Balancing resources for management of root health in HLB–affected groves

Jim Graham
Citrus Institute
April 10, 2012

UF UNIVERSITY of FLORIDA
IFAS
Citrus Research and Education Center

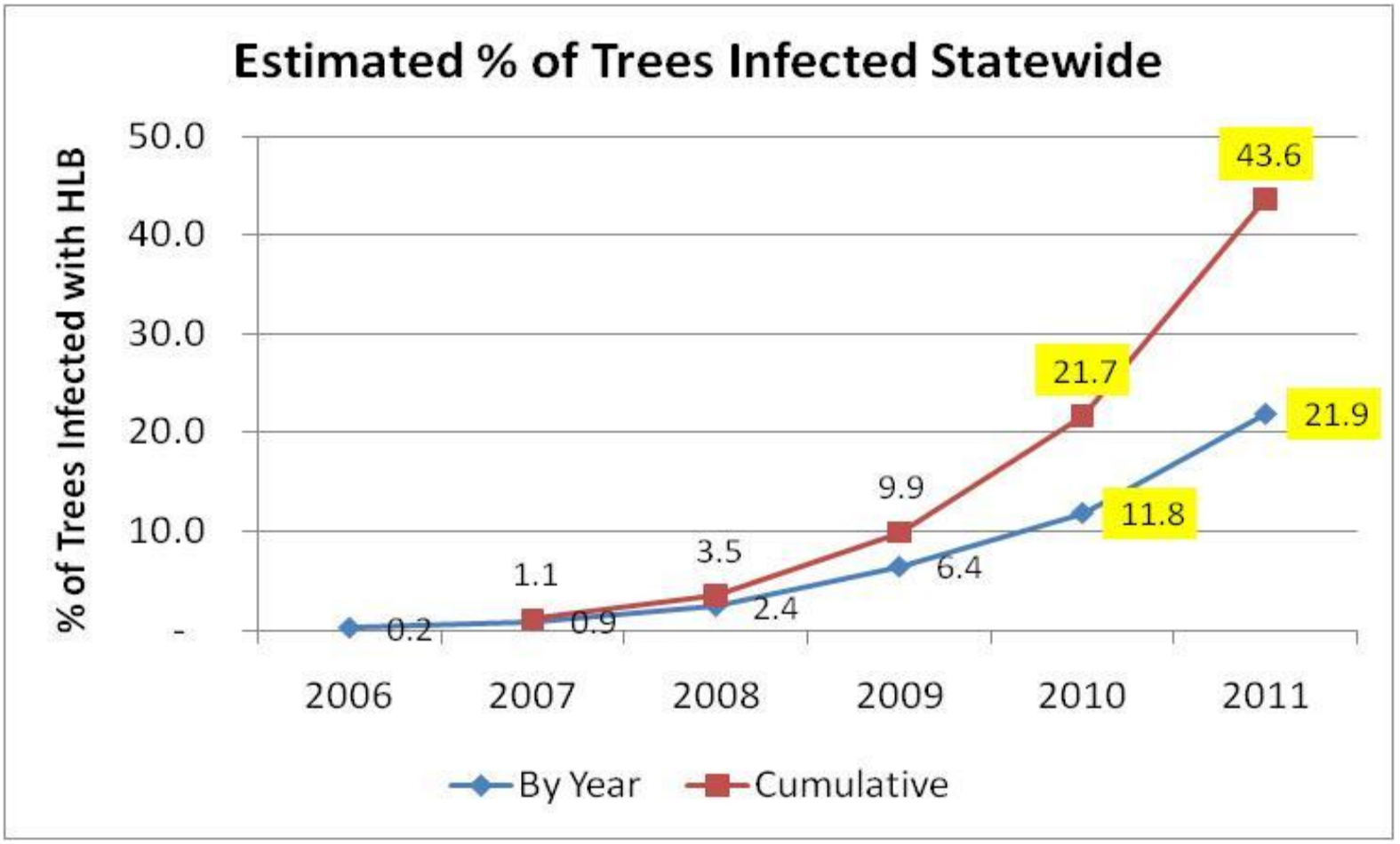
Background

- When HLB, was first found in Florida, the overarching concern was the direct losses associated tree decline
- As a result, the initial HLB control efforts focused on inoculum management
  - Use of disease free trees
  - Scouting for and removal of infected trees
  - Aggressive psyllid vector control

Background

- Now after 6+ years the majority of the industry has moved to the use of enhanced nutritional programs (ENPs) that do not involve the removal of symptomatic/infected trees
- One consequence is that HLB infection levels continue to rise and will approach 100% in a short number of years

Estimates HLB disease incidence doubled from 2010 to 2011 (Mike Irey, USSC)



Background

- Diseases and disease interactions are typically more complex than just the direct losses experienced as a result of symptoms
  - Interactions with soils, fertility and nutrition
  - Interactions with abiotic stresses e.g. drought and temperature extremes
  - Interactions with other diseases and pests

Abiotic stress – Freeze damage 2011

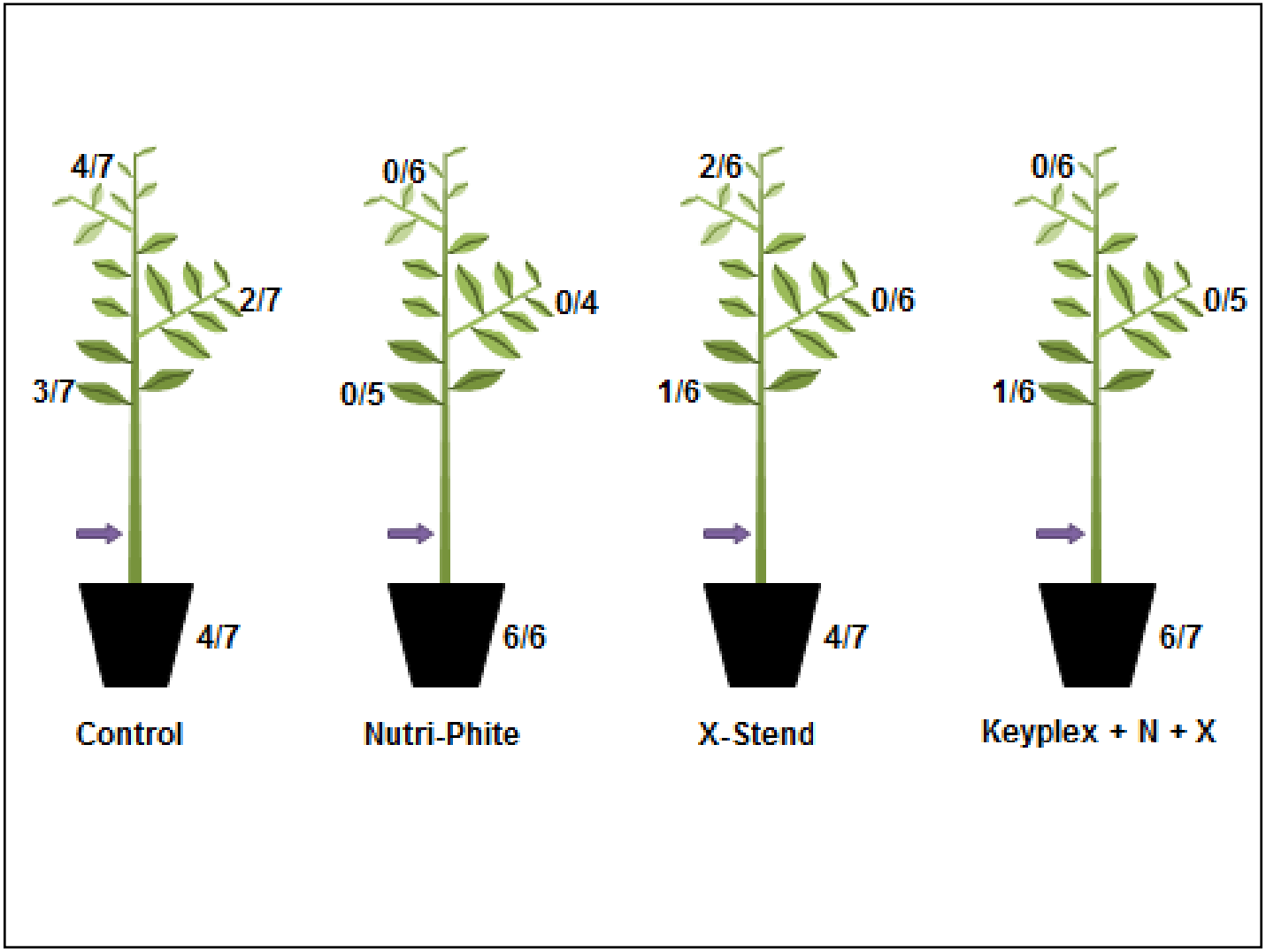
Abiotic stess – Drought 2011

Issues specific to systemic diseases like HLB

- The HLB pathogen, *Candidatus* Liberibacter asiaticus (*Las*) infects the structural and fibrous roots
- How quickly the bacterium moves to the roots after initial infection in the shoots is unknown
- Our greenhouse studies: the bacterium may infect to the roots before the shoots and this infection may cause rapid decline of fibrous root density
- Process may be modified by enhanced nutritional programs (ENP)

Las root infection occurs early and may be affected by an ENP

(Evan Johnson, UF-CREC)



ENPs do not sustain health when tree is stressed

- Aboveground HLB symptoms appear to be reduced by ENPs
- LAS is predicted to cause decline in the health of fibrous roots belowground, as well as leaves, fruit and branches aboveground
- Damage of fibrous belowground may affect stress tolerance before trees show aboveground symptoms

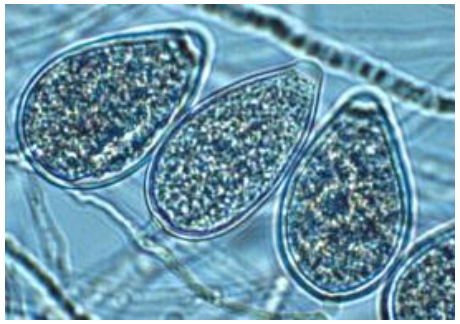
Pre-freeze
2010 (w/ENP)

Post-freeze
2011 dropped
leaves and fruit

Phytophthora spp. are present and affect root health to some degree in every citrus grove

- *Phytophthora* spp. cause fibrous root rot on susceptible rootstocks
- Phytophthora damage to fibrous roots belowground is difficult to assess directly

P. nicotianae



P. palmivora

Phytophthora appears to be interacting with HLB-affected trees

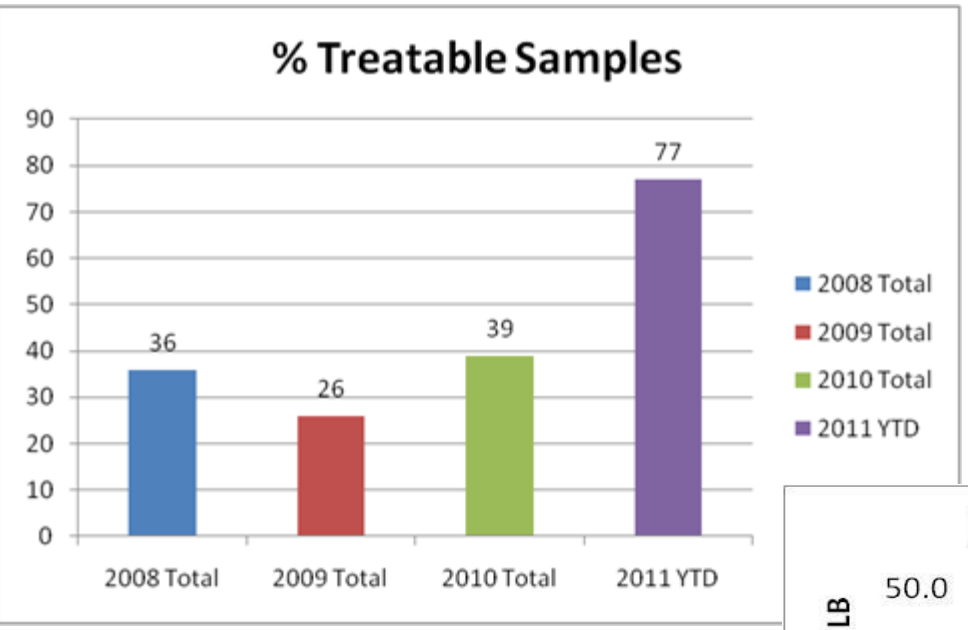
- HLB-affected trees very rapidly decline in response to stress
- Observations statewide are mounting that management of HLB with ENPs is complicated by Phytophthora interaction and may have unanticipated consequences
- e.g., Phosphites which induce resistance of citrus tissues to Phytophthora may no longer be working to control root rot

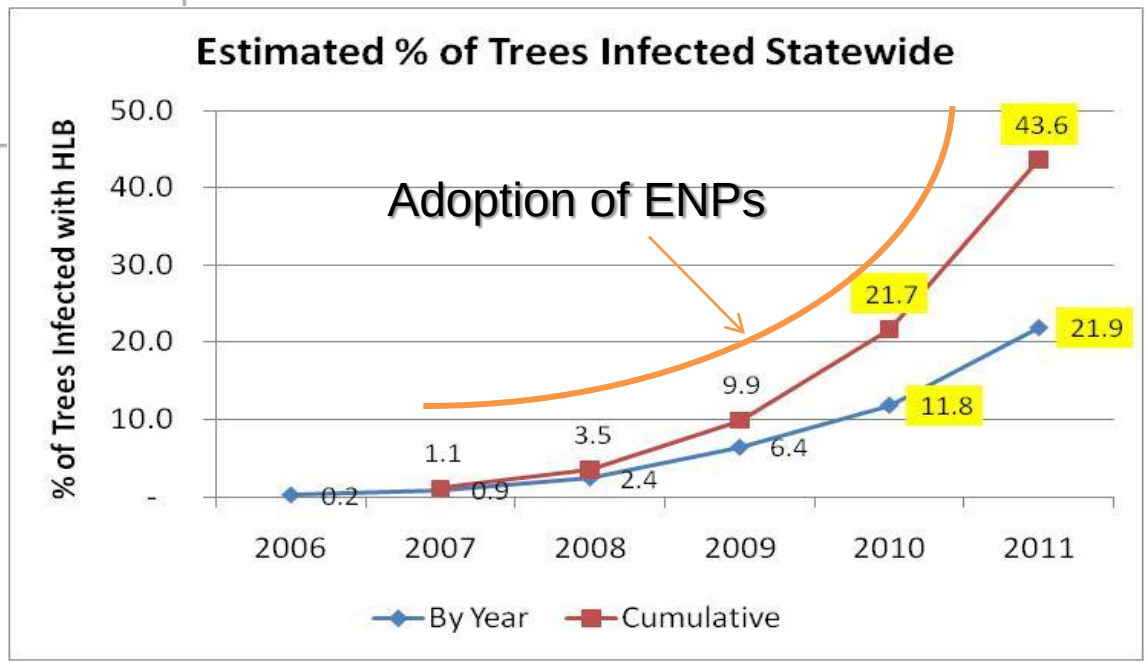
  i.e. Resistance is ‘broken’ by Las infection

Florida survey for the last 25 years

- Syngenta has been providing a Phytophthora sampling assay as service to growers in support of the fungicide Ridomil (mefenoxam)
- Groves are sampled and results are sent to growers to support their management decision to use the fungicide
  - Presence or absence of Phytophthora
  - Species of Phytophthora present
  - Number of propagules per cm^3 of soil
  - Exceeding a threshold of 10-20 propagules per cm^3 soil can be used to consider treatment

Trend in Syngenta survey compared with HLB disease progress and adoption of ENPs





We surveyed trees in groves on ENPs with HLB symptoms within 3-6 months in central, south-central and southern Florida

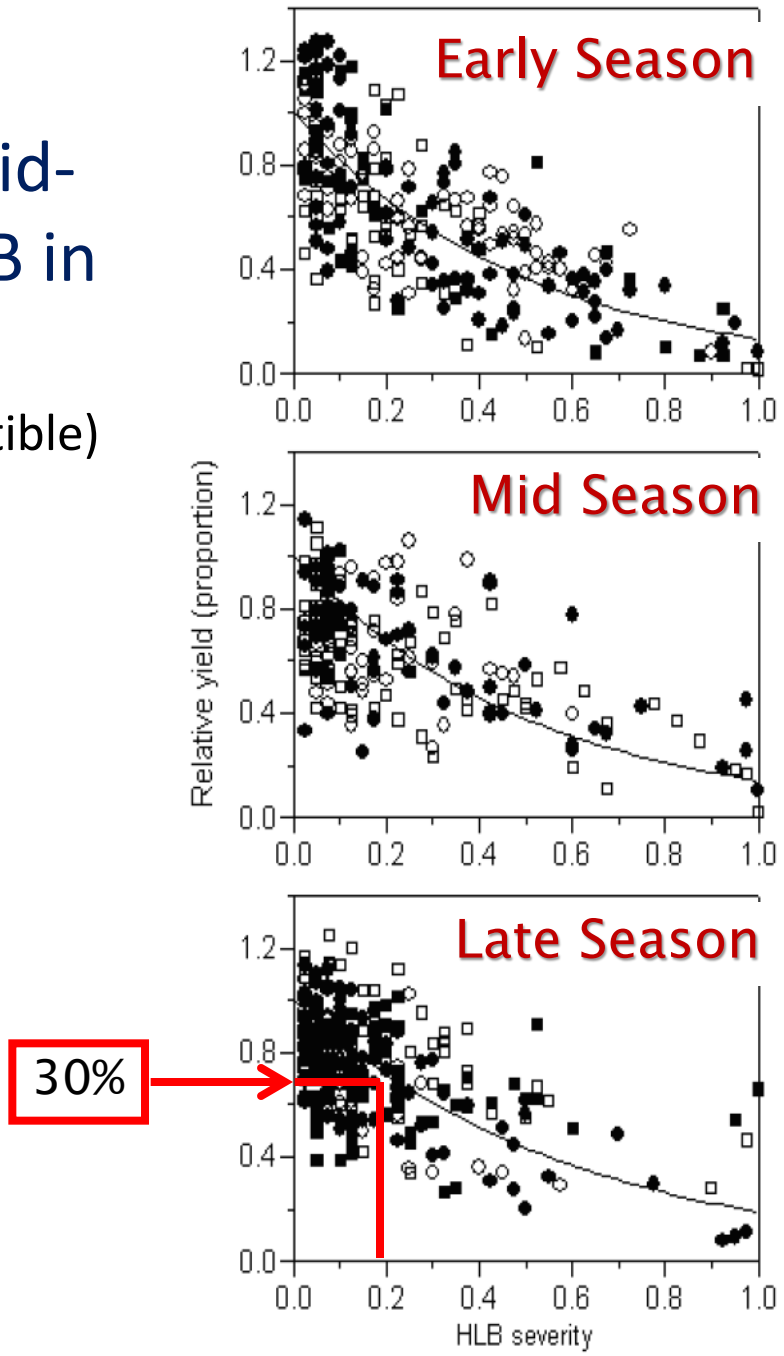
Location	Scion/Rootstock	Month	P. nicotianae propagules /cm³ soil		Root dry weight (g)		P. nicotianae propagules /g root	
			HLB-	HLB+	HLB-	HLB+	HLB-	HLB+
Highlands Co.	Val/Swingle	April	63.1	38.9	0.44	0.28*	144.4	147.5
Desoto Co.	Val/Carrizo	May	92.0	65.5	1.47	0.96*	66.3	74.2
Desoto Co.	Val/Carrizo	June	40.8	33.1	0.81	0.51*	40.6	73.9
Hendry Co.	Val/Swingle	May	58.1	49.0	1.58	1.00*	42.2	50.4
Hendry Co.	Val/Swingle	Oct	63.7	55.1	0.81	0.54*	83.8	119.4*
Highlands Co.	Val/Swingle	Oct	63.1	38.9	0.41	0.28*	144.4	147.7

* HLB+/− significantly different according to paired t test at $P \leq 0.05$

Initial yield decrease for early, mid- and late season cultivars with HLB in São Paulo State is 30%

(All commercial sweet oranges equally susceptible)

Data From: Bassanezi et al. 2011
European Journal of Plant Pathology



Interpretations from HLB root health survey

- Measured a 33-49% reduction in root density for recently symptomatic trees on ENPs
- Root damage has a direct effect on tree productivity
- Root loss belowground probably precedes symptoms aboveground
- May account for the average of 30% yield losses measured on early symptomatic trees in Brazil and Florida (with ENPs)

Further Interpretations

- ENPs do not prevent HLB-induced root damage
- Previous research: *More roots = More Phytophthora*
- ENPs may increase root production of healthy trees exacerbating Phytophthora (statewide survey results)
- In the presence of HLB, less roots occur but still high levels of Phytophthora
- The ratio of Phytophthora to root density on HLB affected trees is slightly higher
- Phytophthora may be exacerbating the HLB damage

What research says ENPs do and don't do

- In CPI's Ranch One grove the standard nutritional program (SNP) was compared with an ENP
- 3 matched blocks per treatment (two sets of Valencia/Carrizo blocks and one set of Valencia/sour orange blocks, all 8 yrs old)
- Survey and removal of trees was on-going
- HLB incidence was recorded during 24 visual assessments from December 2006 through March 2011
- Yield data were collected from each block for the 5 year period from 2007 to 2011

Results from comparison of ENP vs SNP

- From 2007 to 2008, trees did not have the advantage of micronutrient treatments and the production data were used to establish baseline yields per tree for each block
- When yields were adjusted for the pre-existing differences between the sets of blocks, yearly harvests from 2009-2011 treatments showed no effect of the ENP compared to the SNP
- Rates of HLB disease increase between these sets of trees were nearly identical for the ENP and SNP blocks
- The cost of this ENP is approximately $611/acre, >3X the cost of the SNP at $184/acre

Conclusions/recommendations

- Phytophthora may have to be managed with fungicides more aggressively to sustain root health
- If propagule count is >20 recommend fungicide treatments <u>after</u> spring and fall shoot flushes - refer to FCPMG www.crec.ifas.ufl.edu/extension/pest/
- Once program begins should be sustained until populations drop below the damage threshold
- Monitor the progress of the program with yearly sampling of soil populations (April to November)

Conclusions/recommendations

- Not advocating move away from the ENPs developed to manage HLB over the last 5 years
- Match nutritional supply with tree demand with leaf testing of the nutrient status of both HLB+ and HLB- trees
- Integrate root health management program based on the relationship between HLB root decline and yield losses, and research experience with ENPs
- Balance the considerable costs of the root health management with those other resources for HLB, i.e. psyllid control, ENPs, control of other pests and diseases

Acknowledgements

- Mike Irey, US Sugar
- Tim Gottwald, USDA-ARS-HRL
- John Taylor, Syngenta Crop Protection
- Evan Johnson, UF- CREC
- Cooperative Producers, Inc. for sharing ENP study data
- CRDF for sustained support of JHG's research