

*Current Status of Canker Management Research**

Jim Graham, Megan Dewdney

UF/CREC

Monty Myers

UF/IRREC



*Research supported by CRDF and product manufacturers
Special thanks to Hilliard Groves, Estes Citrus and Blue Goose

High levels of canker can occur on any variety depending on host phenology, pest & environmental factors, e.g., timing of wind-blown rain events w/ flush



Valencia – “least susceptible”



Grapefruit – “most susceptible”

Domestic fresh fruit shipping rule change

- APHIS inspections discontinued for canker on fresh fruit: shipments to all US states are allowed
- Shipments to EU still require pre-harvest grove inspections as well as postharvest fruit inspection before shipping
- New domestic canker rule allows diverting such fruit to domestic markets without the costly need to re-grade the fruit.
- Hopefully, new research findings on risk of fruit for canker transmission will encourage EU to reevaluate current citrus import regulations
- Conducting research with Tim Gottwald, USDA-ARS to mitigate residual bacteria in very small, late season lesions



Even with acceptance of canker blemished fruit – Issues and Goals unchanged

- Most economically viable pack-out must have a low incidence of unsightly canker blemishes
- Without windbreaks in place, production of canker-free grapefruit still proves difficult especially on young trees
- Even after an effective copper control program, crop remains in jeopardy of late season infections from storms and hurricanes
- 2010 season was marked by the absence of severe weather
- Moderately effective control of disease on grapefruit with copper formulations (15-20% fruit disease, mostly later season infection)

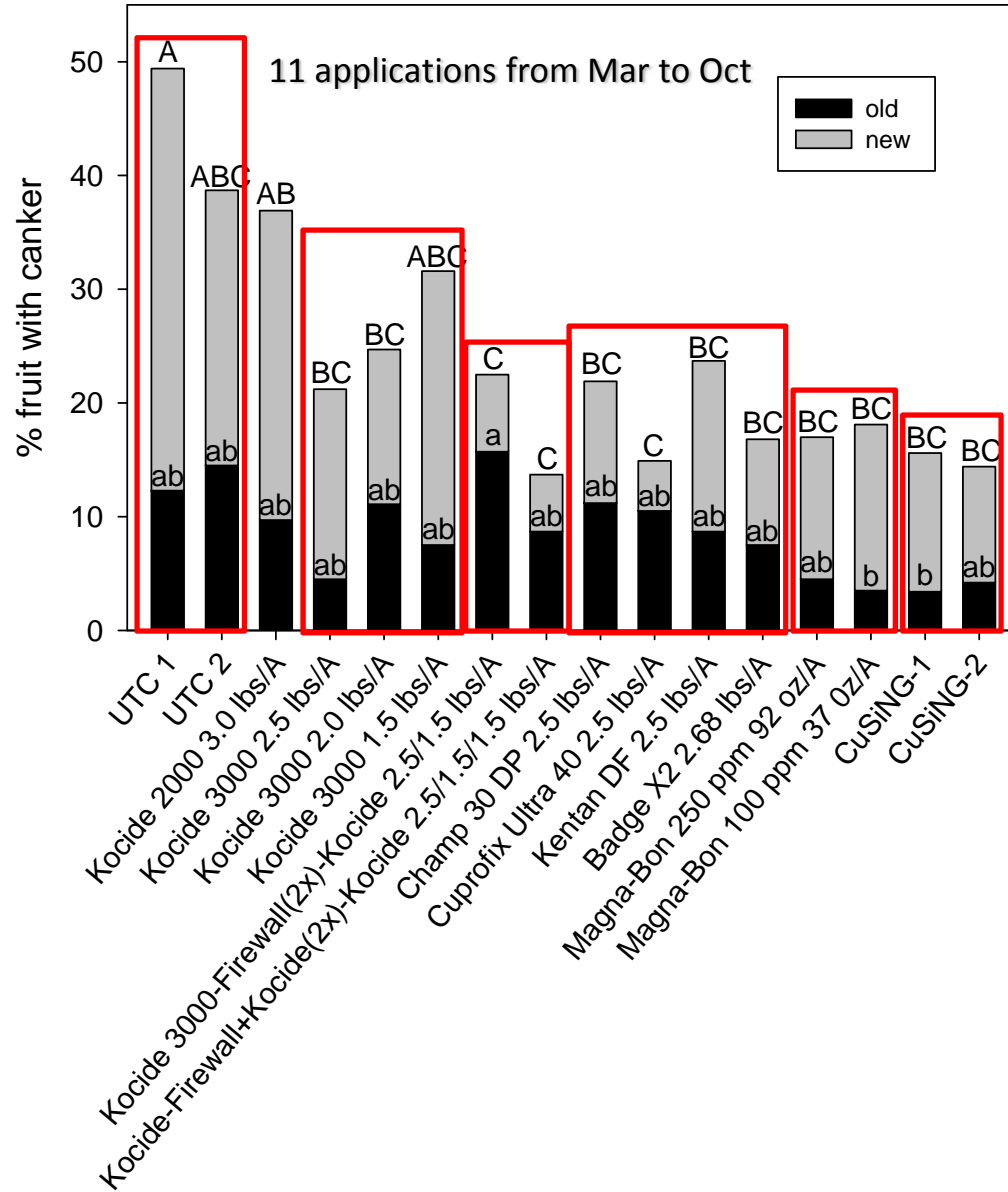


Formulations, rates and manufacturers of products tested in grapefruit

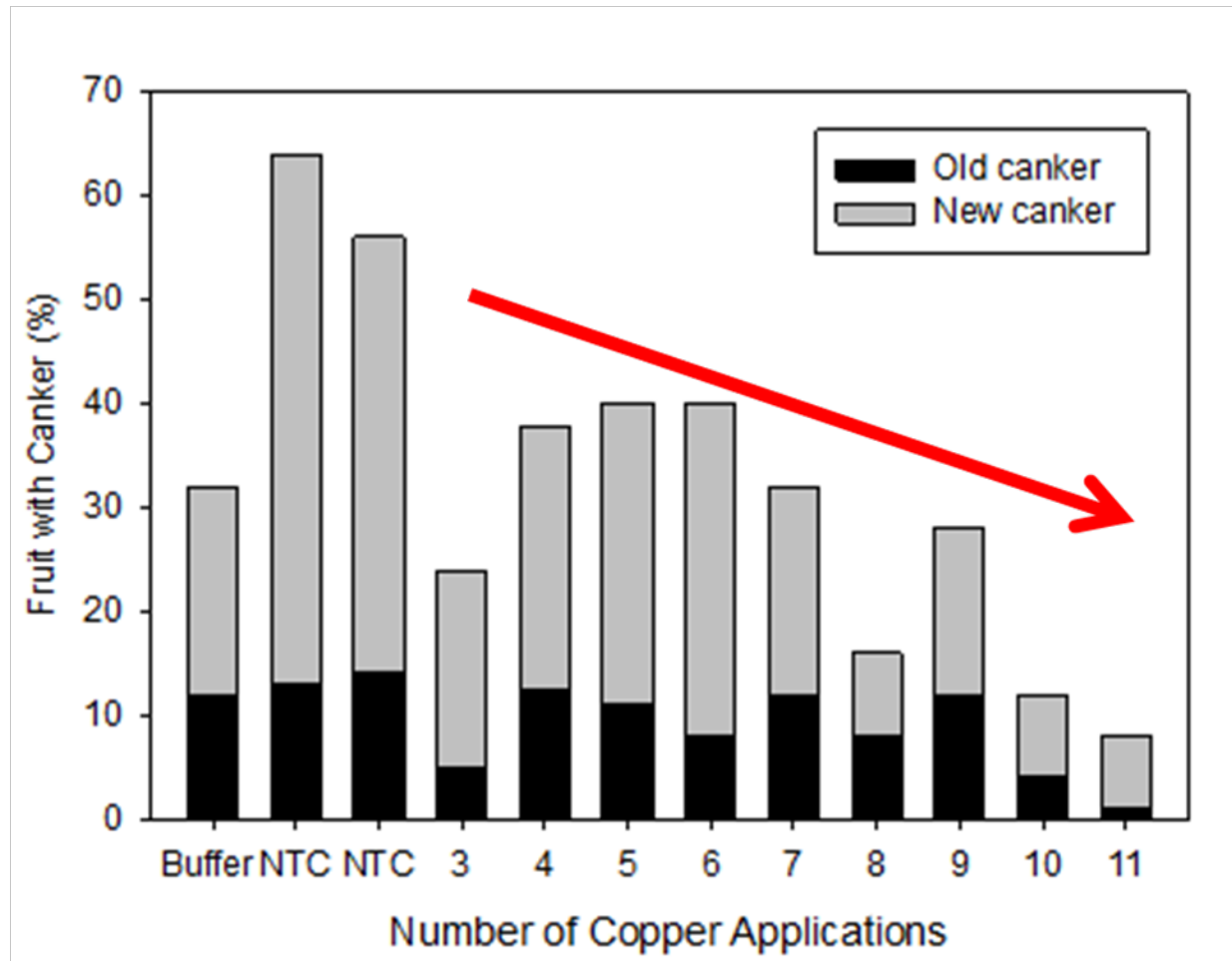
Treatment	Manufacturer /supplier	Metallic Cu (%) or a.i. (%)	Rate (lbs/acre)	Metallic Cu/acre
Kocide 2000	Dupont	35	3.0	1.05
Kocide 3000	Dupont	30	2.5	0.75
Kocide 3000	Dupont	30	2.0	0.66
Kocide 3000	Dupont	30	1.5	0.45
Kocide 3000 – Firewall (2x)- Kocide	Dupont/ Agrosource	30/ 22.4	2.5/ 1.5	0.75
Kocide – Firewall+Kocide (2x) - Kocide	Dupont/ Agrosource	30/ 22.4	2.5 1.5/1.5	0.75 0.45
Champ 30DP	Nufarm	30	2.5	0.75
Cuprofix Ultra 40	UPI	40	2.5	1.0
Kentan DF	Isagro	40	2.5	1.00
Badge X2	Isagro	28	2.68	0.75
Magna-Bon 250 ppm ^z	Magna-Bon	5	92 oz/ac	0.28
Magna-Bon 100 ppm	Magna-Bon	5	37 oz/ac	0.14
CuSiNG-200	UCF			0.75
CuSiNG-300	UCF			0.75
Untreated check 1 (UTC)	---	--	--	--
Untreated check 2 (UTC)	---	--	--	--

^z Applications decrease from 250 to 200 to 100 ppm in first three sprays

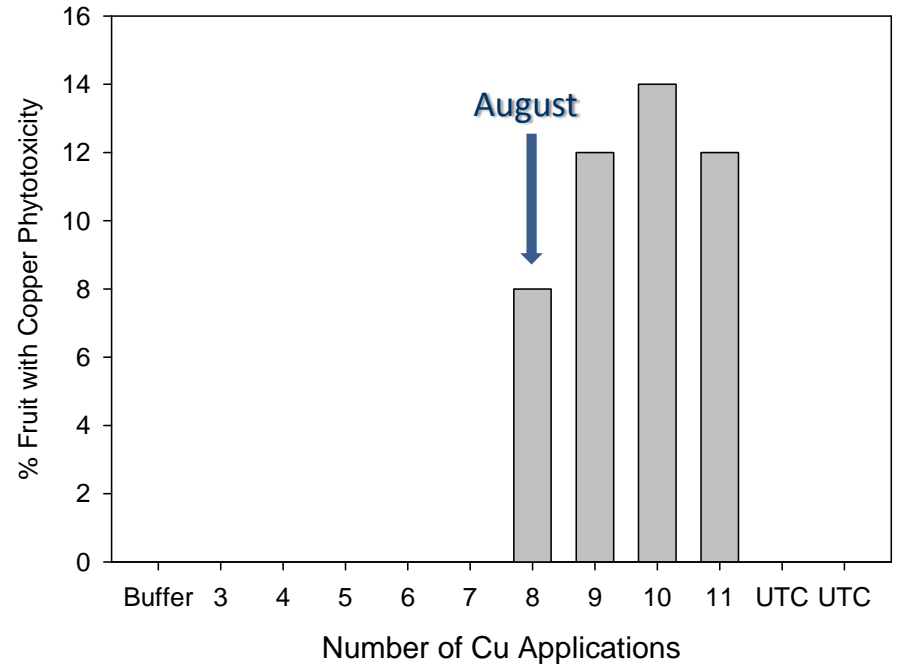
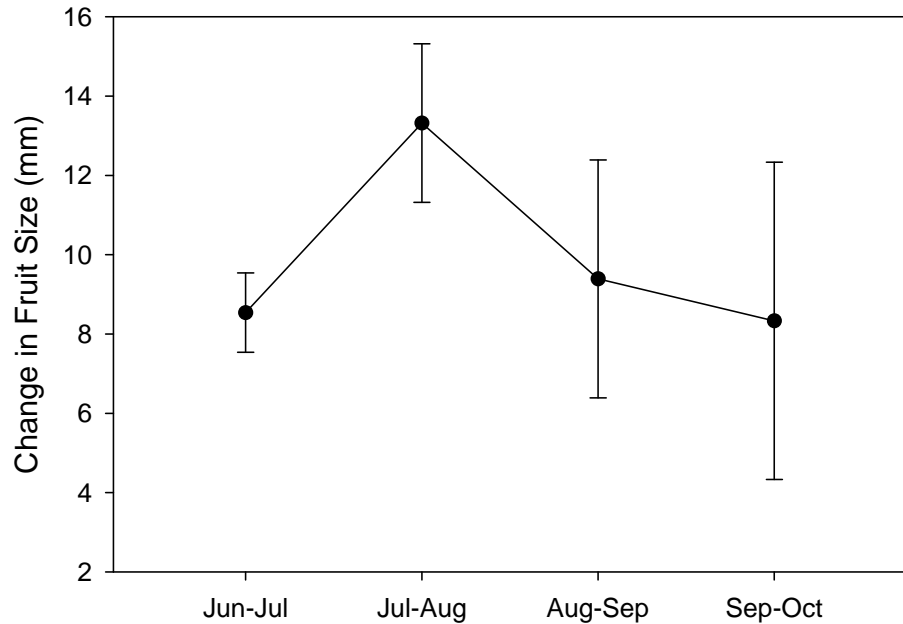
Blue Goose Fruit with Canker
December 2010



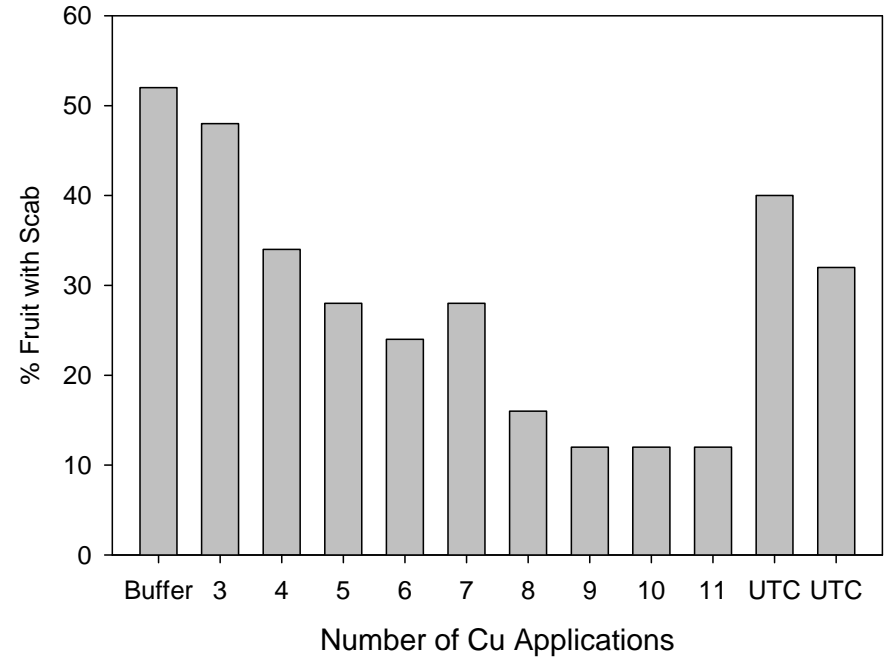
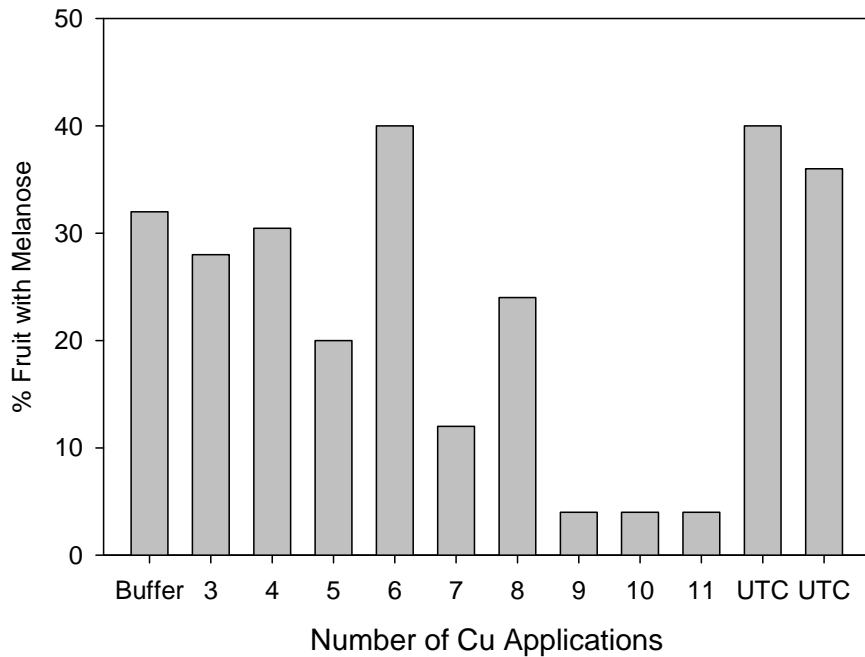
Canker control increases with number of sprays from April to October



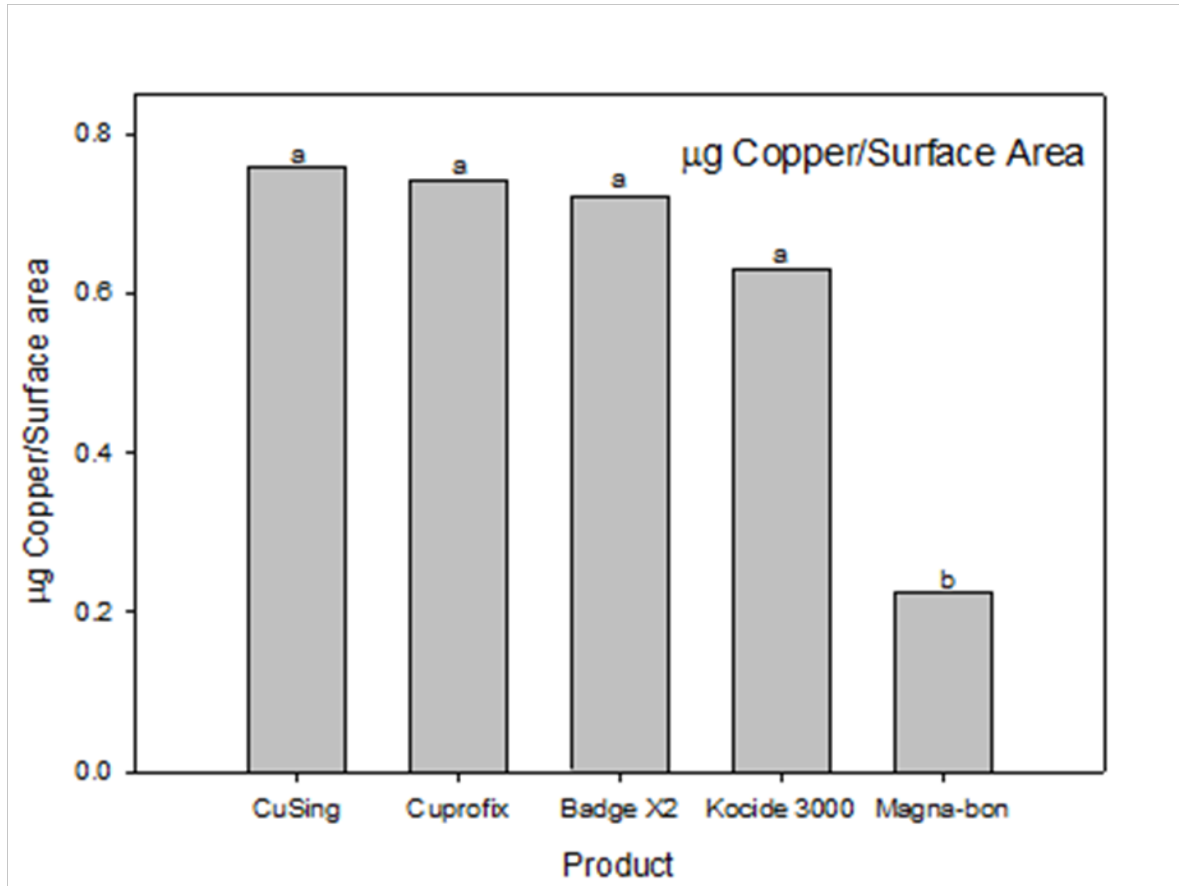
Canker infection and copper burn occurs when fruit are growing most rapidly (July-August)- cuticle is thin and new stomates are opening at higher rate



Season-long copper spray also controls late season scab and melanose on fruit

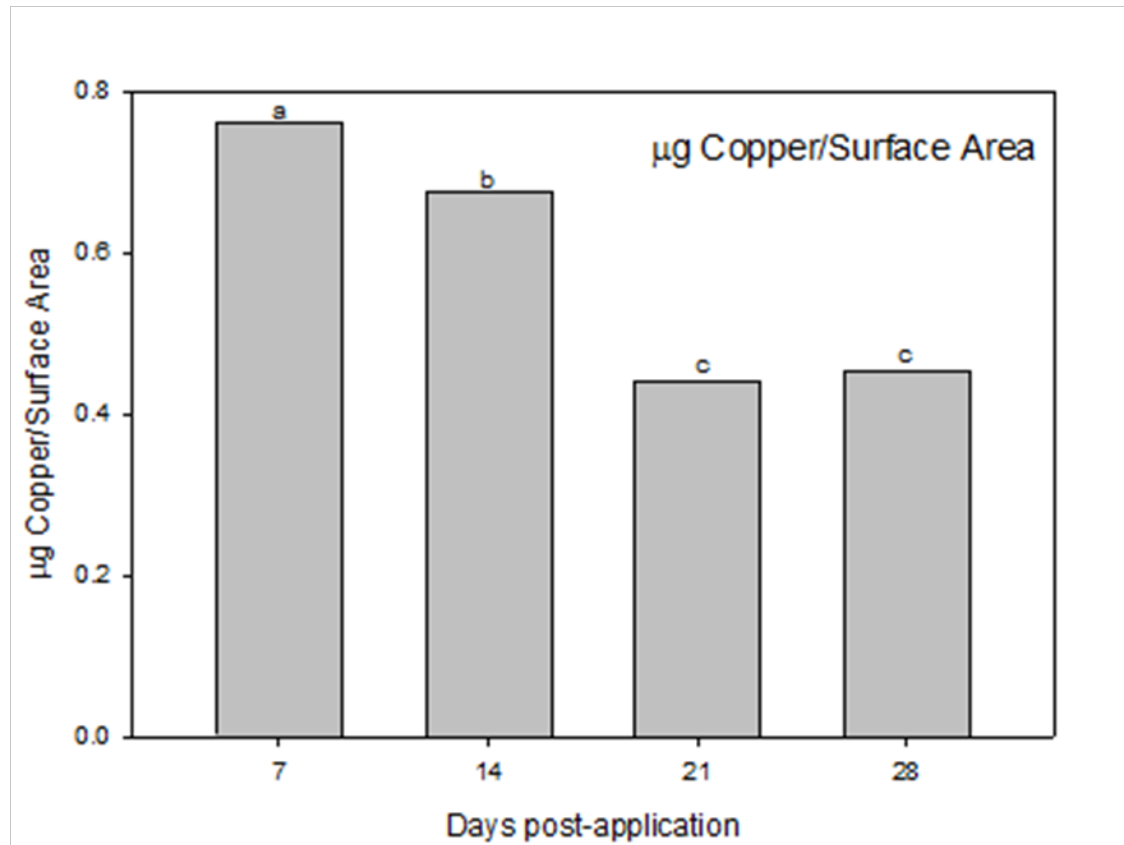


Effect of copper formulation on residual copper on grapefruit (repeated in July and Aug)

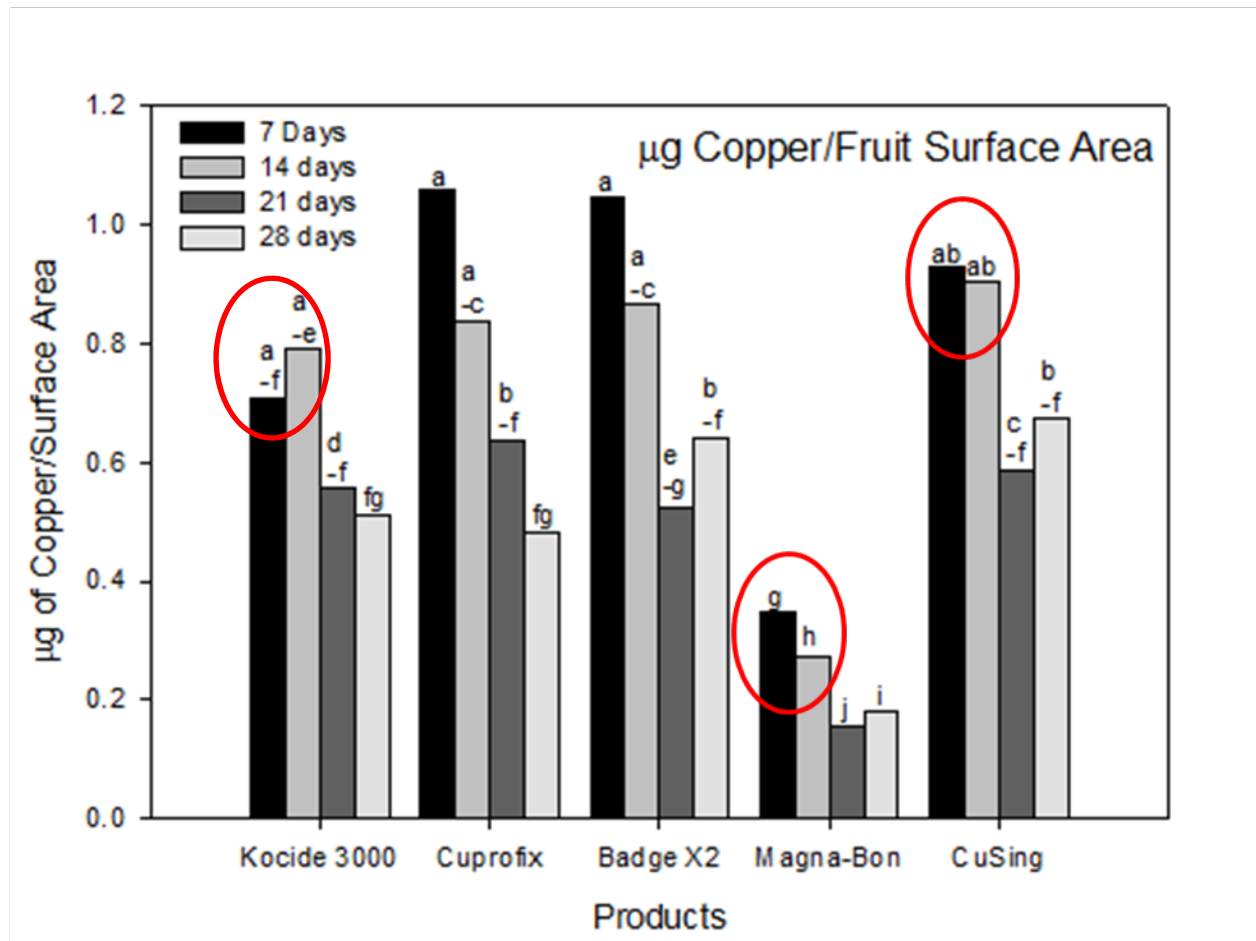


Kocide 3000 (2.5 lb/acre; copper hydroxide; 30% metallic),
Cuprofix Ultra 40 Disperss (copper sulfate; 1.875 lb/acre; 40% metallic),
Badge X2 (copper hydroxide and oxycloiride; 2.68 lb/acre; 28% metallic)
Magna-Bon CS2005 (200 ppm/acre; 5% metallic)
CuSing (copper silica nanogel; 2.5 lb/acre; 30% metallic).

Significant effect time after application on residual copper per surface area of grapefruit (basis for 21 day interval sprays)



Copper residue decrease differed: Kocide 3000 and CuSing smallest change and Magna-Bon the highest drop between days 7 and 14



Major take-homes from the 2010 grapefruit trials

- Fruit are susceptible as long as they are growing. i.e. later season copper sprays improve control
- Most infection after July, i.e. lesions less than a ¼ inch in diameter (after rains commenced, fruit growth rate increased)
- Copper formulations at 1.5 to 3 lbs of product or 0.6 to 1.1 lbs of metallic copper per acre perform similarly
- Copper residues vary among copper products which may explain slight differences in their performance
- Magna-Bon has much lower fruit residue levels yet control is similar in control to film-forming coppers (i.e. Kocide). Need to find out how it works
- July-August applications of Firewall are effective either in combination with a reduced rate of copper or when substituted for copper in the spray program and can be used to reduce risk of copper burn
- Firewall packet for has been submitted to EPA for Section 18 registration for use against canker on fresh grapefruit

*How does soluble copper in Magna–Bon work to control canker on fruit?
Locally systemic in the tissues?*

Comparison of leaf copper concentration in trees sprayed with film-forming and soluble copper formulations on-going research trials in 2010

Cultivar -location	Trial type	Treatment	Sprays per season	Leaf copper ($\mu\text{g/g}$) in late summer flush
Hamlin orange – Hardee Co.	Research	Untreated check	5	20.5
Hamlin orange – Hardee Co.	Research	Kocide 3000 2.0 lbs/ac	5	23.3
Hamlin orange – Hardee Co.	Research	Magna Bon 250 ppm	5	31.8
Red grapefruit – St. Lucie Co	Research	Untreated check	8	215
Red grapefruit – St. Lucie Co	Research	Kocide 3000 3.0 lbs/ac	8	685
Red grapefruit – St. Lucie Co	Research	Magna Bon 250 ppm	8	542

Adoption of windbreaks

- Primary means of disease management are:
1) planting of windbreaks, 2) leafminer control, 3) protection of fruit with copper sprays
- Windbreaks are the single most effective means for reducing canker infection
- Windbreaks reduce windblown rain infection of fruit by canker bacteria
- Without windbreaks to reduce the wind speed < 20 mph, the surface film of copper is no longer protective
- **Canker control on grapefruit was lost after the Tropical Storm Fay in August 2008**
- More grapefruit growers are in the process of establishing windbreaks



Inoculum management for fresh grapefruit

- Reduction of inoculum on spring flush is critical for protection of fruit throughout the season
- CPI protocol for reducing inoculum in grapefruit trees with endemic canker infection
- Perform operations to reduce inoculum after picking the fruit crop and during the cool, driest, i.e. least conducive time for canker re-infection
- Inoculum is initially reduced by hedging off the summer and fall growth infected with canker
- Upon inspection, if excessive infected foliage is identified spot treat with a defoliant.
- Spray copper every 21 days when the spring flush reaches $\frac{1}{2}$ - $\frac{3}{4}$ leaf expansion stage



Soil drenches of neo-nicotinoid insecticides (Admire, Platinum) or Actigard for control of canker by SAR

Leafminer control essential on the leaf flushes of young trees and all grapefruit trees

Leafminer results in explosive build-up of canker on mid-summer leaf flushes



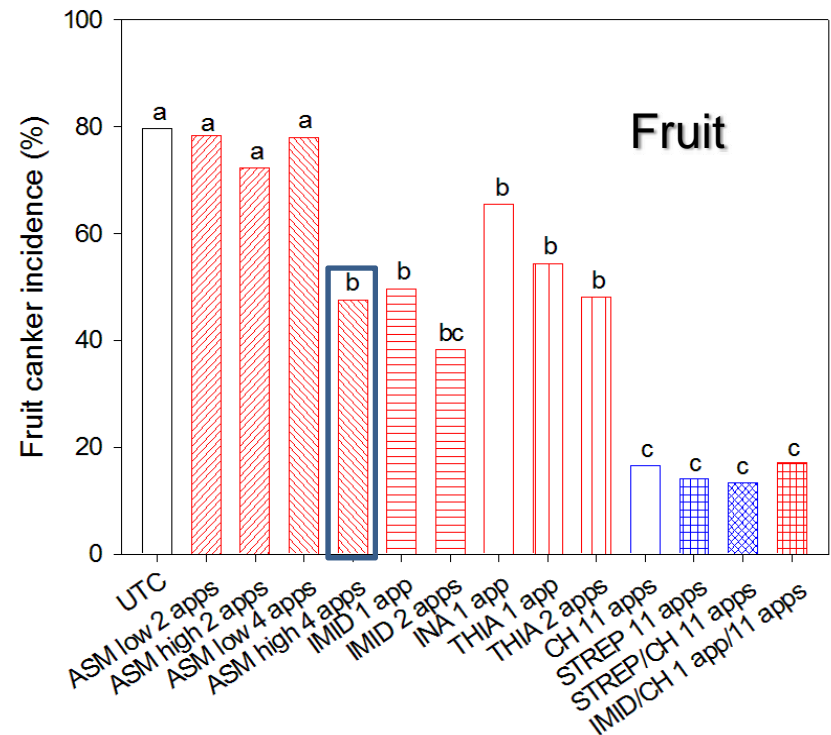
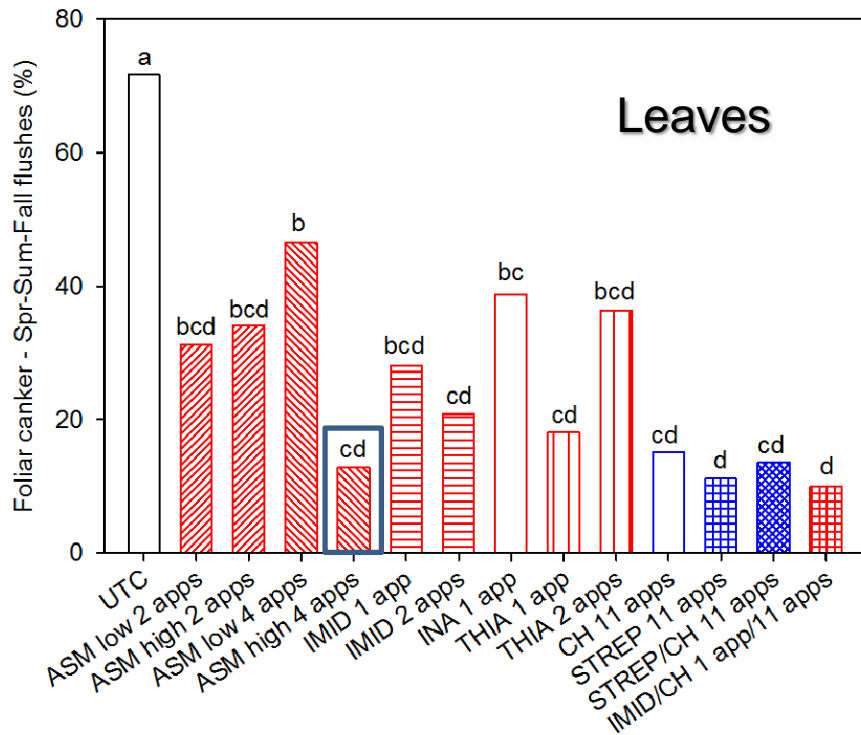
Lapse of leafminer and canker control in July and resumption of control after next Admire



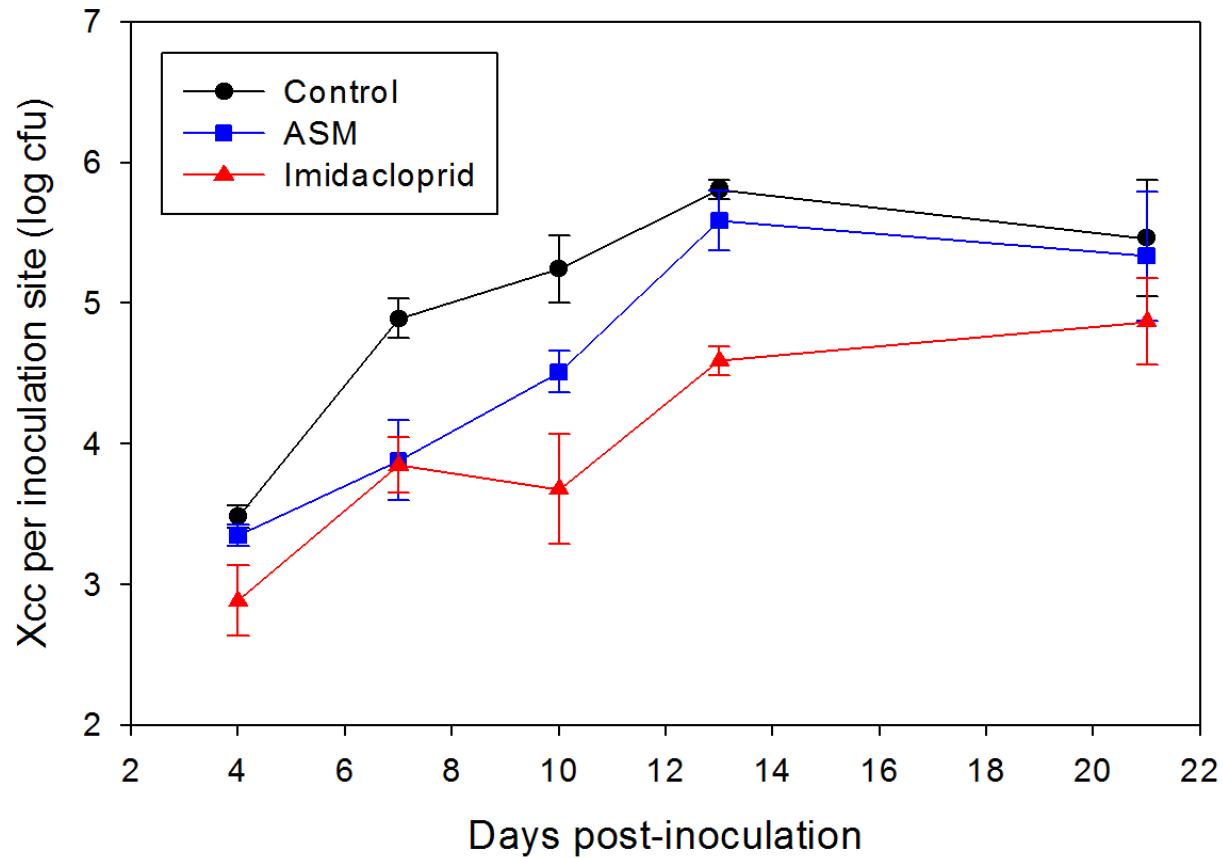
*Why control canker on young trees?
Prevent canker-induced defoliation*



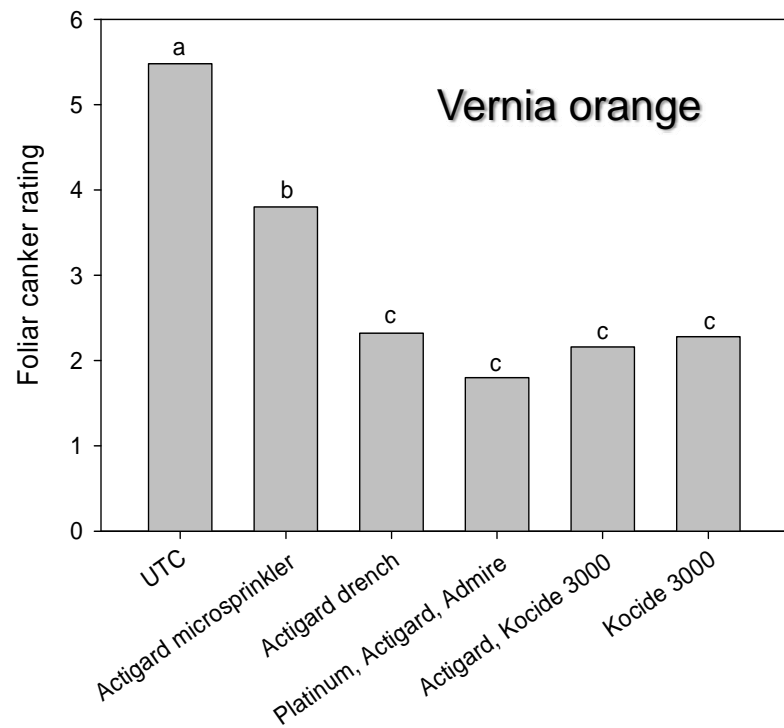
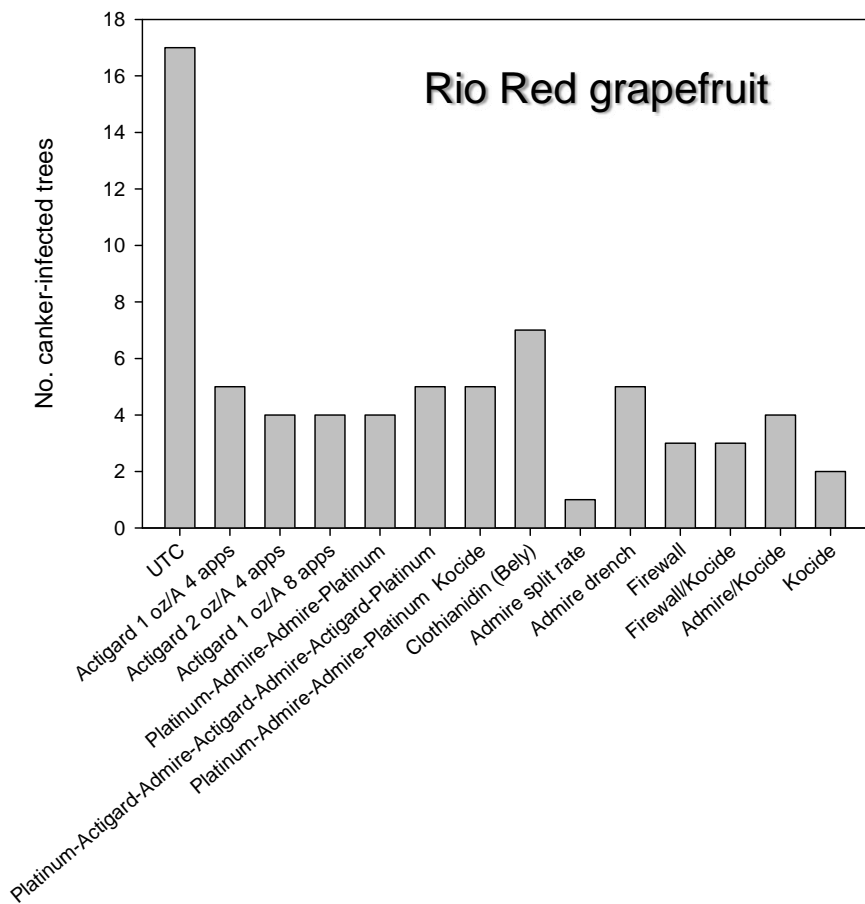
Comparison of soil-applied systemic acquired resistance treatments (in red) with contact sprays (in blue) on canker-infected leaves and fruit on 4 yr-old 'Ray Ruby' grapefruit trees



Actigard and neonicotinoids provide systemic control of canker inoculum on leaves protects the fruit from infection



Evaluation of combinations of SARs for young tree canker management on grapefruit and orange



Next steps for grapefruit trials

- Compare residual activity of copper formulations and Magna Bon on and inside the rind of grapefruit (Is copper systemic?)
- Continue evaluation of nano-silica formulations (Santra-UCF)
- Continue evaluation of combinations of SARs for young tree canker management including trunk applications on fruiting trees
- Evaluate inoculum reduction by hedging and defoliation for grapefruit