Effects of in-Row Spacing on Grafted Watermelon Productivity and Fruit Quality

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Vegetable Grafting

- Organ transplantation;
- Creates a physical hybrid containing desired traits;
- Makes faster and more effective use of genetics in production;
- Solves farmer's practical questions.

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Vegetable Grafting

requires 2 varieties; may use more

Scion: 'recipient'

- supplies shoot
- fruit marketable but roots flawed

Rootstock: 'donor'

- supplies roots
- fruit not marketable but roots better

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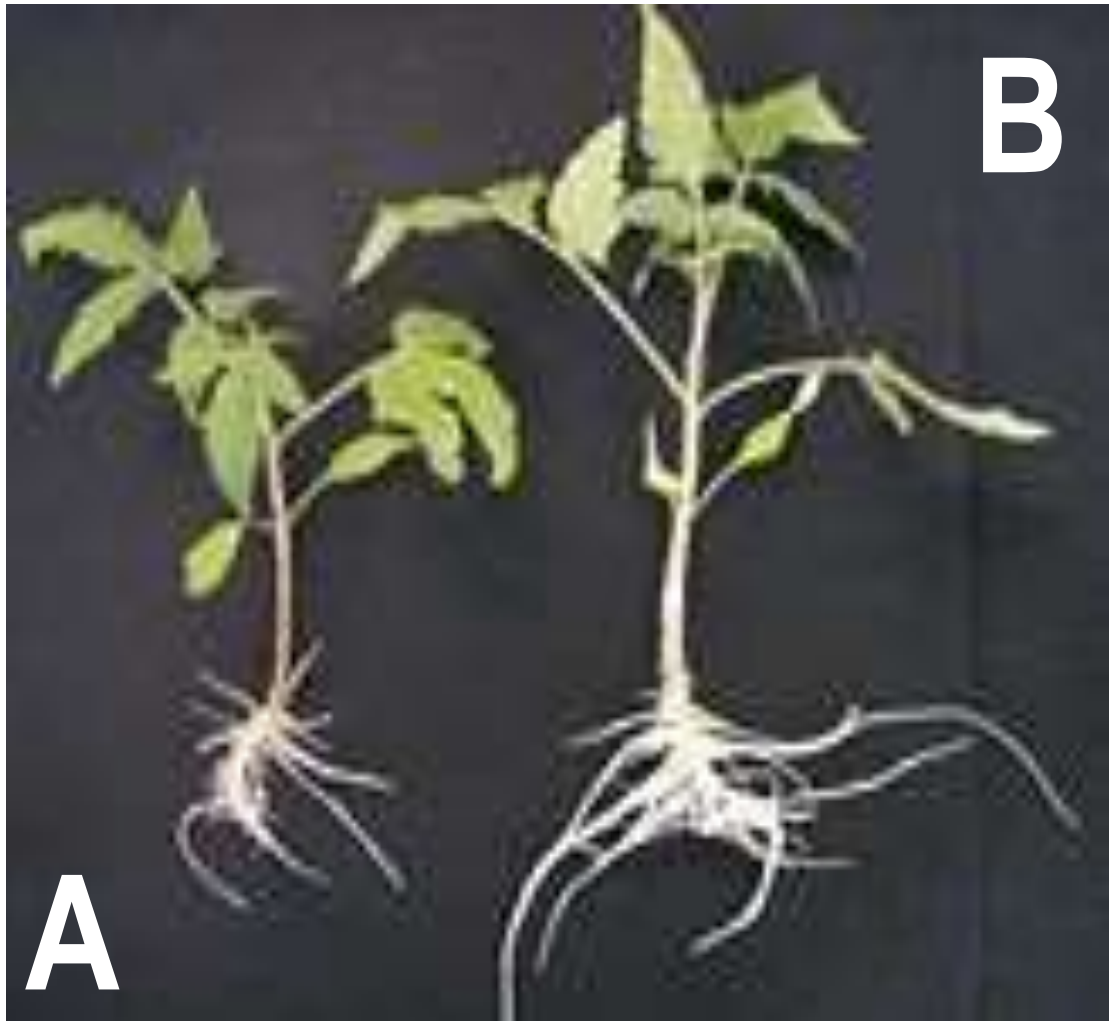
vegetable grafting

scion



rootstock

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combine and secure

several ways possible

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Grafted plants are production tools.

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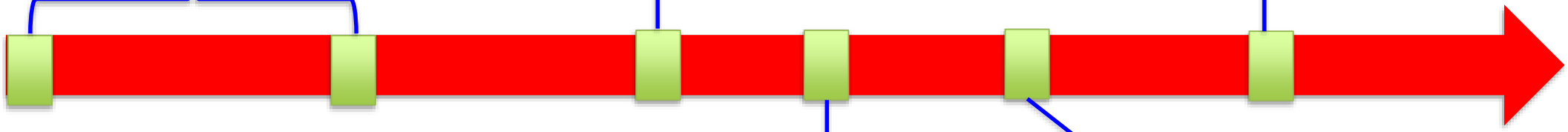
China: Grafting started in 500s.
Japan and Korea: Farmers began using grafting as a tool for combating diseases and enhancing growth in 1920s – 1930s.

From 1950s – 1980s, development of breeding technology gave plant disease resistance. Grafting started in Europe.

During 2010s, vegetable grafting are used in various production systems across US and Mexico. More federal- and state-funded programs bring institutional collaborations.



During 1990s, grafting started in Canada and Netherlands for hydroponic greenhouse.

During 2000s, grafting started in US and Mexico for hydroponic greenhouse.

From: Chieri Kubota, OSU

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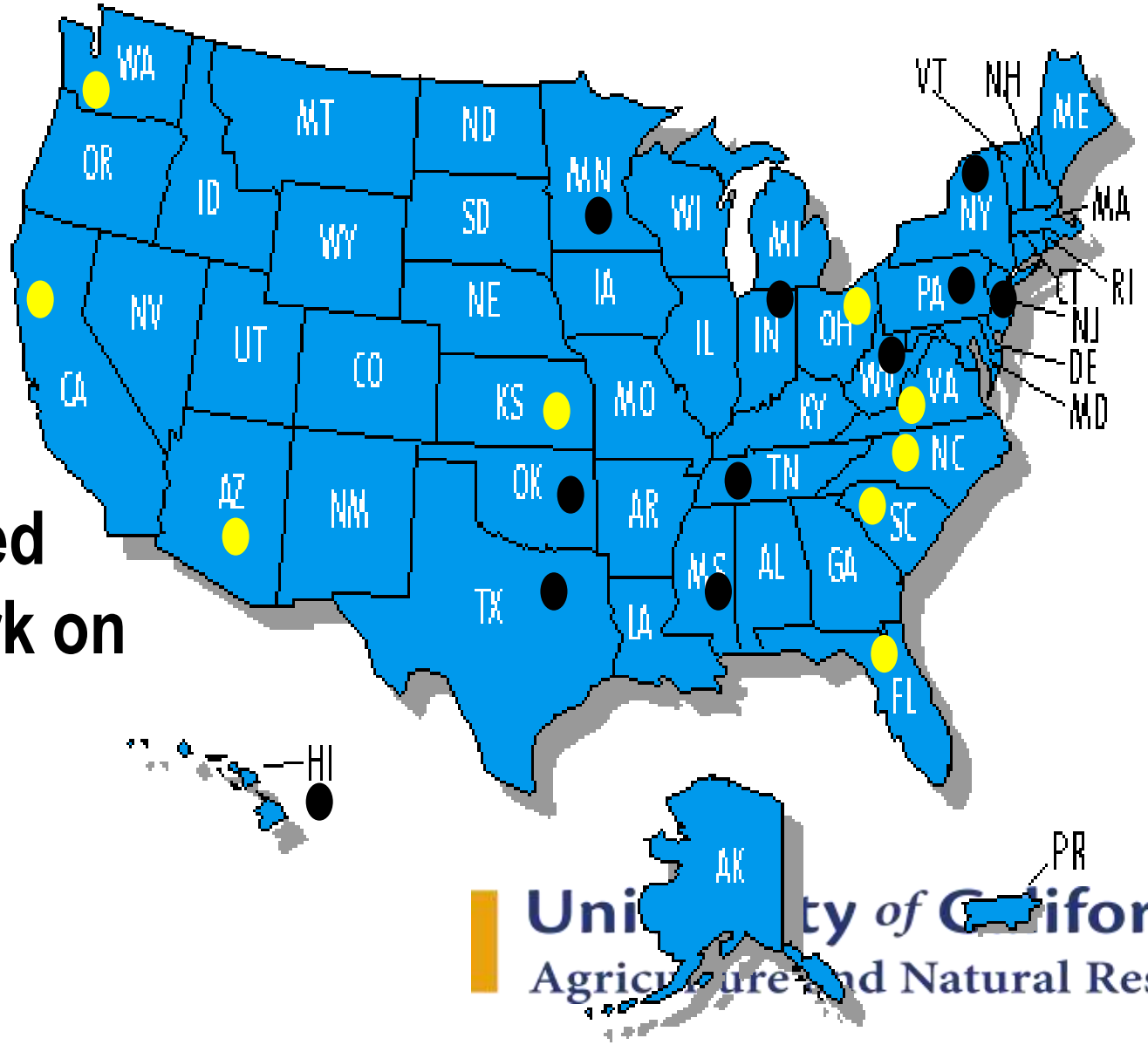
USDA-NIFA SCRI: 2011-2016 and 2016-2020

SCRI Team

other academic teams that have worked or now work on vegetable grafting



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2011-2015: how to produce high quality grafted transplants

2016-2020: how to take the best use of grafted plants in different production systems

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Grafted plants can be more:

(1) resistant to biotic, abiotic stresses,

(2) vigorous in root system,

(3) resource-efficient (e.g., water and fertilizer),

(4) productive (yield potential), but

(5) expensive (seeds, grafting, field management).

than nongrafted counterparts.

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High cost is the no. 1 obstacle from widespread adoption of vegetable grafting.

Lowering cost while maintaining the merits is key: on growers' end, reducing plant population is what they can do.

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2019 Field Trial Setup

- In-row spacing: 3 feet (93 cm), 4 feet (123 cm), and 6 feet (183 cm).
- Scion: Triploids '7187' and 'Fascination'.
- Rootstock: 'RS841', 'Flexifort', 'UG29A', and 'XSQ9901'.
- Pollenizer: 'Wild Card Plus'.
- Study design: split-split plot design.
- Pollenizer placement: xxxpxxxpxxxpx (3-footer), xxxpxxxpx (4-footer), xxxpxxp (6-footer); x=triploid plants; p=pollenizer.
- Reduced population: 3-footer: full population, 4-footer: 25% reduction; 6-footer: 50% reduction.

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Field Management and Data Collection

- Field location: Turlock, California.
- Transplanting: Hand transplanted on April 24, 2019.
- Plot length: 30 feet (9.3 m), containing 10, 7, and 5 plants for each spacing.
- Harvest: Total of five: Jul. 24, Aug. 7 and 23, Sep. 11, and Oct. 2.
- Data Collection: yield, fruit number, Brix, hollow heart rating, flesh firmness, and fruit size.

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Grafted watermelon seedlings in the greenhouse (Photo credit: Ben Hinson, Tri-Hishtil).

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Grafted and non-grafted watermelon plants were transplanted at the spacing of 3 feet, 4 feet, and 6 feet (left to right). The corresponding plant population is 2074, 1555 (25% reduction), and 1037 (50% reduction) per acre, respectively (photos were taken on May 24, 2019).

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Results – Fruit Quality

Table 1. Comparisons of the main effects on fruit quality.

	Brix	Length (in.)	Width (in.)	Fruit penetration (psi)	Hollow heart
3 feet	12.0	11.8	10.1	3.9	ns
4 feet	12.1	12.2	10.3	4.1	ns
6 feet	12.1	12.3	10.0	3.9	ns
7187	12.1	11.9	10.0	4.1	0.3*
Fascination	12.0	12.3*	10.2	3.9	0.1
Flexifort	12.0	12.3*	10.1	4.1*	0
RS841	12.1	12.2	10.2	3.9*	0.2
UG29A	12.2	12.0	10.1	4.0*	0.3
XSQ9901	11.8	12.3*	10.1	4.3*	0
Nongrafted	11.9	11.7	10.2	3.5	0.5*

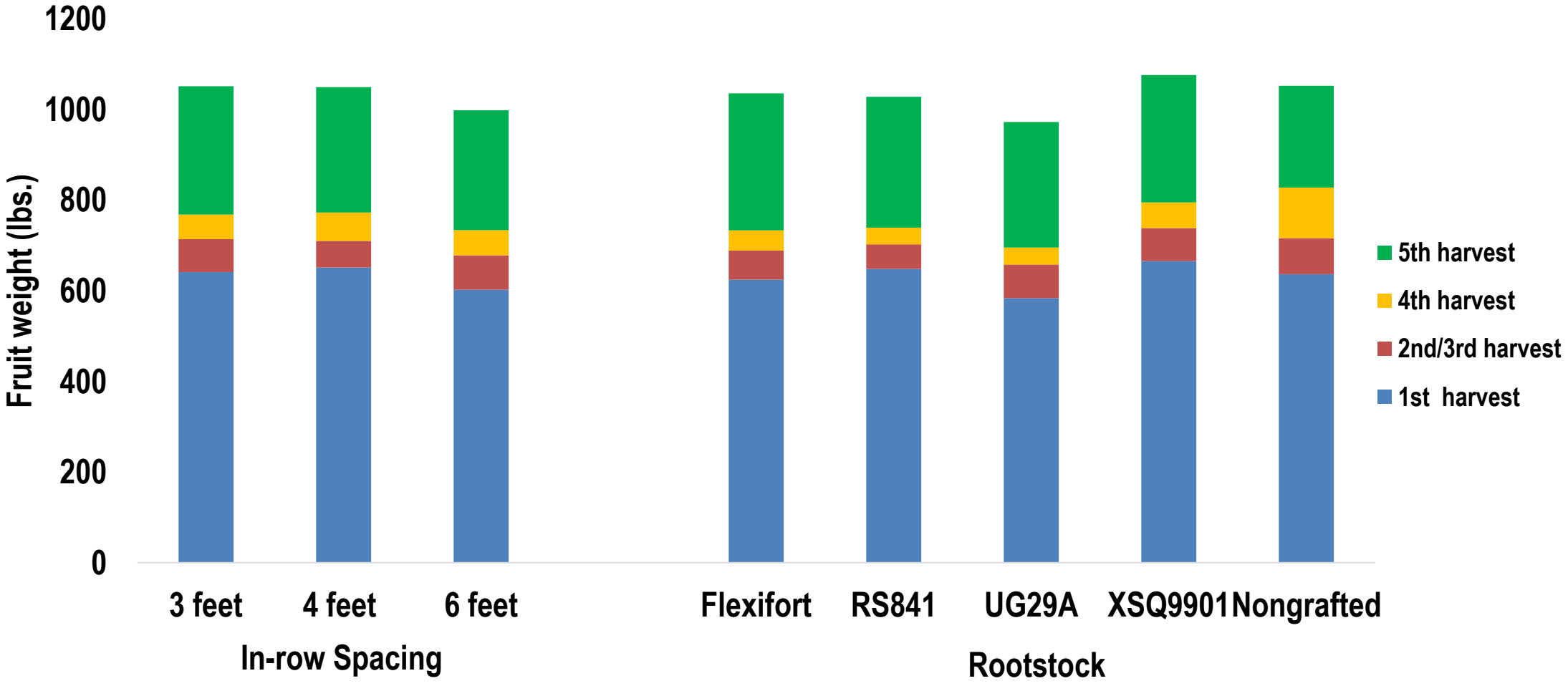
Results – Average Fruit Weight

Table 2. Comparisons of the main effects on average fruit weight (lbs.).

	Average fruit weight (lbs.)			
	1st harvest	2nd/3rd harvest	4th harvest	5th harvest
3 feet	20.7	16.1	14.0	10.8
4 feet	21.3	18.9	15.9	10.9
6 feet	21.8	19.5	16.4	11.0
7187	20.0	18.3	16.6	11.3
Fascination	22.6	18.4	14.3	10.6
Flexifort	21.2	19.6	15.4	10.7
RS841	22.2	16.8	15.2	11.2
UG29A	20.6	17.4	12.4	10.9
XSQ9901	21.5	17.8	16.3	10.5
Nongrafted	20.9	19.2	17.9	11.3

Results – Accumulative Yield

Figure 1. Fruit Accumulative Yield Per Plot (lbs.)



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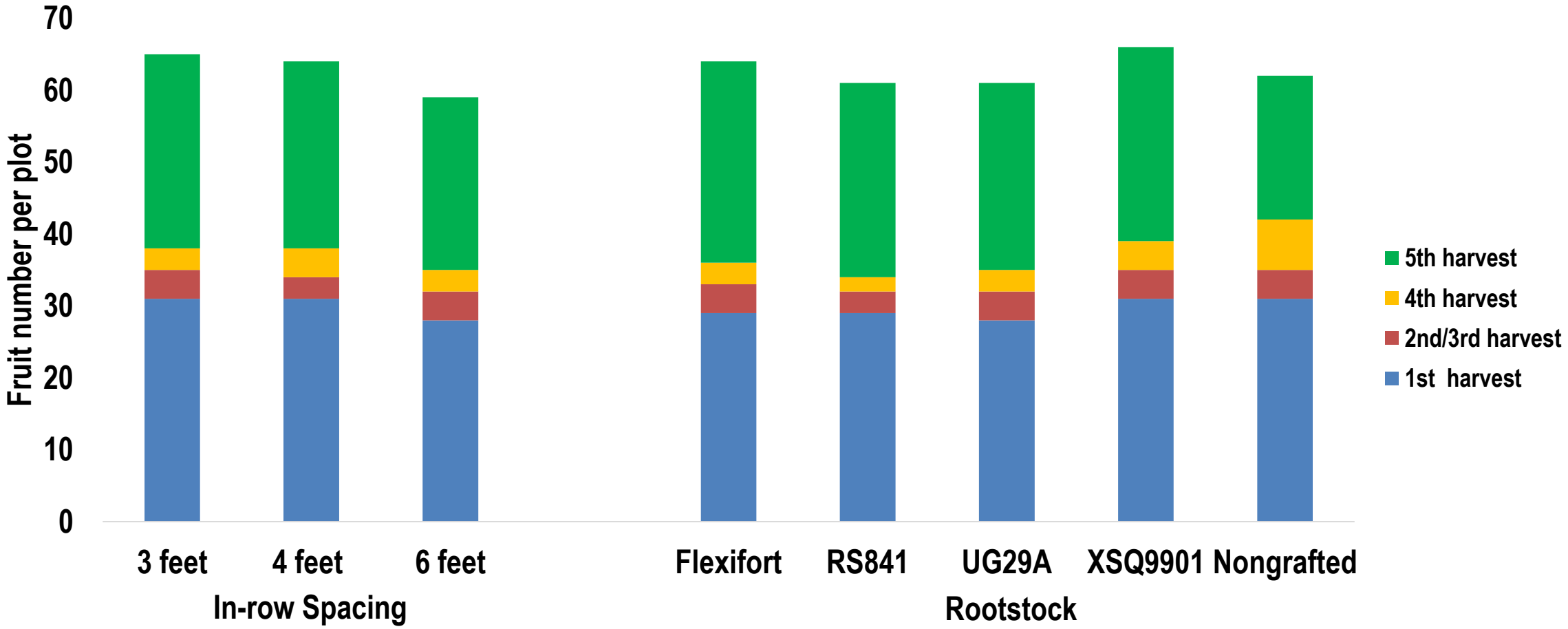
Results – Fruit Number

Figure 2. Total No. of Fruit Per Plot



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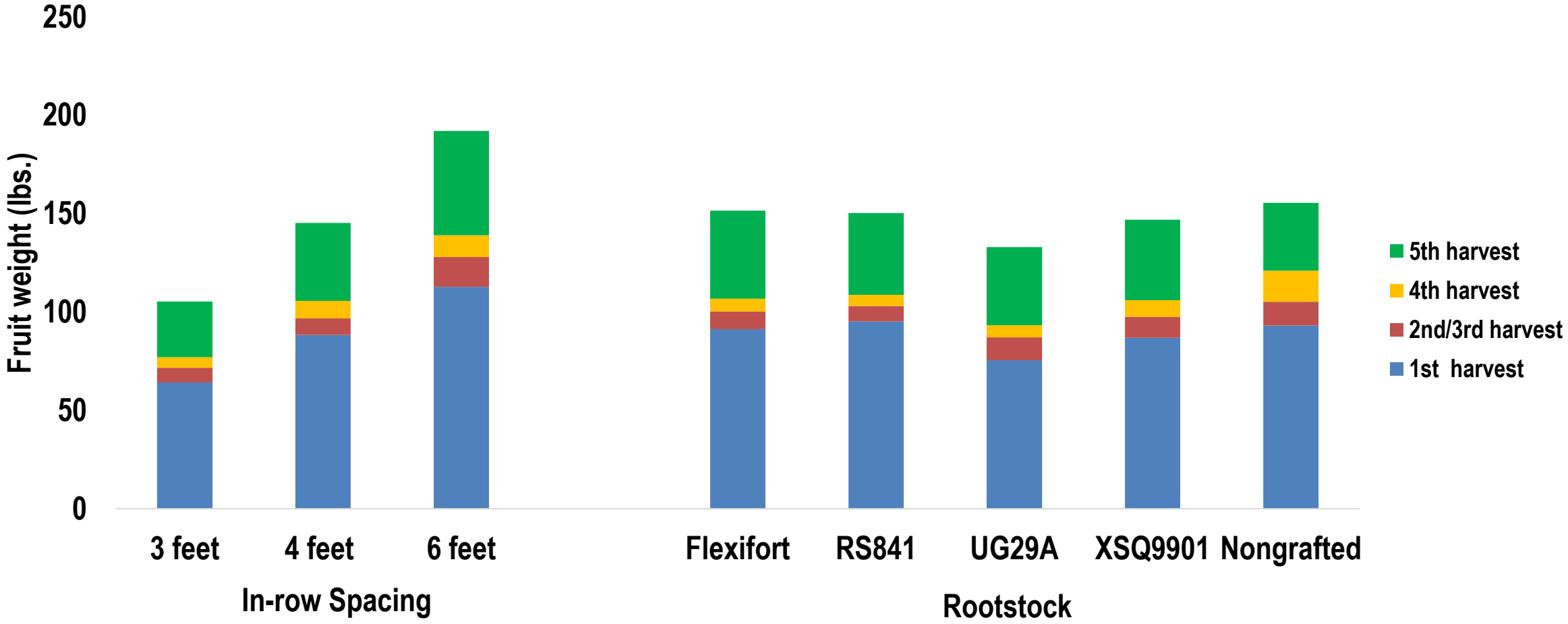
Results – Single Plant Productivity

Figure 3. Productivity Per Plant (lbs.)



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Results – Yield of Each Combination

Table 3. Fruit yield (lbs./plot) from the first harvest for each grafted combination.			
	3 feet-7187	4 feet-7187	6 feet-7187
Flexifort	685.6	561.1	583.7
RS841	689.9	631.6	595.0
UG29A	601.4	673.4	489.4
XSQ9901	621.7	705.1	638.8
Nongrafted	672.8	618.7	625.4
	3 feet-Fascination	4 feet-Fascination	6 feet-Fascination
Flexifort	640.2	655.1	622.1
RS841	653.3	652.0	673.1
UG29A	570.9	600.3	567.6
XSQ9901	650.8	723.3	655.7
Nongrafted	632.6	696.6	574.9

Project Summary

From this trial…

- Fruit quality is more affected by grafting than productivity.
- Rootstocks affect yield and quality differently even when grafting onto the same scion.
- Not all commercial cultivars are suitable for grafting (scion-rootstock incompatibility).
- Choosing the right combination is difficult. Evaluations of rootstock vigor and scion-rootstock performance are needed.

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‘7187’ on ‘RS841’

Nongrafted ‘7187’

‘Fascination’ on ‘RS841’

Nongrafted ‘Fascination’

Incompatibility affects fruit quality, such as more hollow-heart fruit.

Not all commercial varieties are suitable for grafting, such as 7187.

Same rootstock has different performance when grafting with different scions (Fascination vs. 7187).

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Acknowledgements

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USDA SCRI: 2016-51181-25404

Seed supplier: ENZA ZADEN, Seminis, SAKATA SEED AMERICA, INC., UNIGEN SEEDS
New Ideas for Better Seeds

Grower collaborator: Dan Avila & Sons

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THANK YOU!

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