

Managing insecticide resistance in corn earworm on sweet corn

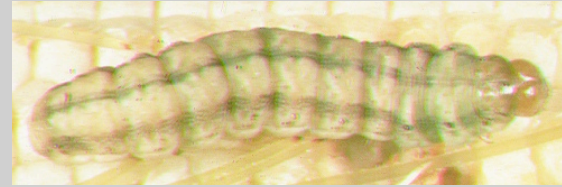


**Celeste Welty
Extension Entomologist
Ohio State University
January 2010**

Target pests

- **Primary:**

- Corn earworm



- **Other caterpillars:**

- European corn borer



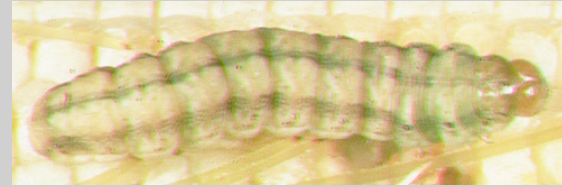
- Fall armyworm



Target pests

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- Fall armyworm



- **Other pests**

- Silk-clipping beetles



- Corn leaf aphid (in husks)



Corn earworm control on sweet corn, field trials 2007-2009



Jim Jasinski, Celeste Welty, Bob Precheur

- **Concern about pyrethroid resistance**
- **Start spray program at 1st silk**
- **6 sprays at 3- to 4-day intervals, late August & early September**

Sweet corn field trials

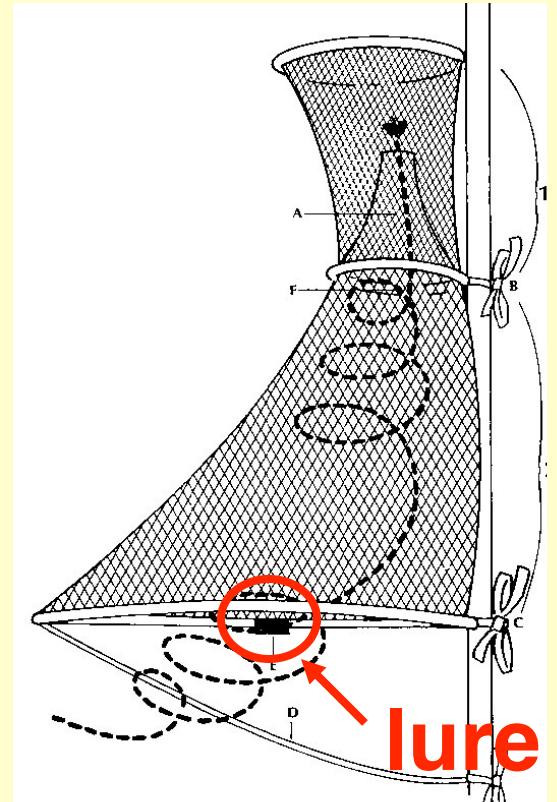
Same all years: number of sprays (6), spray interval (3-4 days), hybrids, plot size, experiment design

Differences:

| | 2007 | 2008 | 2009 |
|----------------------|-----------------------|-------------------|-------------------|
| Sprayer | High clearance boom | Spider (high-boy) | Spider (high-boy) |
| Pest pressure | Very high & prolonged | Moderate | High but quick |

Trap to Monitor Corn Earworm

- Pheromone lure
- Attracts male moths
- Highly effective



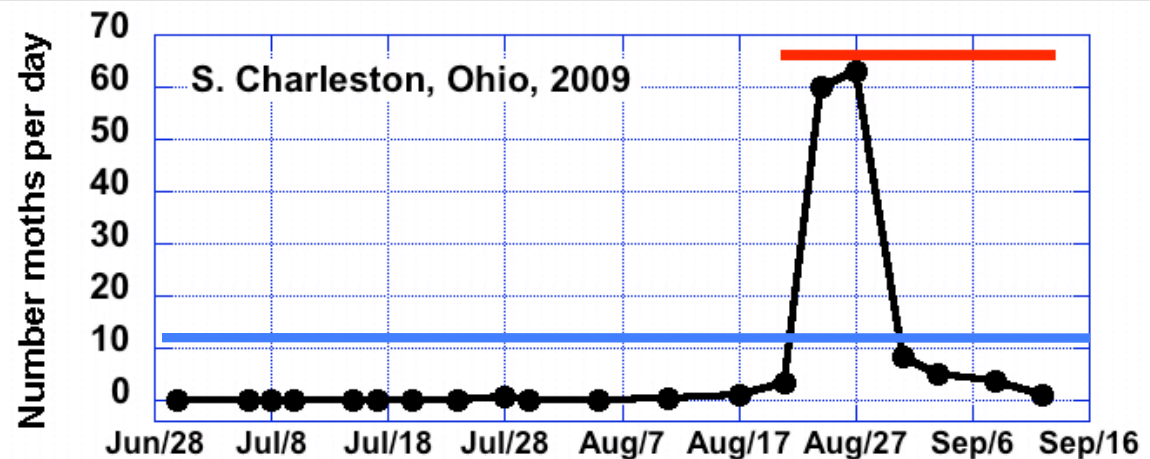
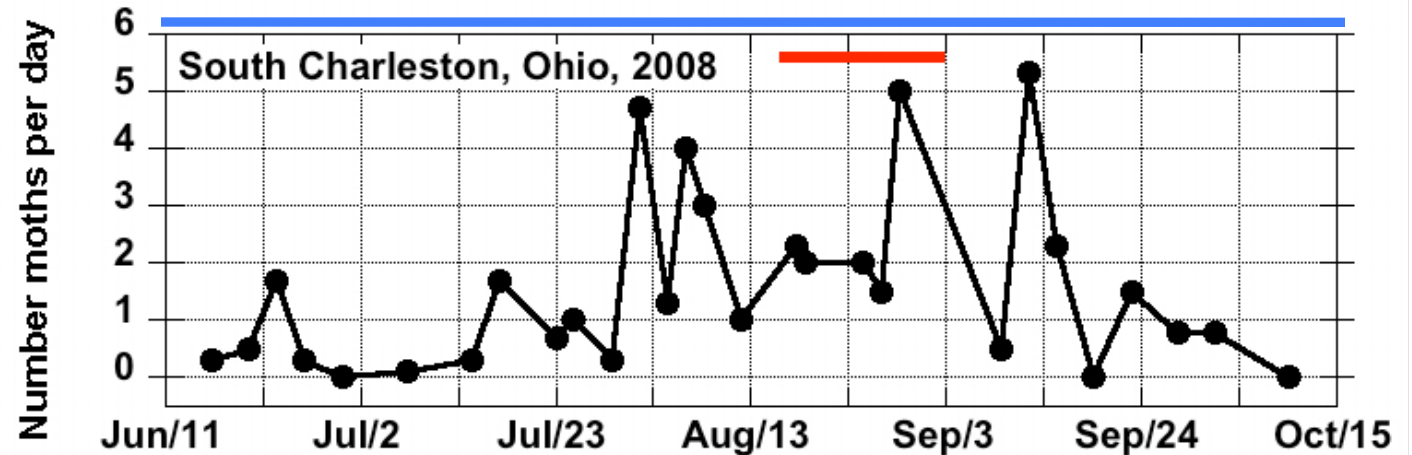
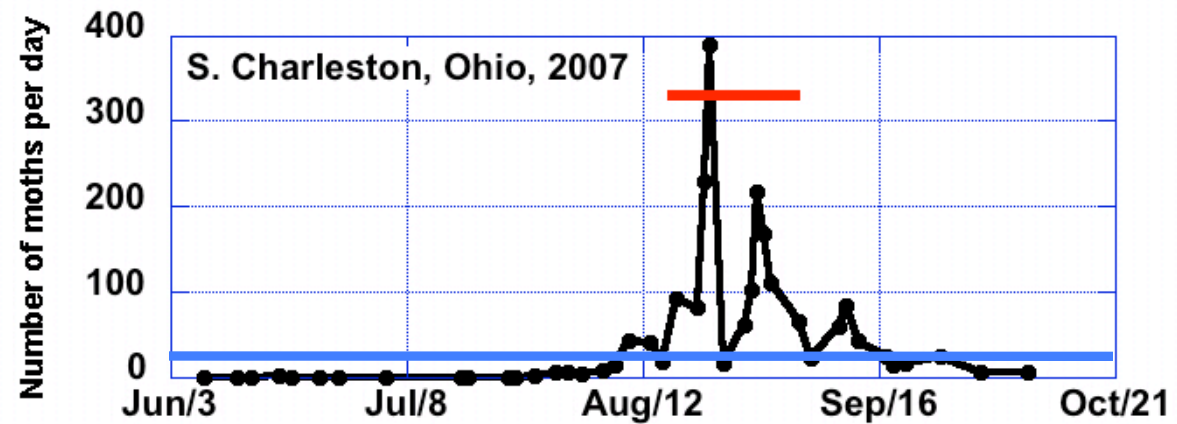
Corn Earworm Insecticide Spray Schedule

| <i>Number moths per pheromone trap per day</i> | <i>Spray interval</i> | |
|---|--|--|
| | <i>Maximum daily temp. <80 F</i> | <i>Maximum daily temp. >80 F</i> |
| < 0.2 | No spray | No spray |
| 0.2 - 0.5 | Every 6 days | Every 5 days |
| 0.5 - 1 | Every 5 days | Every 4 days |
| 1 - 13 | Every 4 days | Every 3 days |
| > 13 | Every 3 days | Every 2 days |

corn earworm in pheromone trap

red bar
shows spray
period

blue bar
shows “high”
moth density,
13 moths/
trap/day



Worm species in field trials

| Year | Number of larvae per ear in untreated plots | | |
|------|---|-----------------|----------------|
| | Corn earworm | Eur. corn borer | Fall army-worm |
| 2007 | 2.7 | 0.9 | 0.01 |
| 2008 | 0.1 | 0.6 | 0.01 |
| 2009 | 1.3 | 0.1 | 0.10 |

Spider sprayer

**(West Texas Lee Company, Inc., Idalou TX),
new in 2008**



Treatments, 2007-2009

- **Hybrids**
 - BT corn 'Attribute BC 0805'
 - 'Providence' isoline
- **Older a.i.s:**
 - Pyrethroids: Brigade (= Capture), Warrior, Hero, Asana, MustangMax
 - Carbamates: Lannate, Larvin
 - Virus: Gemstar
- **New a.i.s:**
 - Radiant (registered)
 - Belt (registered)
 - Coragen (pending)
 - Alverde (not registered)

15 Treatments in 2009 trial

- **Pyrethroid, single product, alone (3)**
- **2 pyrethroids, mixed or alternated (2)**
- **New non-pyrethroids, alone (3)**
- **Pyrethroids + new, alternating (4)**
- **B.T. corn ('Attribute') (2)**
- **Untreated (1)**

Treatments 2009

- **Pyrethroid, single product, alone**
 - 1. Warrior II**, 1.92 fl oz/A (upper end of rate range)
 - 2. Warrior II**, 1.26 fl oz/A (lower end of range)
 - 3. Brigade** (formerly called **Capture**) 2EC, 2.56 fl oz/A (near low end of rate range), max 5 sprays allowed

Treatments 2009

- **Pyrethroid combos**

1. **Brigade** 2EC (6.4 oz/A = max rate) in first 2 sprays; **Warrior** II (1.92 oz/A = max rate) in last 4 sprays
2. **Hero** (8 oz/A = mid) in first 3 sprays; **Mustang Max** (4 oz/A = max rate) in last 3 sprays
 - Note Hero is premix of Brigade + Mustang

Treatments 2009

- New non-pyrethroids, alone
 1. **Belt**, 3 oz/A + MSO, 0.5%
 2. **Coragen**, 5 oz/A + MSO, 0.5%
 3. **Radiant**, 6 oz/A

Treatments 2009

- New + old, combos
 1. **Belt** (sprays 1, 3, 5) alternated with **Baythoid** (sprays 2, 4, 6)
 2. **Coragen*** (sprays 1, 2) then **Asana** (sprays 3, 5), **Lannate** (sprays 4, 6)
 3. **Voliam Xpress***, 7 fl oz/A
 4. **Voliam Xpress***, 9 fl oz/A
 - Note Voliam Xpress is premix of Coragen + Warrior
 - *Note Coragen and Voliam Xpress not yet registered

Treatments 2009

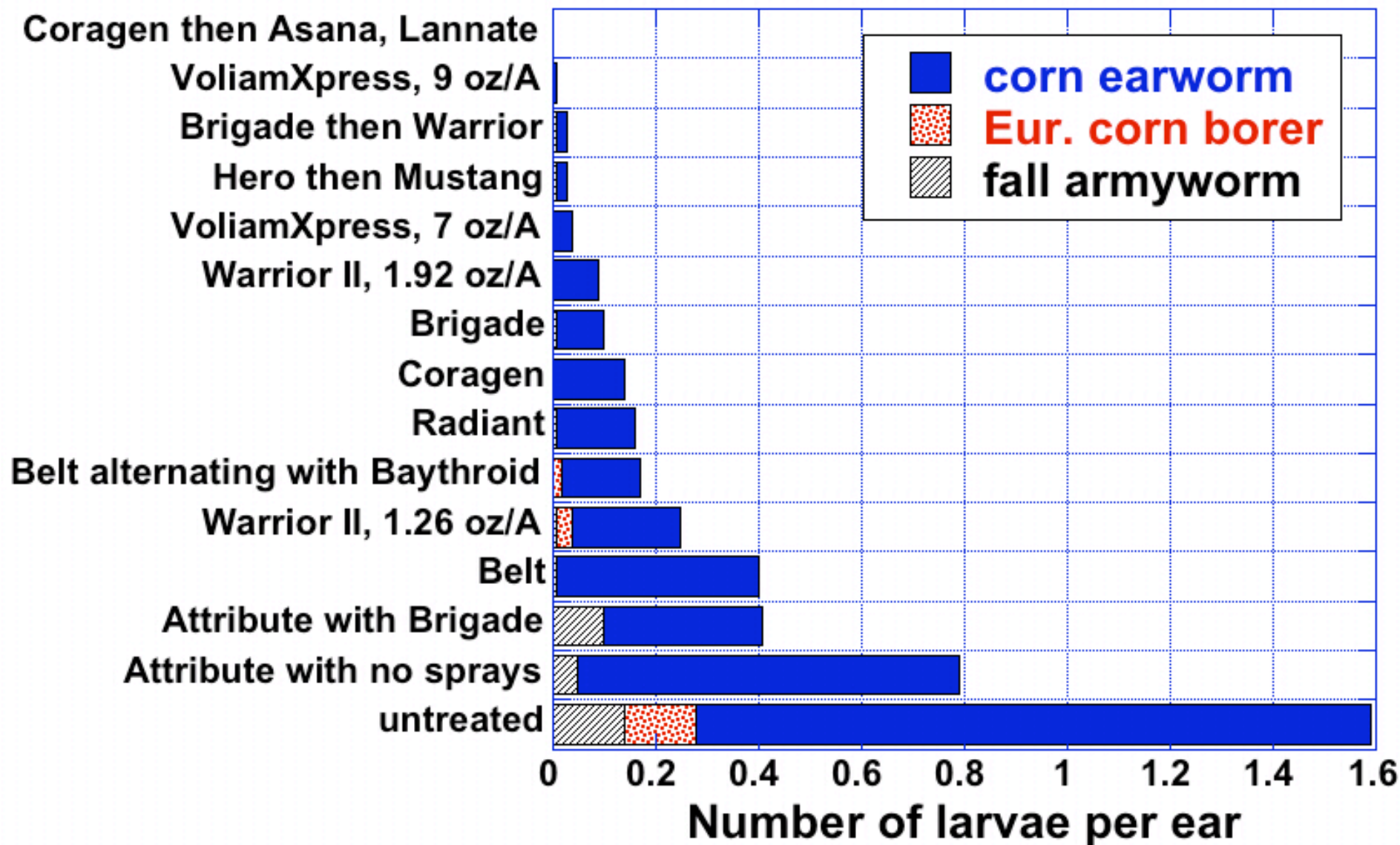
1. Transgenic B.T. corn ('Attribute 0805'), **no** insecticide sprays
 2. Transgenic B.T. corn ('Attribute 0805') + **Brigade** 6.4 oz/A in last 2 sprays
- Isoline 'Providence' used in all other treatments

Evaluation

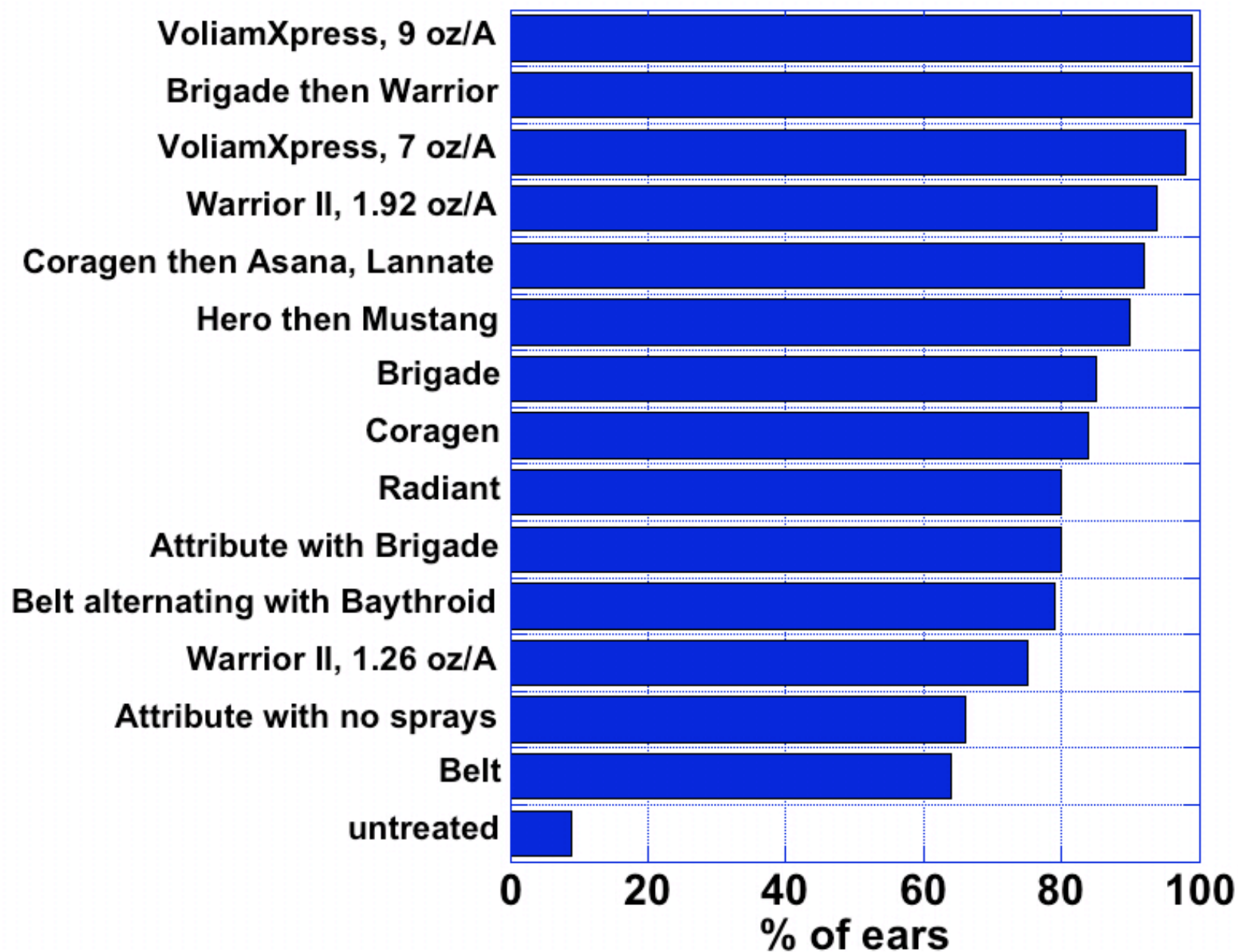
- 20 ears/plot
- 1200 ears total!



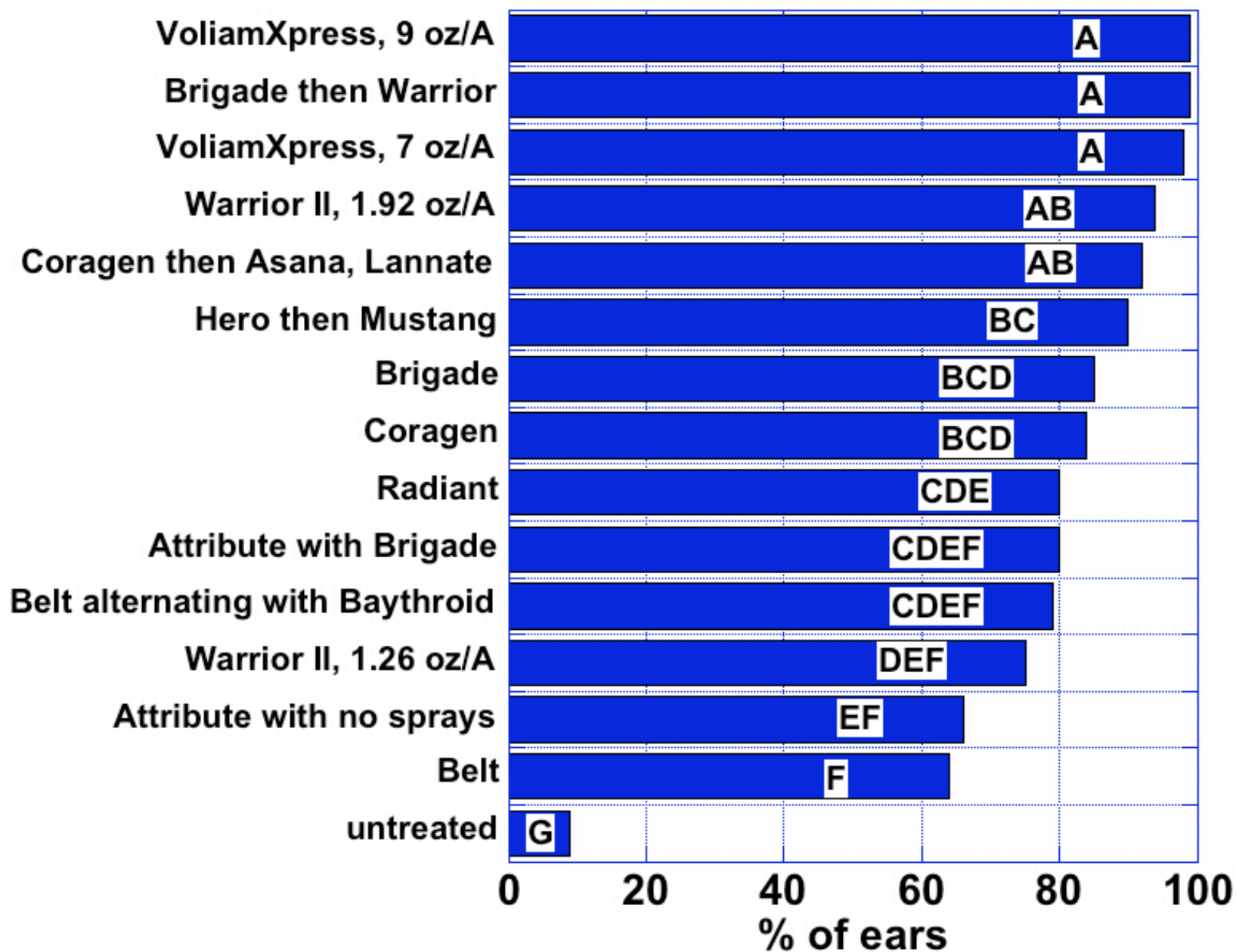
Sweet corn 2009: species of caterpillars



Sweet corn 2009: ears with no kernels damaged by insects

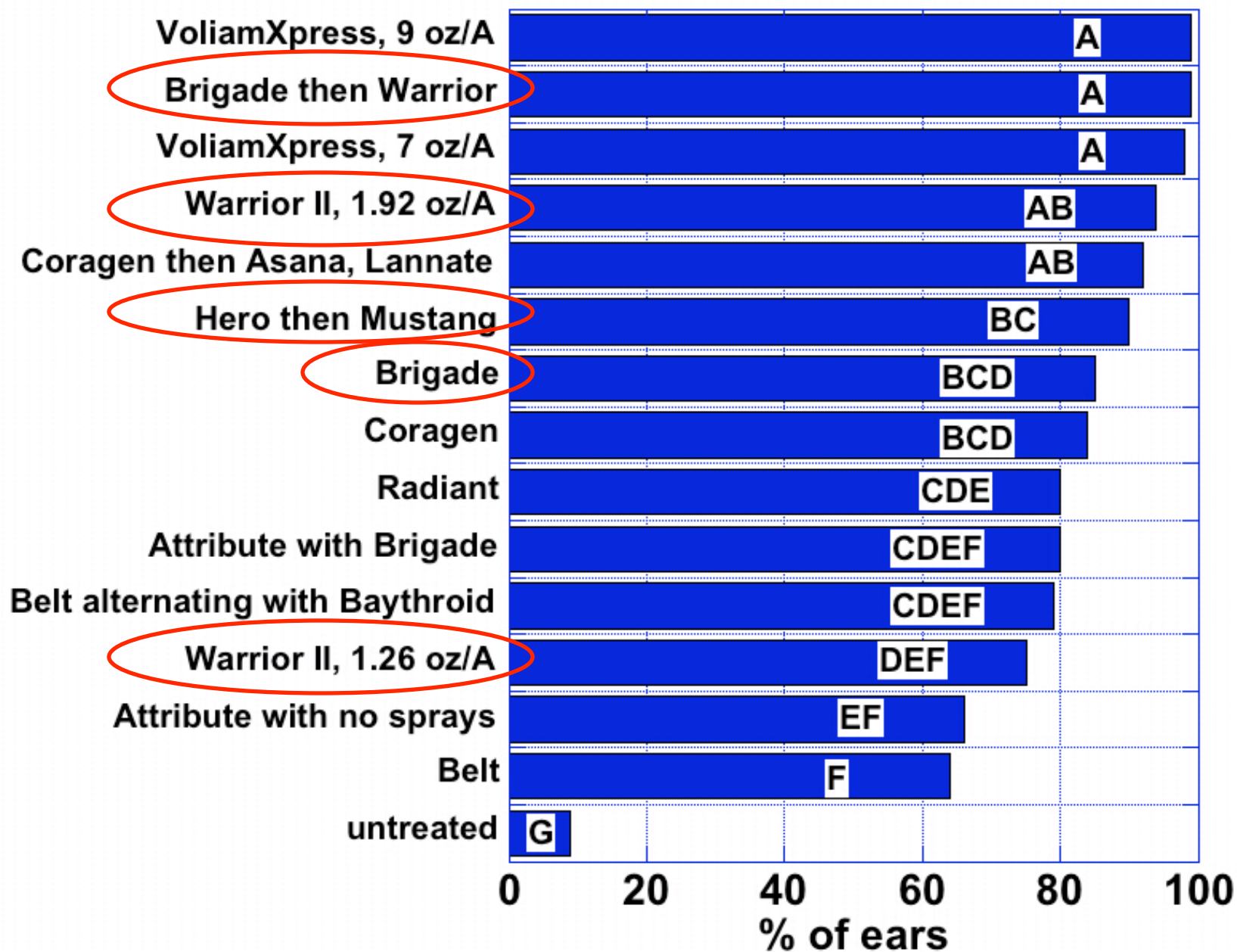


Sweet corn 2009: ears with no kernels damaged by insects



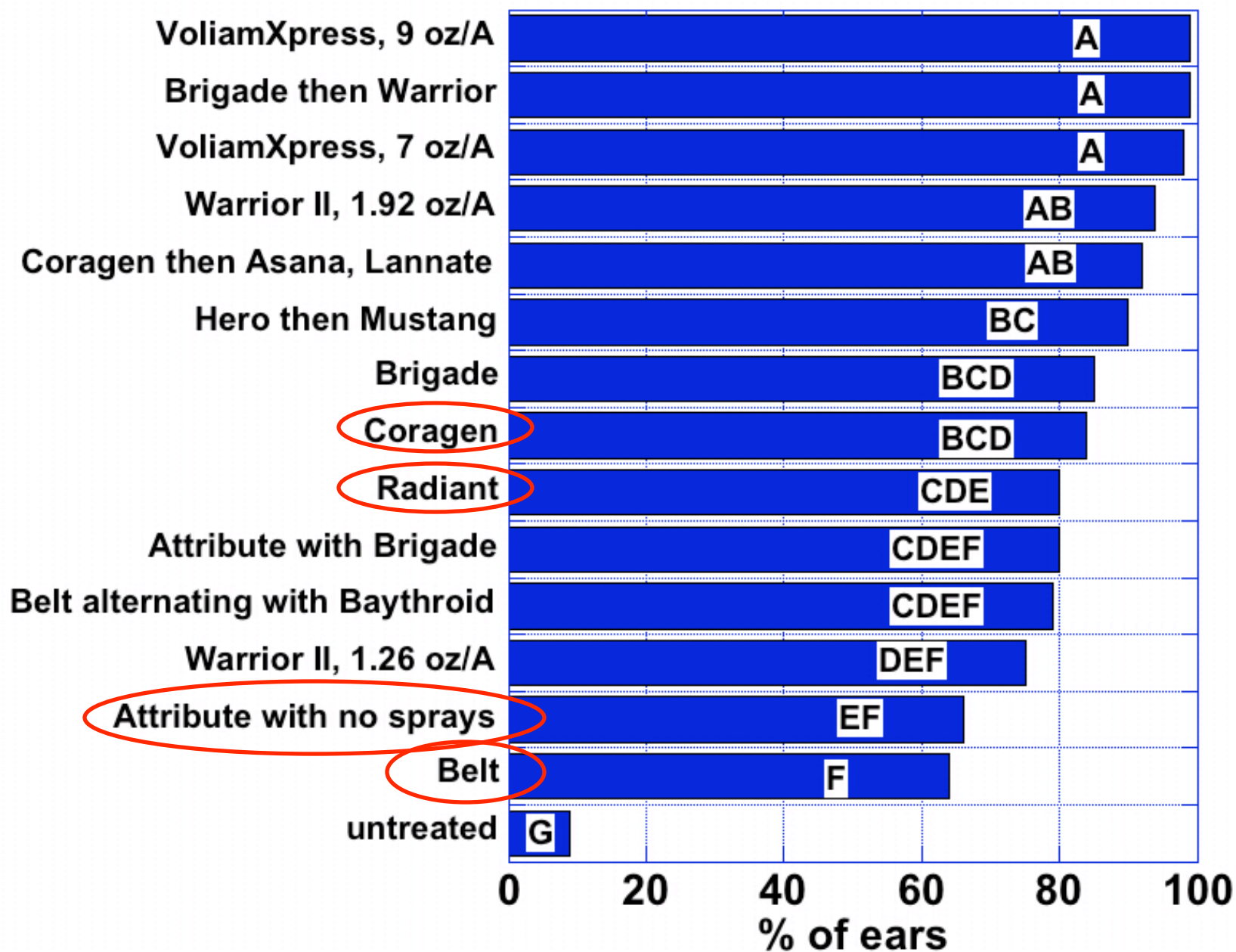
pyrethroids

Sweet corn 2009: ears with no kernels damaged by insects



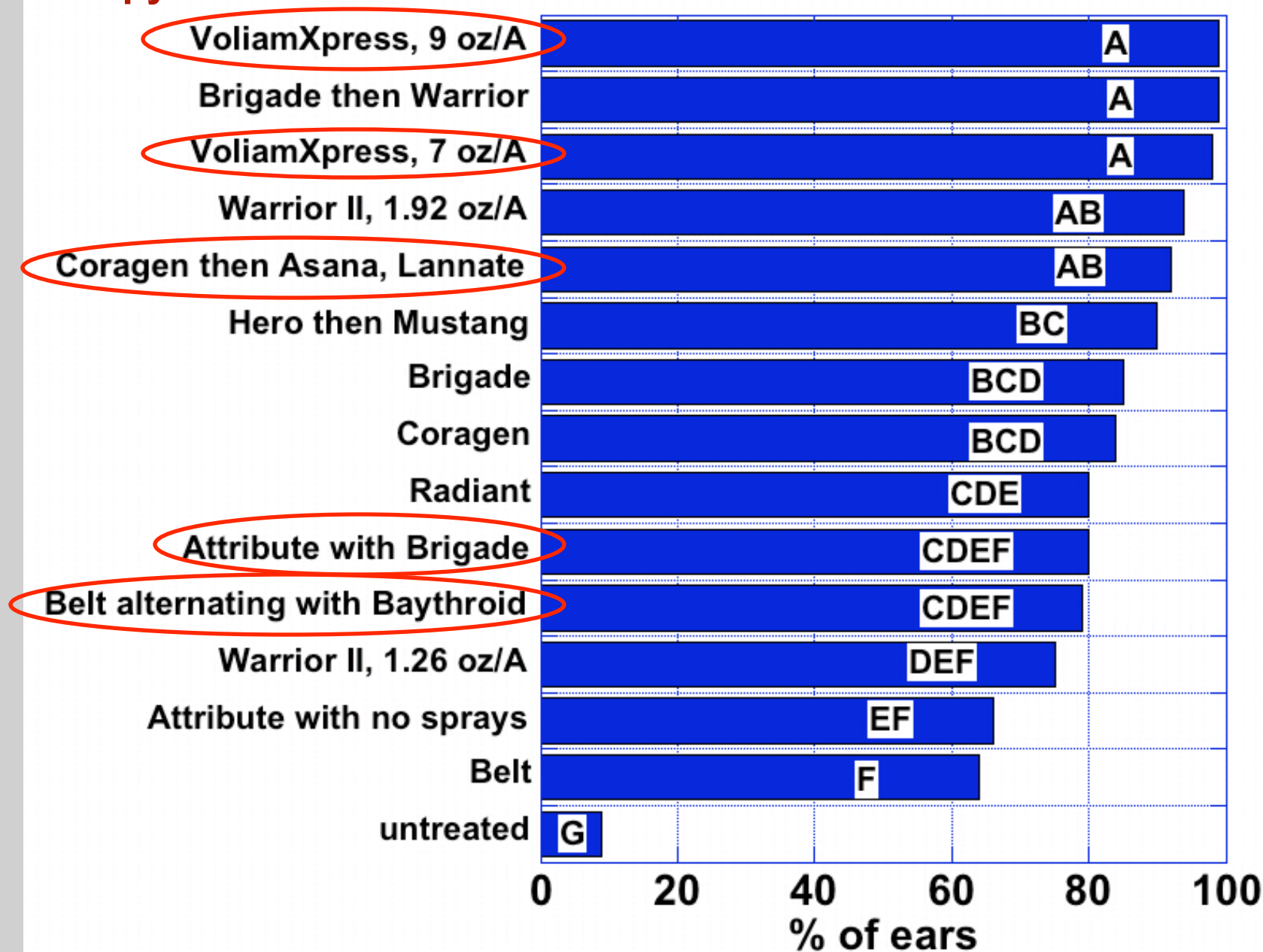
Non-pyrethroids

Sweet corn 2009: ears with no kernels damaged by insects

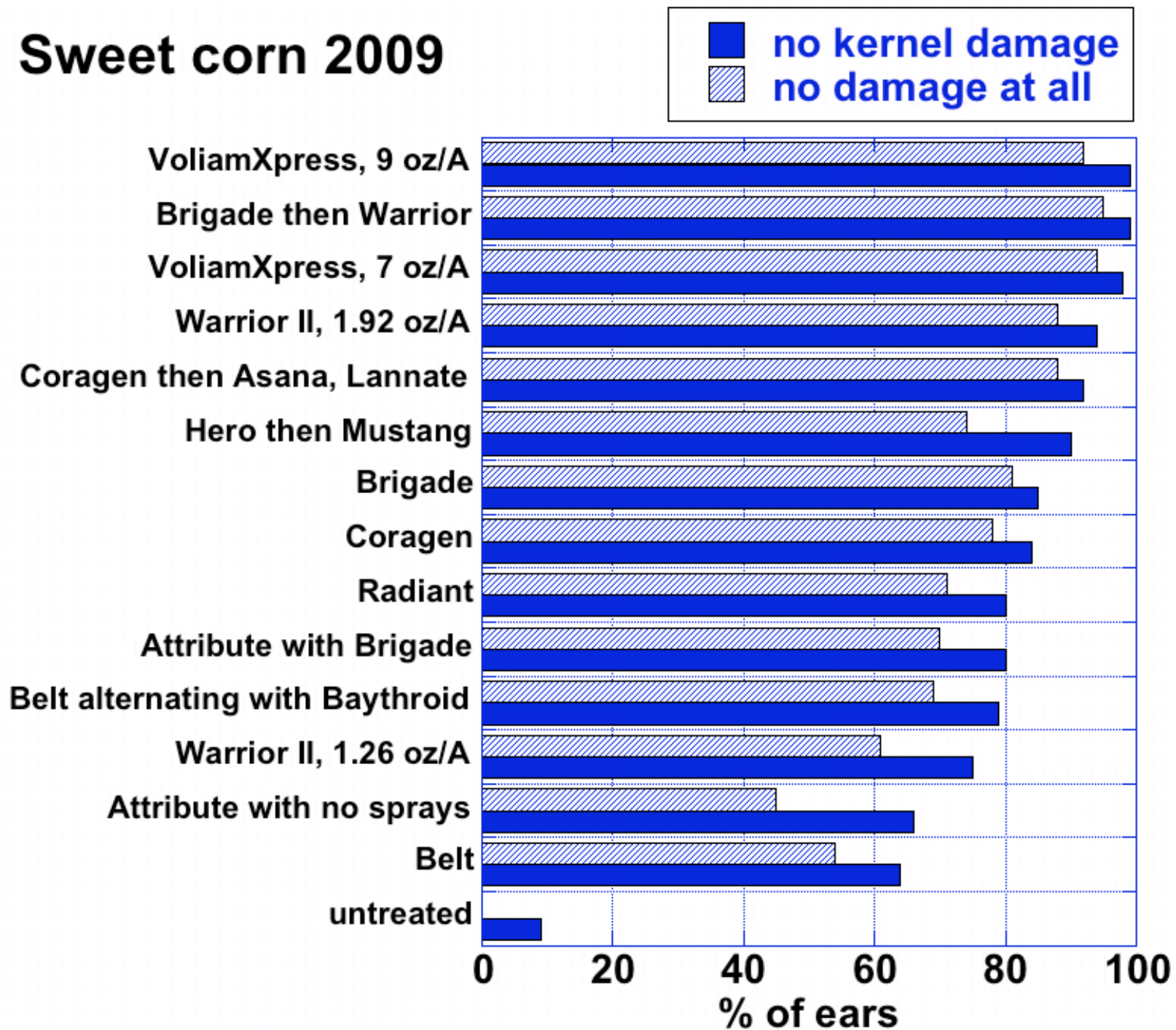


**Combo pyrethroids
and non-pyrethroids**

**Sweet corn 2009:
ears with no kernels damaged by insects**

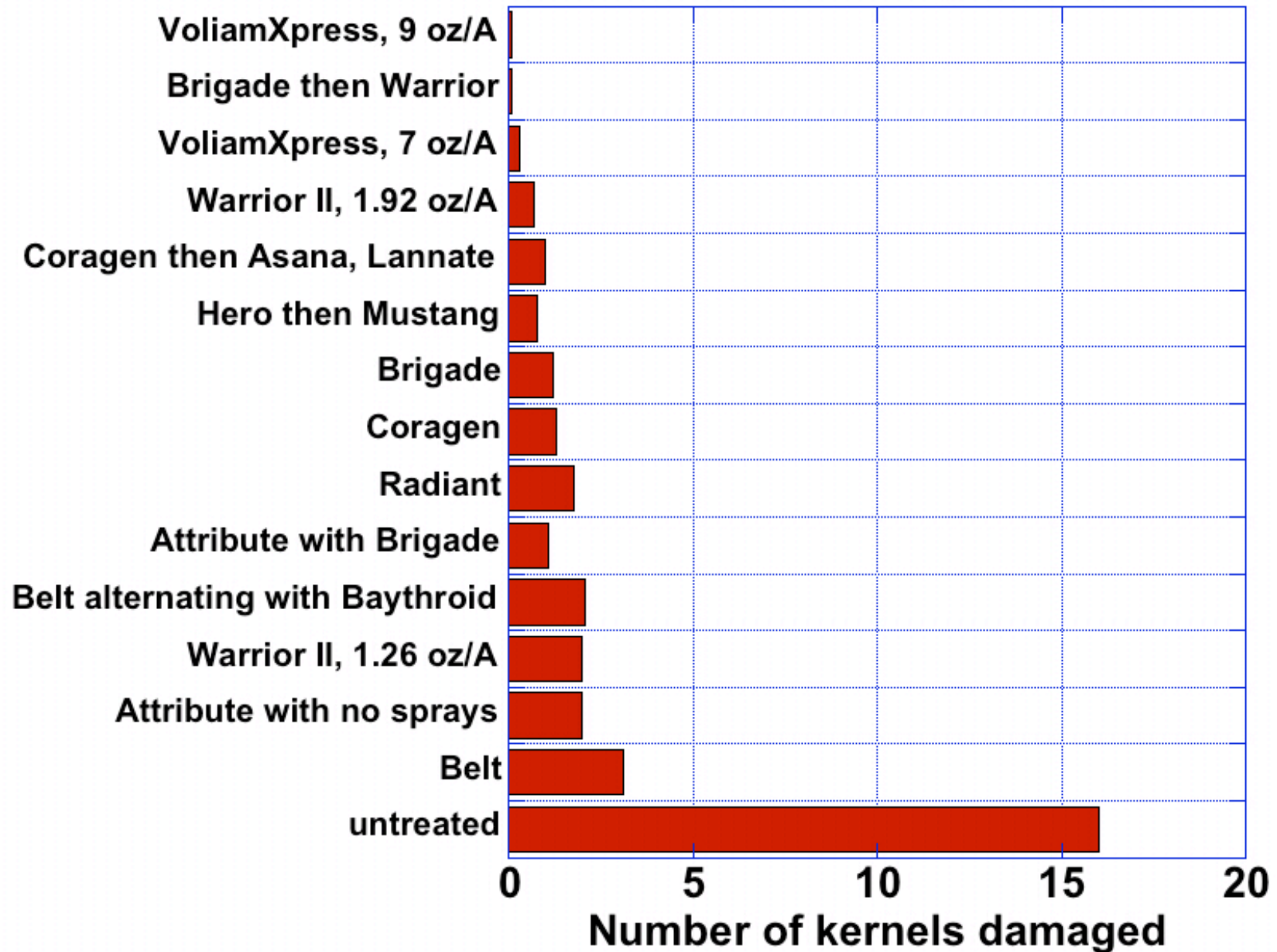


Sweet corn 2009



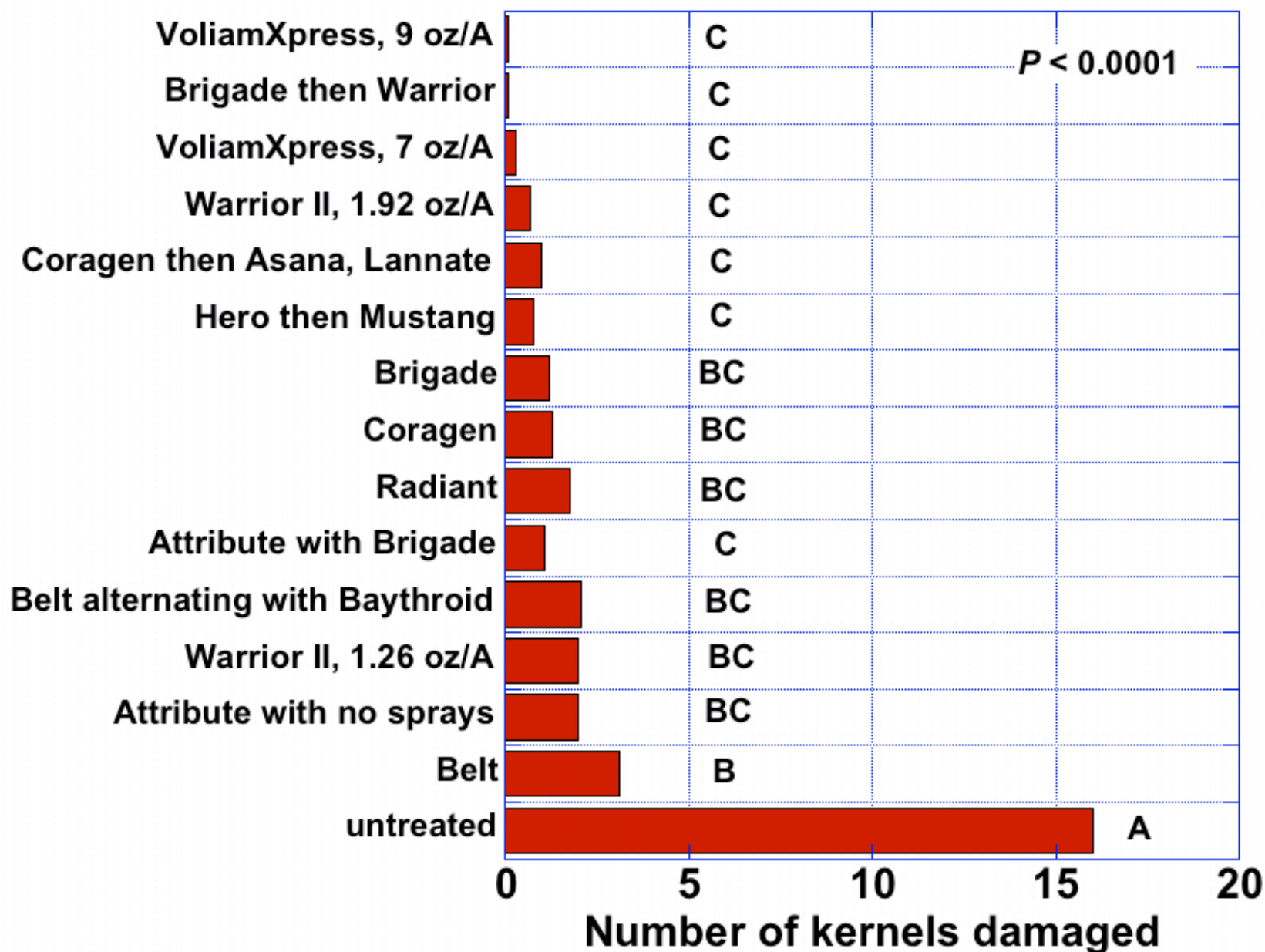
Sweet corn 2009

number of kernels damaged per ear

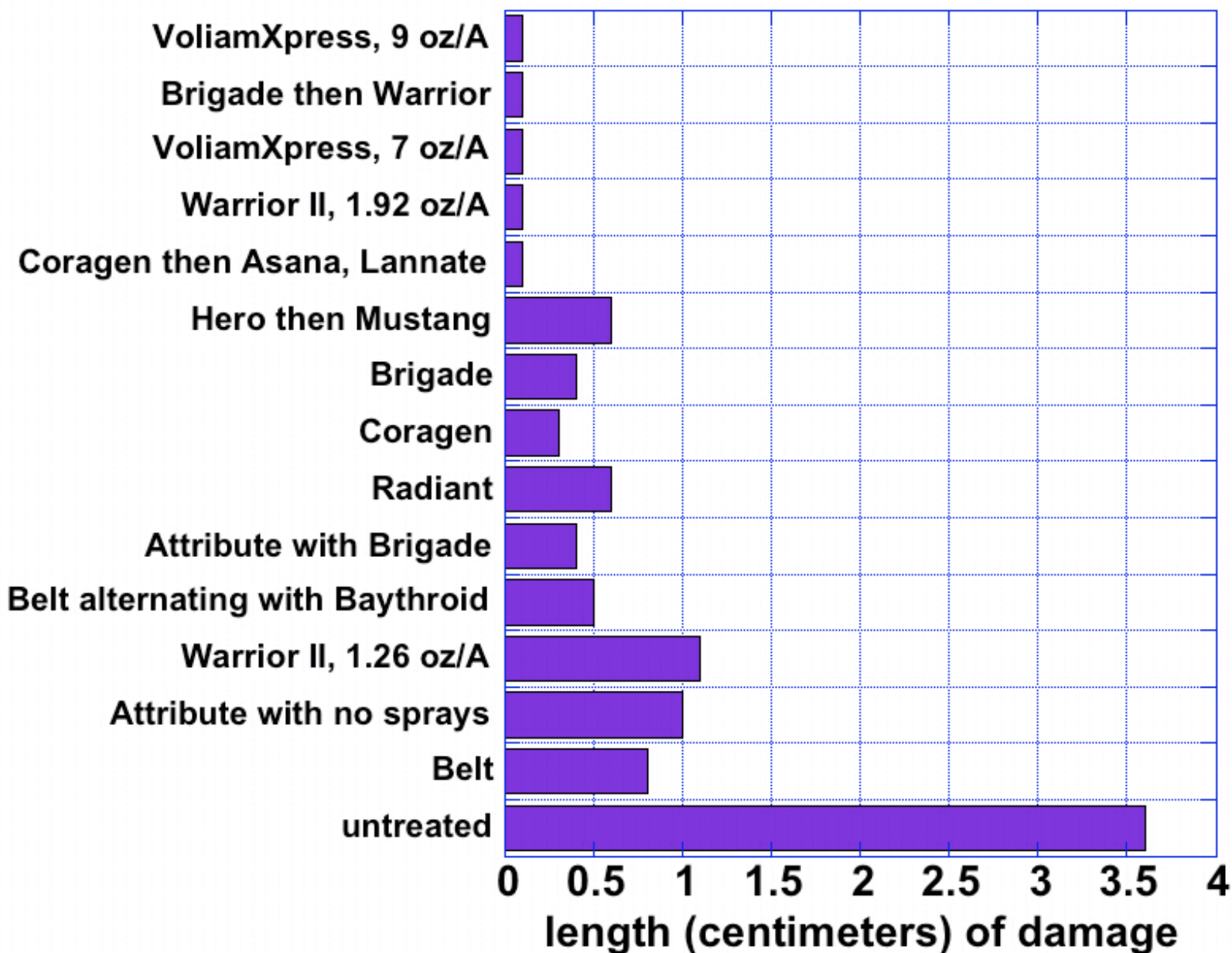


Sweet corn 2009

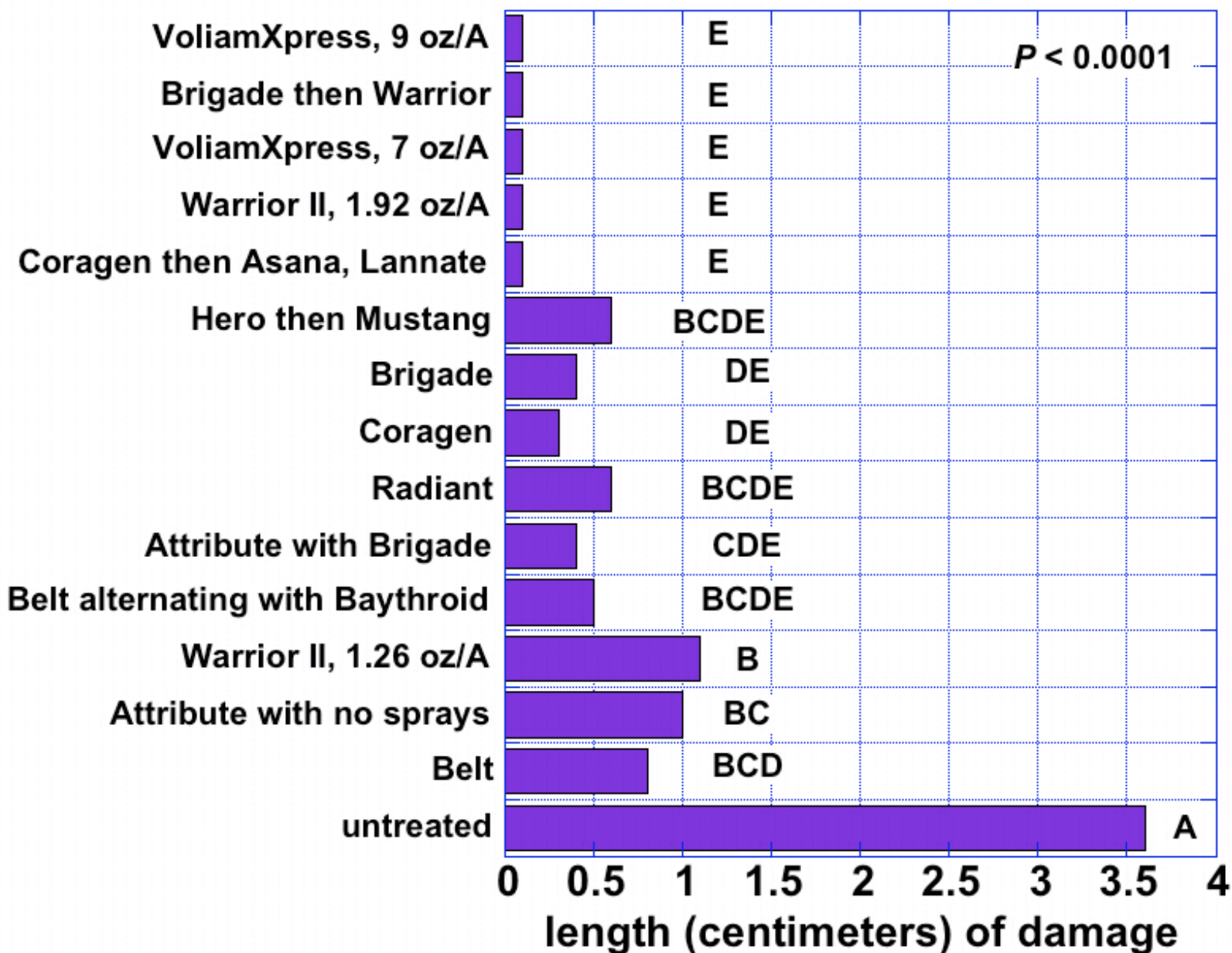
number of kernels damaged per ear



Sweet corn 2009: length of kernel damage from ear tip

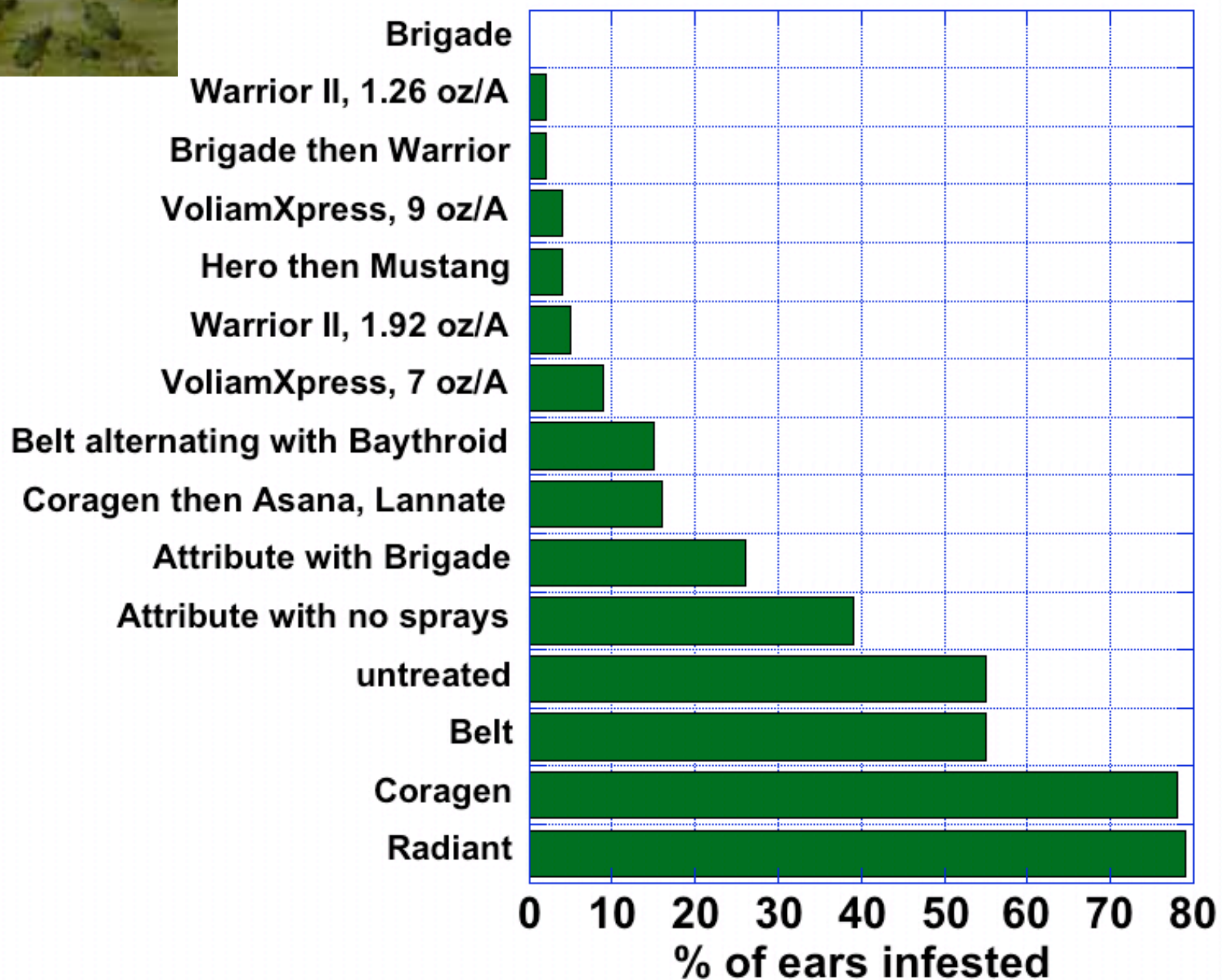


Sweet corn 2009: length of kernel damage from ear tip



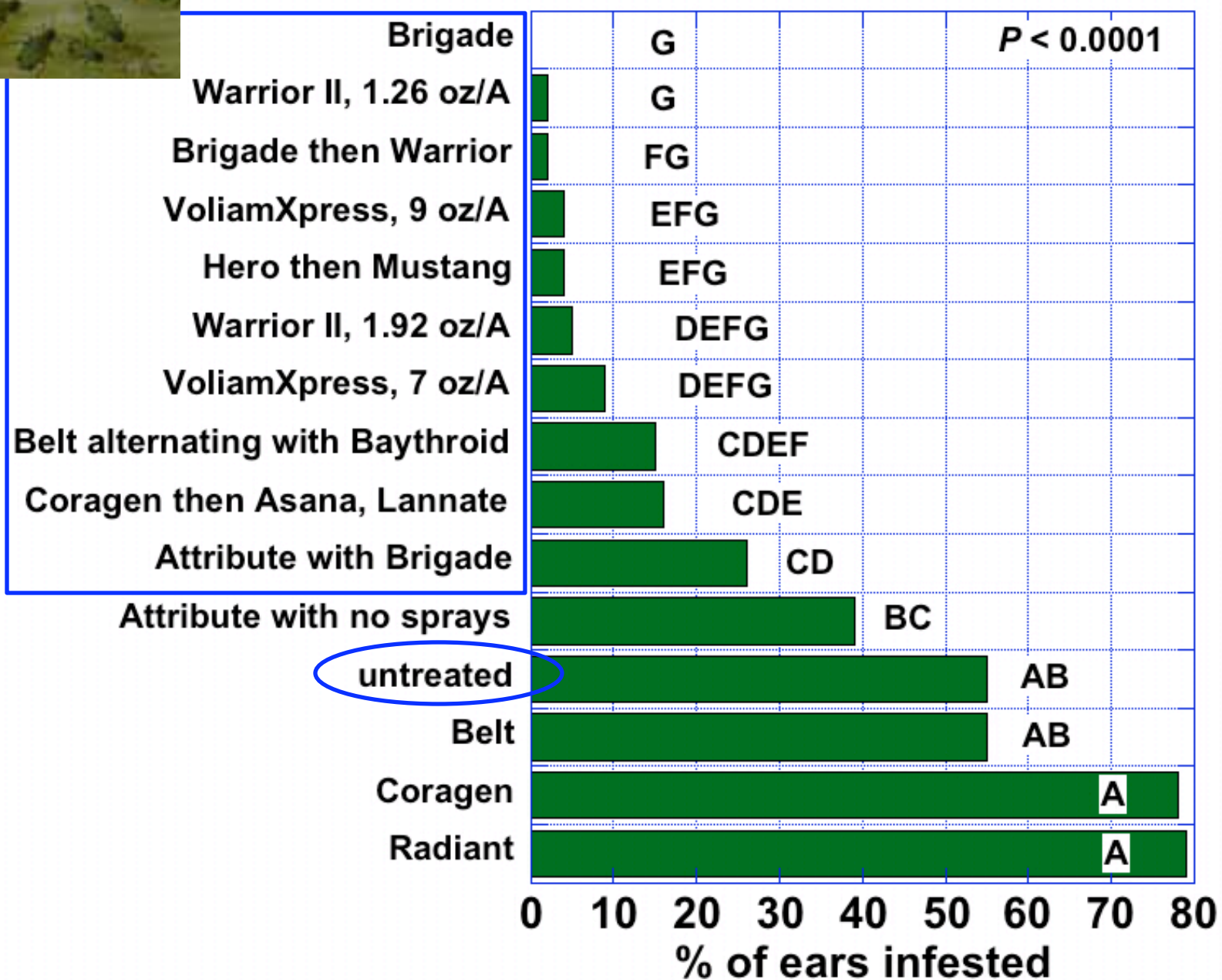


Sweet corn 2009: Corn leaf aphid in husks at harvest

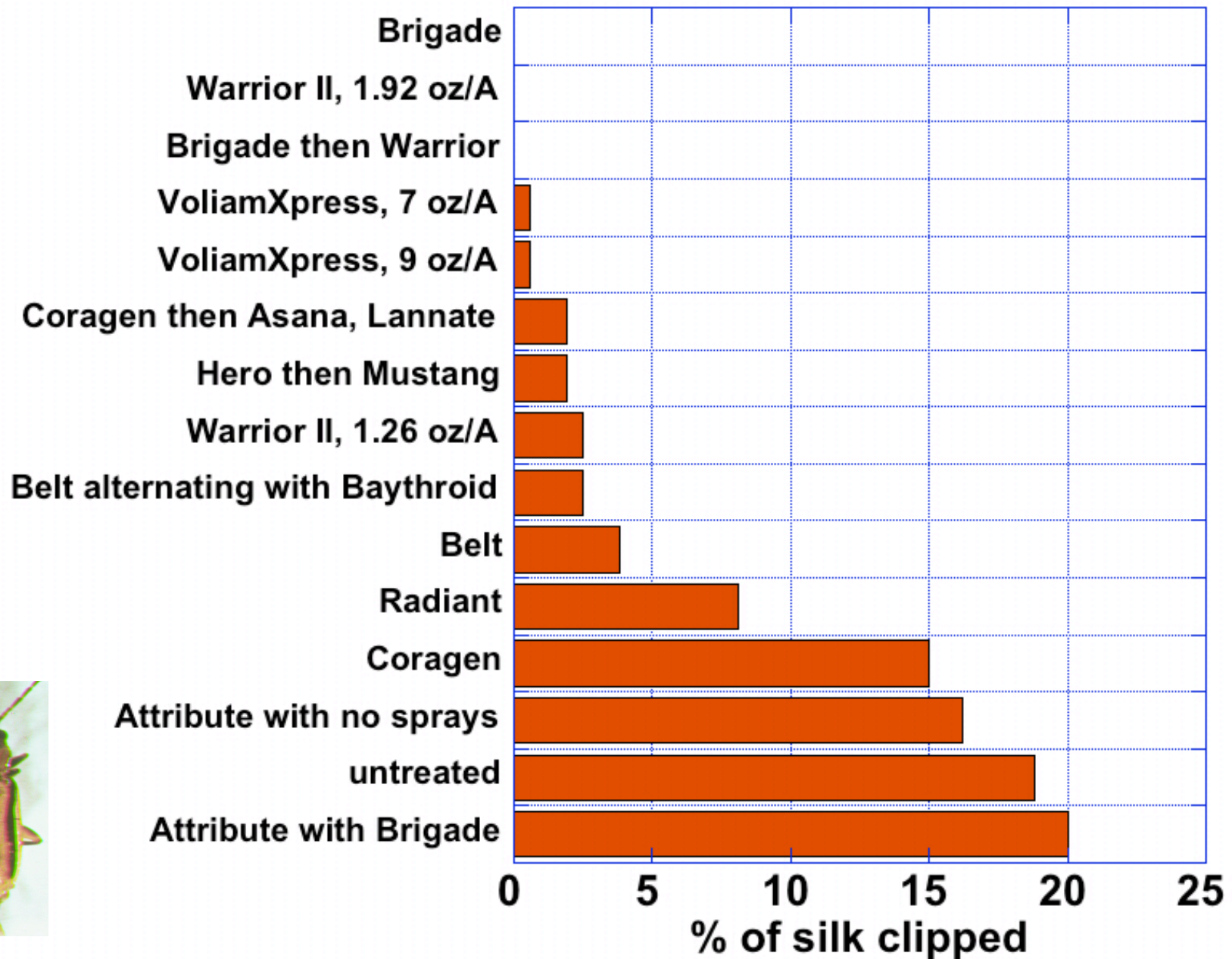




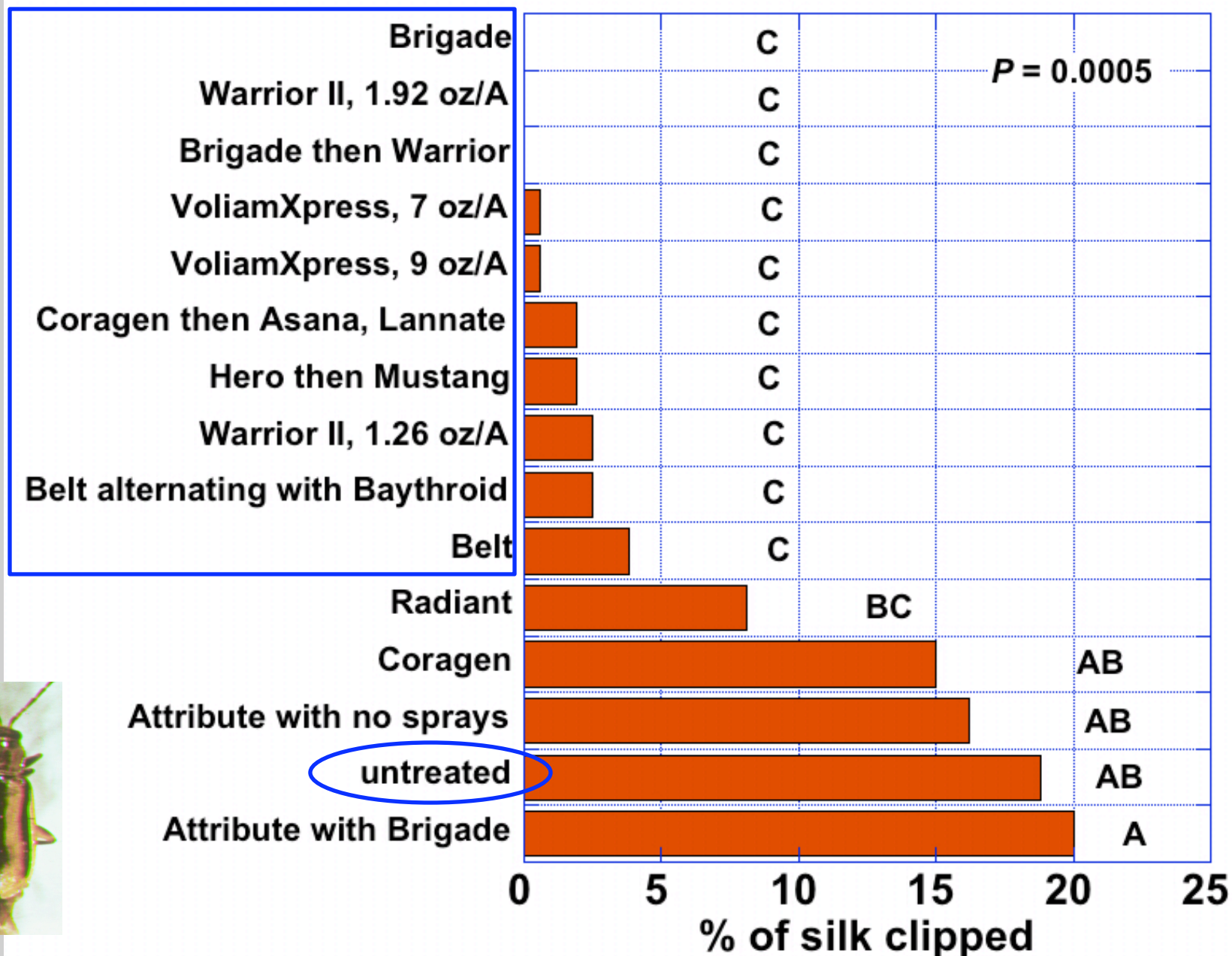
Sweet corn 2009: Corn leaf aphid in husks at harvest



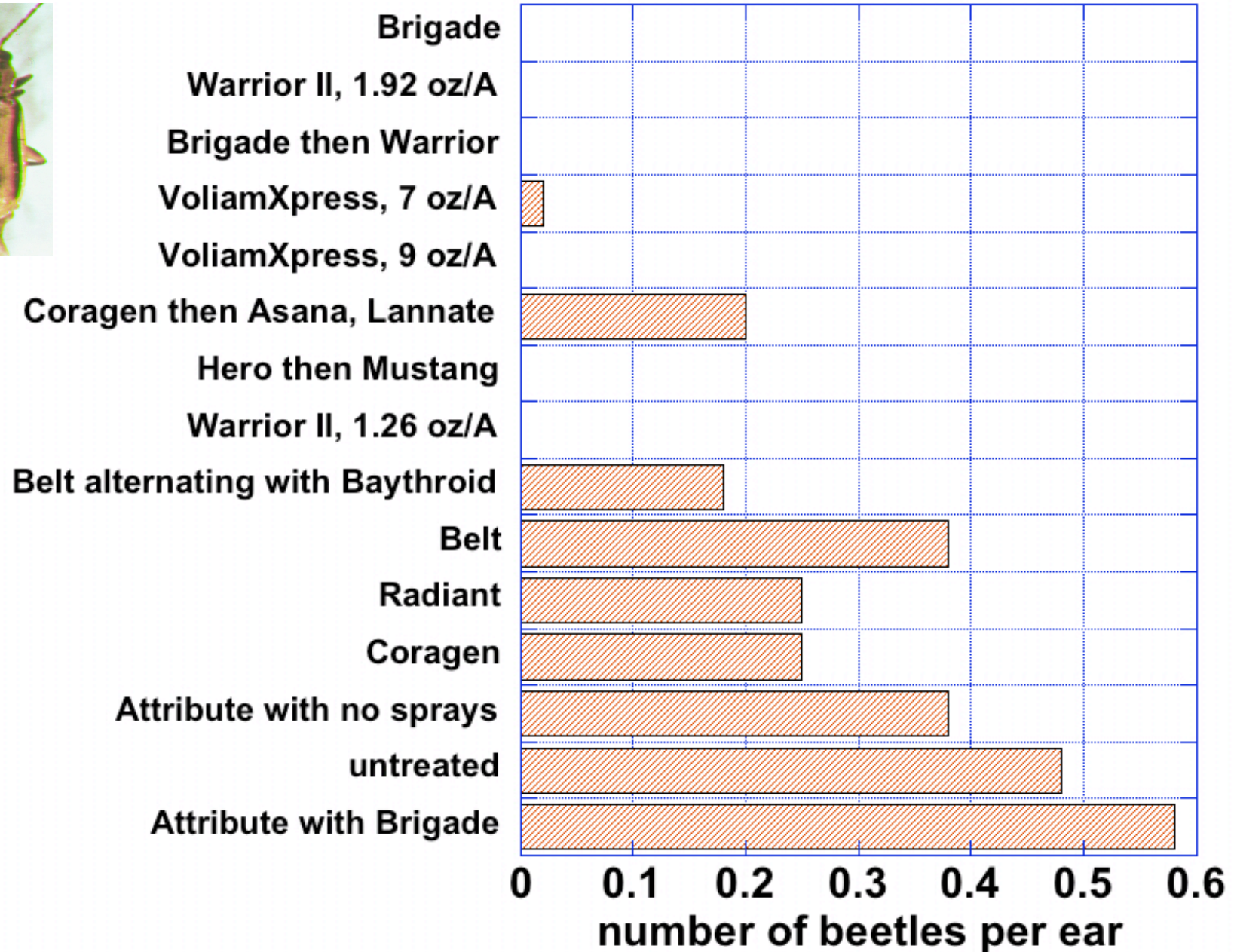
**Sweet corn 2009:
silk clipping on 3 Sept., before 4th spray**



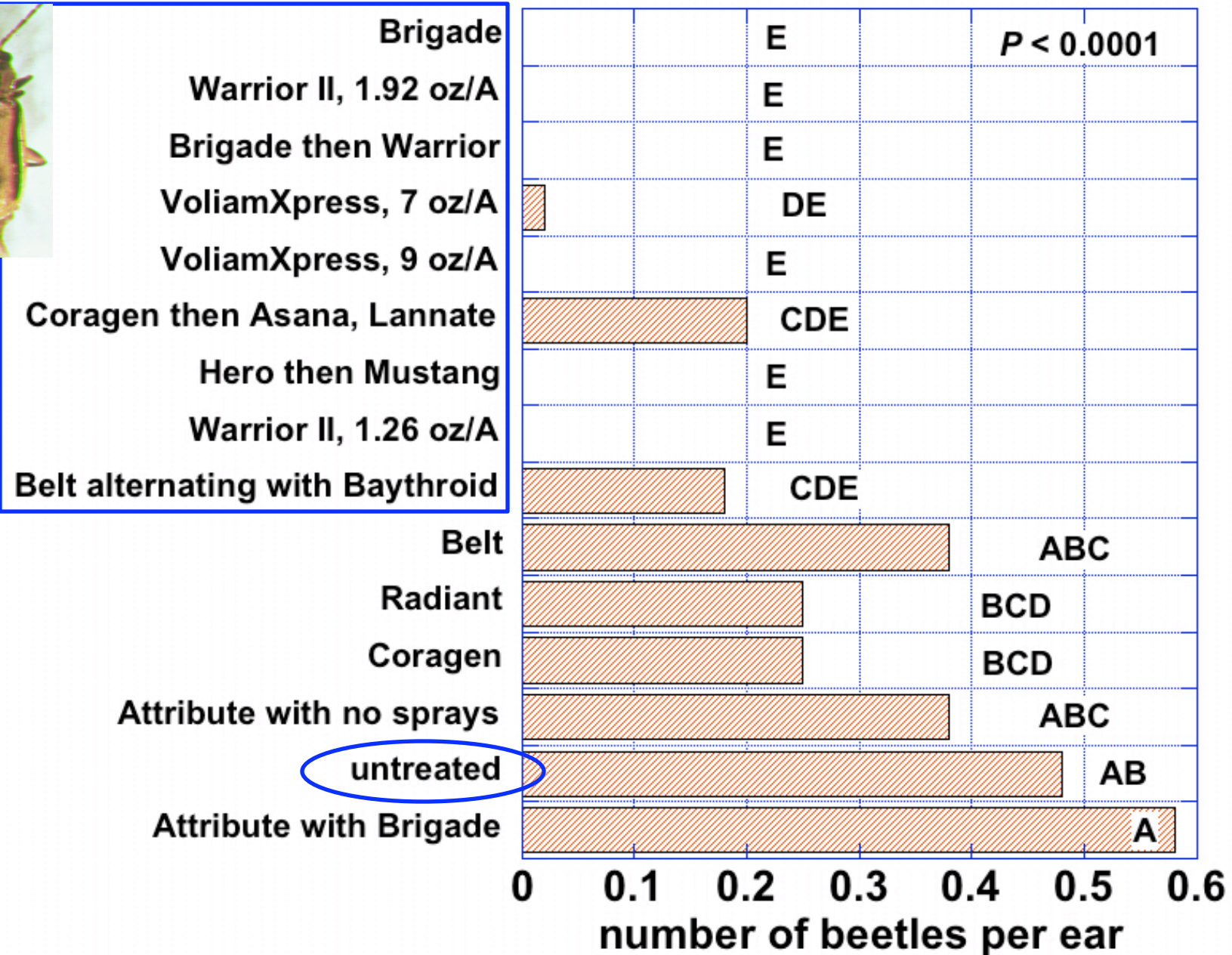
Sweet corn 2009: silk clipping on 3 Sept., before 4th spray



Sweet corn 2009:
Number of beetles per ear on 27 August, before 2nd spray



Sweet corn 2009: Number of beetles per ear on 27 August, before 2nd spray



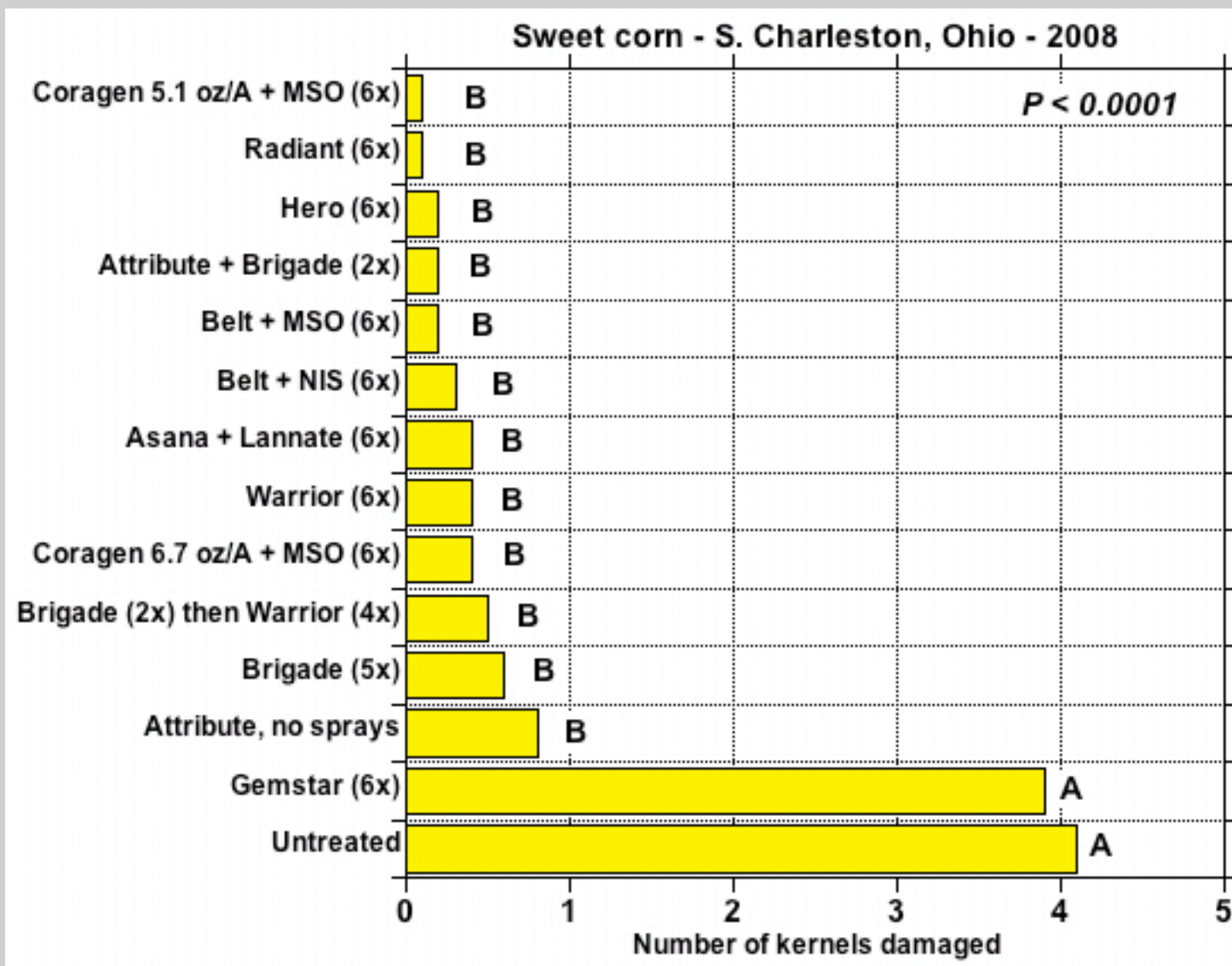
Conclusions, 2009

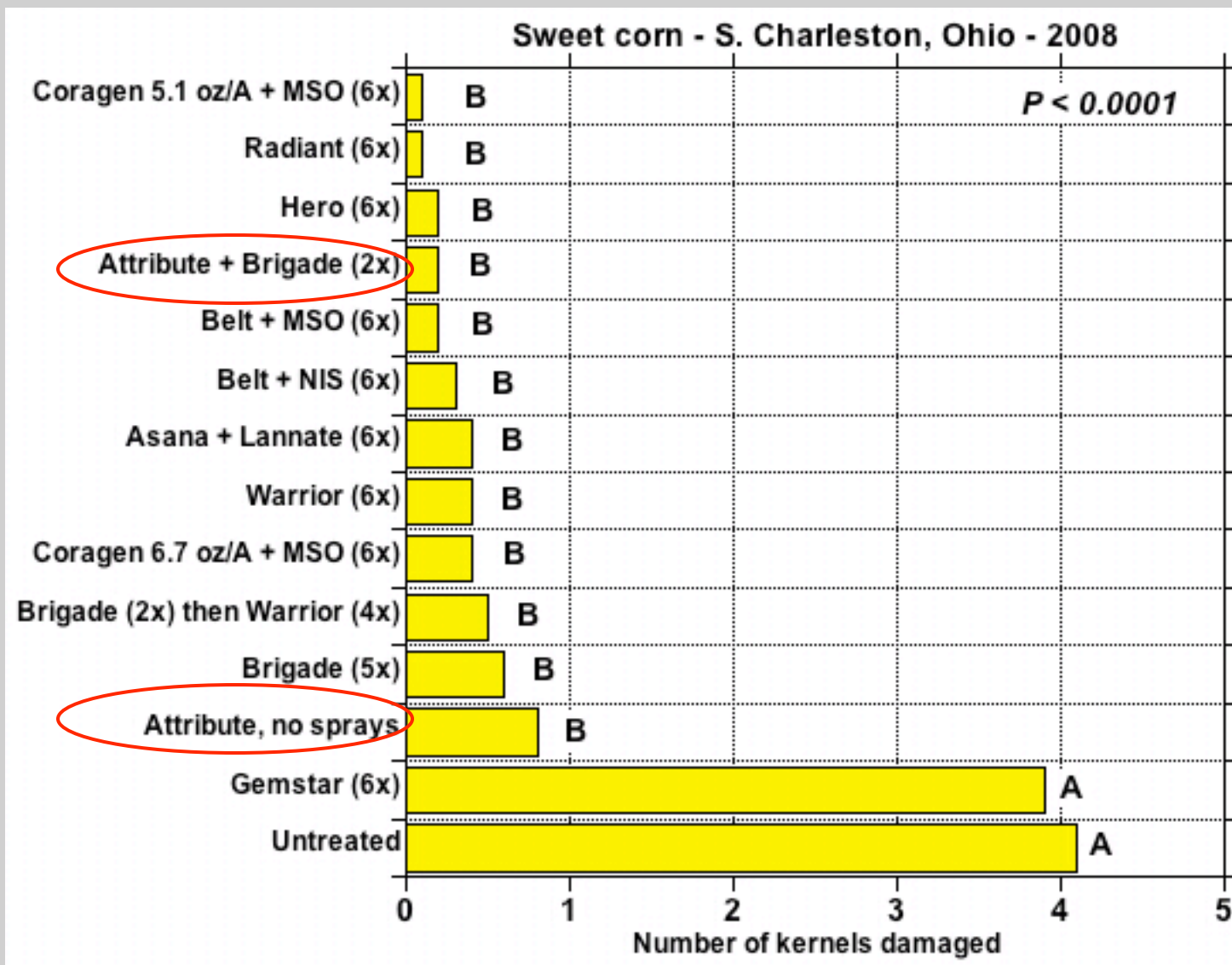
- **3 new insecticides**
 - Provide good control
 - Kill caterpillars only
 - Must combine with other materials for aphid and beetle control
- **Pyrethroids working quite well if max rates used**

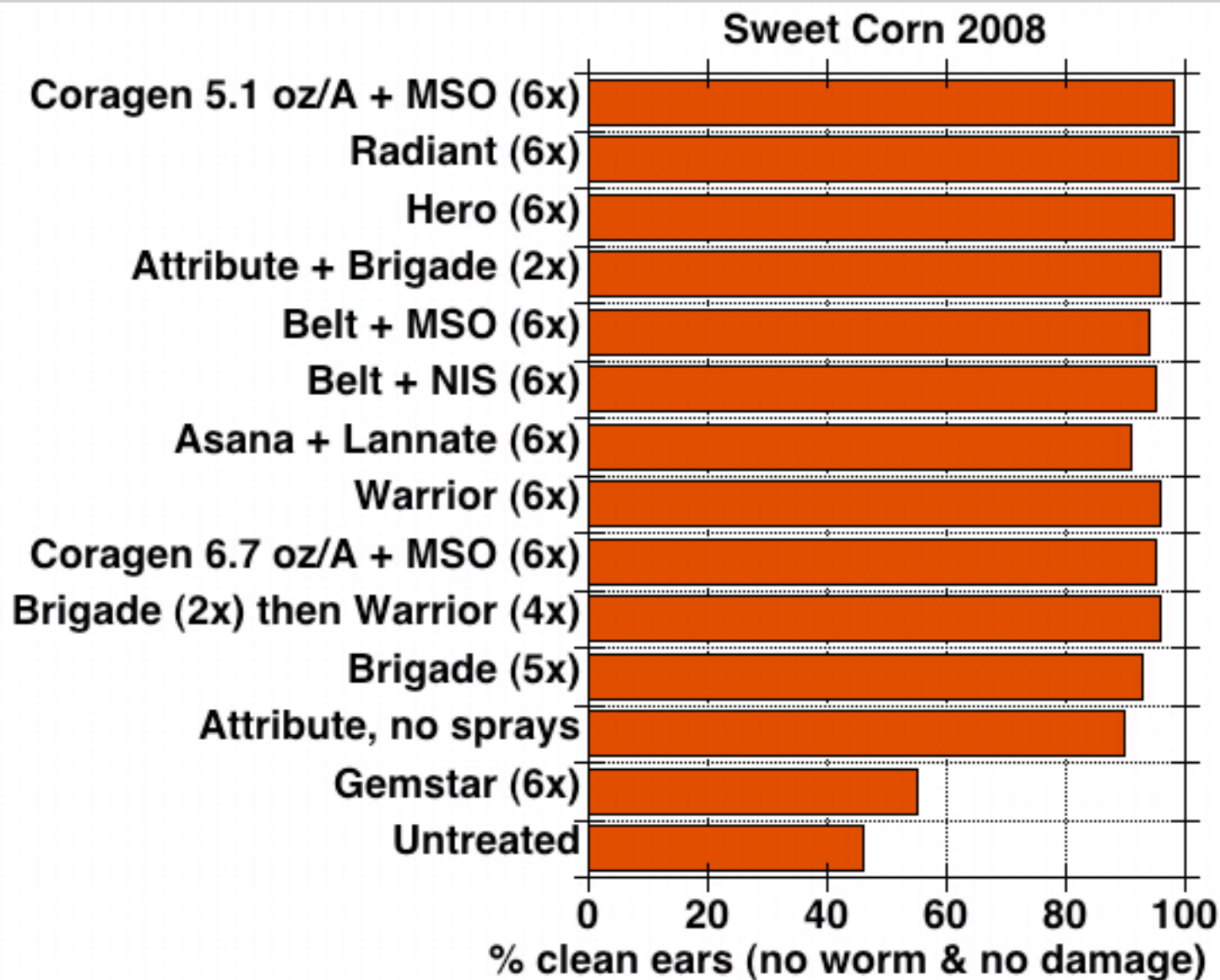
Sweet corn trial, 2008

- Corn earworm targeted
- Eur. corn borer most abundant
- Included 'Gemstar' virus spray





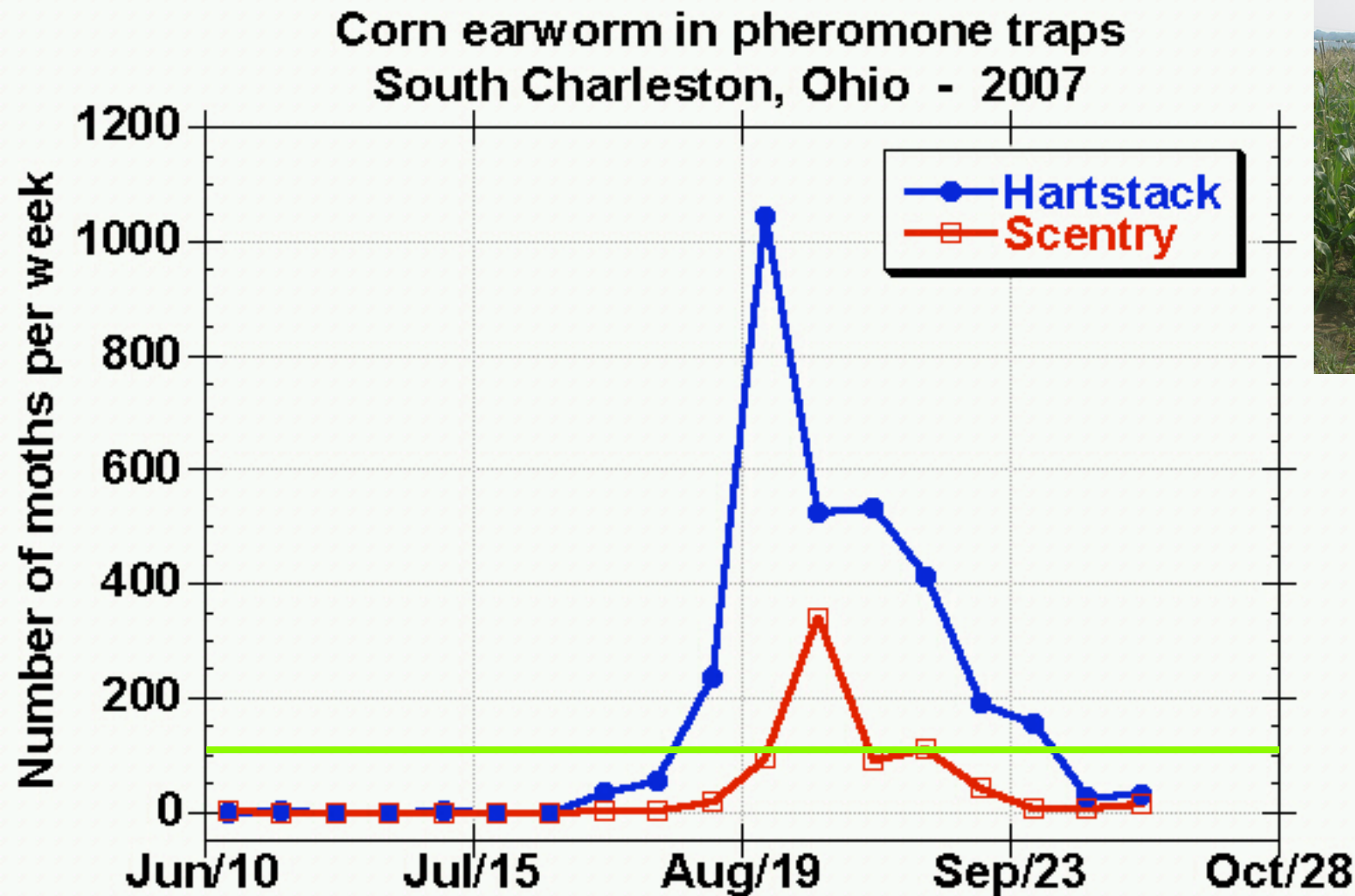




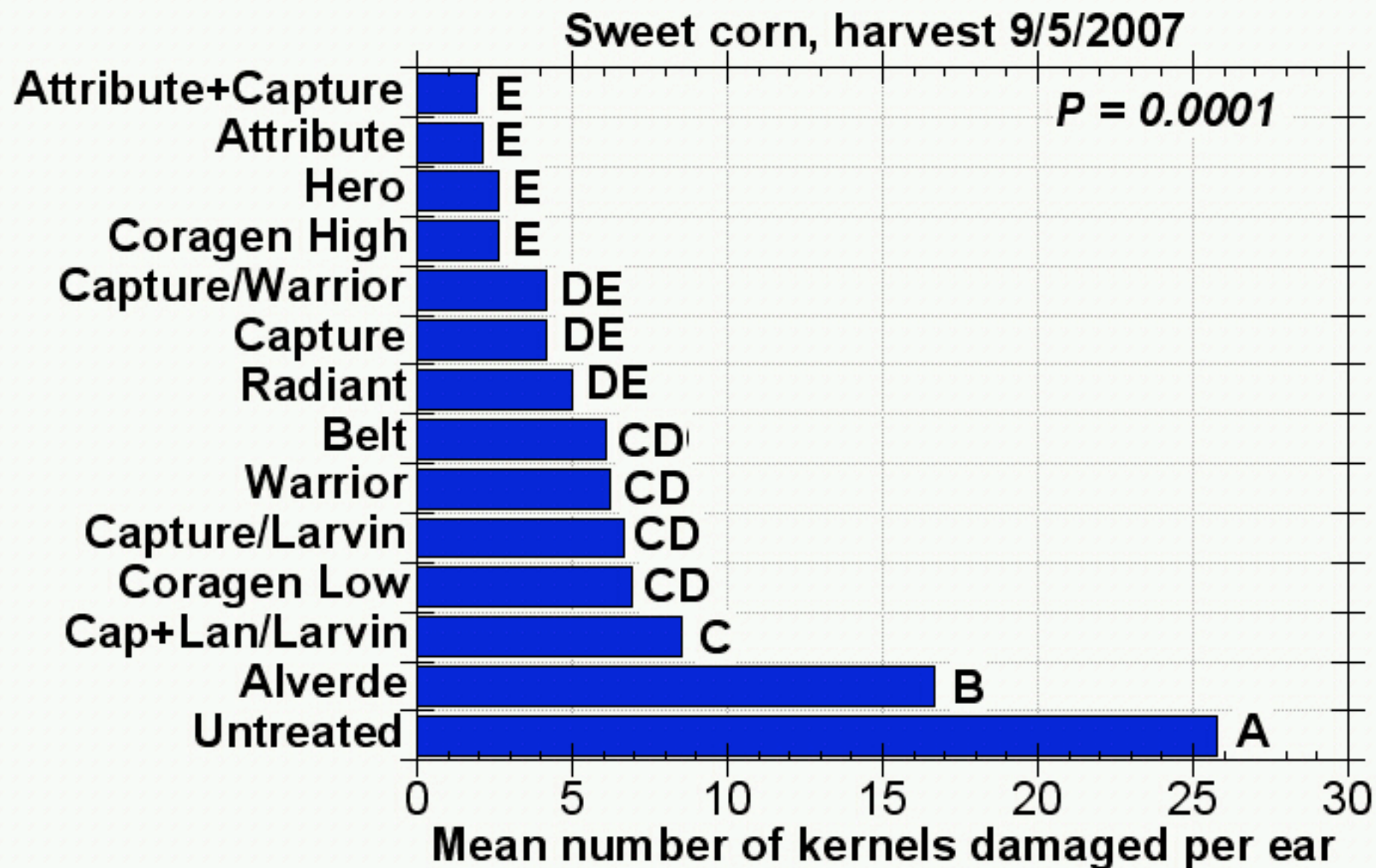
Conclusions, 2008

- **B.t. sweet corn: excellent when supplemented with 2 sprays**
- **New a.i.s good:**
 - **Coragen (pending)**
 - **Radiant (registered)**
 - **Belt (registered)**
- **Among pyrethroids, Hero best**

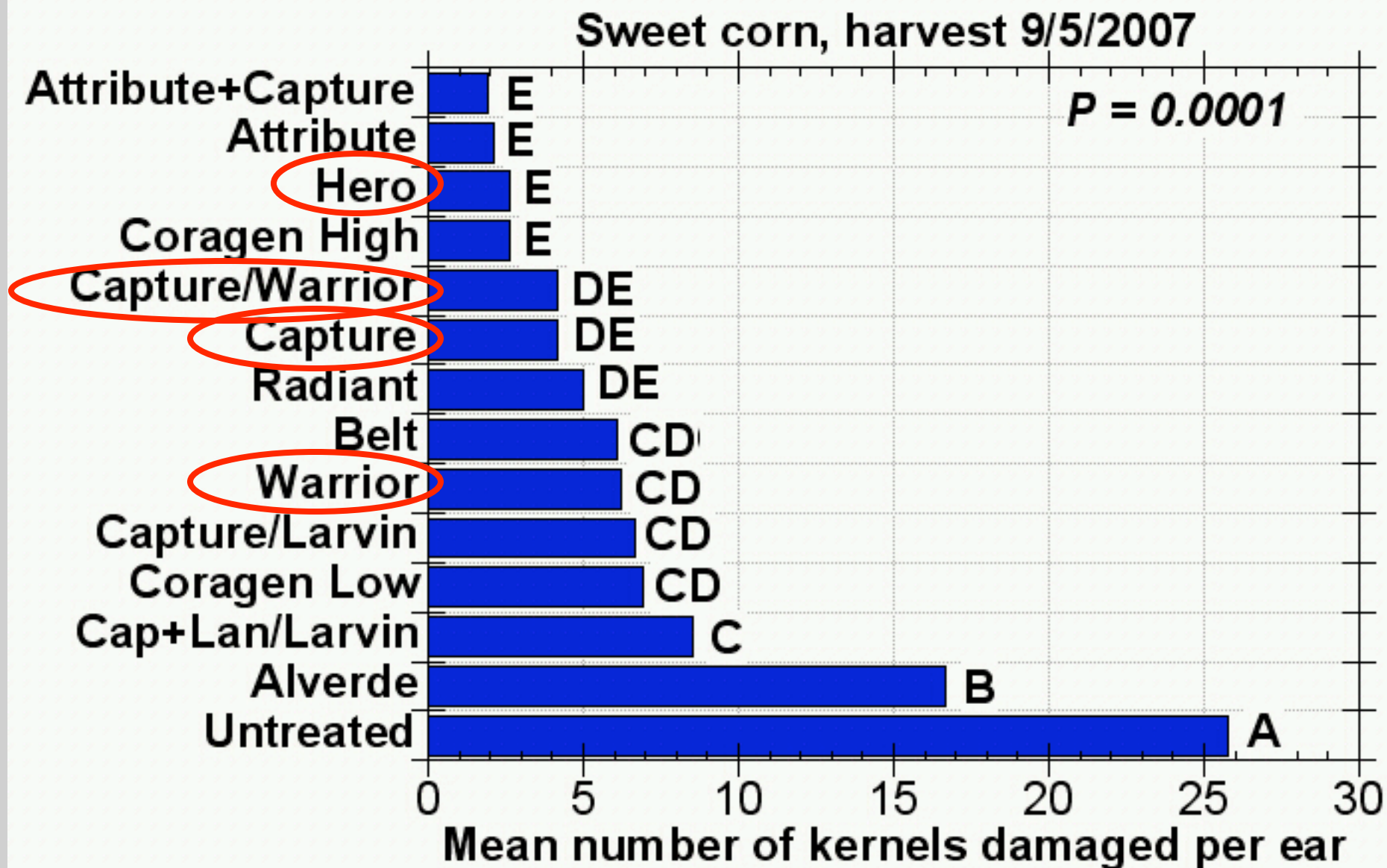
Corn earworm trial, 2007



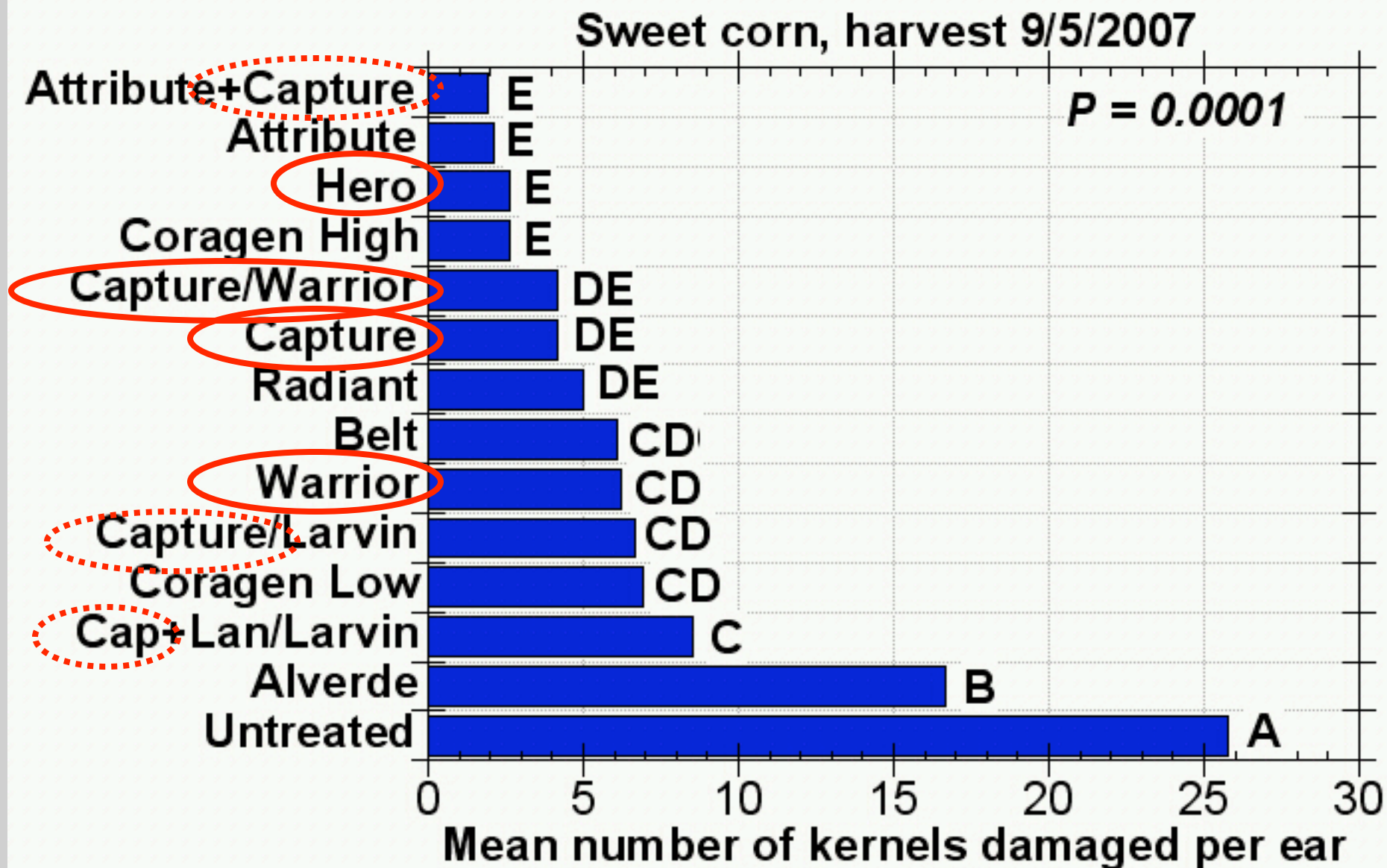
Sweet corn: after 6 sprays at 3-day interval



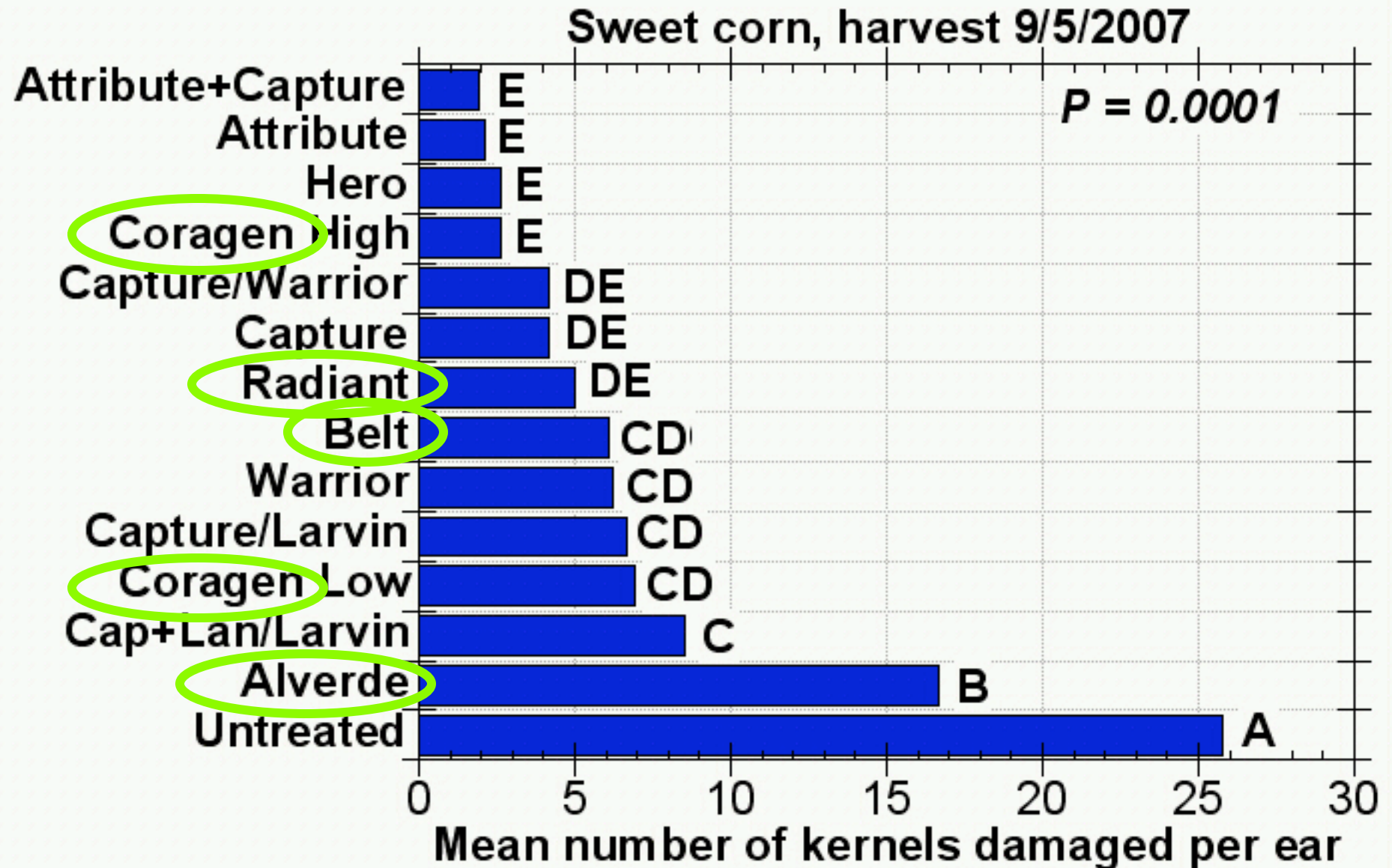
pyrethroids



pyrethroids with non-pyrethroids



Experimental products



Conclusions from 3 years of field trial data

- **Relief that pyrethoids still ok**
 - but max rates needed
- **Relief that new a.i.s now available**

Conclusions from 3 years of field trial data

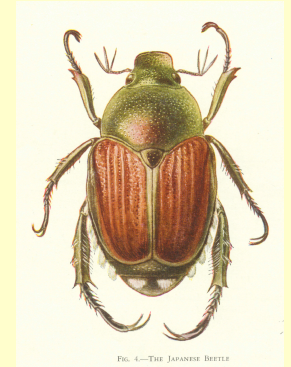
- **Relief that pyrethroids still ok**
 - but max rates needed
- **Relief that new a.i.s now available**
- **Concern about variability in performance of new a.i.s**
 - but whole-field better than small plot
- **Worry about whether efficacy of pyrethroids will suddenly drop**

The end

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**