NONFUMIGANT STRAWBERRY PRODUCTION ACTION PLAN

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THE NONFUMIGANT COMMITTEE – GILROY AUG. 8 & 9, 2012

ACTION PLAN PROCESS

- ❖Live meetings Gilroy, August 2012 and Sacramento Oct. 2012.
- ❖There have been conference calls to maintain communication and move the process along.
- ❖Many phone calls, emails and edits have been made.
- ❖This action plan has inputs from 10 members and many constituents.
- ❖The action plan is still a work in progress.

CALIFORNIA STRAWBERRY FRUIT PRODUCTION

- History of fumigation in California strawberry
- Strawberry production
- Soil pests
- Discovery
- Research and Evaluation
- Adoption and Demonstration
- Summary

FUMIGANT HISTORY

- ❖Methyl bromide/chloropicrin introduced commercially in 1960, widely adopted by 1965.
- ❖Fumigation controls most soil pests, allowing strawberry breeders to concentrate on “fruit production and quality”.
- ❖Fumigation allowed yields in the 1950s at 5-6 tons/A to rise to 22 tons/A in the late 1970s & 36 tons/A in 2012.

Wilhelm & Paulus 1980,
NASS 2013

FRUIT PRODUCTION ZONES

STRAWBERRY ACREAGE BY REGION AND PLANTING SEASON

Area	Fall	Summer	Total
Orange, San Diego	1,446	0	1,446
Oxnard	9,075	2,567	11,642
Santa Maria	8,557	1,192	9,749
Watsonville/ Salinas	15,377	5	15,382
San Joaquin Valley	153	0	153
Total	34,608	3,764	38,372

CSC acreage survey 2012

PRODUCTION STEPS – FLAT FUMIGATION

- ❖Soil preparation
- ❖Fumigation (flat fumigation)
- ❖Bed listing
- ❖Installation of the drip tape, fertilizer, plastic mulch
- ❖Transplanting
- ❖Plant establishment
- ❖Harvest season

SEQUENCE OF EVENTS

Flat fumigation – fumigate before listing

PRODUCTION STEPS – DRIP FUMIGATION

- ❖Soil preparation
- ❖Bed listing
- ❖Installation of the drip tape, fertilizer, plastic mulch
- ❖Fumigation (drip fumigation)
- ❖Transplanting
- ❖Plant establishment
- ❖Harvest season

SEQUENCE OF EVENTS

Drip fumigation – fumigate after listing

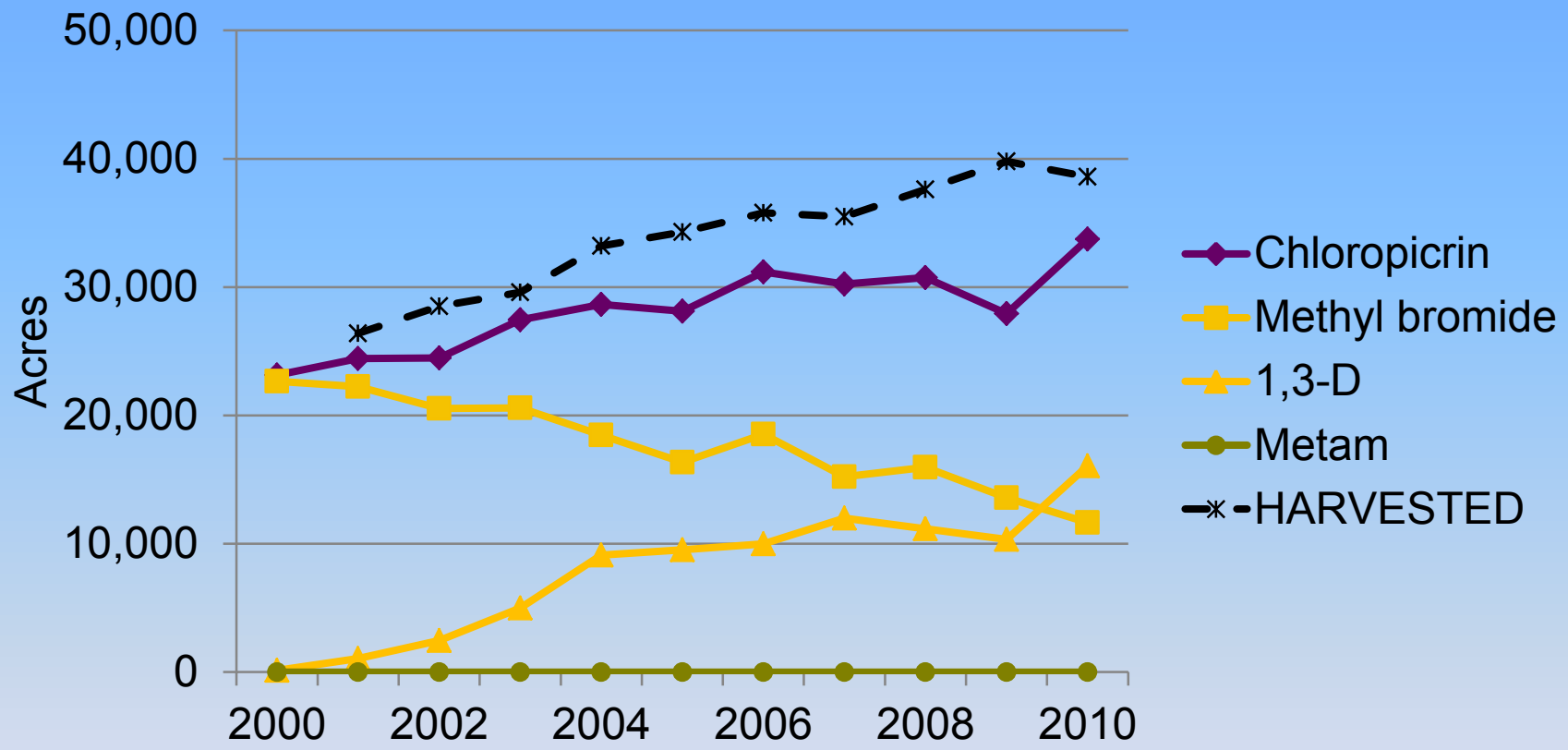
MAJOR SOIL PESTS

- ❖Verticillium dahliae
- ❖Phytophthora spp.
- ❖Pythium spp.
- ❖*Macrophomina phaseolina*
- ❖Weeds

BENEFITS OF FUMIGATION

- In a large number of trials Shaw and collaborators observed 94% higher strawberry yields in MBPic fumigated soils compared to NF (Shaw et al. 1999).
- In individual trials we have generally observed a >80% increase in strawberry yield in fumigated treatments vs. non fumigated treatments (Fennimore and Ajwa 2011).
- Strawberries are rotated with crops like lettuce to suppress diseases of lettuce like lettuce drop (*Sclerotinia minor*). In Monterey County alone this disease causes $32 million in annual losses to lettuce (Fennimore unpublished).

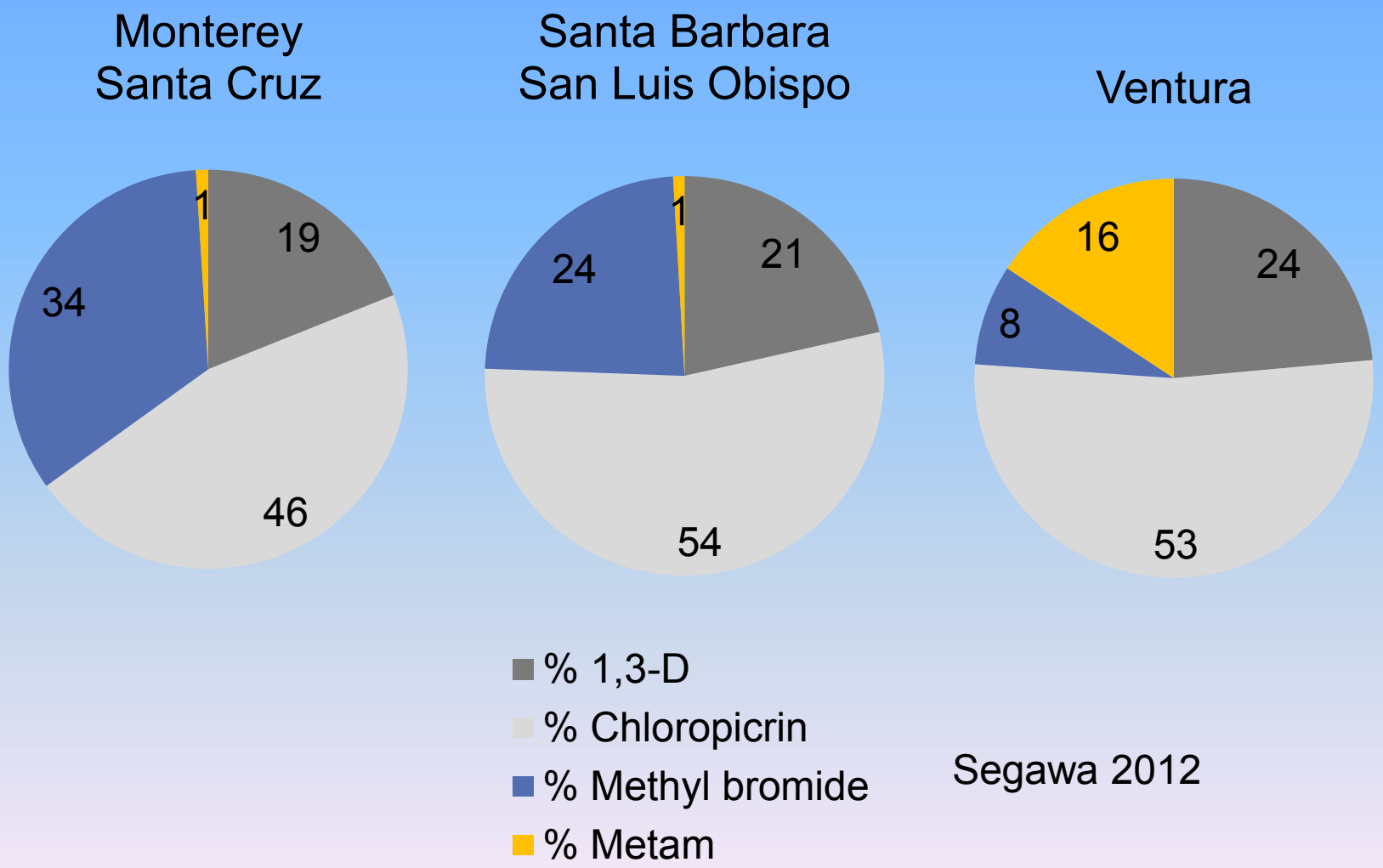
STRAWBERRY FUMIGANT USE – ACRES*



*Fumigant use based on treated acres reported

Segawa 2012

STRAWBERRY FUMIGANT COMPARISON BY REGION (% OF POUNDS IN 2010)



Segawa 2012

NONFUMIGANT PRODUCTION

- A transition to a largely nonfumigant strawberry production system will be much more complex and challenging than the transition that was made in the early 1960s from nonfumigant to fumigant production.
- Currently land, labor and material costs are much higher and so the economic risks are much higher.

I. DISCOVERY – PLANT BREEDING

- ❖Breed for genetic resistance
- ❖Screen for resistance to major California strawberry diseases – a long term solution?
- ❖ Identify markers associated with disease resistance genes – marker assisted selection
- ❖Try grafting as a method of enhancing disease resistance.

I. DISCOVERY: BREEDING FOR VERTICILLIUM RESISTANCE

- Breeding for increased resistance is being conducted by the University of California and private breeders. See Shaw et al. 2010 California Agriculture 64:37-41.
- Thus far Verticillium wilt tolerance in strawberry is not adequate.

SCREENING FOR VERTICILLIUM RESISTANCE – UC BREEDING PROGRAM

Since 1994, the UC strawberry breeding program has screened more than 480 genotypes for *V. dahliae* resistance. *Left*, a resistant cultivar; *right*, a susceptible breed.

Shaw et al. 2010

TUBE GRAFTING IN TOMATO TO ENHANCE DISEASE RESISTANCE

Tube Grafting (Source: Rivard and Louws, 2006)

I. DISCOVERY – MANAGE SOIL HEALTH

- **Identify & evaluate soil microorganisms that influence strawberry plant health.**
- **Explore how soil microbial ecology is influenced by the cropping environment.**
- **Develop treatments for managing soil microbial populations.**
  - Anaerobic soil disinfestation (ASD)
  - Brassica seed meals
  - Cover crops & composts

I. DISCOVERY – DEVELOP PRODUCTION PROTOCOLS

- ❖Track soil microbial community change over time in nonfumigated fields
- ❖Crop rotation research – eg. strawberry to vegetables
- ❖Evaluate plant nutrient and water-use strategies that promote disease tolerance.
- ❖Develop methods to map and predict disease pressure.

II. RESEARCH AND EVALUATION – FOCUS AREA 1. IMPROVE VIABILITY OF MANAGEMENT OPTIONS

- Strawberry production in substrates
- Biological pesticides
- Anaerobic soil disinfestation (ASD)
- Soil disinfestation with steam
- Solarization for soil disinfestation

II. RESEARCH AND EVALUATION – STRATEGY REVIEW

- Pest Exclusion
  - Strawberry production in substrates
- IPM soft pesticide approach
  - Biological pesticides
- Soil disinfestation
  - Anaerobic soil disinfestation (ASD)
  - Soil disinfestation with steam
  - Solarization for soil disinfestation

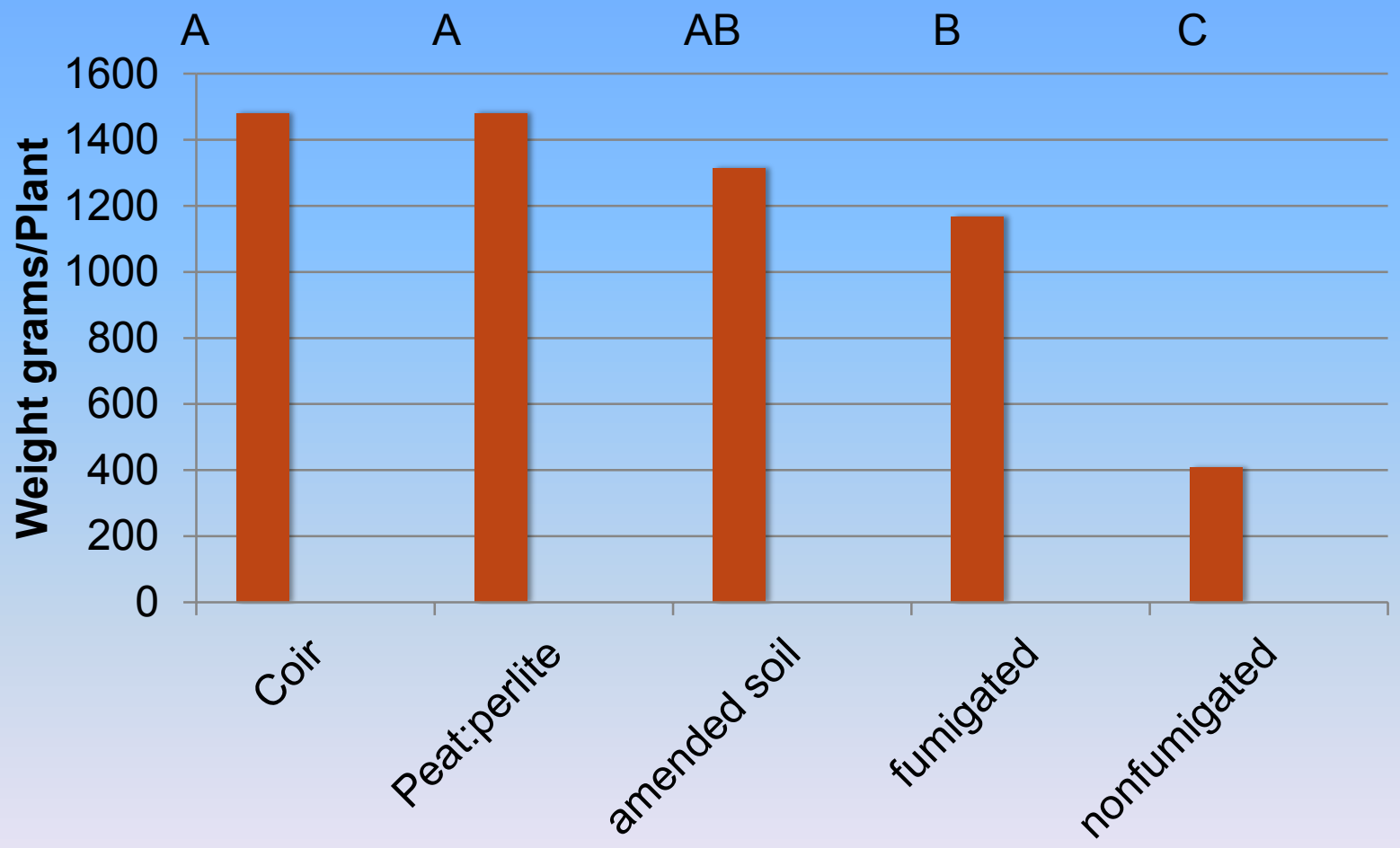
SUBSTRATE PRODUCTION IN SANTA MARIA

one

two

three

SUBSTRATE MARKETABLE FRUIT WATSONVILLE 2010-11



Scaling up

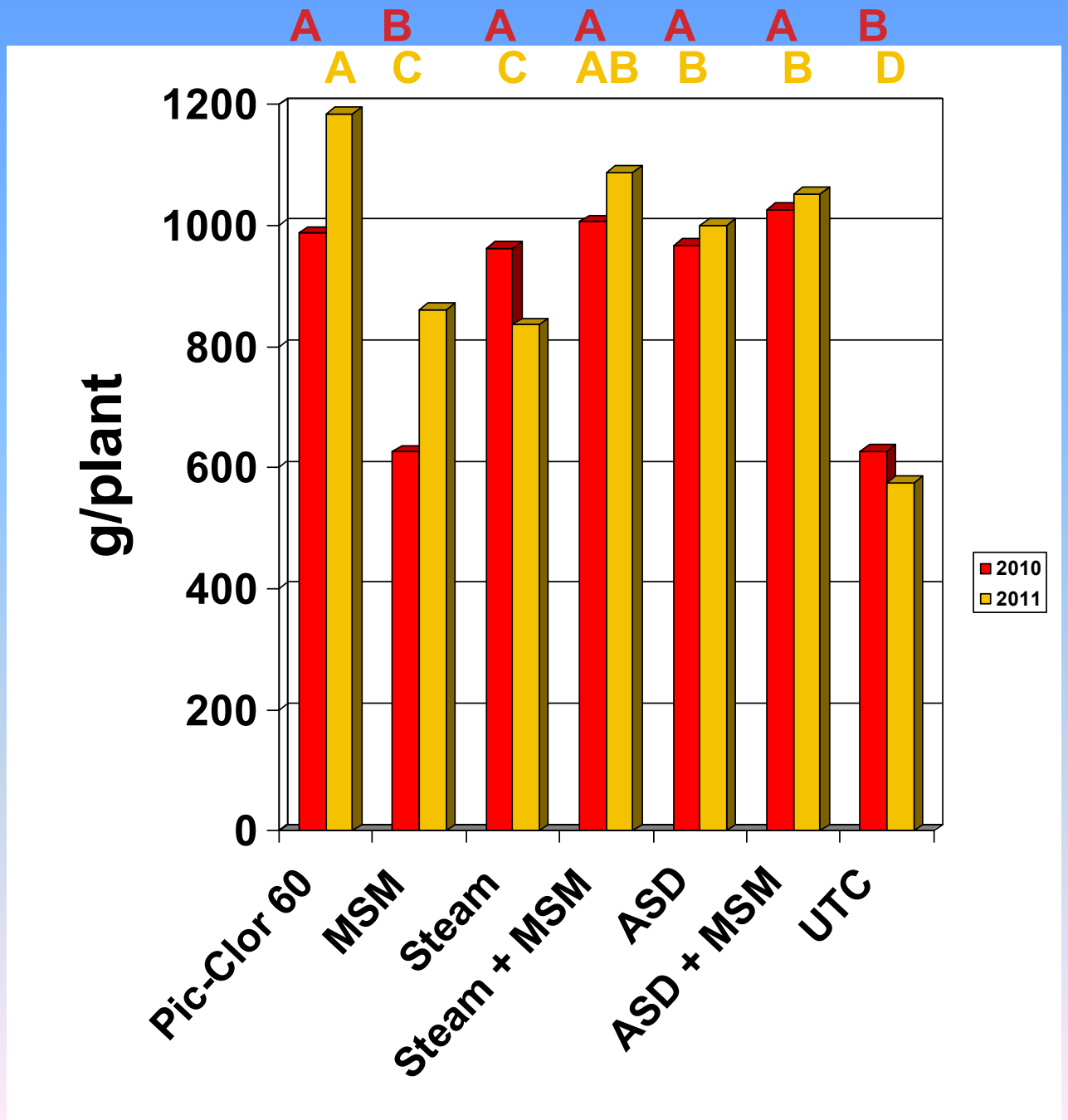
ASD MOLASSES INJECTION 2012 AT SALINAS

Strawberry plants April 19, 2011
Ventura County

ASD 3 weeks/clear **Untreated/clear**

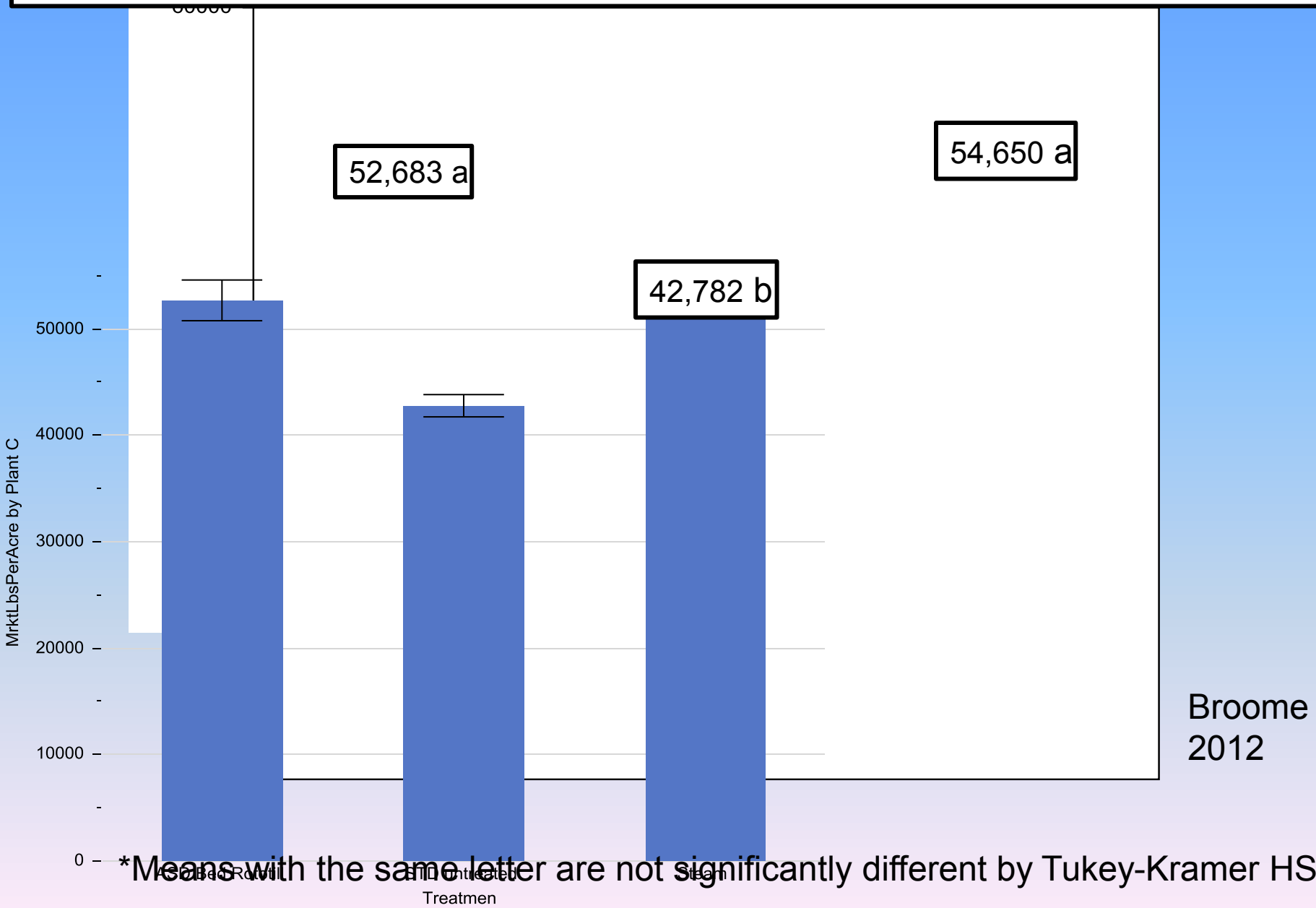
9 ton/ac rice bran used in ASD

Strawberry Yield Watsonville 2010-12



STEAM APPLICATION- WATSONVILLE SEPTEMBER 2012

Proprietary Variety 273M171 Organic Marketable Yield 2012 Watsonville



*Means with the same letter are not significantly different by Tukey-Kramer HSD.

II. RESEARCH & EVALUATION: FOCUS AREA 1. IMPROVE VIABILITY OF MANAGEMENT OPTIONS

- **Increase scale of research**
  - Large-scale on farm research
- **Develop mechanical equipment to support nonfumigant options**
  - Engineer machinery to facilitate the implementation of non-fumigant production systems
    - Substrates
    - Steam
- **Explore geographical and temporal limitations for strawberry production**
  - Can the geographical range of strawberry be expanded?

II. RESEARCH & EVALUATION: FOCUS AREA 2. INTEGRATE NF SYSTEMS WITH IPM PRACTICES

- **Improve understanding of nonfumigant options + IPM practices**
  - Removal of old plants from field to reduce inoculum load
  - Crop rotations
  - Use of soil amendments such as mustard seed meals

- **Explore IPM practices that combine fumigant and nonfumigant options**
  - Combine fumigant use in high disease pressure areas with non

II. RESEARCH & EVALUATION: FOCUS AREA 3. PROMOTE COLLABORATION

- **Develop venues designed to foster collaboration between growers and researchers to develop nonfumigant options.**
  - Meetings and workshops focused on collaboration
- **Increase number of field facilities focused on collaborative strawberry research.**
  - There are very limited field research facilities in strawberry production districts.
  - Eg. link CalTrans land funding to research stations
- **Promote collaborative research**
  - Link grant funding to interdisciplinary collaboration
- **Fund more research and extension positions to develop nonfumigant production systems**

III. ADOPTION AND DEMONSTRATION

- ❖Focus area 1. Ensure rapid & effective communication of information on nonfumigant alternatives
- ❖Focus area 2. Develop approaches to mitigate risk
- ❖Focus area 3. Encourage early adoption of nonfumigant production systems

III. ADOPTION AND DEMONSTRATION: FOCUS AREA 1. OUTREACH & INFORMATION DELIVERY

- ❖Ensure rapid dissemination of information on nonfumigant alternatives
- ❖Develop information on economics and efficacy of nonfumigant production systems
- ❖Create a comprehensive producer-oriented online resource
- ❖Expand on-farm training and education opportunities for growers
- ❖Network and collaborate with public and private groups that support growers

III. ADOPTION AND DEMONSTRATION: FOCUS AREA 2. RISK MITIGATION

- ❖We must recognize the risk of significant losses to growers that adopt nonfumigant production practices.
- ❖Appropriate incentives and protections are needed to protect growers from the risk of catastrophic loss.

III. ADOPTION AND DEMONSTRATION: FOCUS AREA 2. RISK MITIGATION PRIORITY ACTIONS

- ❖Ensure that growers know about grant and incentive programs for nonfumigant systems
- ❖Explore opportunities to cover nonfumigant pest management under crop insurance

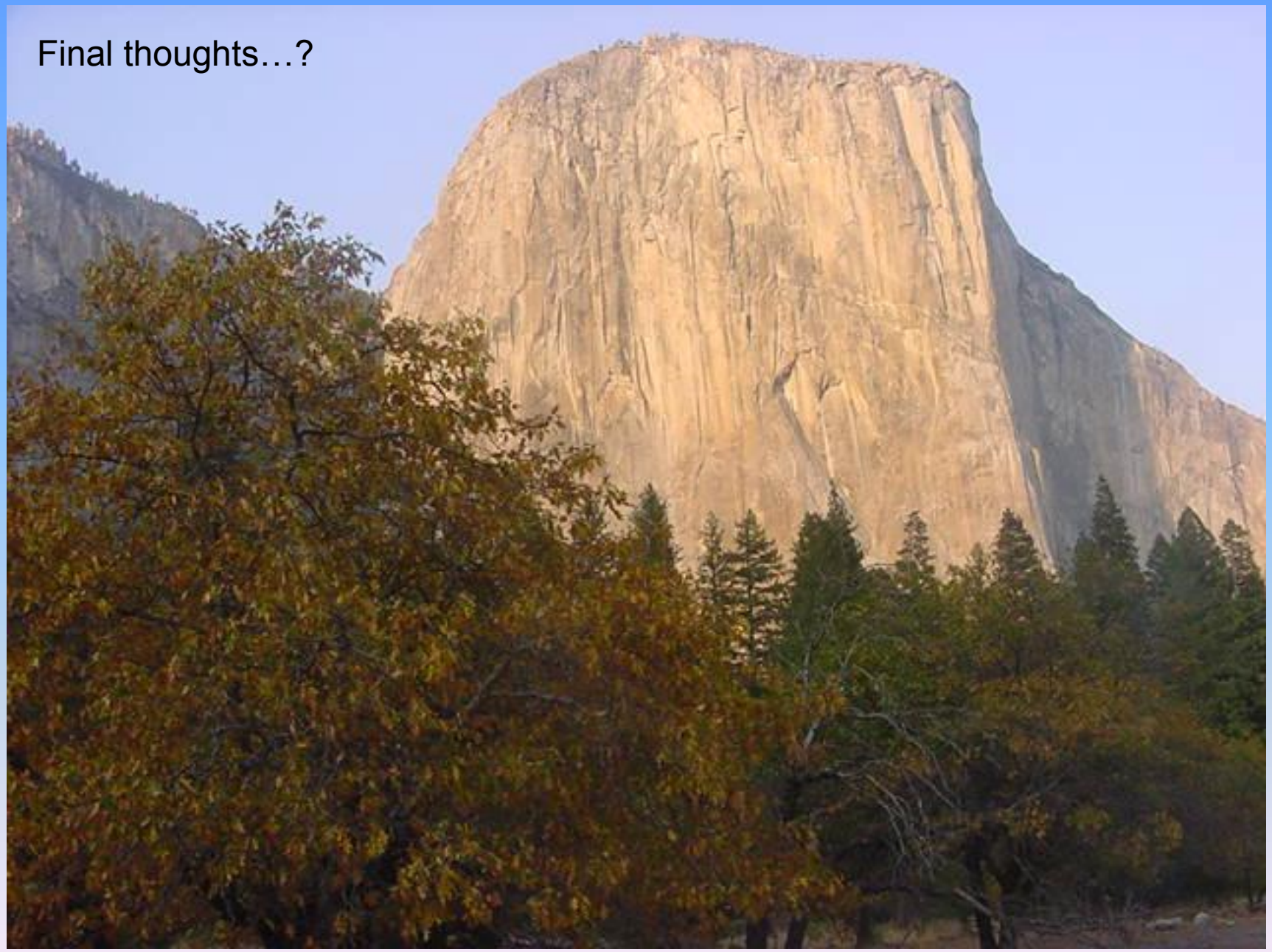
III. ADOPTION AND DEMONSTRATION: FOCUS AREA 3. ENCOURAGE EARLY ADOPTERS

- **Identify regions with many early adopters**
  - Organic producers
  - Producers in areas with many sensitive sites
- **Develop strategies to promote nonfumigant options among early adopters**
  - Organic certifiers
  - Pest control advisors
  - County agricultural commissioners
- **Track progress of early adopters**
  - Monitor yields, costs and acreage of practices

SUMMARY

- Conversion of even a fraction of the California strawberry industry to nonfumigant systems is a significant commitment that will take time and money to implement.

STRAWBERRY PRODUCTION: CLOSING COMMENTS

- ❖Strawberry is an extremely expensive crop to establish.
- ❖Growers like fumigants because they are dependable and reduce the risk of catastrophic crop loss to soil pests.
- ❖Growers will not voluntarily adopt alternative practices until they understand the risks.
- ❖Alternative practices must have manageable risks that allow the grower to remain profitable.
- ❖Focus on solutions that make sense for California.

Final thoughts…?