Sugarcane Resistance to the Sugarcane Aphid- Insights on Biochemical Bases of Resistance

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Aphids in Louisiana Sugarcane

Sugarcane Aphid (SA)

Yellow sugarcane aphid (YSA)

Sugarcane Aphid- *Melanaphis sacchari*

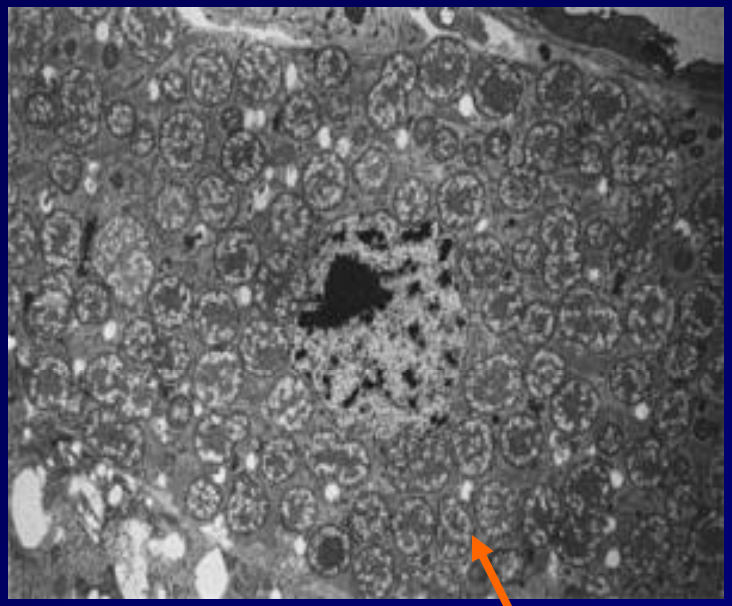
- No visible feeding signs
- Honeydew/black sooty mold
- Virus vector
- In South Africa, 46-78% yield losses
- In Louisiana, 11-14% sugar yield losses due to SCYLV
- Addition of yellow leaf in certification standards for micropropagated seedcane

(Hall and Bennett 1994, Singh et al. 2004, Van den Berg et al. 2001, Grisham et al. 2001 McAllister et al. 2005)

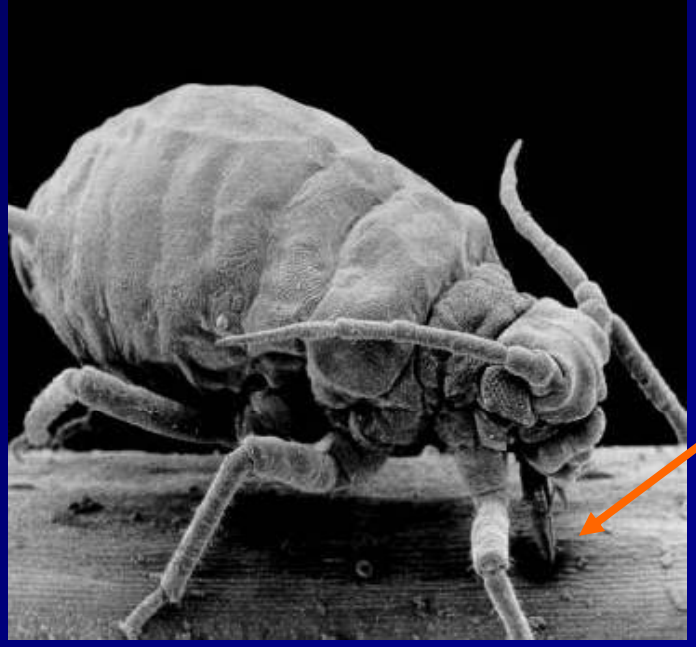
Yellow Sugarcane Aphid- *Sipha flava*

- Reddish stippling on leaves
- Reduced tillering, or leaf death in young plants
- Transmits sugarcane mosaic potyvirus
- Honeydew/sooty mold

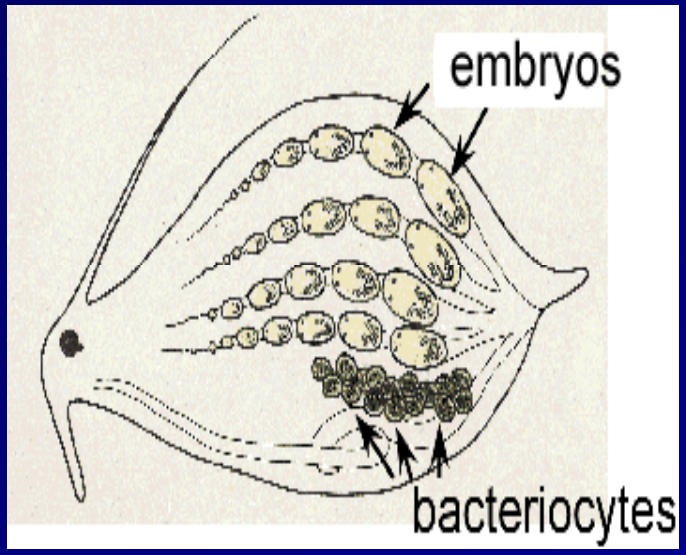
(Hall 2001, Blackman and Eastop 2000, Nuessly and Hentz 2002)

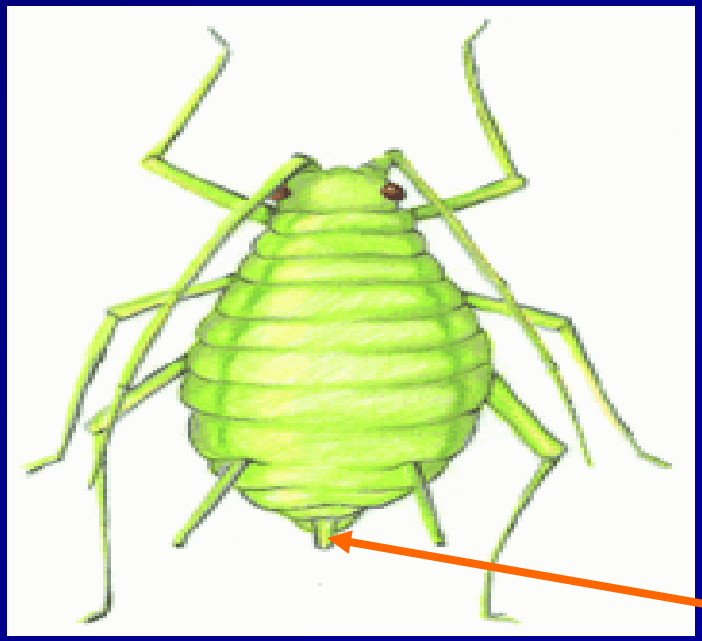


Buchnera



Stylet





Anus

http://images.google.com/images?q=Buchnera

1. Cultivar resistance - greenhouse study
2. Cultivar resistance - field study
3. Possible mechanism of resistance

Materials and Methods

LCP 85-384, HoCP 91-555, Ho 95- 988, HoCP 96- 540, L 97-128

- 5 reps
- 2 nymphs per cage
- Days to maturity
- Days in reproduction
- Number of nymphs produced/aphid

Materials and Methods

Cultivar resistance – greenhouse study

Intrinsic rate of aphid increase (Biotic Potential) – r_m

Wyatt and White (1977) Formula

$$r_m = 0.738(\log_e M_d)/d$$

M_d = number of nymphs produced by Parent aphid (P1),

d = number of days for F1 to reach reproductive maturity,

0.738 = mean regression slope of M_d over d for 4 aphid spp.

Materials and Methods

- **5-Cultivars** (LCP 85-384, HoCP 91-555, Ho 95- 988, HoCP 96- 540, L 97-128)
- **Planted on Aug. 15, 2006, in Youngsville, LA**
- **5-reps, RCB design**
- **1-row, 24 ft plots**

Materials and Methods

Data Collection:

- April-September 2007, April- August 2008
- Biweekly
- 10 plants per plot
- 50 plants/cultivar
- Data on both yellow and sugarcane aphid
- Aphid nymphs, adults

Materials and Methods

Honeydew Collection:

- L 97-128, HoCP 91-555
- Grown to 6-7 leaf stage
- 20-reps of each cultivar
- Leaf # 4- caged aphids

Materials and Methods

Honeydew Collection:

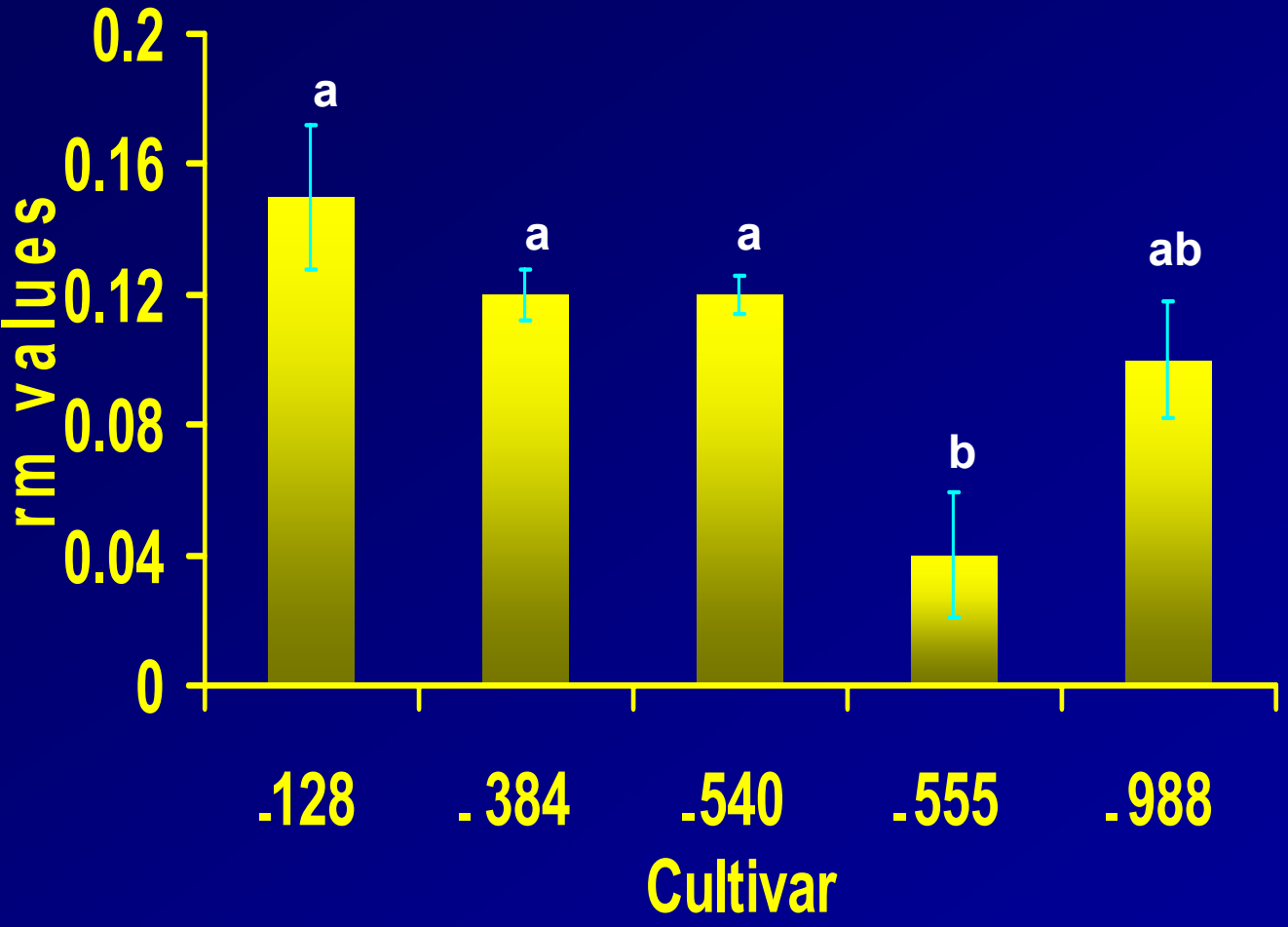
- Cage= mounting tape+parafilm
- 15 nymphs
- Confined for 3 days
- Honeydew weighed, pooled together, and dissolved in 1 ml of water
- Samples frozen at - 80 ^{o}C before HPLC analysis

Materials and Methods

Phloem Sap Collection:

- EDTA Solution – 5mM
- Incubation time – 60 min.
- > 90% RH
- 1 ml samples stored at – 80 ^{o}C before HPLC analysis

Cultivar Effect on Population Growth Rate of Sugarcane Aphid



L 97-128

LCP 85-384

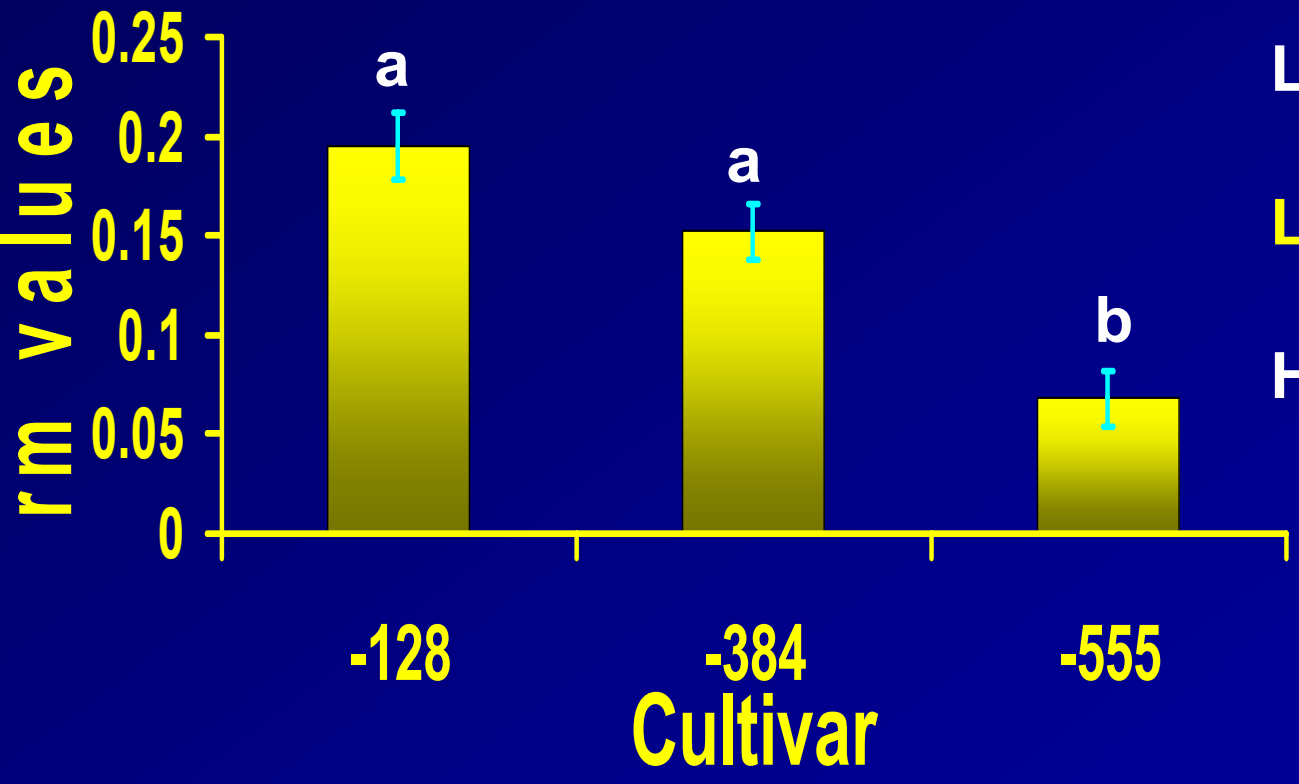
HoCP 96- 540

Ho 95-988

HoCP 91-555

Cultivar *P<0.0001*

Cultivar Effect on Population Growth Rate of Yellow Sugarcane Aphid



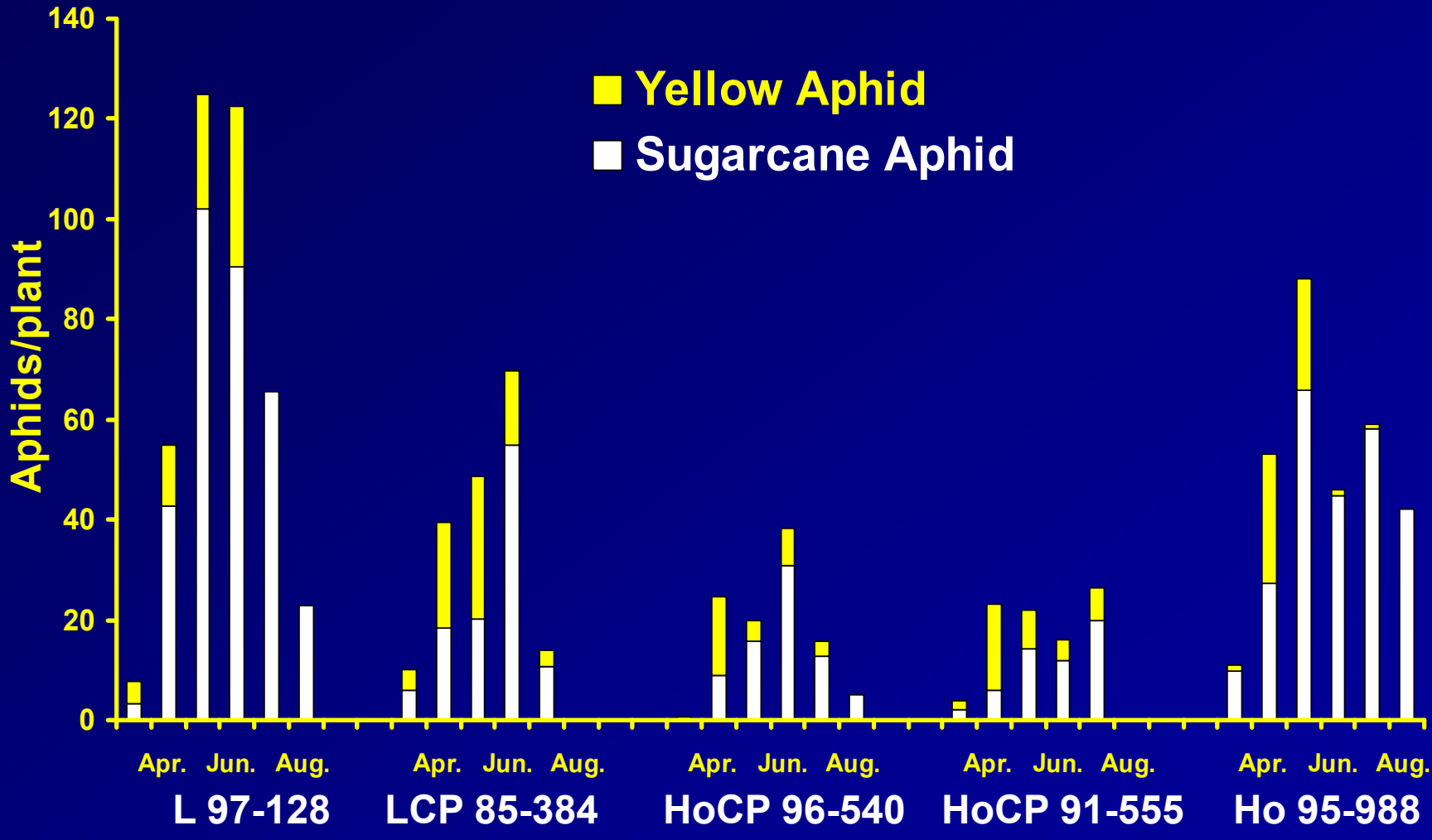
L 97-128

LCP 85-384

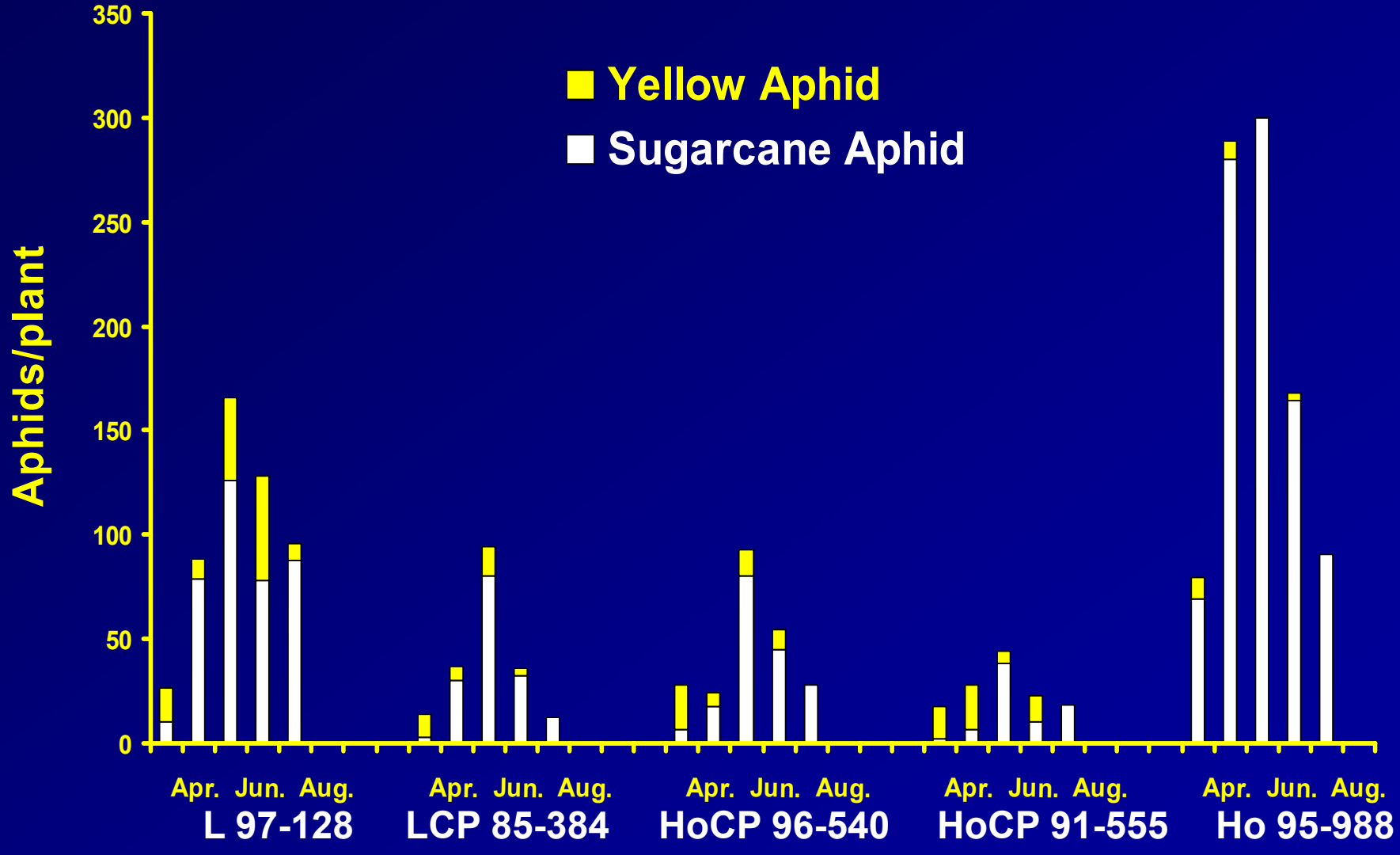
HoCP 91-555

Cultivar *P<0.0001*

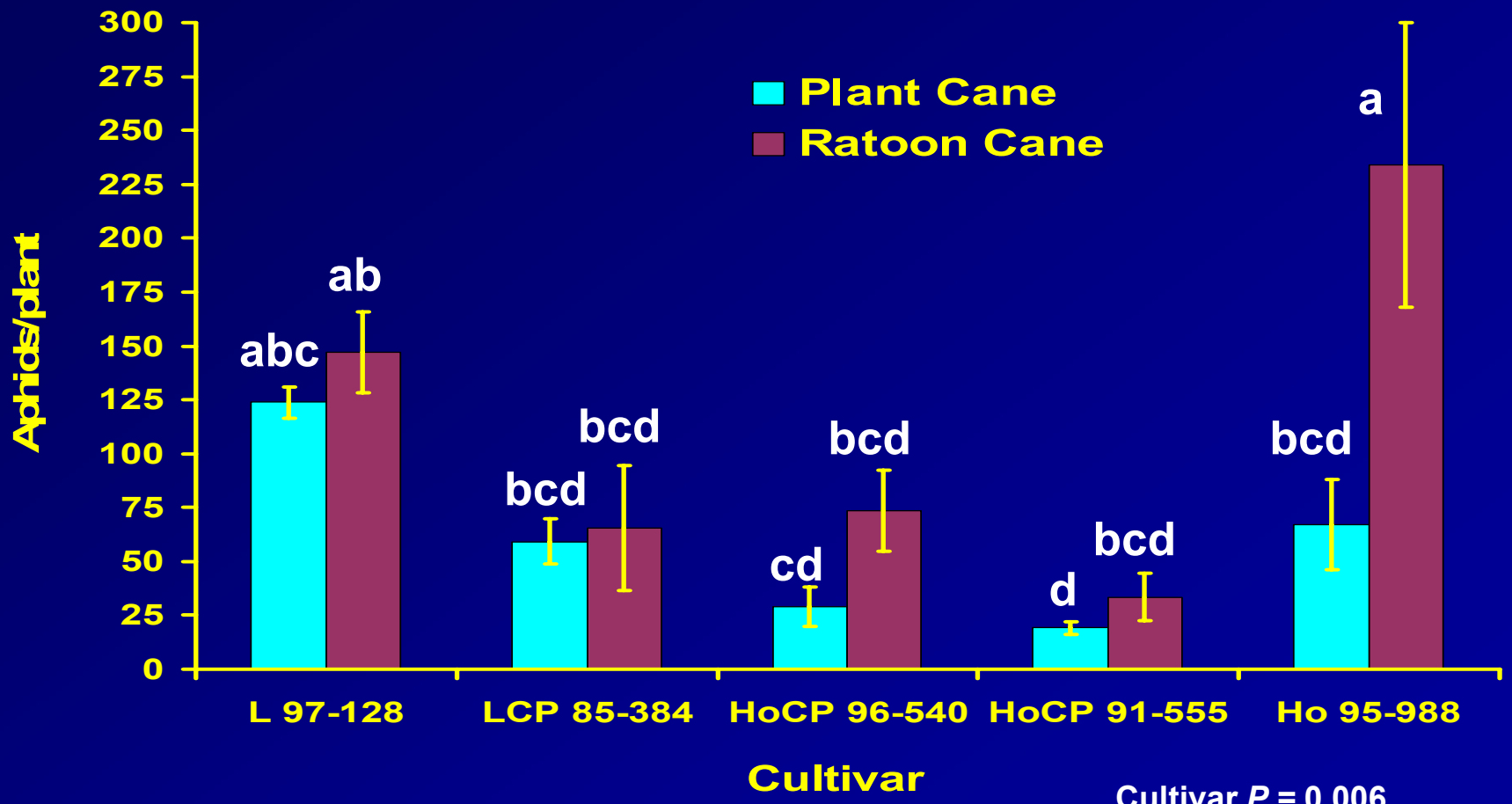
Comparison of Cultivars Over Time – Plant Cane



Comparison of Cultivars Over Time – Ratoon Cane



Comparison of mean number of aphids on plant and ratoon cane in June and July



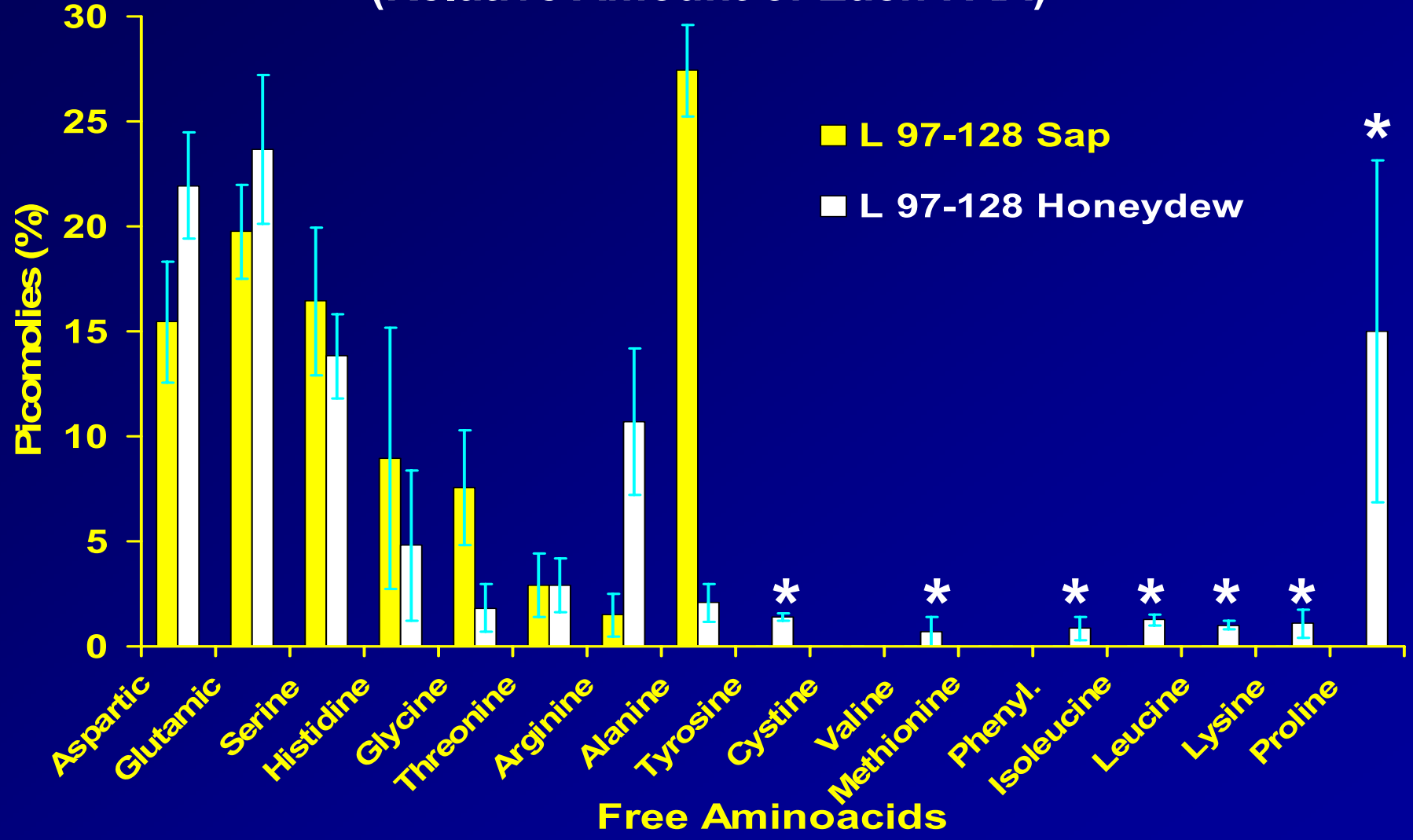
Cultivar *P* = 0.006

Plant age *P* = 0.009

Cultivar X Plant age *P* = 0.215

Phloem Sap and Honeydew of Susceptible Cultivar

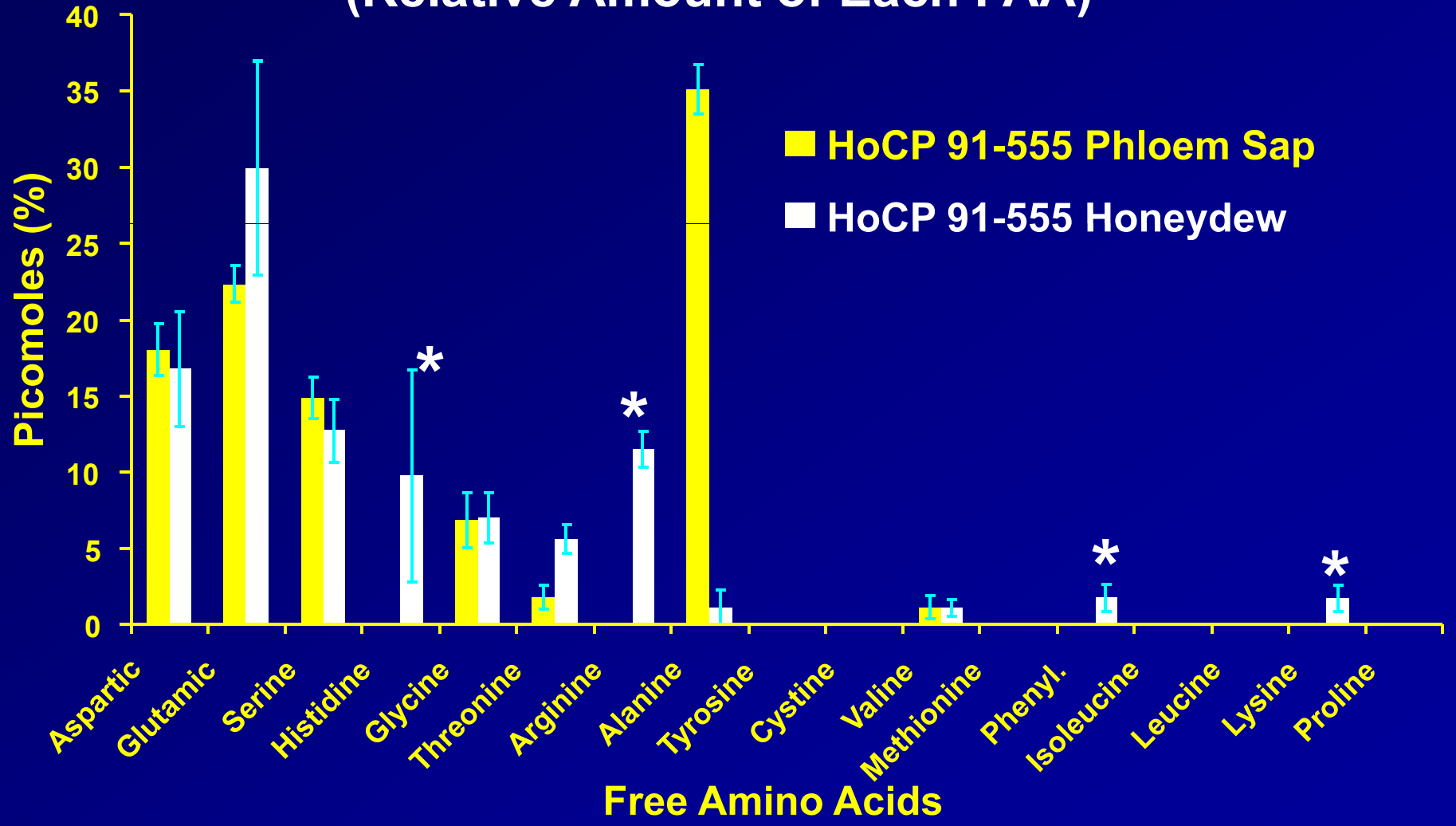
(Relative Amount of Each FAA)



* Compound-specific presence of amino acid

Phloem Sap and Honeydew of Resistant Cultivar

(Relative Amount of Each FAA)



* Compound-specific presence of amino acid

EXCRETION – INGESTION

Differential Free Amino Acids

Essential- Isoleucine

Essential- Leucine

Non-essential- Tyrosine

Non-essential- Proline

CONCLUSION

- Sugarcane aphid is the dominant aphid on sugarcane in Louisiana
- Cultivar Susceptibility- -

  Susceptible - L 97-128 and Ho 95-988

  Resistant - HoCP 91-555
- Aphid populations peak in June and July
- Ratoon cane has higher aphid infestations
- Absence of certain FAA in the phloem sap or aphid inability to obtain these FAA contributes to resistance