



# *Pruning Automation*

AUTOMATION OF DORMANT PRUNING OF SPECIALTY CROPS

## Stubs and Buds

Jim Schupp, *Brady Griest*, *Tyler Van Dyke*, *Matt Wagner*, Edwin Winzeler, Tom Kon and Melanie Schupp

Penn State University

Fruit Research and Extension Center

# 1) The Dutch Cut

- Renewal pruning is a tenet of modern apple pruning
  - short stub to stimulate branching
- Upward facing bevel recommended
  - Renewal shoot sprouts underneath
  - Wide crotch angle = calm flat branch
- First recommended in 1968
- Requires extra effort / training
- **What is the scientific basis for this recommendation?**
  - Do engineers need to include this rule?



# Does Stub Length & Cut Angle Matter in Renewal Pruning?



# Procedures

10 mature Gala/ M.9 apple trees with uniform size and vigor

Pruned during dormancy

Treatments applied to half-inch diameter branches

10 replicates in 2014

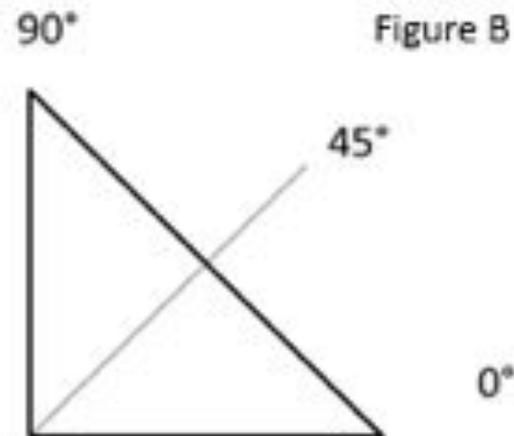
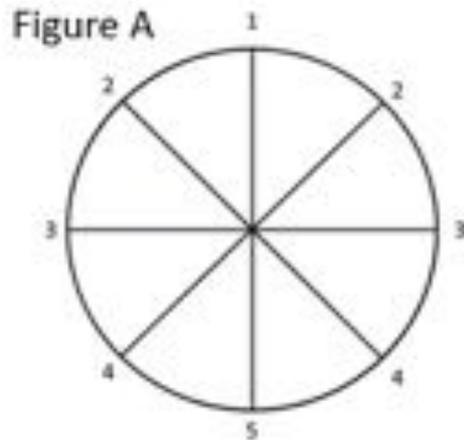
16 replicates in 2015

# 6 Stub Treatments



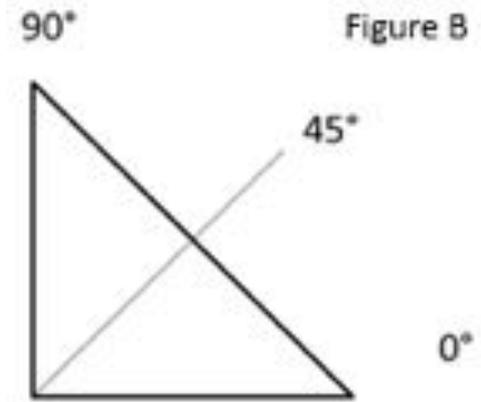
# Measurements Taken

- Number of renewal shoots from each cut
- Position of shoot around the stub (Figure A)
- Angle of renewal shoot from horizontal (Figure B)
- Length of renewal shoots

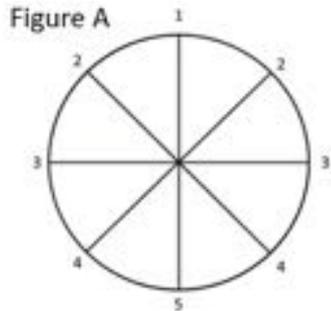


# Results 2014

Stub length (cm)	Cut angle	Plant response per cut		
		Renewal shoots (no.)	Shoot length (cm)	Renewal angle °
0.5	Perpendicular	1.1	38	31
0.5	Dutch	0.9	49	24
0.5	Inverted Dutch	1.3	50	39
2	Perpendicular	0.9	41	20
2	Dutch	1.4	50	28
2	Inverted Dutch	1.4	34	24
<b>Signif</b>				
	Stub Length	N.S.	N.S.	N.S.
	Cut Angle	N.S.	N.S.	N.S.
	Interaction	N.S.	N.S.	N.S.



# Results 2014

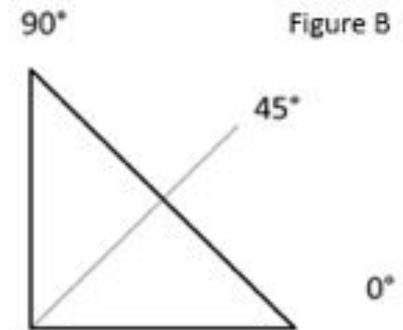


Renewal shoot orientation 2014  
(avg. number of shoots per 10 cuts)

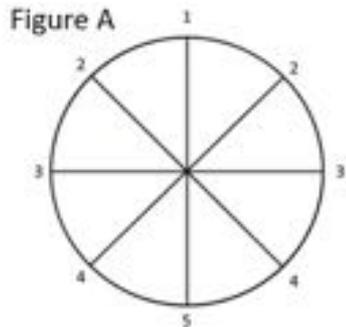
Stub length (cm)	Cut angle	Straight up	Side up	Horizontal	Down side	Straight down
0.5	Perpendicular	1	2	3	3	2
0.5	Dutch	2	2	2	1	2
0.5	Inverted Dutch	5	4	0	0	4
2	Perpendicular	0	0	5	2	2
2	Dutch	0	5	5	3	1
2	Inverted Dutch	3	4	4	2	1
<b>Signif</b>						
	Stub Length	N.S.	N.S.	0.03	N.S.	N.S.
	Cut Angle	N.S.	N.S.	N.S.	N.S.	N.S.
	Interaction	N.S.	N.S.	N.S.	N.S.	N.S.

# Results 2015

Stub length (cm)	Cut angle	Plant response per cut		
		Renewal shoots (no.)	Shoot length (cm)	Renewal angle °
0.5	Perpendicular	0.8	48	33
0.5	Dutch	0.9	58	31
0.5	Inverted Dutch	0.8	53	20
2	Perpendicular	1.3	49	31
2	Dutch	0.9	53	27
2	Inverted Dutch	1.1	56	31
<b>Signif</b>				
	Stub Length	N.S.	N.S.	N.S.
	Cut Angle	N.S.	N.S.	N.S.
	Interaction	N.S.	N.S.	N.S.



# Results 2015



Renewal shoot orientation 2015  
(avg number of shoots per 10 cuts)

Stub length (cm)	Cut angle	Straight up	Angled up	Horizontal	Down angled	Straight down
0.5	Perpendicular	1	1	3	3	2
0.5	Dutch	1	1	0	5	1
0.5	Inverted Dutch	1	1	2	3	2
2	Perpendicular	1	3	1	5	5
2	Dutch	0	2	2	4	2
2	Inverted Dutch	2	1	3	3	1
Significance						
	Stub Length	N.S.	N.S.	N.S.	N.S.	N.S.
	Cut Angle	N.S.	N.S.	N.S.	N.S.	N.S.
	Interaction	N.S.	N.S.	N.S.	N.S.	N.S.

# Summary & Conclusions

- Stub length and cut angle did not influence renewal shoot no. or angle
- Stub length had a slight impact on the position of the renewal shoots around the stub in 2014, but not in 2015
- Perpendicular renewal cuts as effective as the upward facing Dutch cuts for stimulating desirable renewal branches
- Shorter cuts are preferable to leaving a long stub



# Renewal Pruning & Fire Blight

- Horticultural practices generate revenue
- Plant protection practices protect investment and revenue
- Some horticultural practices increase risk
  - Renewal pruning generates shoots next to leader
  - Trauma event causes shoot blight, can infect renewal shoots,
  - Cause canker in leader

# Renewal Pruning & Fire Blight

- Horticultural Necessities:
  - Variety and rootstock (Susceptible host)
  - Trees in close proximity (Spread of pathogen)
  - Pollination (Spread of pathogen)
  - Annual pruning (invigorates and may spread pathogen)
  - Weed control (invigorates host)
  - Fertilizer (invigorates host)

# Renewal Pruning & Fire Blight

- Renewal pruning: acceptable risk under normal circumstances
- Use all practices to moderate vigor / reduce susceptibility
- Suspend renewal pruning (all pruning) under high inoculum
- Use Apogee or Kudos to reduce susceptibility of trees
- Trauma event: add 8-12 oz/ Acre Apogee or Kudos to strep



*Pruning Automation*

AUTOMATION OF DORMANT PRUNING OF SPECIALTY CROPS

# Thank You!

USDA-NIFA SCRI

State Hort Assoc of Pennsylvania

## 2) Increasing Bud Break and Shoot Growth of Newly Planted Trees with Notching and 6BA Sprays

- Blind wood in apple trees results in a lack of fruiting side branches
- Nurseries use 6BA to stimulate side branches on actively-growing young trees
- McArtney evaluated notching and 6BA sprays to increase bud break on blind wood
  - 2-year-old wood on 5-year-old trees
- PSU Interns compared results
  - 1-year-old wood on newly-planted trees

# Procedures:

- Newly planted Fuji / Bud.9 apple trees
- A length of blind wood with five buds was selected from each whip
- One of six treatments was applied to each tree
- Number of buds broken and shoot length were recorded and analyzed

# Treatments:

1. Un-notched and unsprayed control
  2. Un-notched + 6BA spray
  3. Un-notched + 6BA + 6BA/GA spray at bud break
  4. Notched and unsprayed
  5. Notched + 6BA
  6. Notched + 6BA + 6BA/GA spray at bud break
- Notching applied ~3 weeks after planting
  - 6BA applied immediately after notching
  - 6BA + GA applied at bud break (~4-5 weeks after)

# Treatments:

- Notching applied ~3 weeks after planting
  - Sawzall hacksaw blade
- 6BA applied immediately after notching
  - 1500 ppm MaxCel
- 6BA + GA applied at bud break
  - (~4-5 weeks after)
  - 250 ppm Promalin

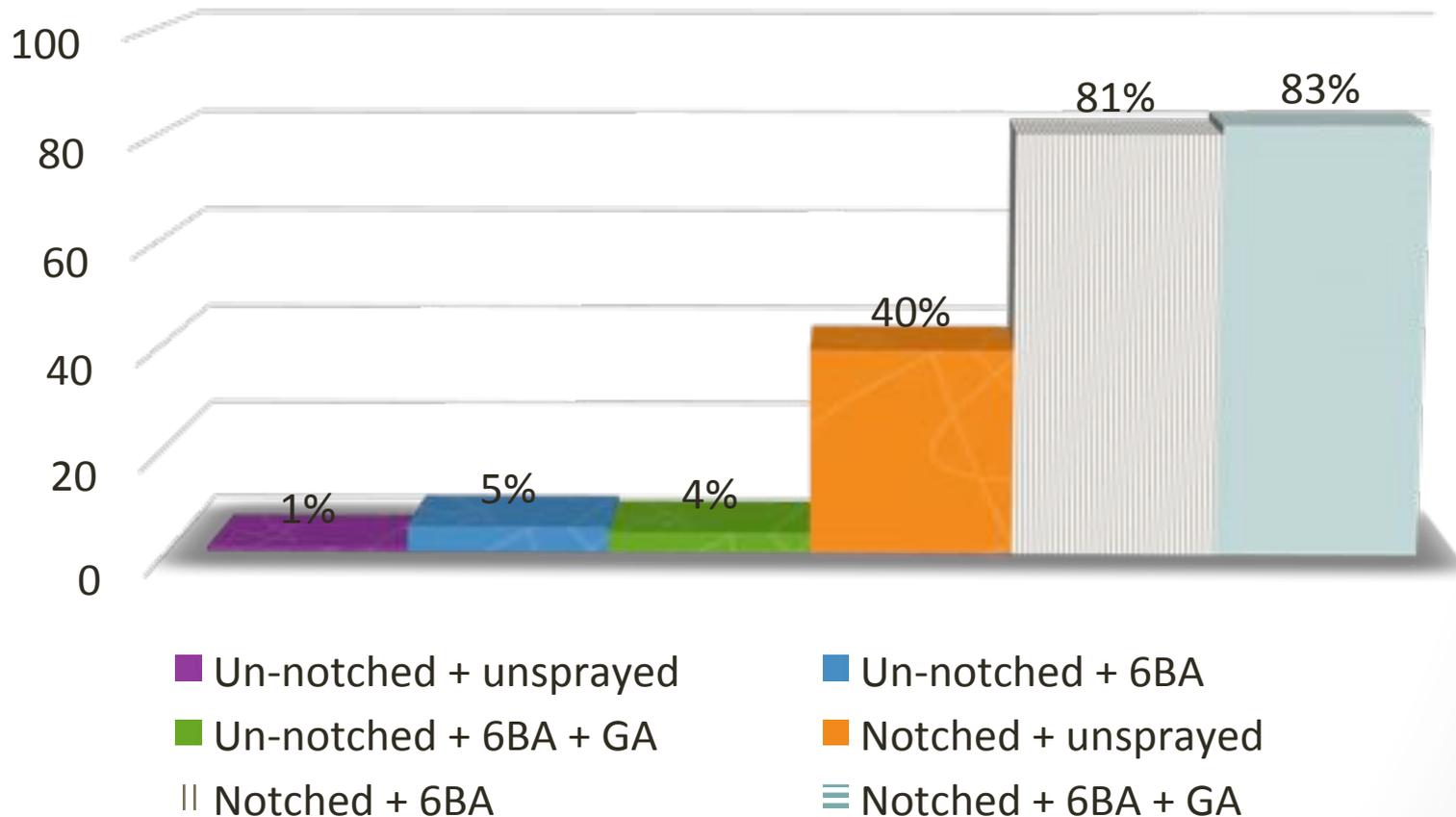


5 buds between flagged and taped test zone



Many of the buds treated with notching and spraying (Fig 1) broke, while few of the buds without treatment (Fig 2) broke.

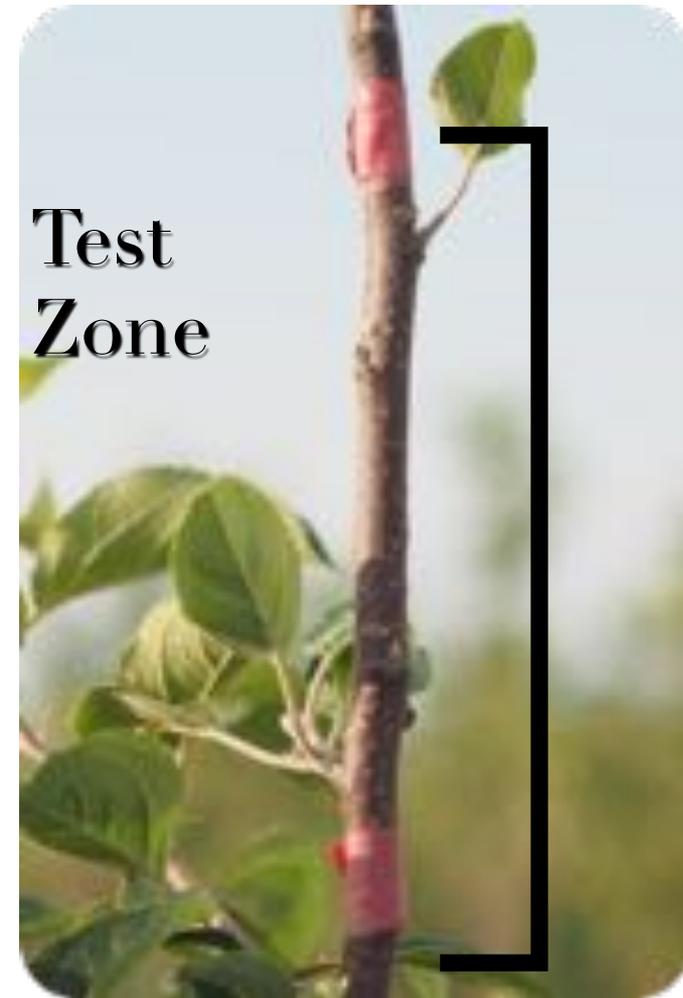
# Bud Breaks (%)



# Results

Treatment	Buds broken	Buds with shoot growth				
		> 1 in	> 7.5 in	> 1 ft	> 20 in	
		----- % -----				
Untreated control	1c	0b	0b	0b	0b	
M	5c	1b	0b	1b	1b	
M + P	4c	1b	0b	0b	0b	
Notched only	40b	10b	9b	7b	3b	
Notched + M	81a	56a	30a	23a	13a	
Notched + M + P	83a	54a	33a	28a	14a	
Significance						
	Notching	0.000	0.000	0.000	0.000	0.000
	Maxcel	0.000	0.000	0.037	N.S.	N.S.
	Promalin	0.000	0.000	0.021	0.050	N.S.

Notching promoted bud break (Fig 7), notching and spraying 6-BA increased bud break and shoot length (Fig 8).



**Fig 6**

**Fig 7**

**Fig 8**

# Bud Conclusions:

- Notching newly-planted trees was effective
- 6BA increased bud break & shoot growth only after notching
  - 6BA alone stimulates side branches in nursery stock
- No increase in shoot growth from follow-up spray of 6BA + GA in our study on newly planted trees.
  - McArtney documented an increase in shoot growth on 5-year-old trees from adding Promalin
  - The additional spray of Promalin may be more important when addressing blind wood on older trees