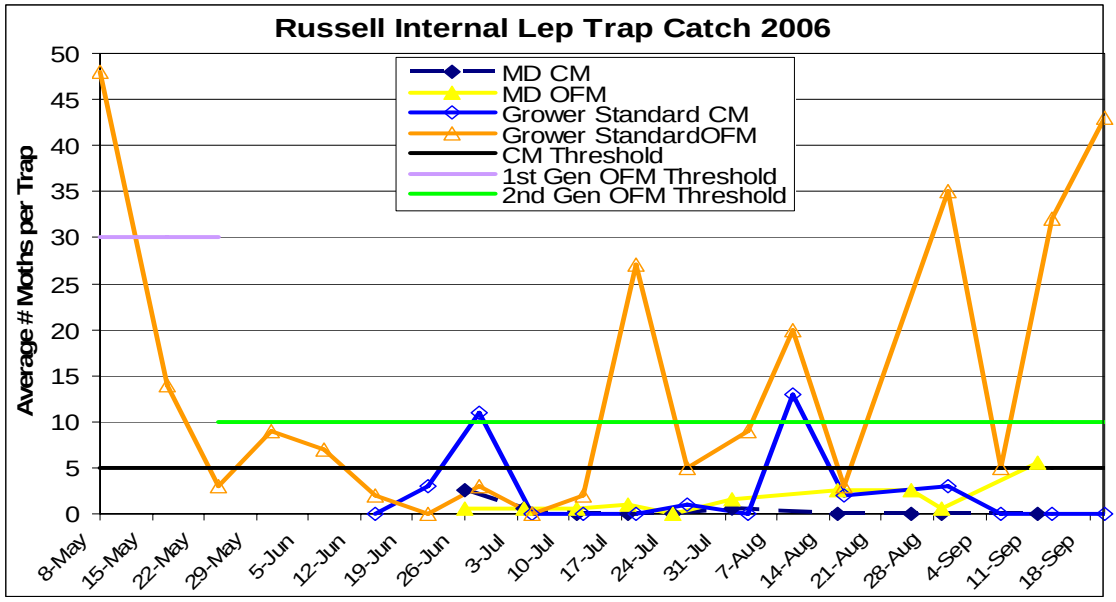



Figure 5. 2007 Trap data for MD and Grower Standard – Russell.

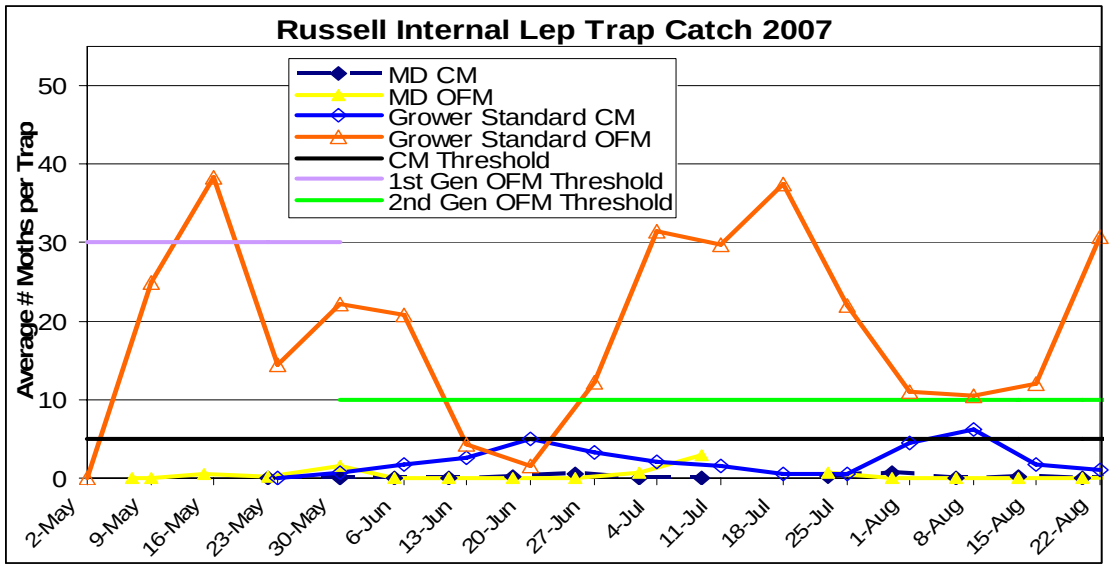



Figure 6. 2008 Trap data for MD and Grower Standard – Russell.

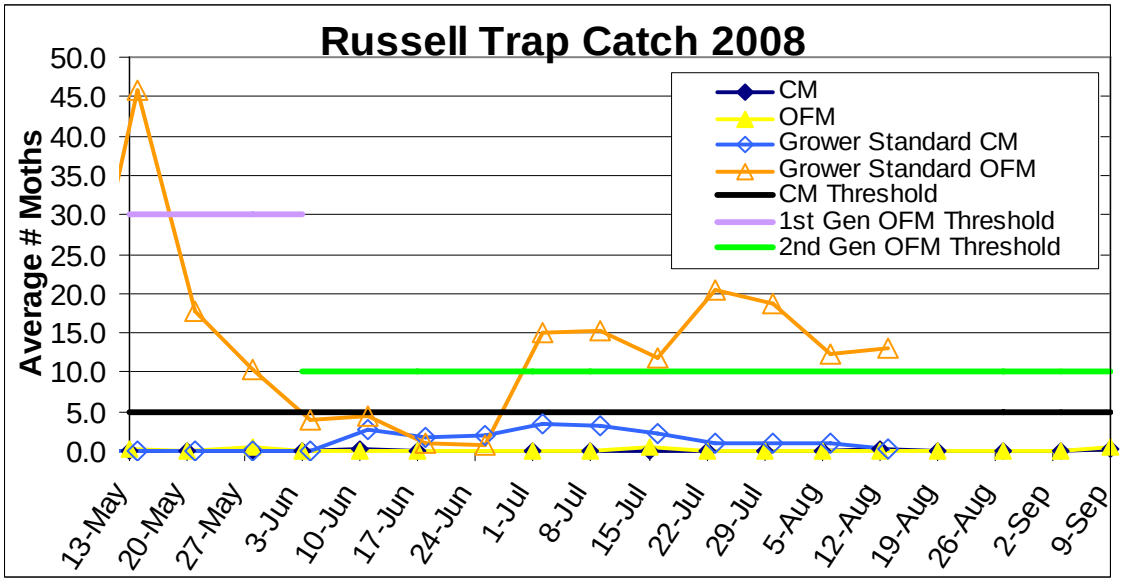


**Table 1. 2006 Harvest evaluation for Mating Disruption trial.**

| | % Damage | | | | | | |
|---|---|---|---|---|---|---|---|
| Treatment | IntLep | OBLR-OW | OBLR-S | AM | sting | TPB | PC |
| **Kast** | | | | | | | |
| MD W/Cidex | 0.0 | 0.1 | 6.6 | 0.0 | 2.9 | 0.1 | 0.0 |
| MD W/out Cidex | 0.0 | 0.1 | 1.3 | 0.0 | 0.4 | 0.5 | 0.0 |
| Grw Std Morrissey | 3.4 | 2.0 | 15.0 | 0.2 | 3.2 | 0.6 | 0.8 |
| **Russell** | | | | | | | |
| MD W/Cidex | 0.1 | 0.0 | 0.3 | 0.0 | 0.5 | 0.0 | 0.9 |
| MD W/out Cidex | 0.0 | 0.0 | 0.1 | 0.0 | 0.4 | 0.0 | 0.0 |
| Grw Std | ND | ND | ND | ND | ND | ND | ND |

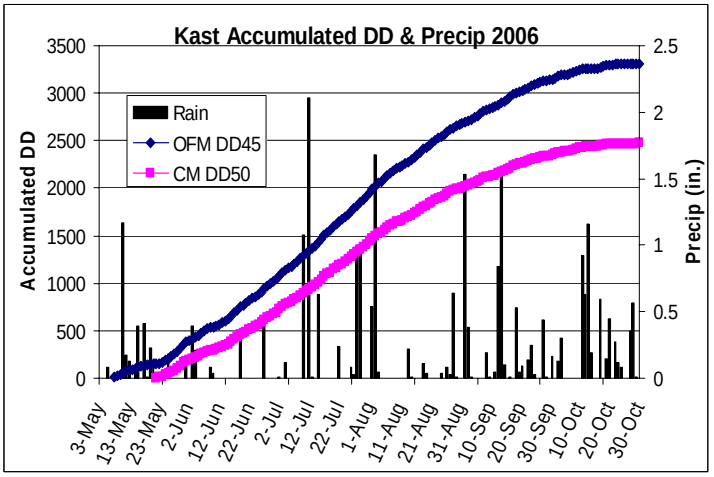
**Table 2. 2007 Harvest Evaluations for Mating Disruption trial.**

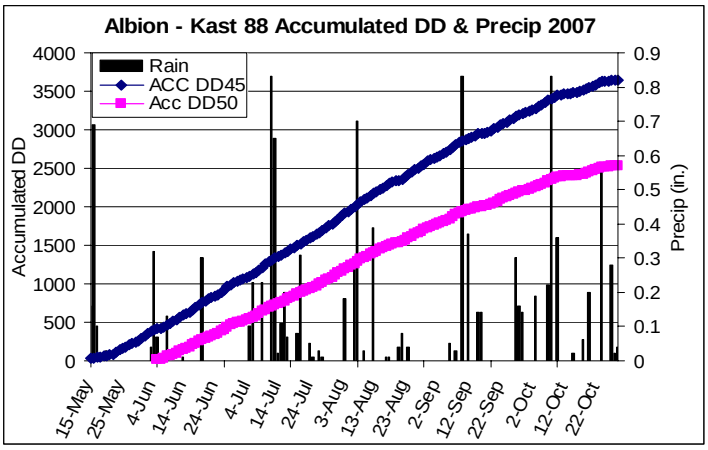
| | % Damage | | | | | | |
|---|---|---|---|---|---|---|---|
| | IntLep | OBLR-OW | OBLR-S | AM | sting | TPB | PC |
| **Kast** | | | | | | | |
| MD | 0 | 0.7 | 0.2 | 0 | 0 | 0.3 | 0.2 |
| Grower Std | 7.2 | 2.4 | 0.8 | 0 | 3.4 | 0.4 | 0 |
| **Russell** | | | | | | | |
| MD | 0 | 0.2 | 2.4 | 0 | 0 | 0.4 | 1.2 |
| Grower Std | 0 | 0 | 1.3 | 0 | 0 | 0.3 | 0.2 |

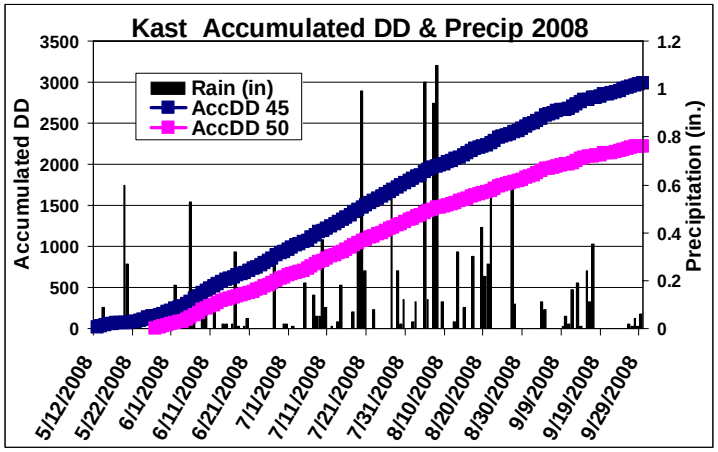
**Table 3. 2008 Harvest Evaluations for Mating Disruption trial.**

| | % Damage | | | | | | |
|---|---|---|---|---|---|---|---|
| | IntLep | OBLR-OW | OBLR-SB | AM | Sting | TPB | PC |
| **Kast** | | | | | | | |
| MD | 0.2* | 0 | 0.2 | 0 | 0.2 | 0 | 0 |
| Grower Std | 3.8 | 0.2 | 0.4 | 0.0 | 0.2 | 0.0 | 0.0 |
| * European corn borer | | | | | | | |
| **Russell** | | | | | | | |
| MD | 0 | 0.0 | 0.2 | 0.0 | 0.2 | 0.1 | 0.0 |
| Grower Std | 0 | 0 | N/A | N/A | N/A | N/A | N/A |

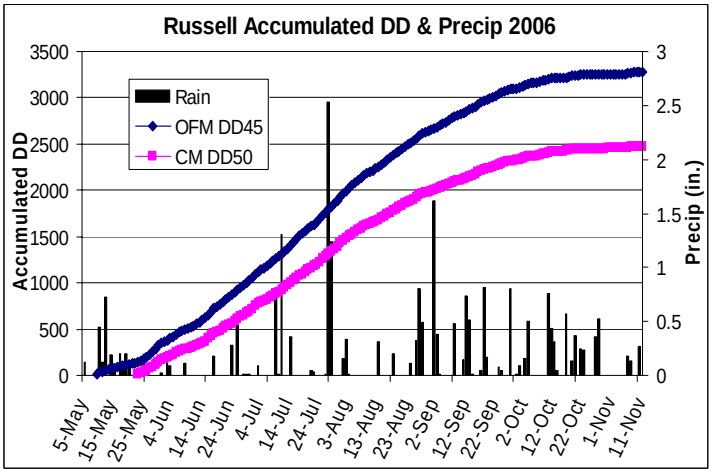
Figures 7, 8 & 9. Accumulated Degree-Days and precipitation for Kast at Albion.

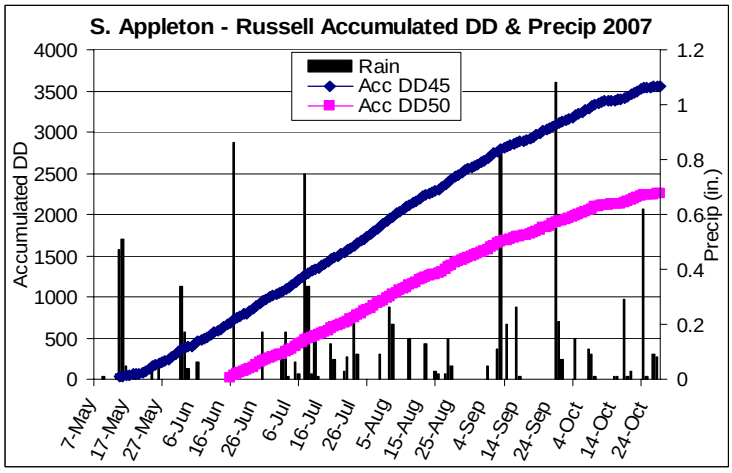



Figures 10, 11 & 12. Accumulated Degree-Days and precipitation for Russell at Appleton.



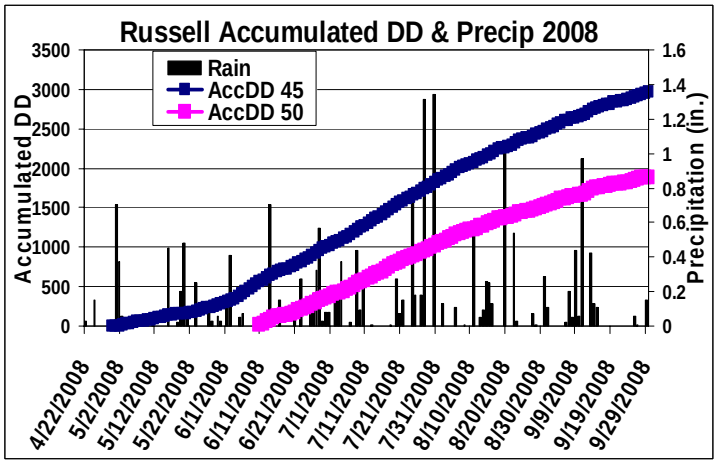



**Table 4. Summary of Insecticide Applications by Class and Cost for Kast.**

| KAST | 2006 MD + Cyd-X | 2006 MD - Cyd-X | 2006 Grw Std | 2007 MD | 2007 Grw Std | 2008 MD | 2008 Grw Std |
|---|---|---|---|---|---|---|---|
| Pheromone | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| OP | 5 | 5 | 7 | 3 | 6 | 1 | 2 |
| IGR | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Pyrethroid | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| Neonic | 0 | 0 | 2 | 3 | 2 | 1 | 2 |
| Bio | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Avaunt | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delegate | | | | | | | 2 |
| **Cost ($)** | **336** | **208** | **199** | **304** | **201** | **188** | **181** |
| **% internal lep** | **0** | **0** | **3.4** | **0** | **7.2** | **.2** | **3.8** |

**Table 5. Summary of Insecticide Applications by Class and Cost for Russell, excluding cost of Isomate.**

| Russell | 2006 MD + Cyd-X | 2006 MD - Cyd-X | 2006 Grw Std | 2007 MD | 2007 Grw Std | 2008 MD | 2008 Grw Std |
|---|---|---|---|---|---|---|---|
| Pheromone | 1 | 1 | | 1 | | 1 | 0 |
| OP | 4 | 4 | 4 | 0 | 4 | 2 | 3 |
| IGR | | | | 1 | | 1 | 1 |
| Pyrethroid | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| Neonic | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Bio | 3 | 0 | 0 | 0 | 0 | 0 | |
| Avaunt | 0 | 0 | 0 | 2 | 0 | | |
| **Cost ($)** | **314** | **186** | **67** | **232** | **132** | **209** | **102** |
| **% Internal lep** | **0.1** | **0** | **0** | **0** | **0** | **0** | **0** |

## Conclusions:

Mating Disruption is an excellent pest management tool when used under heavy pressure from CM and OFM. A significant reduction in sprays directed at CM and OFM was achieved without an increase in damage. MD for the season should also relieve the need to apply insecticide sprays in September for late harvested varieties reducing late season residues on the fruit.

If using MD over the long term, growers could possibly revert back to their previous IPM strategies and focus on control of plum curculio at the beginning and apple maggot at end of the season. The one caution is to understand that CM and OFM traps and damage must be monitored throughout the season, and other pests such as San Jose scale are on the rise with the increased use of more selective, non-OP insecticides.

Appendix –

Spray Records 2006 Cyd-X treatments applied to 5 acres of the disrupted orchard.

| Kast 88 MD w/Cyd-X | | | | | w/o Cyd-X |
|---|---|---|---|---|---|
| Date | Material | Rate/A | $/acre | | |
| | Isomate CM/OFM TT | 200 | $119.00 | | $119.00 |
| 19-May | Lorsban 75WG | 2 lbs | 26.60 | OP | 26.60 |
| 13-Jun | CYD-X | 3.2 oz | 32.00 | BIO | |
| 21-Jun | CYD-X | 3.2 oz | 32.00 | BIO | |
| 21-Jun | Guthion solupak 50% wp | 1.5 lbs | 13.28 | OP | 13.28 |
| 23-Jul | CYD-X | 3.2 oz | 32.00 | BIO | |
| 23-Jul | Guthion solupak 50% wp | 1.6 lbs | 13.28 | OP | 13.28 |
| 29-Jul | CYD-X | 3.2 oz | 32.00 | BIO | |
| 5-Aug | Imidan 70-w | 2.5 lbs | 17.88 | OP | 17.88 |
| 6-Sep | Imidan 70-w | 2.5 lbs | 17.88 | OP | 17.88 |
| | | Total | $335.92 | | 207.92 |
| | | | | | |
| Kast Morrisey - Grower Standard | | | | | |
| Date | Material | Rate/A | $/acre | | |
| 18-May | Azinphos-M 50 WSB | 1.50 lbs | 13.28 | OP | |
| 7-Jun | Calypso 4 Flowable | 0.05 gal | 36.48 | N | |
| 21-Jun | Guthion solupak 50% wp | 1.50 lbs | 13.28 | OP | |
| 28-Jun | Warrior | 0.04 gal | 9.06 | P | |
| 21-Jul | Guthion solupak 50% wp | 1.60 lbs | 13.28 | OP | |
| 5-Aug | Imidan 70-w | 2.60 lbs | 18.59 | OP | |
| 16-Aug | Imidan 70-w | 2.60 lbs | 18.59 | OP | |
| 31-Aug | Imidan 70-w | 2.60 lbs | 18.59 | OP | |
| 4-Sep | Imidan 70-w | 2.60 lbs | 18.59 | OP | |
| 16-Sep | Assail 30SG | 0.50lb | 39.20 | N | |
| | | Total | 198.94 | | |
| | | | | | |

| Russell MD w/Cyd-X | | | | | w/o Cyd-X |
|---|---|---|---|---|---|
| Date | Material | Rate/A | $/acre | | |
| | Isomate CM/OFM TT | 200 | $119.00 | | $119.00 |
| 22-May | Azinphosmethyl 50W Soluble | 1.5 lbs | 13.28 | OP | 13.28 |
| 15-Jun | CYD-X | 3.2 oz | 32.00 | BIO | |
| 28-Jun | CYD-X | 3.2 oz | 32.00 | BIO | |
| 28-Jun | Warrior | 0.04 gal | 9.06 | P | 9.06 |
| 17-Jul | Imidan 70-w | 2.5 lbs | 17.88 | OP | 17.88 |
| 24-Jul | CYD-X | 3.2 oz | 32.00 | BIO | |
| 3-Aug | CYD-X | 3.2 oz | 32.00 | BIO | |
| 8-Aug | Imidan 70-w | 2.5 lbs | 17.88 | OP | 17.88 |
| 24-Aug | Imidan 70-w | 1.25 lbs | 8.94 | OP | 8.94 |
| | | Total | $314.04 | | 186.04 |
| | | | | | |
| Russell Grower Standard | | | | | |
| Date | Material | Rate/A | $/acre | | |
| 22-May | Azinphos-Methyl | 1.5 lb | 13.28 | OP | |
| 28-Jun | Warrior | 0.04 gal | 9.06 | P | |
| 18-Jul | Imidan 70-w | 2.5 lbs | 17.88 | OP | |
| 8-Aug | Imidan 70-w | 2.5 lbs | 17.88 | OP | |
| 24-Aug | Imidan 70-w | 1.25 lbs | 8.94 | OP | |
| | | Total | 67.04 | | |

Spray Records 2007

| Kast 88-MD | | | | | |
|---|---|---|---|---|---|
| Date | Material | Rate/A | Pesticide Type | Price/Unit | Cost/Acre |
| | Isomate CM/OFM TT | 200 | | $0.60 | $119.00 |
| 29-May | Intrepid 2F | 16 oz | G | $1.80 | $28.80 |
| 29-May | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $9.80 | $14.70 |
| 6-Jun | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $9.80 | $14.70 |
| 24-Jun | Danitol 2.4 ec spray | 16 oz | P | $0.94 | $15.04 |
| 2-Jul | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| 22-Jul | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| 11-Aug | Imidan 70-W | 3 lbs | OP | $7.30 | $21.90 |
| 10-Sep | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| | | | | Total Cost/Acre | $304.14 |

| Kast Shop Grower Std | | | | | |
|---|---|---|---|---|---|
| Date | Material | Rate/A | Pesticide Type | Price/Unit | Cost/Acre |
| 29-May | Intrepid 2F | 16 oz | G | $1.80 | $28.80 |
| 29-May | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $9.80 | $14.70 |
| 5-Jun | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $9.80 | $14.70 |
| 24-Jun | Danitol 2.4 ec spray | 16 oz | P | $0.94 | $15.04 |
| 3-Jul | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| 22-Jul | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| 8-Aug | Azinphosmethyl 50W Soluble | 1.6 lbs | OP | $9.80 | $15.68 |
| 20-Aug | Imidan 70-W | 3 lbs | OP | $7.30 | $21.90 |
| 5-Sep | Azinphosmethyl 50W Soluble | 1.5 lb | OP | $9.80 | $14.70 |
| 18-Sep | Azinphosmethyl 50W Soluble | 1.6 lbs | OP | $9.80 | $15.68 |
| | | | | Total Cost/Acre | $201.20 |

| Russell -MD | | | | | |
|---|---|---|---|---|---|
| Date | Material | Rate/A | Pesticide Type | Price/Unit | Cost/Acre |
| | Isomate CM/OFM TT | 200 | | $0.60 | $119.00 |
| 25-May | Intrepid 2F | 16 oz | G | $1.80 | $28.80 |
| 25-May | Avaunt WDG | 6 oz | Other | $4.50 | $27.00 |
| 8-Jun | Avaunt WDG | 6 oz | Other | $4.50 | $27.00 |
| 20-Jul | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| | | | | Total Cost/Acre | $231.80 |

| Russell Grower Std | | | | | |
|---|---|---|---|---|---|
| Date | Material | Rate/A | Pesticide Type | Price/Unit | Cost/Acre |
| 24-May | Intrepid 2F | 16 oz | G | $1.80 | $28.80 |
| 24-May | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $9.80 | $14.70 |
| 8-Jun | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $9.80 | $14.70 |
| 20-Jul | Assail 30SG | 6 oz | N | $5.00 | $30.00 |
| 6-Aug | Imidan 70-w | 3 lbs | OP | $7.30 | $21.90 |
| 21-Aug | Imidan 70-w | 3 lbs | OP | $7.30 | $21.90 |
| | | | | Total Cost/Acre | $132.00 |

Spray Records 2008

| Kast 88-MD | | | | | |
|---|---|---|---|---|---|
| Date | Spray | amt/A | Pesticide Type | Price/Unit | Cost/Acre |
| 29-Apr | Isomate CM/OFM TT | 200 | MD | $0.60 | $119.00 |
| 24-May | Intrepid 2F | 16 oz | IGR | $1.84 | $29.38 |
| 24-May | Azinphosmethyl 50W Soluble | 1.6 lbs | OP | $8.90 | $14.24 |
| 5-Jun | Calypso 4 Flowable | 5 oz | N | $5.00 | $25.00 |
| | | | | Total Cost/Acre | $187.62 |

| Kast Stone House Grower Std | | | | | |
|---|---|---|---|---|---|
| Date | Spray | amt/A | Pesticide Type | Price/Unit | Cost/Acre |
| 24-May | Intrepid 2F | 16 oz | OP | $1.84 | $29.38 |
| 24-May | Azinphosmethyl 50W Soluble | 1.6 lbs | P | $8.90 | $14.24 |
| 6-Jun | Calypso 4 Flowable | 5 oz | N | $5.00 | $25.00 |
| 20-Jun | Calypso 4 Flowable | 5 oz | N | $5.00 | $25.00 |
| 22-Jul | Azinphosmethyl 50W Soluble | 1.6 lbs | OP | $8.90 | $14.24 |
| 28-Jul | Delegate WG | 5.2 oz | OP | $7.00 | $36.40 |
| 14-Aug | Delegate WG | 5.2 oz | OP | $7.00 | $36.40 |
| | | | | Total Cost/Acre | $180.66 |

| Russell -MD | | | | | |
|---|---|---|---|---|---|
| Date | Spray | amt/A | Class | Price/Unit | Cost |
| 30-Apr | Isomate CM/OFM TT | 200 | MD | $0.60 | $119.00 |
| 23-May | Intrepid 2F | 16 | IGR | $1.84 | $29.38 |
| 23-May | Azinphosmethyl 50W Soluble | 1.5 | OP | $8.90 | $13.35 |
| 10-Jun | Calypso 4 Flowable | 5 | N | $5.00 | $25.00 |
| 18-Jul | Imidan 70-w | 3 | OP | $7.30 | $21.90 |
| | | | | Total Cost/Acre | $208.63 |

| Russell Grower Std | | | | | |
|---|---|---|---|---|---|
| Date | Spray | amt/A | Pesticide Type | Price/Unit | Cost/Acre |
| 23-May | Intrepid 2F | 16 oz | IGR | $1.84 | $28.80 |
| 23-May | Azinphosmethyl 50W Soluble | 1.5 lbs | OP | $8.90 | $14.70 |
| 10-Jun | Calypso 4 Flowable | 5 oz | N | $5.00 | $14.70 |
| 17-Jul | Imidan 70-w | 3 lbs | OP | $7.30 | $21.90 |
| 7-Aug | Imidan 70-w | 3 lbs | OP | $7.30 | $21.90 |
| | | | | Total Cost/Acre | $102.00 |