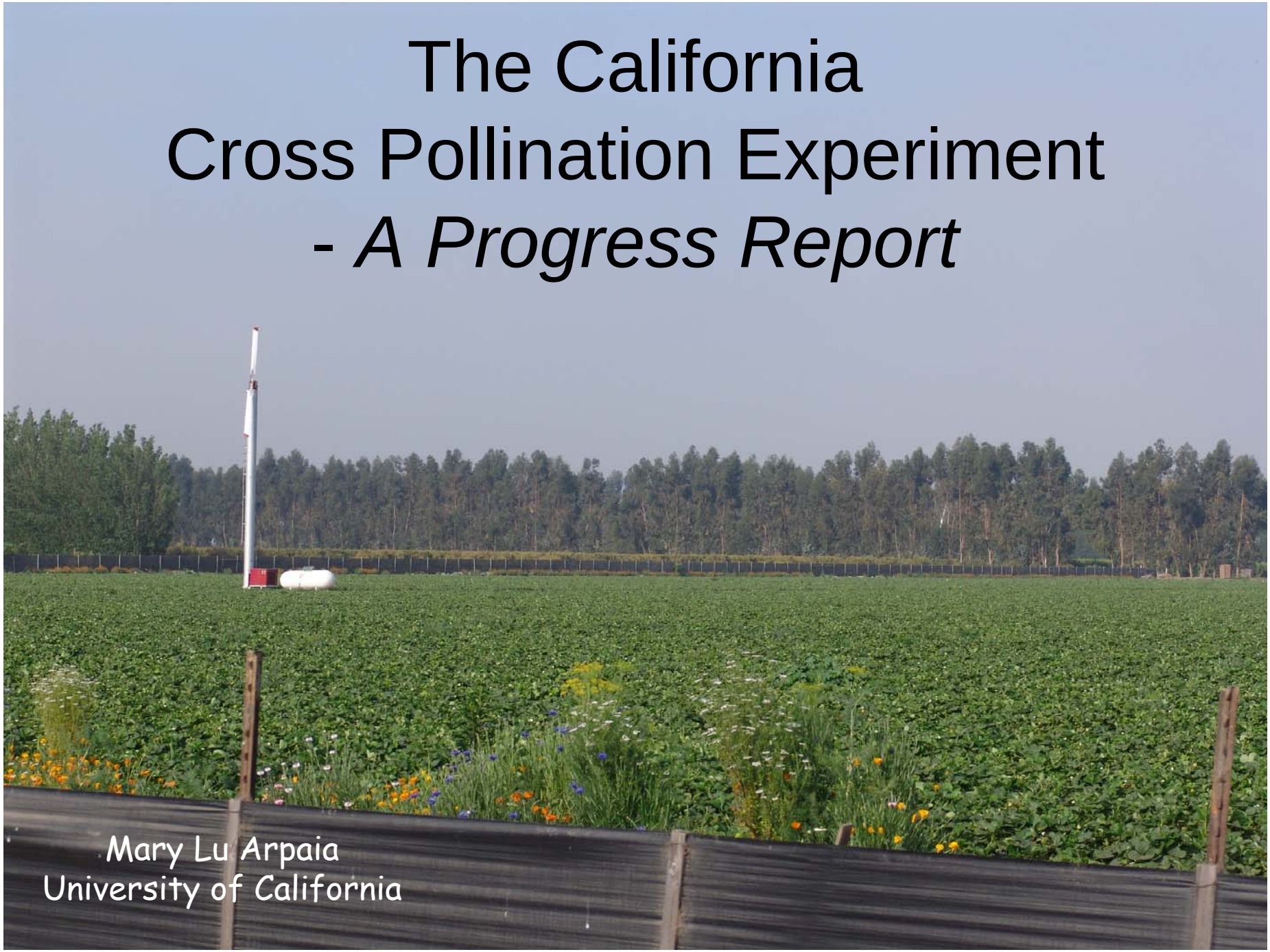
SESSION SEVEN

Session Seven
Flowering, fruit set and yield

New Zealand and Australia Avocado Grower's Conference'05
20-22 September 2005
Tauranga, New Zealand

The California Cross Pollination Experiment - *A Progress Report*



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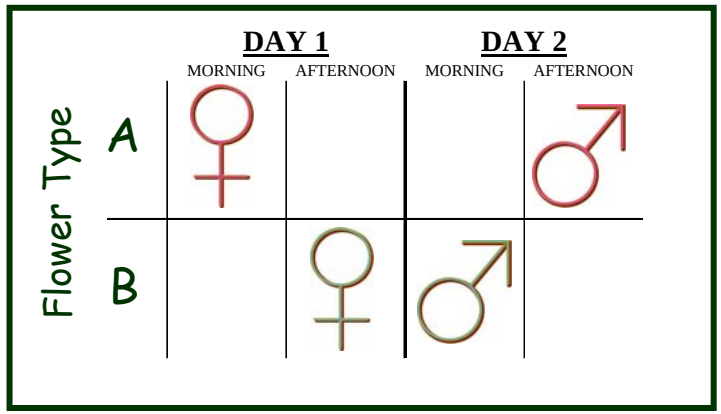
Historical perspective –
avocado pollination in
California

The early days – 1920's

- Recognition of floral dichogamy – Stout
  - A and B flower types



- Recognition of the importance of pollinators – Clark
  - Caging studies

The next steps – Bergh, Garber and Gustafson

- Recognition of proximity effects in trials looking at Fuerte fruit set as a function of distance from pollinizer varieties

- Recognition of the potential of the honeybee as a pollinator for avocados

Status by the end of 1970's

- Native vegetation – wild honeybees plentiful
- No significant use of introduced hives
- When used, growers did not pay for honeybees
- Beekeepers place hives in avocado groves following almond pollination
- Honeybees were not kept in groves for entire flowering period
- Some controversy over the need for pollinizer varieties

Steps backwards – 1980's

- The rise of Hass as the dominant variety and subsequent loss of value of "greenskins"
- The introduction of varroa mite and decimation of feral honeybees
- RESULT – Loss of pollinizers and pollinators throughout the industry

Rekindling of interest – 1980's and 90's

- Loss of productivity industry wide
- International Research focused on pollination/pollinizers
  - Sedgley – Flower stages, temperature and fruit set
  - Robbertse et al – Boron and fruit set
  - Köhne, Robbertse – pollination in South Africa
  - Davenport – flowering and pollination in Florida
  - Degani, Gazit et al – importance of cross pollination and fruit retention
  - Vithanage – visitors to avocado flowers
  - Ish-Am, Eisikowitch – honeybee behavior
  - Ish-Am, Gazit – searching for the native pollinator of avocado

Understanding and manipulating flowering and fruitset in California

Funding of research by the industry – *Focused on the Plant*

- Genetic analysis for determining outcrossing
  - Ellstrand (isozymes); Clegg (RFLP, microsatellites); Davenport/Schnell (microsatellites)
- Shifting flowering
  - Salazar-Garcia, Lovatt (Gibberellins, boron)
- Selection of new varieties as pollinizers for Hass
  - Bergh et al (SirPrize, BL667, BL516)
- Pollinizer Trials
  - Arpaia et al (DeBusschere Pollinizer Trial)

Understanding and manipulating flowering and fruitset in California

Funding of research by the CA industry – *Focused on the Pollinator*

- Honeybee visitation and other pollinators
  - Visscher and Sherman
- Honeybee races
  - Hofshi (Carniolan vs Italian)
  - Fetscher, Waser, Hofshi, Arpaia (perseitol to monitor pollination efficacy) has led to collaborative research with Israel – Shafir, Dag, Arpaia, Davenport

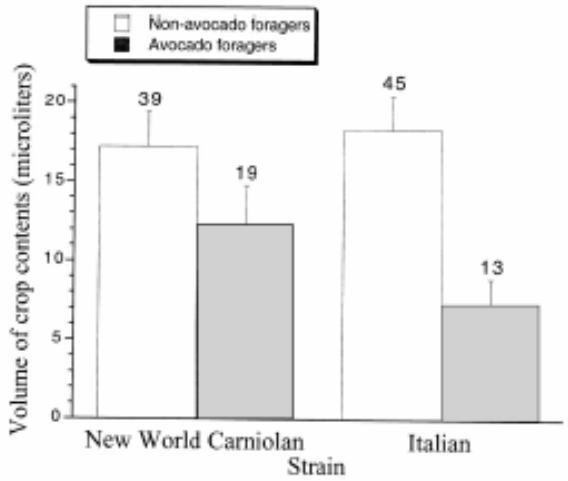


Figure 3. Total volume of crop contents (μL; mean + SE) of foragers caught upon return to their hives from Italian (IT) and New World Carniolan (NWC) colonies placed in a California avocado orchard (CA2), in 2000. Numbers above the error bars are the sample size. The type of bloom visited by a given forager was inferred by the presence or absence of perseitol in the crop sample.

Appreciating Proximity once again

DeBusschere Pollinizer Trial – Coastal Ventura County

NORTH ROW

26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	1
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	2
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	c	c	x	x	x	x	x	x	3
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o	o	x	x	x	x	x	x	4
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	5
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	6
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	c	c	x	x	x	x	x	x	7
Poplar			ET						67						F						Z				
Windbreak	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o	o	x	x	x	x	x	x	8
			ET						67						F						Z				TREE #
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	9
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	10
			ET						67						F						Z				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	11
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	12
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	13
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	14
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	16
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	17
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	18
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	19
			16						HV						B						SP				
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	20
			16						HV						B						SP				
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	

SOUTH

Eucalyptus W

ET	Ettinger	16	BL 516	c	c
67	BL 667	HV	Harvest		
F	Fuerte	B	Bacon	o	o
Z	Zutano	SP	SirPrize		

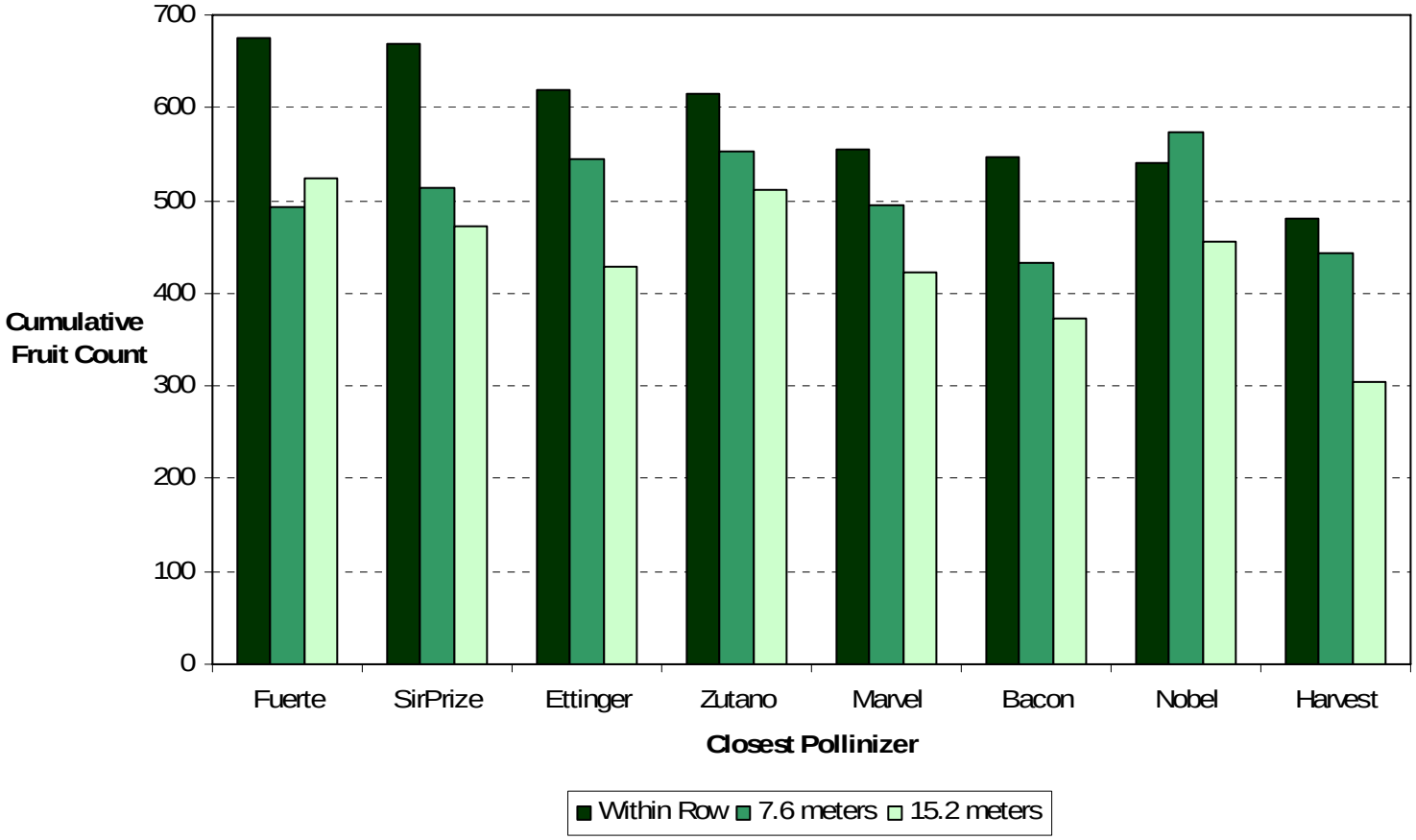
These are Tom Davenport's trees.
c is trees that had closed cages during Spring 2003
o is trees that were open controls during Spring 2003

x These are the trees that we have been collecting yield data from

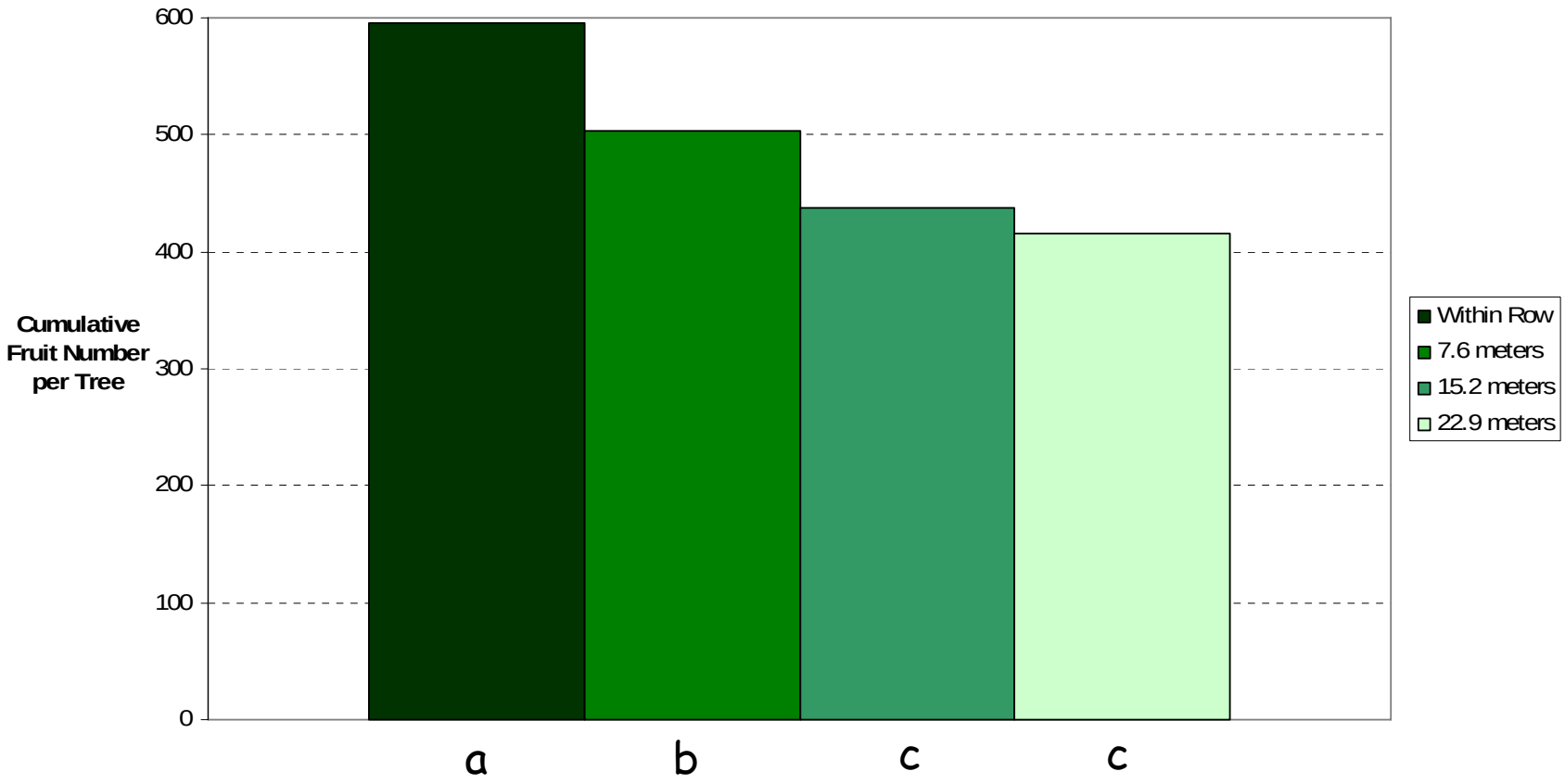
Pollinizer Varieties: 8
Field trial replicates: 6
Pollinizers interset with Hass

8 Pollinizer Varieties:
Bacon, Ettinger, Fuerte, *Harvest*, Marvel, Nobel, SirPrize, Zutano

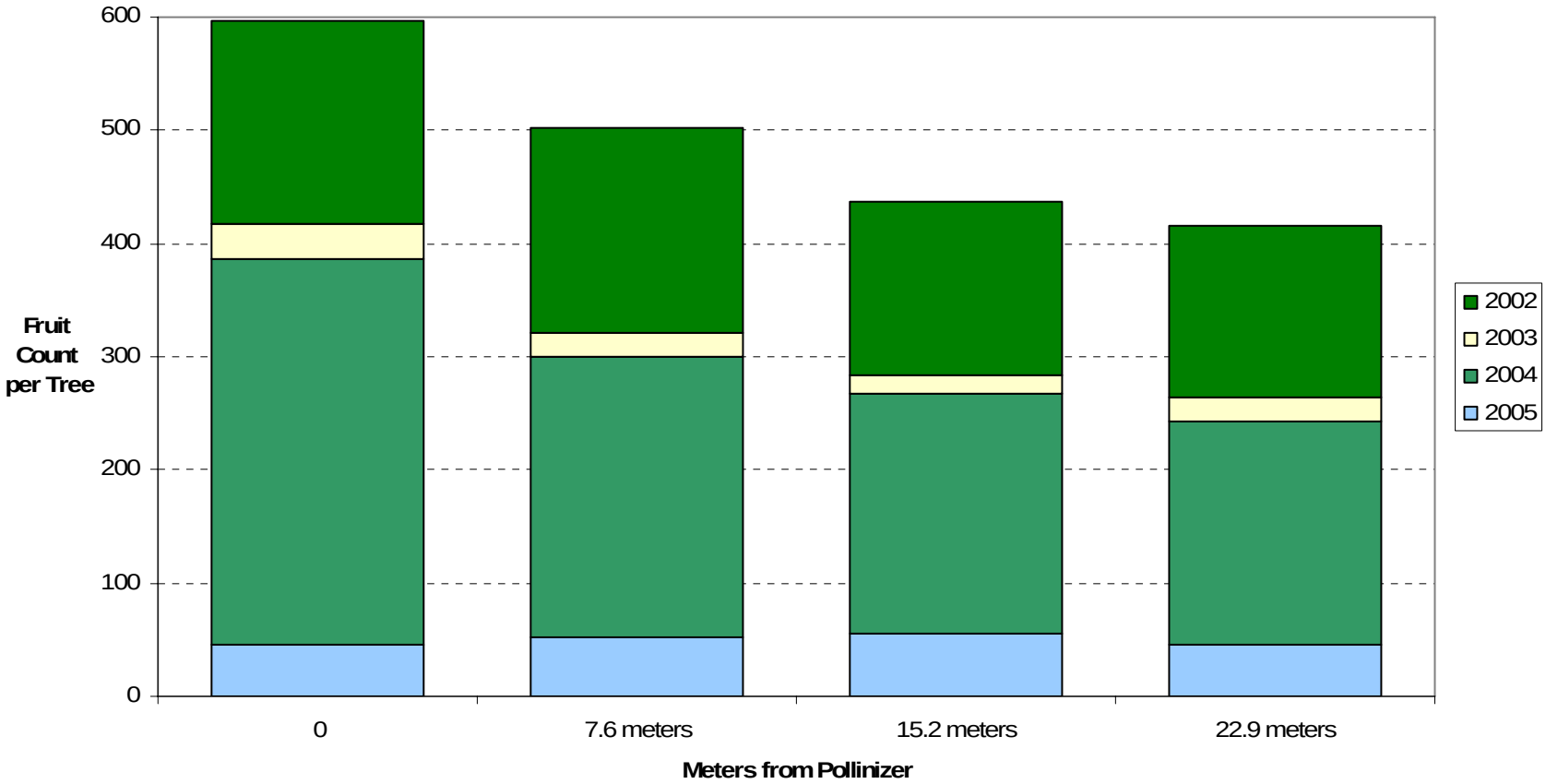
Cumulative Data



Is there a proximity affect?

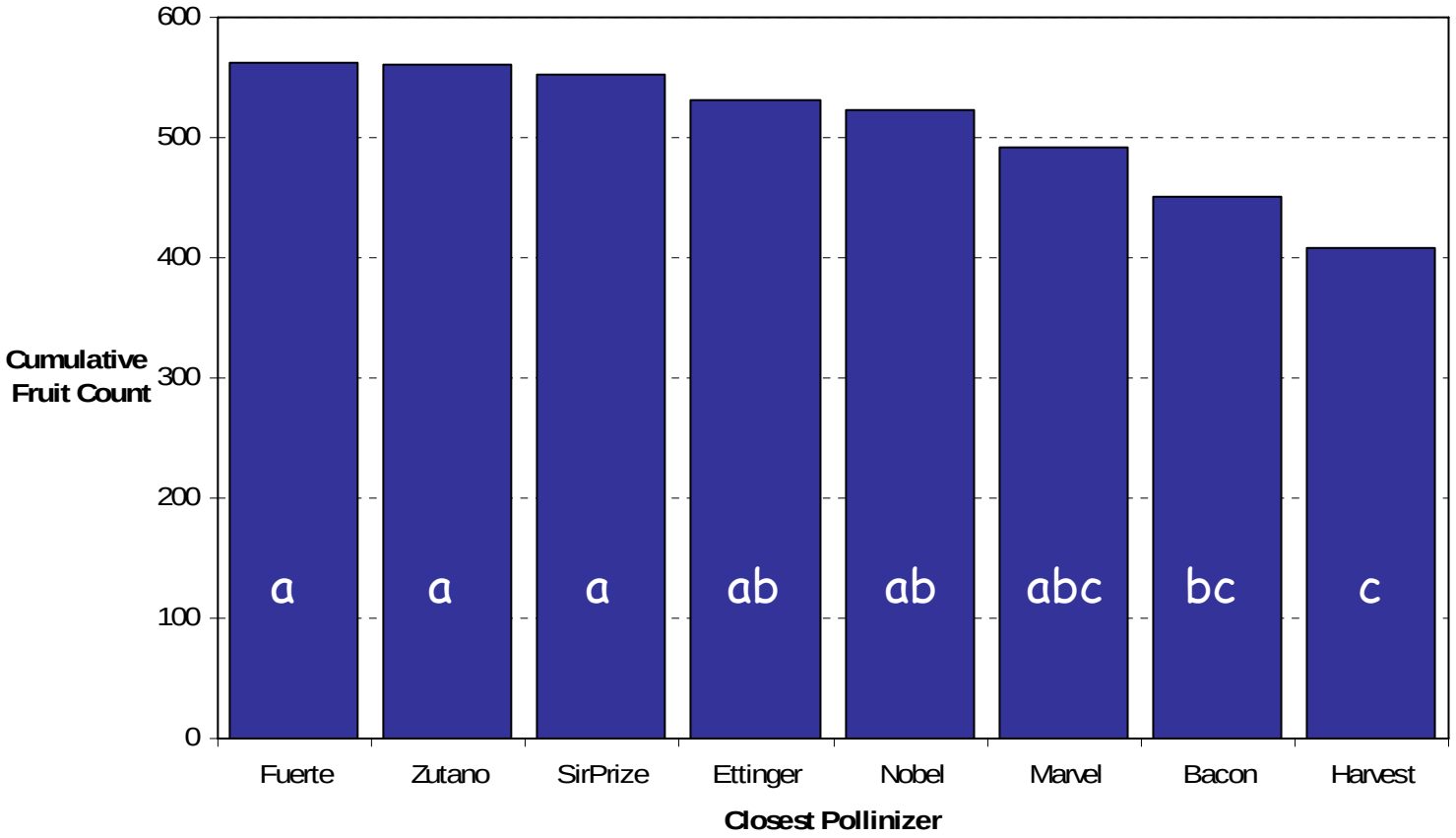


Is the distance affect influenced by year?



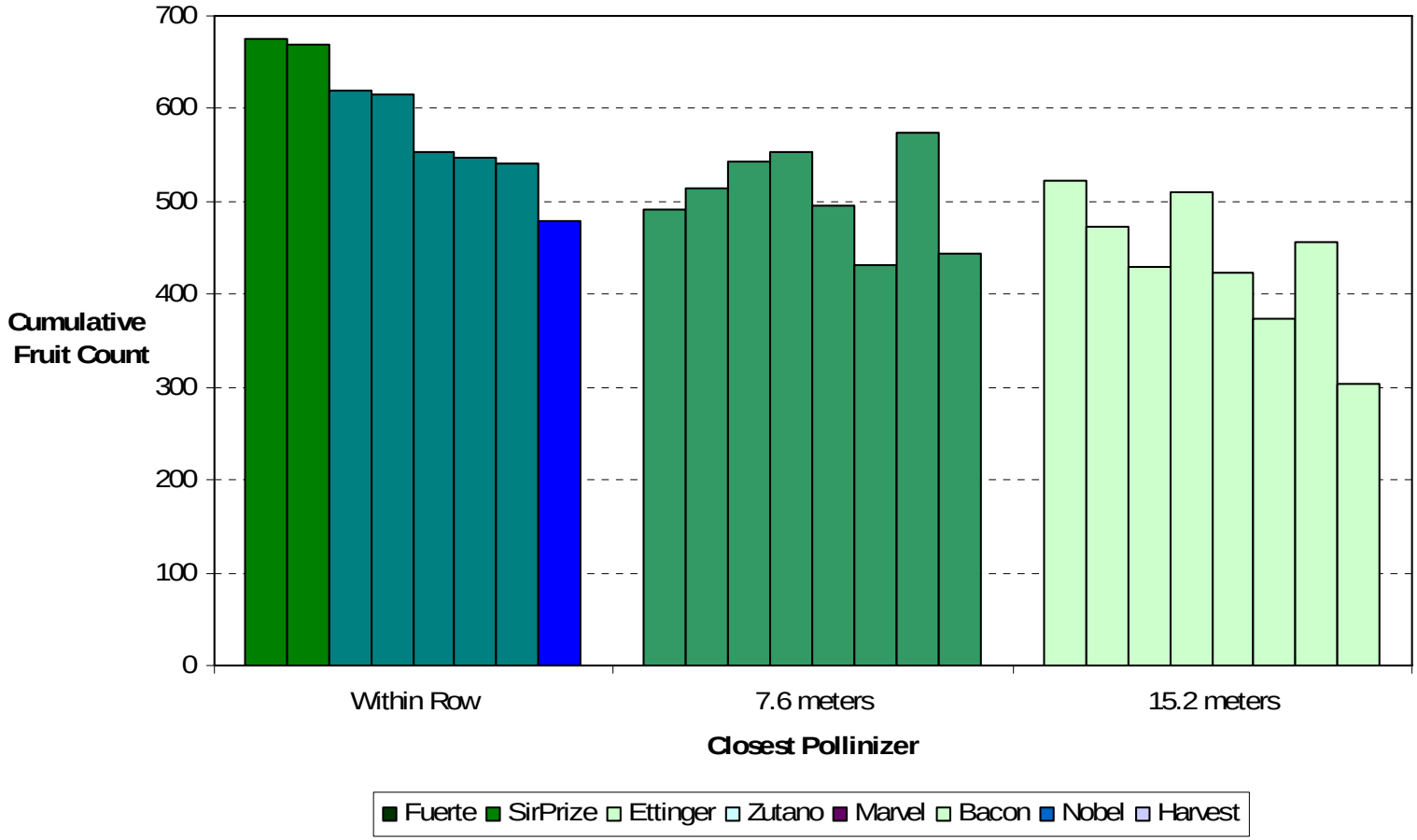
2002, n.s.; 2003, *; 2004, *; 2005, n.s.

Is there a Pollinizer Difference?



Yield for Rows 0 – 2 combined

Distance x Pollinizer Differences



Significant Differences between PZ for 'within row', N.S. at 7.6 or 15.2 m

Where do we go from here?

- 2 more years of yield data to be collected
- Summarizing flowering data (3 years) by phase within tree and individual flower
- Complete honey analysis

- Continue fruit quality measurements
  - Dry weight, seed size, L/W

Trends in California

Honeybees

- Placement (on pallets)
- Honeybee race (???)
- Paying for bees (~$18-30/hive)
- How many hives? (avg. 2-4 hives/HA, as high as 10)
- Keeping the hives for the entire flowering season

Trends in California

Planting multiple pollinizers in the same hole

Increasing the % of pollinizers and the placement of pollinizers

Goal: Maximize the opportunity for cross pollination

An example where Bacon, Zutano and Ettinger planted in same hole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