

# **‘Biofumigation’ potential of mustards**

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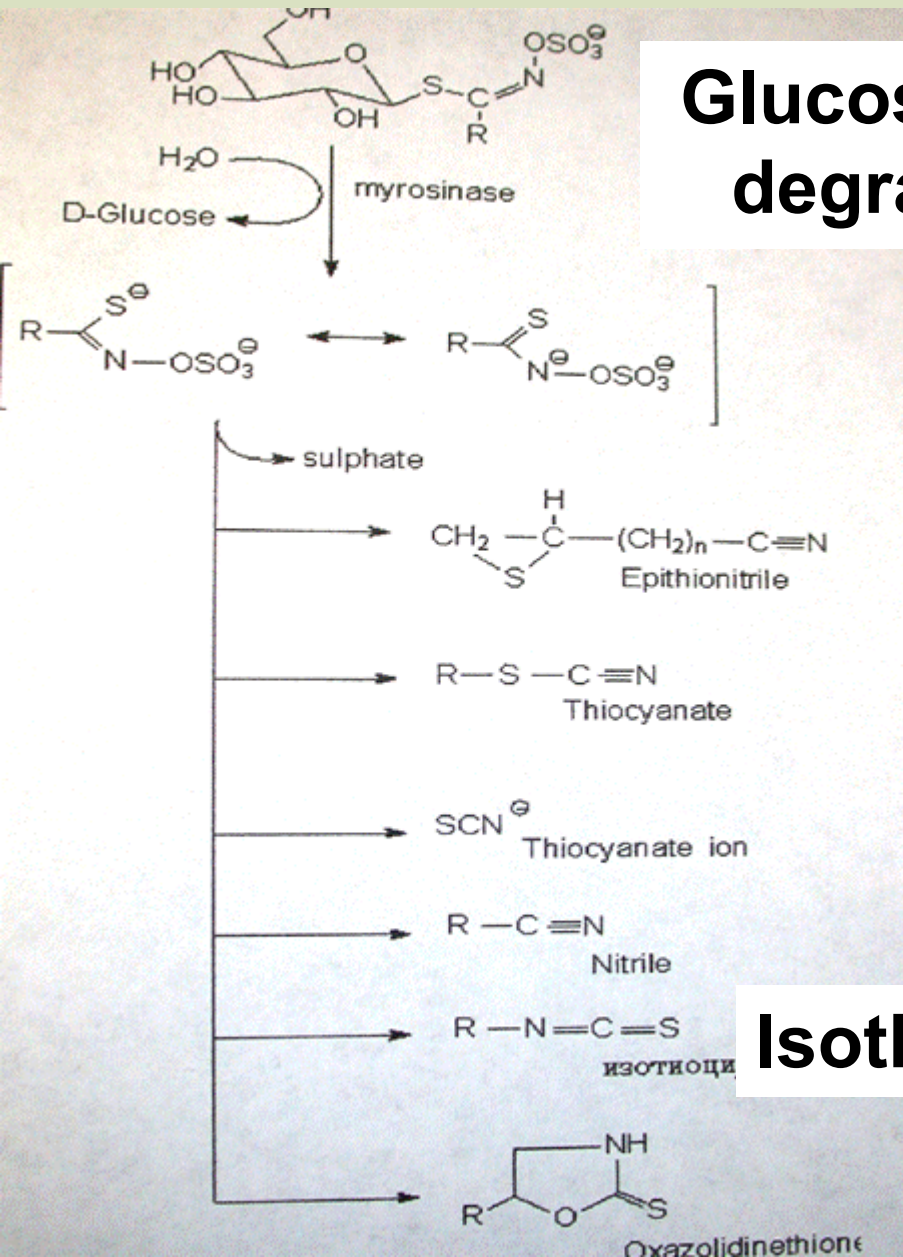
# Mustards: *Brassicaceae* family

- Excellent weed competitors
- Taproot breaks compaction
- Abundant fast-degrading biomass
- Drought tolerance, plasticity
- Support bees and natural enemies
- Contain allelochemicals



# Pick your active ingredient

## Glucosinolates (GSL-s) degradation



## Isothiocyanates (ITC-s)

# ITC-s

- Methyl ITC (active ingredient of Metham Sodium/Vapam)
- Allyl-ITC
- Phenyl-ITC

## And other S – containing

- Dimethyl sulfide
- Methanethiol
- Unidentified

# **Methyl ITC (a. i. of Metham Sodium, Vapam)**

- Vapam at 75 gal/ac → 252 lb/ac ITC
- It will take **250 000 lb/ac** of dry biomass of mustard (at ITC conc =1000 mg/kg) to match this
- Mustard in Ventura Co. produces **20-25,000 lb/ac (10%)**
- Australia: **25%**

# Biofumigation

<b>Green biomass</b>	<b>Seed products</b>
High amounts of C and water	High C, 5% N
Low concentration of GSLs	High concentration of GSLs
Cheap – can be grown locally, need time to grow	Available from seed processors, often in Canada and PNW, \$

# **Biomass:**

## **How to make mustard ITC-s work for you?**

- 1. High initial GSL concentration in plant**
- 2. Break cells = release**
- 3. Minimize losses = wet soil (aid hydrolysis)**

# Studies near Santa Paula, CA

## 5 treatments

- Faba/Bell bean
- Cereal mix
- Oriental mustard
- Yellow mustard
- Bare ground (control)



# Breaking cells



# Permeable bags with:

- Citrus Nematodes
- Sclerotinia minor
- Weed seed:
  - Burclover,
  - Annual ryegrass,
  - Red root pigweed

**Buried at: 12”**



**1.4" water:**  
**to trap and hydrolyze**



# Strawberry pathogens and weeds

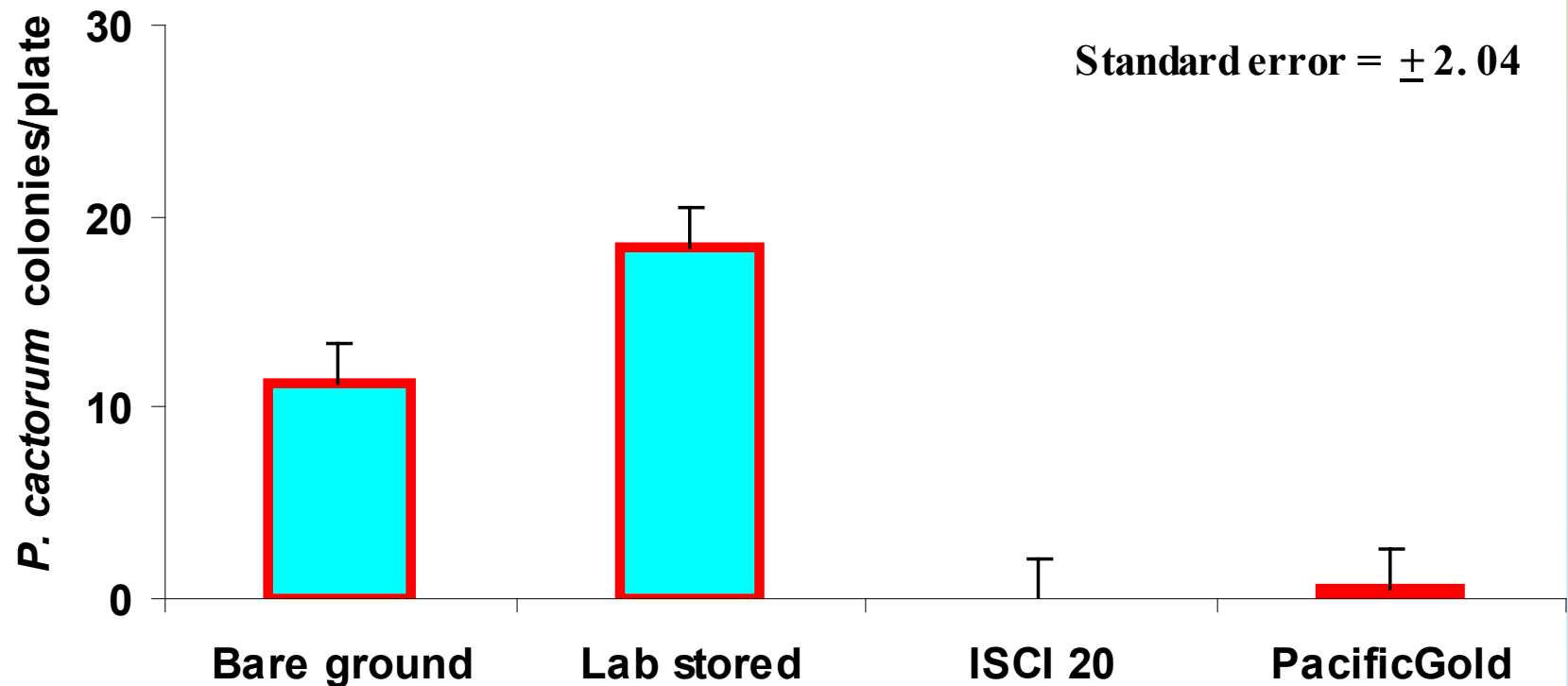
At 15 and 30 cm (6 and 12")



- **Phytophthora (*P. cactorum*)**
- **California burclover, little mallow, goosefoot**
- ***Verticilium dahliae* soil samples**

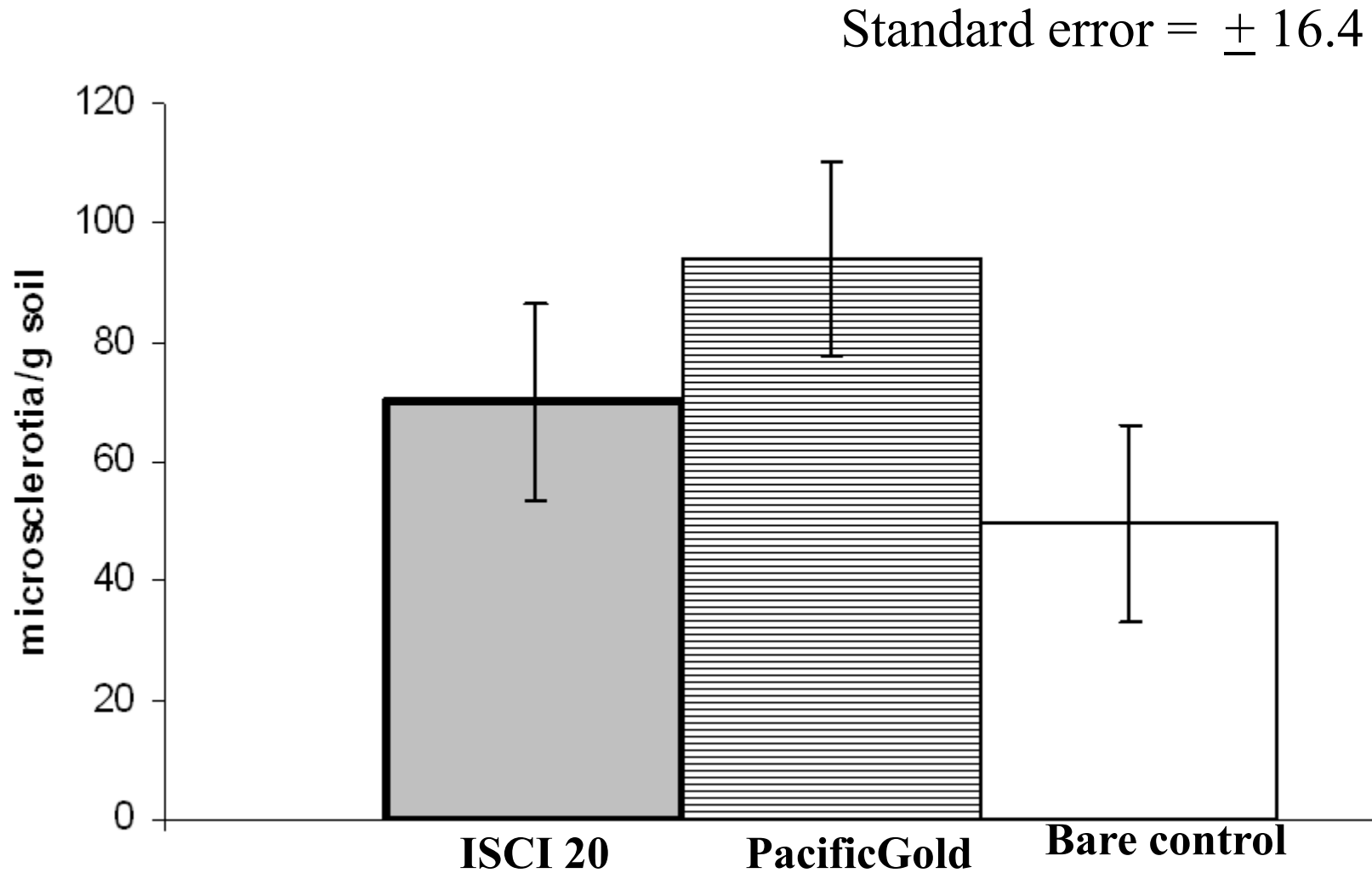
# Phytophthora: depth of burial – no effect

## *Phytophthora cactorum* survival following biofumigation



Severe overgrowth with *Pythium* spp. after mustards

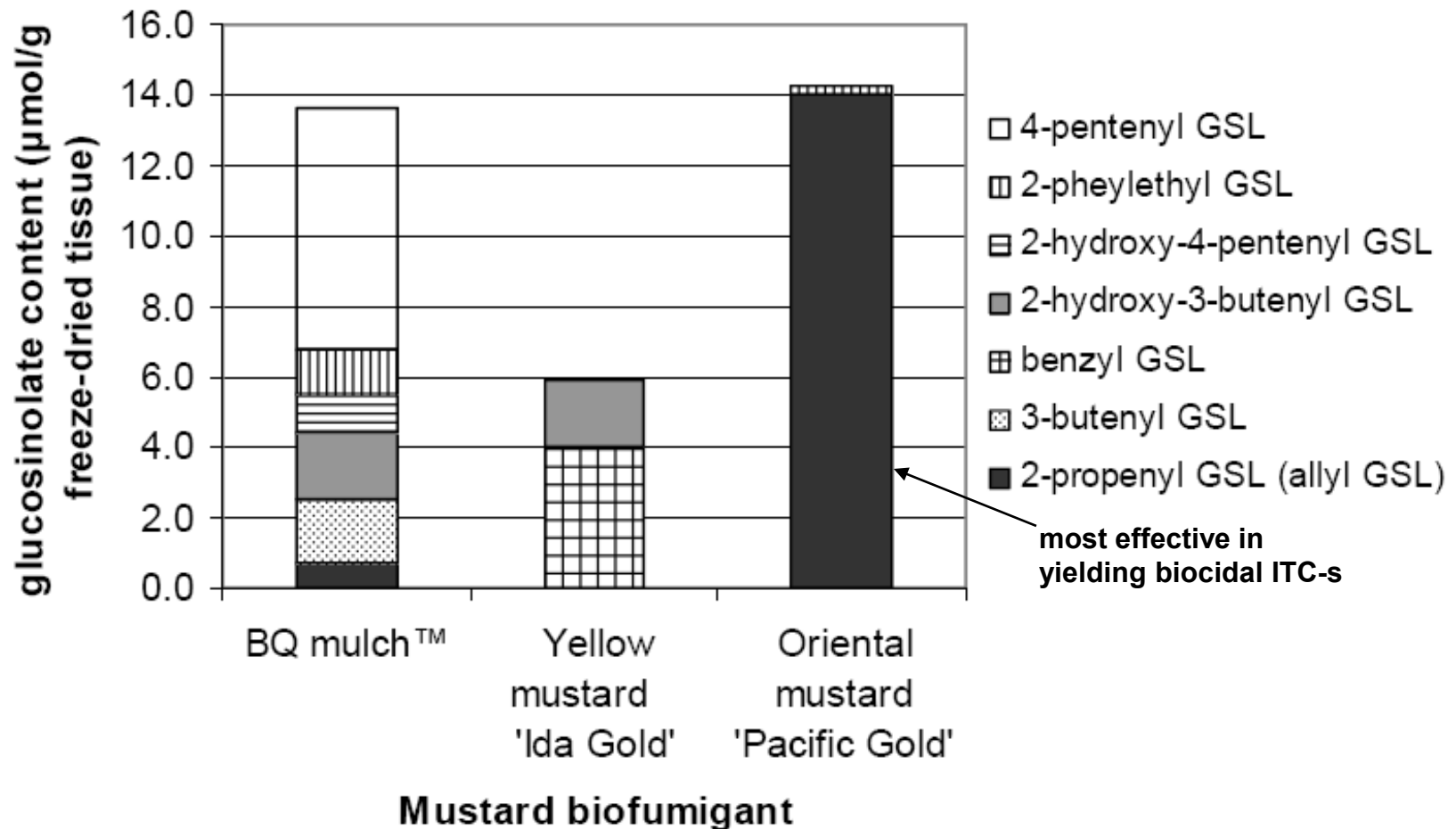
# *Verticillium dahliae* in soil following biofumigation



# Changes in microbiological activity

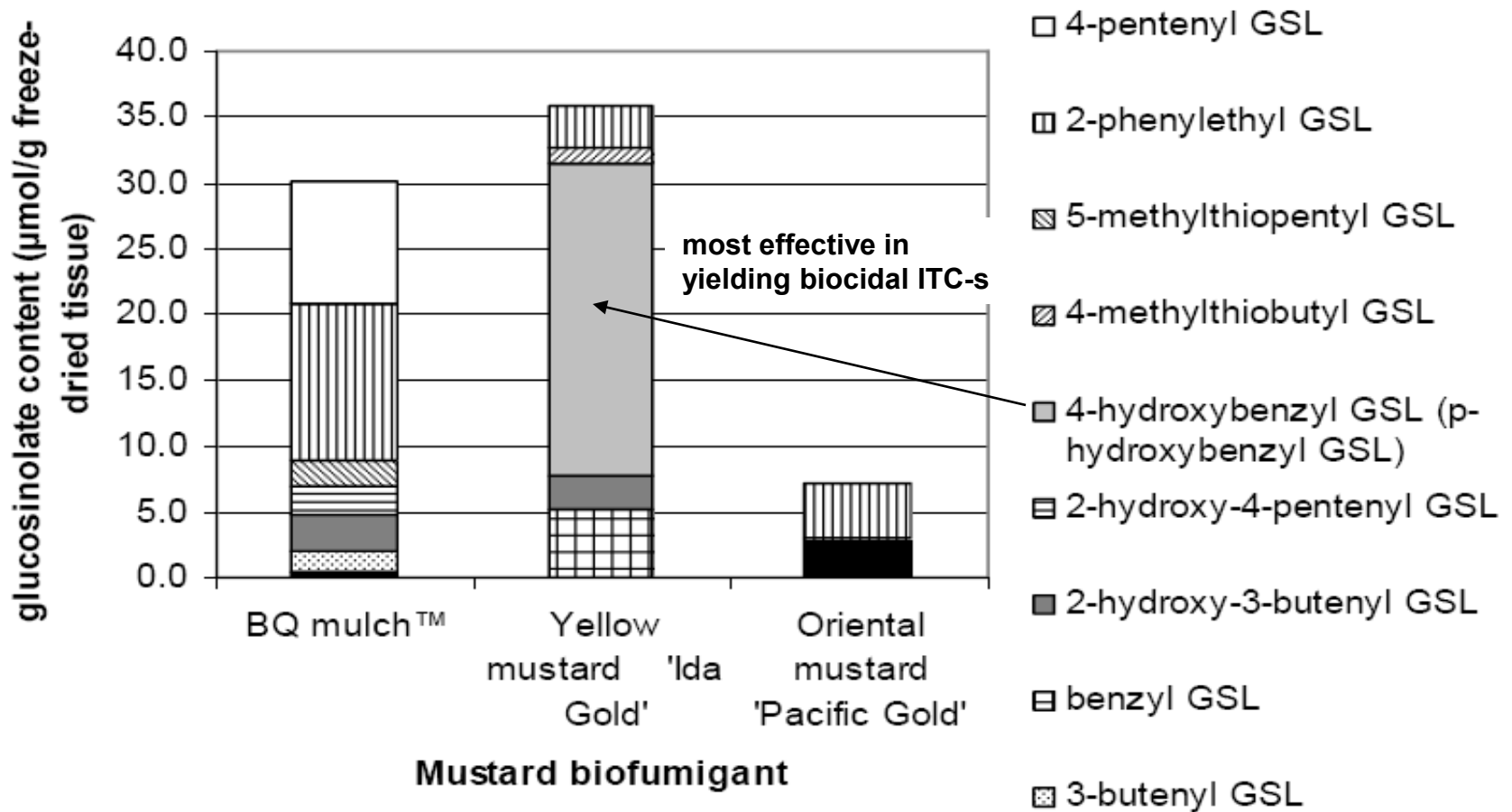
Factor	Soil microbial activity ( $\mu\text{g}$ fluorescein hydrolyzed per g soil per h)
Cover crop ( $P < 0.0001$ )	
Bareground	0.084 bc
Bell bean	0.163 bc
Triticale	0.662 ab
'BQ Mulch' <sup>TM</sup>	0.754 a ←
'Ida Gold'	0.933 a ←
'Pacific Gold'	1.023 a ←
Residue ( $P = 0.07$ )	
1x	0.513 b
2x	0.694 a ←

# Composition of glucosinolates: above-ground





# Composition of glucosinolates: roots



# Mustard seed meal

Treatment	Rate/ description	Weed densities No. (1,000/Acre)	Albion ----- g/plant -----	Ventana
1. Untreated	0	1,322 a	542.6	699.3
2. MBPic 67:33	350 lb/A	49 d	784.2	877.4
3. Steam	70°C 30 min.	29 d	775.0	1017.3
4. Muscodor	2000 lb/A	261 cd	518.7	629.4
5. Brassica meal	2000 lb/A	822 b	743.3	996.8
6. Furfural	600 lbs/A	702 bc	872.7	640.0
7. Fludio. + Ridomil	1 pint + 0.5 lb/A	432 bcd	572.3	863.5
8. Stabilized Urea <sup>1</sup>	300 lbs/A	374 bcd	619.8	651.0
9. Steam+ AgroThrive	70°C 30 min. + 150 lb/A	12 d	648.1	889.9
10. AG3 (NP)	75 GPA	776 b	418.8	598.9
LSD (P=.05)		500	298.0	351.0
Treatment Prob.		0.0001	0.094	0.128

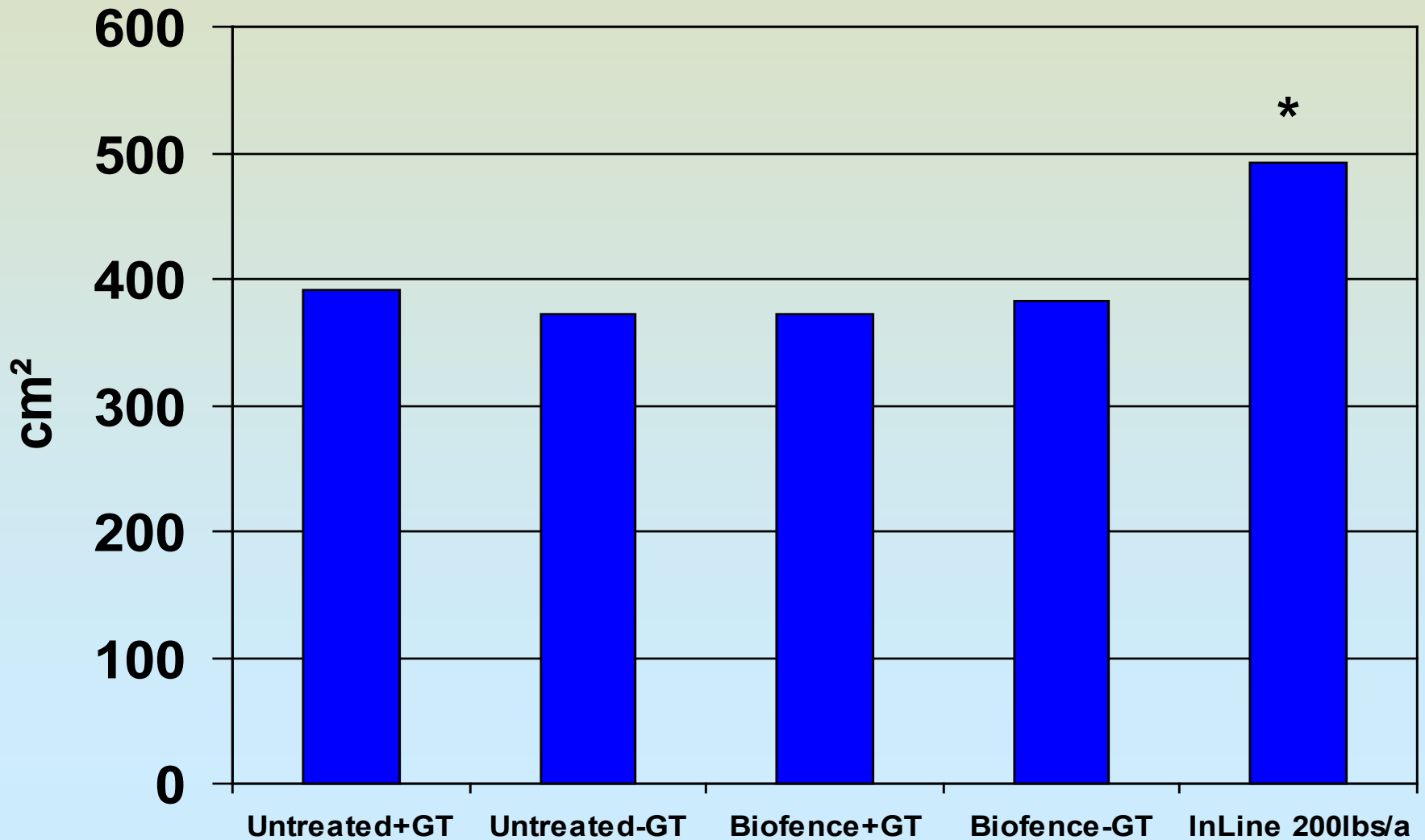


Oxnard,  
2009-10

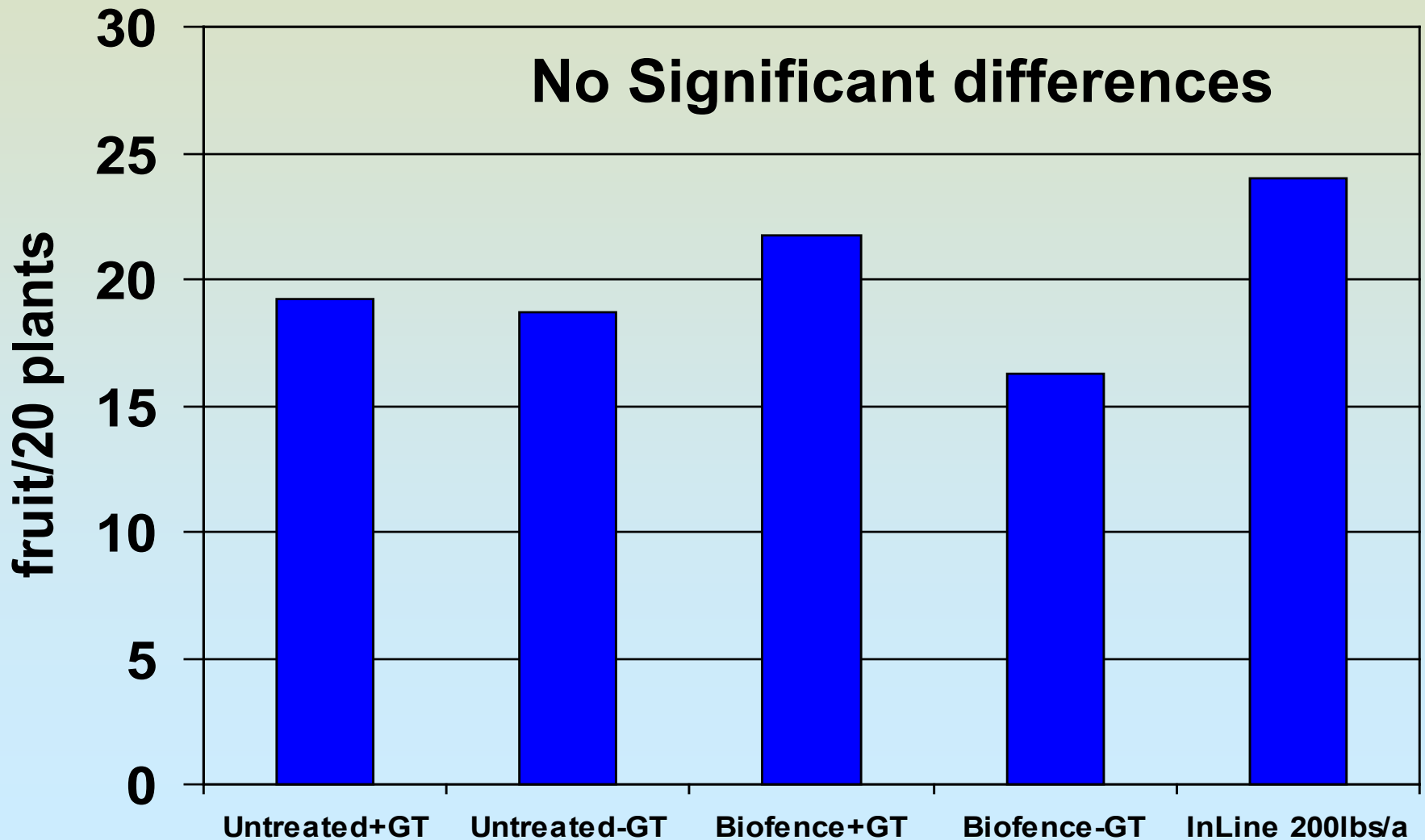
2,000 lbs/a



# Plant diameters, 7 Jan., 2010



# Red fruit counts, cumulative of 2 picks, Feb. 2010



# **No significant differences between Biofence and untreated control in:**

- **Plant mortality,**
- **Weed number**

24 Dec., 2010

# **Use of Brassica seed meal products:**

- **How much to apply to get the effect?**
- **Is it feasible?**
- **Effect on known soil pathogens?**