

# How to Keep Worms Out of Sweet Corn Ears



Celeste Welty  
Extension Entomologist  
Ohio State University  
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# Topics

- Life cycles & management
- Insecticide use
  - Emphasis on best timing
  - During silking vs before silking
  - Main/late season corn vs early season corn
  - Conventional vs organic options
- How to monitor pests

# Caterpillars in Sweet Corn



- Key pests; can ruin the crop
- Pest management is complex
  - Several insect species
  - Sequential plantings
- The need to control them varies through the season
  - No control
  - Low intensity control
  - High intensity control

# Caterpillar Species Mix

June                      July                      Aug./Sep.

## Corn

### Earworm

-/\*

-/\*

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## European

### Corn Borer

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## Fall

### Armyworm

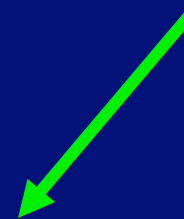
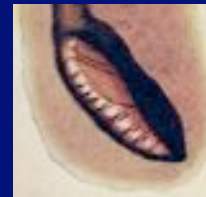
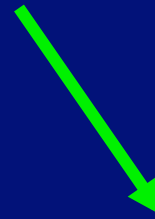
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# Life Cycle

Caterpillar (Larva)

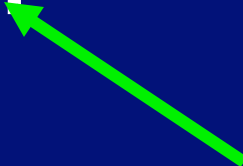
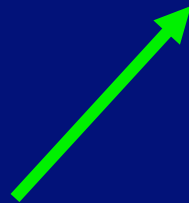


Moth (Adult)

Egg



Pupa



# Sweet Corn Development

- Seedling
- Whorl stage
- Emerging tassel stage \*\*
- Fresh silk \*\*\*
- Dry silk

# **Control of Caterpillars During Silking in Main Season & Late Season Corn**

- \*\* Spray interval**
- \*\* Coverage of ear zone**
- \* Choice of insecticide**

# Relative importance of pests during silking

<u>Rank</u>	<u>Pest</u>	<u>Spray Interval</u>
1	Corn earworm	2-6 d
2	Eur. corn borer	5-7 d
3	Fall armyworm	5-7 d
4	Sap beetles	4-5 d
5	Silk clip. beetles	(1 spray)



# Difference in 'Worm' Invasion



car worm

European corn borer

Egg location

**silks**

**ear leaf**

Egg hatch

**2-3 days**

**3-5 days**

Source

**migratory**

**local**

# Insecticides During Silking

Moths active?

**Corn**

**Eur. corn**

**Insecticide need**

**earworm**

**borer**

**to control larvae**

**+**

**+ or -**

**More intensive**

**-**

**+**

**Less intensive**

**-**

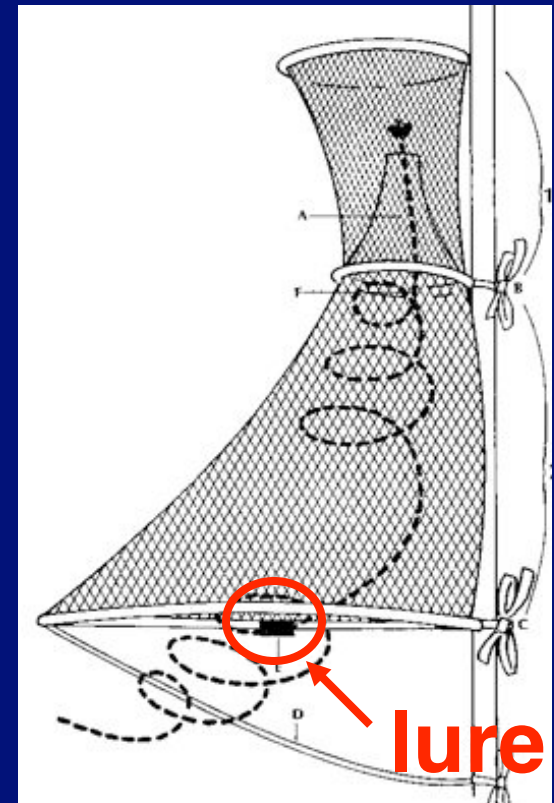
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**None**

# 1. Corn earworm

# Trap to Monitor Corn Earworm

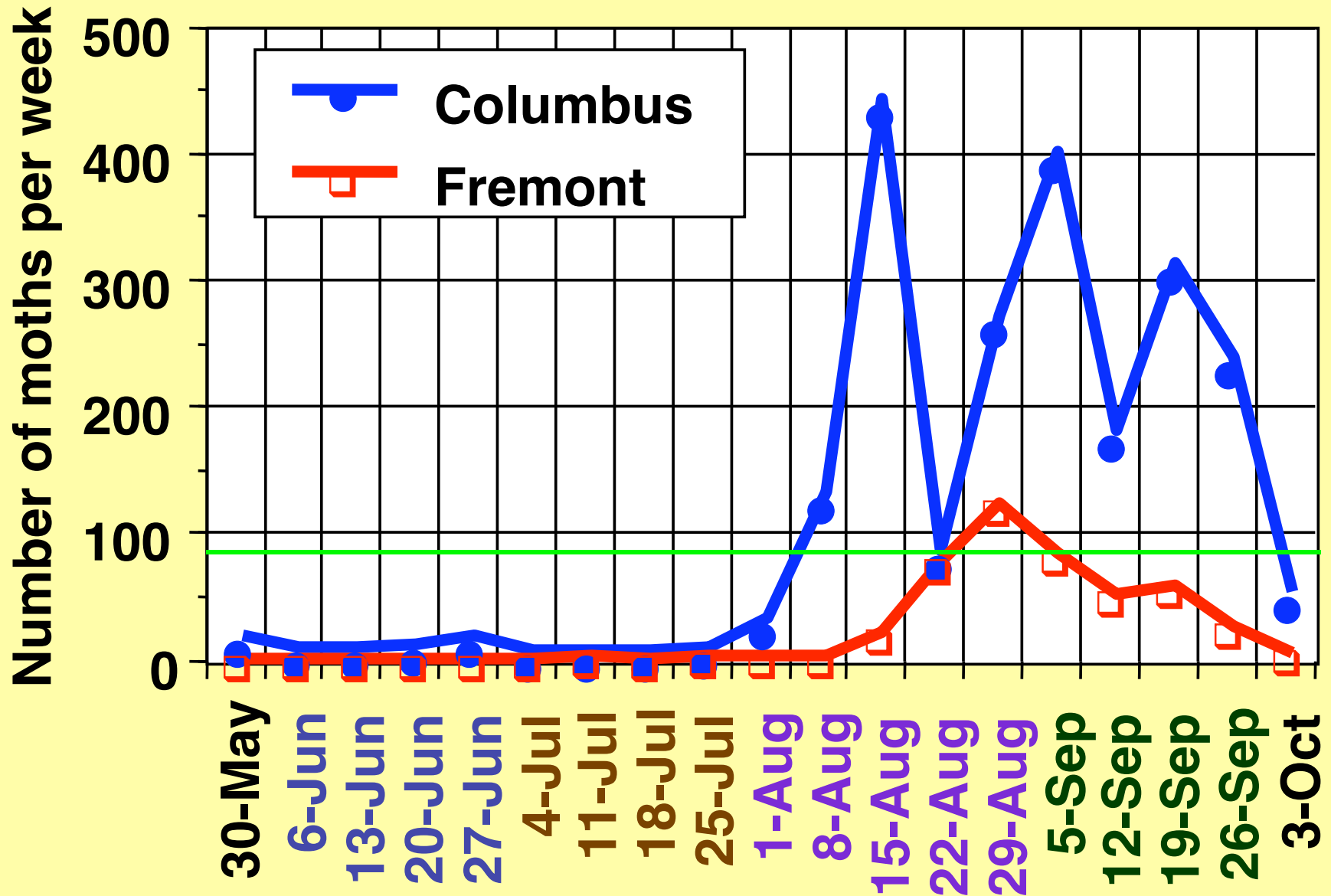
- Pheromone lure
- Attracts male moths
- Highly effective



# Corn Earworm Insecticide SPRAY SCHEDULE Based on Scentry Pheromone Trap & Maximum Daily Air Temperature

<u>Number moths per trap</u>			<u>Spray interval</u>	
<u>Per day</u>	<u>Per 5 d</u>	<u>Per week</u>	<u>&lt;80 F</u>	<u>&gt;80 F</u>
< 0.2	< 1	< 1.4	No spray	No spray
0.2-0.5	1.0-2.5	1.4-3.5	Every 6 days	Every 5 days
0.5-1	2.5 - 5	3.5 - 7	Every 5 days	Every 4 days
1 - 13	5 - 65	7 - 91	Every 4 days	Every 3 days
>13	>65	>91	Every 3 days	Every 2 days

# Corn Earworm Pheromone Traps, 2000



## **2. European corn borer**

# European Corn Borer & Sweet Corn



- Moths active:
  - 1<sup>st</sup> flight:
    - Late May to late June
    - Most eggs on whorls
    - Move to tassel to ear
    - Control before silking
  - 2<sup>nd</sup> flight:
    - Late July to late August
    - Most eggs near ear
    - Control during silking
- Monitor moths with pheromone traps



# European corn borer: generations per year

- **2 generations**
  - when summer has average temperatures (60% of years in Ohio)
- **3 generations**
  - when summer has high temperatures (40% of years)

# European Corn Borer on Sweet Corn

- Spray during silking if moths active (> 1 moth per night = 7 moths per week in pheromone trap)
- **1<sup>st</sup> spray when 10-20% of plants silking**
- **Spray every 5 - 7 days**
  - 5-day during peak egg hatch
  - 5-day when temperatures hot (>80 F)

# **3. fall armyworm**

# Fall Armyworm During Silking



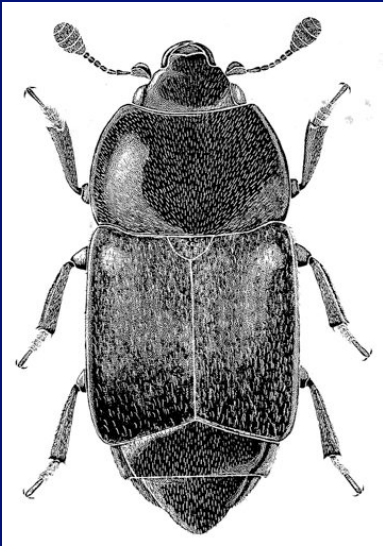
- Pheromone trap
  - All-green unitrap
- Spray every 5-7 days during silking if more than 3 moths per week in trap



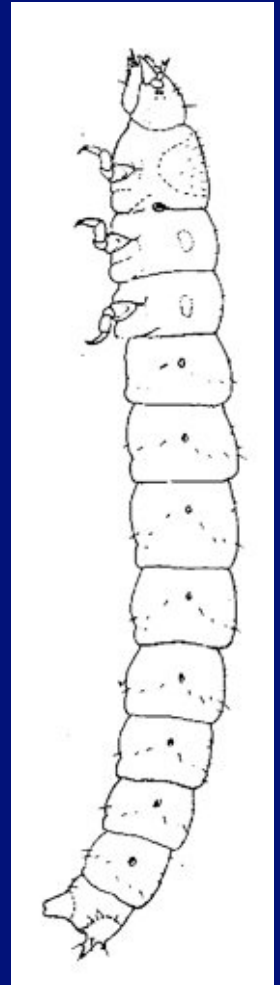
*fall armyworm moth*

# 4. beetles

# Dusky Sap Beetle



- Adults & larvae in kernels
- Often follow caterpillars
- Can infest uninjured ears
- **Eggs hatch in 2-3 days**
- **Larvae feed for 14 days, first on silks or frass, then kernels**



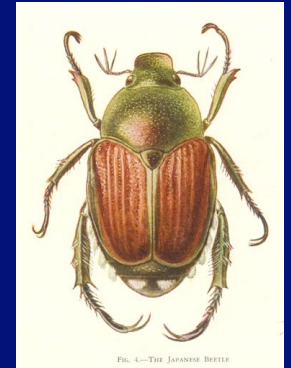
# Sap Beetle Management

- **Scout (examine ears)**
  - 50 ears in small plantings (<2A)
  - 100 ears in large plantings (>2A)
  - Record # infested with adult or larval sap beetles
- **Action threshold**
  - Treat every 4-5 days during silking if sap beetles in >10% of ears

# Silk-Clipping Beetles



- Several species:
  - Japanese beetle
  - corn rootworm beetles
    - western
    - southern
    - northern



- Treat once, early-silk, if:
  - >2 Jap. beetles per ear or
  - >5 rootwm beetles per ear



# Managing Worms Before Silking

# Managing European Corn Borer First Generation & Fall Armyworm

- **Q:** Do you have equipment to apply granules to whorl stage corn?
- If answer is **YES**, then scout at whorl stage
- If answer is **NO**, then delay scouting until emerging-tassel stage

# Whorl Stage Corn

- Scout (examine plants)
  - 50 plants in small plantings (<2A)
  - 100 plants in large plantings (>2A)
  - Record # with fresh feeding:
    - Big holes, messy = fall armyworm
    - Small holes, tidy = European corn borer



# Whorl Stage Corn

- Action thresholds:
  - Treat with spray or granules if fall armyworm on >15% of plants
  - Treat with granules if European corn borer on >30% of plants



# Emerging-Tassel Stage

- Scout (examine plants)
  - 50 plants in small plantings (<2A)
  - 100 plants in large plantings (>2A)
  - Record # with fresh feeding damage
- Action threshold
  - Spray if fall armyworm and/or European corn borer on >10% of plants



# Caterpillar Control in EARLY Corn

Step 1) if threshold exceeded:

1 application of granules to **whorls**

*OR*

1 spray application to **emerging tassels**

Step 2) spray on silking ears:

1 spray at early silk, 2<sup>nd</sup> spray 5-7 days later if corn borer flight not over

*OR*

Spray every 2-6 days if corn earworm active

# Insecticide Issues

- Coverage
- Choice of product
  - Conventional alternatives
  - Organic alternatives
- Rates
- Mixtures
- Application method

# Spray Coverage

- Direct spray to ear zone
- Drop nozzles effective





# Insecticides on Sweet Corn

	<u>Eur. corn borer</u>	<u>Corn earworm</u>	<u>Fall armyworm</u>
Mustang	G	G	G
Capture	G	G	G
Baythroid	G	G	G
Warrior	G	G	G
SpinTor	G	G	G
Pounce	G	F	F
Asana	F	G	P
Larvin	G	G	G
Penncap-M	G	P	P
Lannate	F	F	F
Sevin	F	F	F
Diazinon	F	F	F
B.t.	F	F	F

# B.t. on Sweet Corn

- **Whorl stage:**
  - Granules or spray
  - Target corn borer (1<sup>st</sup> gen.) & fall armyworm
- **Silking**
  - Spray
  - Target corn borer (2<sup>nd</sup> gen.) & corn earworm & fall armyworm

## B.t. vs Conventional?

Sweet corn in Minnesota (Hutchison et al. 1992)  
4 sprays, earworm & borer; harvest 12 Sept.

<u>Product &amp; relative rate</u>	<u>% marketable ears</u>	
<b>Pounce (mid)</b>	<b>79</b>	<b>a</b>
<b>Ambush (mid)</b>	<b>66</b>	<b>abcd</b>
<b>Javelin (high)</b>	<b>66</b>	<b>abcd</b>
<b>MVP (mid)</b>		<b>64</b>
abcde		
<b>Pennacap-M (min)</b>	<b>51</b>	<b>abcdefgh</b>
<b>Asana (max)</b>	<b>46</b>	<b>bcdefgh</b>
<b>Pennacap (&lt;min)</b>		<b>42</b>
cdefghi		
<b>Pennacap (&lt;min) + Javelin (low)</b>	<b>41</b>	<b>defghi</b>
<b>Lannate (max)</b>	<b>37</b>	<b>efghi</b>
<b>Untreated</b>	<b>15</b>	<b>i</b>

# Organic Alternative for Earworm & Borer on Sweet Corn: B.t. + Oil

(Ruth Hazzard, Univ. Mass.)

- Hand-held 'Zea-later' applicator
  - Johnny's Selected Seeds, \$79
- Mix:
  - 900 ml food-grade corn oil
  - Lecithin 5% (emulsifier)
  - 28.6 grams DiPel DF (B.t.)
  - 100 ml water
- Treat once, 5 days after silking begins
- Squirt 0.5 ml. of oil mix into each ear tip





# Corn earworm = tomato fruitworm



- Normal year in Ohio:
  - Large number of moths arrive in late summer from South
  - Pyrethroids work well
- In September 2004:
  - Average number of moths arrived
  - Larvae NOT susceptible to pyrethroids (Warrior, Baythroid)

# **Corn earworm = tomato fruitworm**

- **What to expect in 2005?**
- **Known to not overwinter well here**
- **Problem could re-occur**
- **Growers should have alternative insecticide**

# Corn earworm = tomato fruitworm

- Pyrethroid alternatives:
  - **Sweet corn**
    - SpinTor
    - Larvin
    - Lannate
  - **Tomato**
    - SpinTor
    - Proclaim
    - Avaunt
    - Intrepid

# Insecticide Rates?

Sweet corn in Wisc., 1999 (Wedberg & Jensen):

Treatment, rate/A <u>(3 applications)</u>	<u># infested ears per 25 ears</u>	
	w/ borer	w/ earworm
Capture, 2.6 oz (mid)	1.5 a	1.5 a
Capture, 2.1 oz (min)	0.8 a	2.2 a
Warrior, 3.2 oz (mid)	1.5 a	2.0 a
Warrior, 2.6 oz (min)	0.2 a	4.5 abc
SpinTor, 6 oz (max)	1.5 a	2.2 a
SpinTor, 3 oz (min)	1.0 a	3.5 abc
Pounce, 8 oz (max)	1.5 a	4.2 abc
Pounce, 6 oz (mid)	3.0 a	4.8 abc
Baythroid, 2.8 oz (max)	0.2 a	5.8 abcd
Baythroid, 1.6 oz (min)	2.0 a	8.0 bcd
untreated check	8.8 b	5.8



# Insecticide Rates?

## Conclusion:

- For European corn borer:
  - **low rates fine**
- For corn earworm
  - **higher rates better**

# Insecticide Combinations?

Sweet corn in Virginia, 1999 (Nault & Speese)

<u>Treatment, rate/A; 4 applications</u>	<u>No. larvae per ear</u>	
	<u>earworm</u>	<u>borer</u>
Warrior, 3.8 oz (max) alone	0.04 c	0.09 b
Baythroid, 2.8 oz (max) alone	0.05 bc	0.05 c
Penncap-M, 1 qt (min) +Warrior, 1.6 oz (<min)	0.03 c	0.02 c
Penncap-M, 1 qt (min) +Baythroid, 0.8 oz (<min)	0.13 b	0.02 c
Untreated check	0.38 a	0.26 a

# Insecticide Application Options for Sweet Corn

- **Old way**
  - **Foliar spray**
    - High clearance boom sprayer (High Boy)
    - Airblast sprayer
- **New ways**
  - **Chemigation via overhead irrigation**
  - **Commercial seed treatment**
    - Gaucho, Cruiser, Poncho
  - **Transgenic BT corn**
    - 'Attribute'

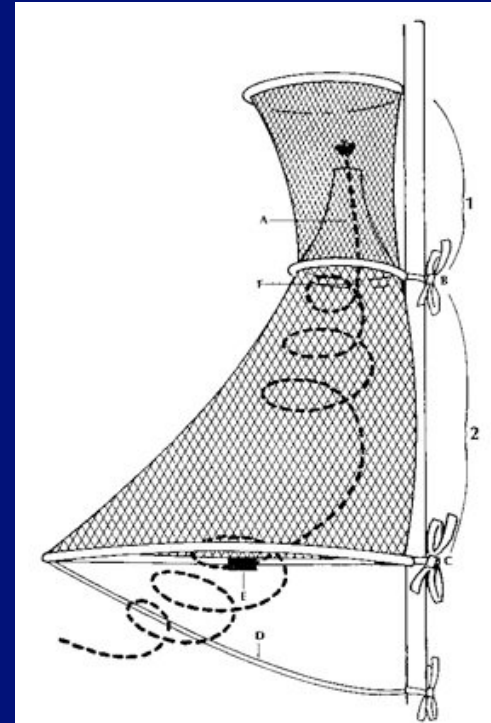
# **'Attribute' BT Sweet Corn**

- **European corn borer:**
  - **Excellent control**
- **Corn earworm:**
  - **Adequate protection if population low**
  - **Supplement with insecticide if corn earworm population high**
    - **Spray at 75% fresh silk**
    - **2<sup>nd</sup> spray 4 days later**

# Monitoring

# Traps for Corn Earworm & European Corn Borer

- **Set up:**
  - At edge of corn field
  - **CEW: best near fresh-silking corn**
  - **ECB: over long grass is best; not over bare soil**
- **Maintenance:**
  - Check 2 to 3 times per week; count target moths
  - Replace lure every 2 or 4 weeks (as per manufacturer)



# Pheromone Lures for European Corn Borer

Two lure types available:

- **'Iowa' strain:**
  - Also known as **'Z'**-strain
  - Best for Ohio
- **'New York' strain:**
  - Also known as **'E'**-strain
  - Not needed in Ohio

# Traps for Corn Earworm & European Corn Borer

## Suppliers:

- **Great Lakes IPM** (Vestaburg, Mich.)
- **Gempler's** (Belleville, Wisconsin)
- **Salem Fruit Growers Co-op** (Salem, Ohio)



# Traps for Corn Earworm or European Corn Borer

<u>Trap</u>	<u>Lures</u>		
Manufacturer:	<b>Scentry</b>	<b>Hercon</b>	<b>Trécé</b>
Life span:	<b>2 - 4 yrs</b>	<b>2 wks</b>	<b>4 wks</b>
# per season:	<b>1 (minimum)</b> <b>2 (preferred)</b>	<b>4 - 10</b>	<b>2 - 5</b>
Cost:	<b>@\$48 - 75*</b> <b>\$8 - 13 (for 5)</b>		<b>\$16 (for 10)</b>

*\* plus optional spare tops @\$17 - 24*