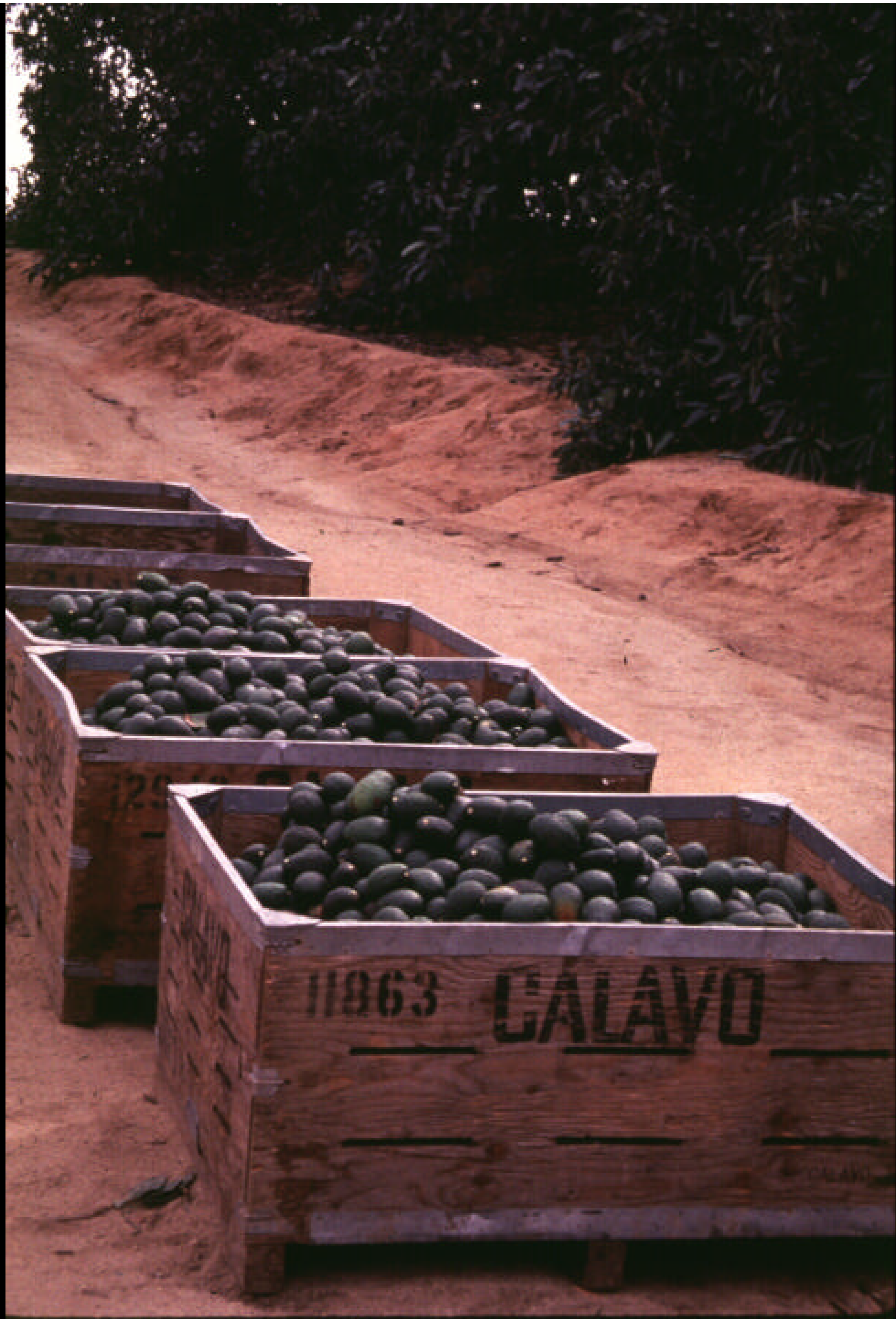
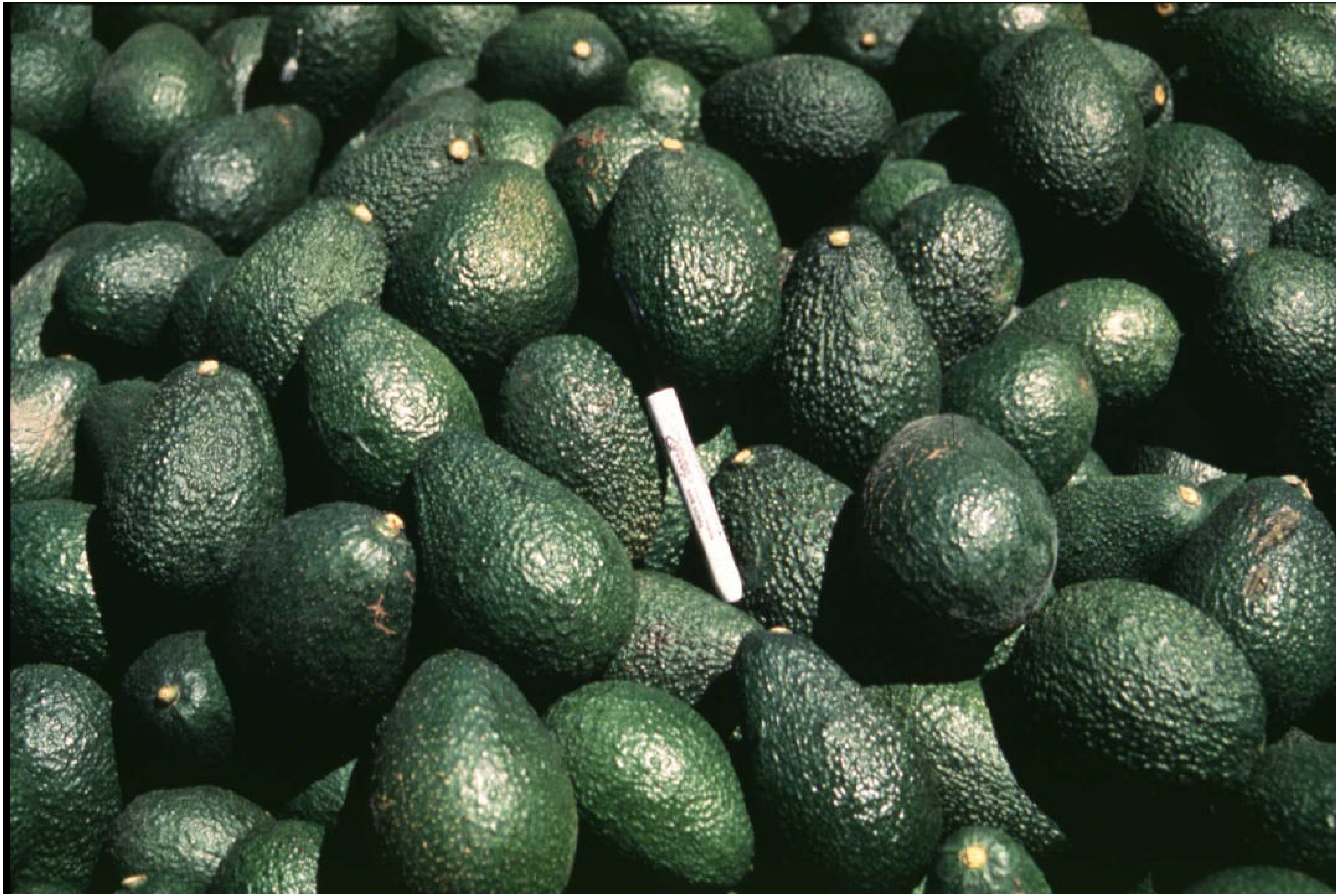
DEVELOPMENTS IN PLANT GROWTH REGULATOR USE IN AVOCADO PRODUCTION

MANIPULATION OF AVOCADO GROWTH, FLOWERING AND FRUITING

Avocado production is a commercial enterprise that is supposed to produce a net income for the grower. Thus, my goal as a researcher is the same as your goal as a grower – to maximize yield and optimize fruit size and quality and increase net grower return.


11863 CALAVO



Because I am a plant physiologist, I try to achieve this goal by learning how to regulate flowering, fruit set and fruit development. The initial research of my lab was to develop strategies using foliar fertilization to increase fruit set, size and quality, because foliar fertilizers are inexpensive and safe to humans and the environment. In cases where we have been unable to meet our goals with foliar fertilizers, we have employed plant growth regulators.

Goal

Develop strategies to increase fruit set, size and quality.

1) Foliar fertilizers

2) Plant growth regulators

PGRs in Citriculture: World Current Uses

Manipulation of flowering	PGR
• early bud break	BA
• reduced flowering	GA_3

PGRs in Citriculture: World Current Uses

Manipulation of fruiting	PGR
• reduced early drop	GA_3
• reduced June drop	GA_3
• reduced pre-harvest drop	2,4-D

PGRs in Citriculture:
World Current Uses

Manipulation of fruit size	PGR
• stimulate fruit growth	2,4-D
• fruit thinning	ethephon, NAA

PGRs in Citriculture: World Current Uses

Manipulation of fruit size	PGR
• early fruit color	ethephon
• delay color and rind senescence	GA_3
• fruit loosening	ethephon
• late harvest	2,4-D

PGRs in Citriculture: World Current Uses

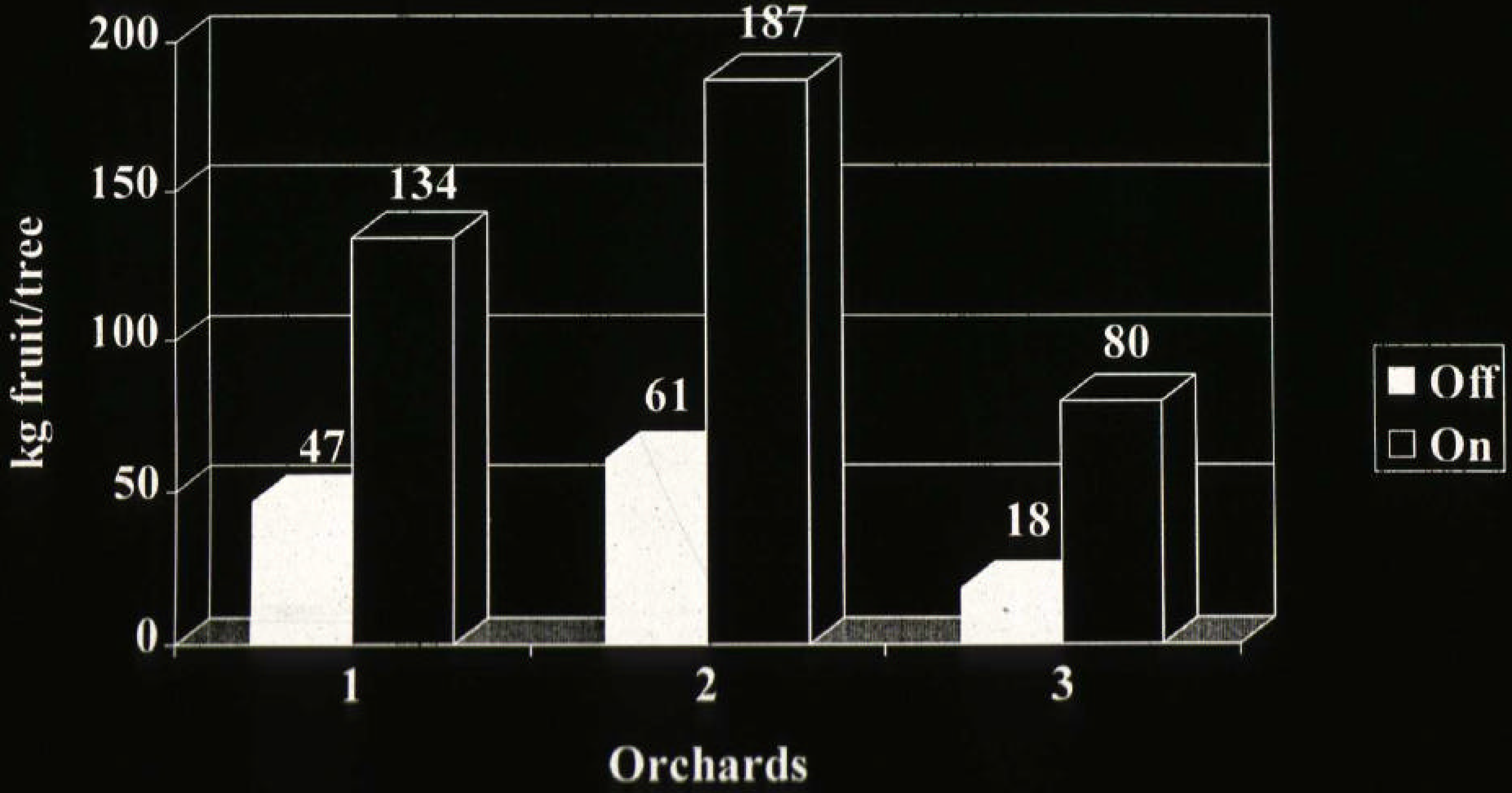
Manipulation of fruit quality	PGR
• reduce albedo breakdown	GA_3
• reduced splitting	2,4-D
• reduced pre-harvest decay	2,4-D

PGRs in Avocado Production

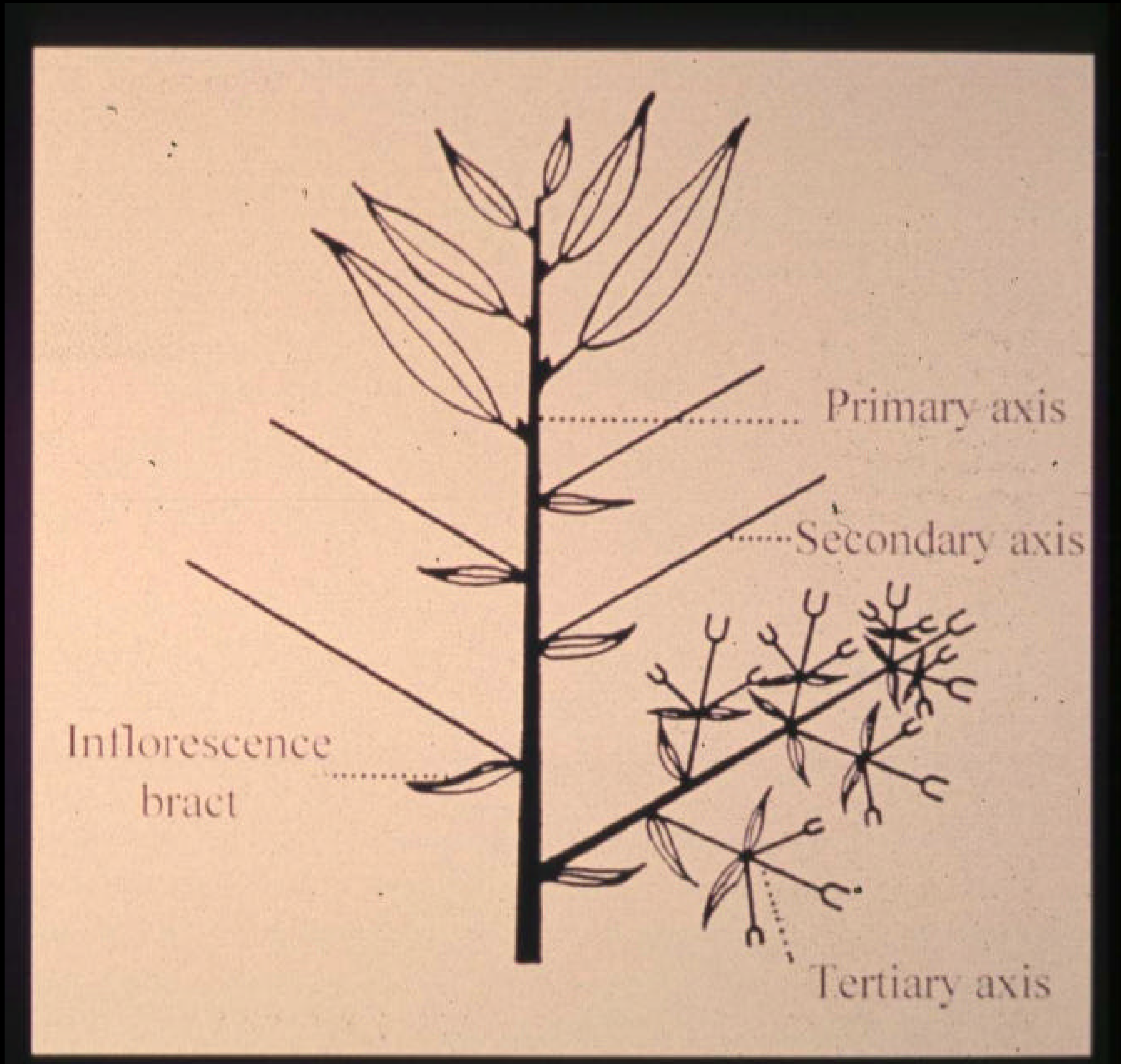
- most powerful tool currently available
- use is underdeveloped

Avocado production in California has two problems: (1) low yields and (2) extreme alternate bearing.

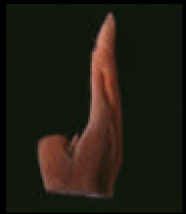
ALTERNATE BEARING



The primary, secondary and tertiary axes of an avocado floral shoot.



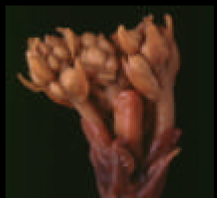
Stages of inflorescence development, and their approximate calendar dates in California, important to this talk:



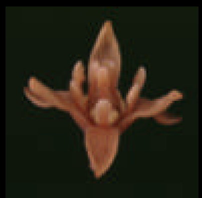
S-2 – Just after the transition from vegetative to reproductive growth (1 to 3 secondary axis meristems are present).

S-4 – The 10 secondary axis inflorescence meristems are formed; flowers are not yet formed.

S-5 – Development of flower organs on the oldest (most basal) secondary axis with tertiary axis meristems present.



S-8 – Cauliflower stage of inflorescence development; flower parts are present, final stages of pollen and ovule development are occuring



S-11 – Anthesis

Effects of GA_3 (25 mg/L)

- early bud break of apical buds
- S-2 (late July-early Aug.) spray advanced flowering
- S-4 (Nov.) spray reduced floral intensity

Effects of GA_3 (25 mg/L)

- precocious development of vegetative shoot of indeterminate floral shoots
- S-8 (March) spray increased fruit size and delayed blackening of current crop
- S-8 (March) spray increased yield and fruit size of developing crop

Effect of GA_3 (25 mg/L) on 'Hass' avocado yield (kg/tree).

Treatment	On year	Off year
Control – none	18	80
S-4, November	35	42
S-5, January	27	60
S-8, March	34	89

Effect of GA_3 (25 mg/L) on 'Hass' avocado 2-year cumulative yield.

Treatment	kg/tree	ABI (%)
Control – none	98	57
S-4, November	77	28
S-5, January	87	44
S-8, March	123	41

Effect of prohexadione-Ca (250 mg/L) on shoot growth.

Repeated treatments	Growth (cm) 30 days after application	
	Vegetative	Indeterminate
Control – none	1.1^{NS}	2.4*
S-8	1.0	2.0
Control – none	4.6*	10.7*
S-11	3.4	9.4
Control – none	3.8^{NS}	12.0**
Fruit set	3.2	9.9

Effect of Prohexadione-Ca (250 mg/L) on fruit shape (L/W).

Treatment	Control	P-Ca
S-11, April	1.38	2.08**

Effect of 6-BA (25 mg/L) on % fruit set.

Treatment	Control	6-BA
S-11, April	3	4
Fruit set, May	3	3
June drop, June	9	1*[1]

1. Fruit size (g) 94 84

Effect of AVG on % fruit set.

Treatment	Control	250 mg/L	2000 mg/L
S-11, April	3	2	2 [1, 2]
Fruit set, May	3	1	8 *
June drop, June	9	2	7

1. Reduced final yield of mature crop present at time of application.
2. Significantly increased vegetative growth.

Use of PGRs in Avocado Production

• Flowering	GA_3
• Vegetative Shoot Growth	Prohexadione-Ca, GA_3, AVG
• Fruit Set	AVG
• Fruit Size	GA_3
• Fruit Thinning	6-BA
• Increased Yield	GA_3
• Delayed Blackening	GA_3
• Alternate Bearing	GA_3
• Controlled Ripening	Ethylene

Research Needs

- Field research
- Basic research
- Tree phenology
- Application methods
- “Green” PGRs

The Future

- Molecular Research
- GMOs –
  Genetically Modified Organisms
- Inducible Promoters

Candidate Genes

Floral Genes:
LEAFY, APETALA 1, TERMINAL FLOWER

Sink Strength:
***SUSY*, sucrose synthase**

Cytokinin Biosynthesis:
Gene for 3-hydroxy-3-methylglutaryl coenzyme A reductase (HMGR)

Candidate Genes

Abscisic Acid Biosynthesis:

***NCED1*, 9-CIS-epoxycarotenoid dioxygenase**

Ethylene Synthesis:

Gene for 1-aminocyclopropane-1 carboxylic acid (ACC synthase)

Conclusion

We have a lot of work to do!

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Samuel Salazar-Garcia
samuelsalazar@prodigy.net.mx

Lauren Garner
garnerl@prodigy.net

Larry Summers

Grant Klein