Walnut Improvement Program

Chuck Leslie
Wes Hackett
Gale McGranahan
UC/USDA Researchers
Farm Advisors

Nursery Participation

Grower Participation

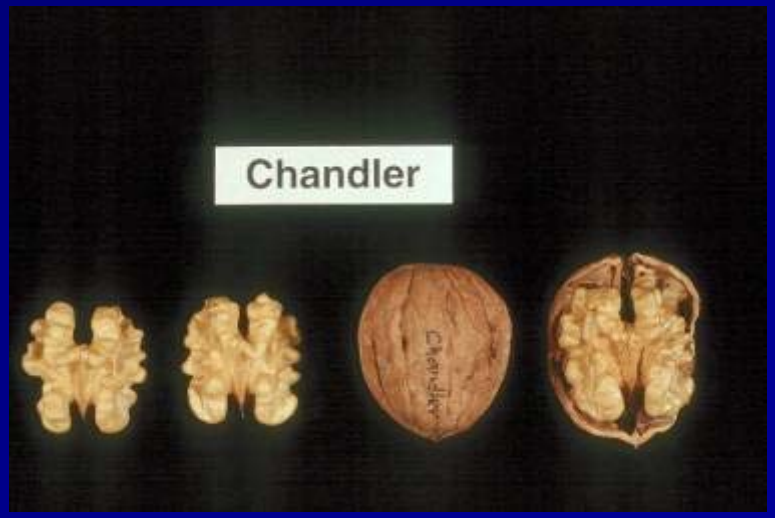
Walnut Improvement Program

- Breeding for new varieties
- Breeding for blackline resistance
- Developing improved rootstocks

Breeding for New Varieties

Goals:

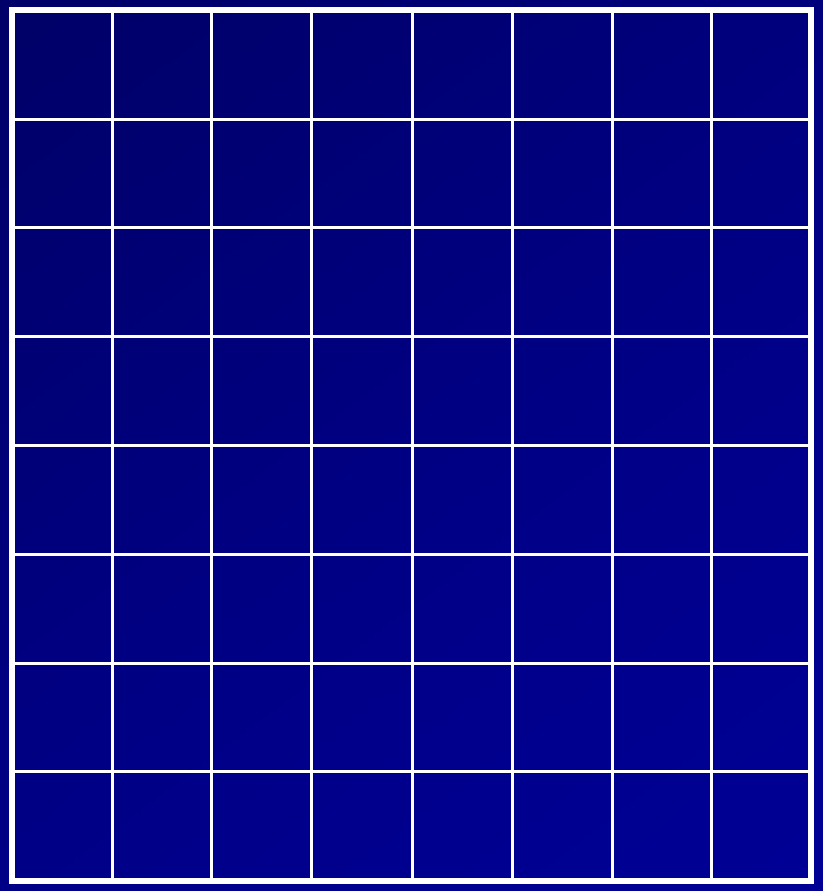
- **Early Harvest date**
- High yield
- Light color kernel
- High percent kernel
- Blight resistance
- Low PFA
- Laterally fruitful
- Ease of halves
- Precocity
- Nut size
- In-shell traits



Current Crossing Design

HIGH QUALITY and YIELD

EARLY HARVESTING



Controlled Crosses

Seedling Evaluation

- Phenology
  - Leafing date
  - Flowering dates
  - Harvest timing
- Precocity
- Lateral bearing
- Yield
- Growth habit
- PFA
- Blight resistance

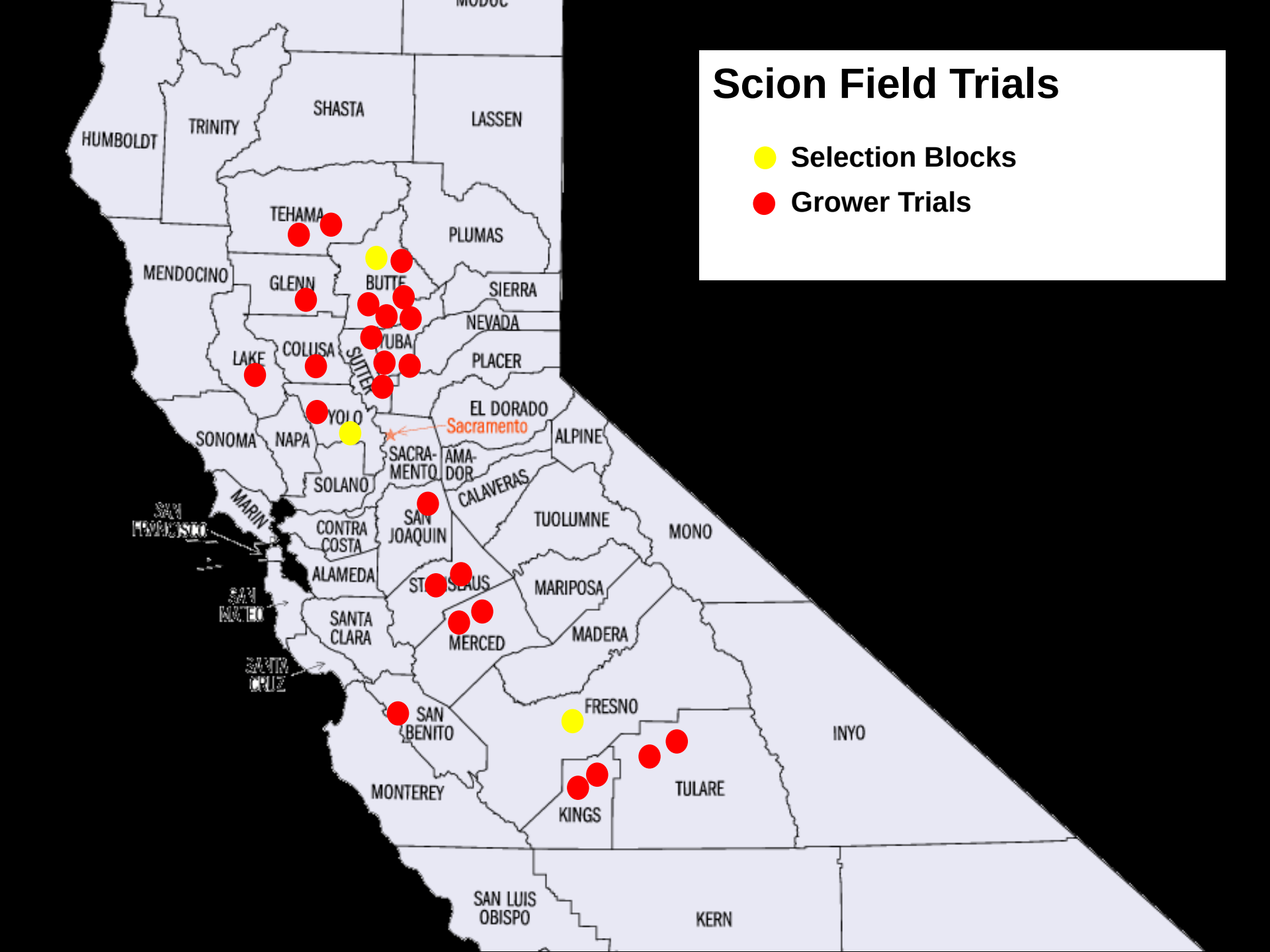
Nut Evaluation and Crackout Meeting

Cull

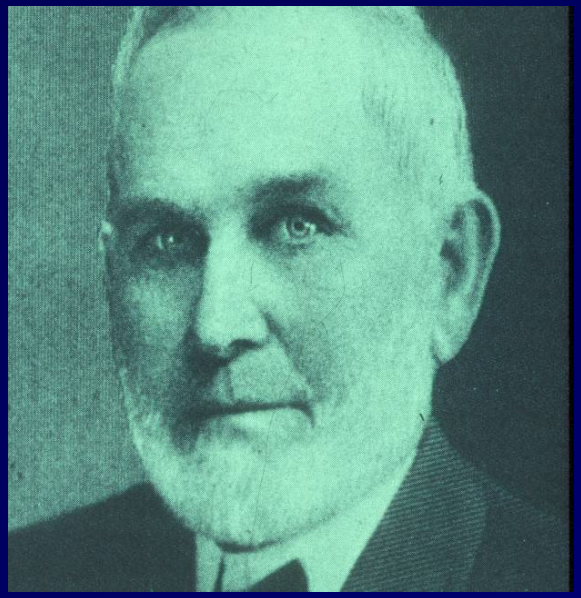
Non-performing

Seedlings

Grower Trials and Selection Blocks


Scion Field Trials
Selection Blocks
Grower Trials
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
NEVADA
LAKE
COLUSA
SUTTER
YUBA
PLACER
YOLO
EL DORADO
Sacramento
SONOMA
NAPA
SACRA-MENTO
AMA-DOR
ALPINE
SOLANO
CALAVERAS
MARIN
SAN FRANCISCO
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
MONO
ALAMEDA
STANISLAUS
MARIPOSA
SAN MATEO
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
SAN BENITO
FRESNO
INYO
MONTEREY
KINGS
TULARE
SAN LUIS OBISPO
KERN

Three Releases

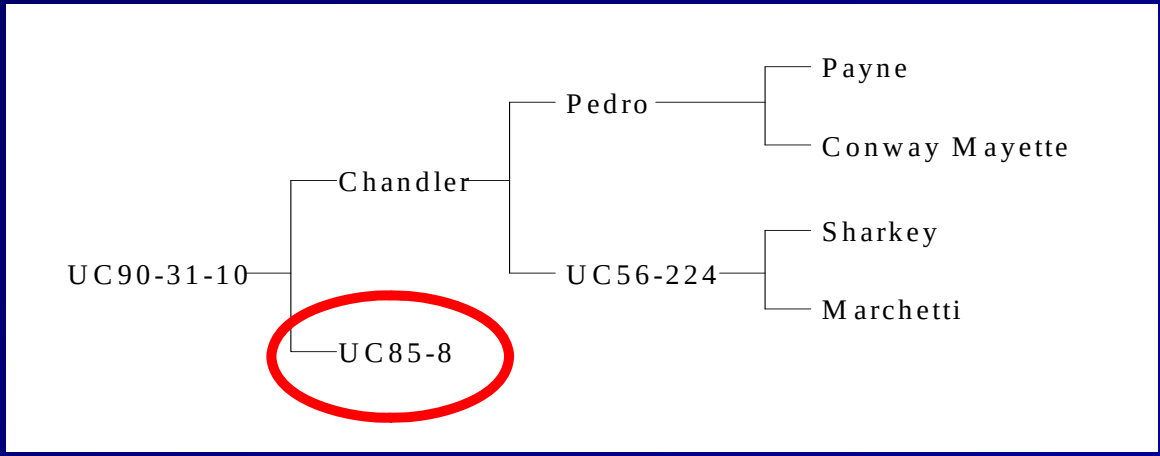


Joseph Sexton

Harold Forde

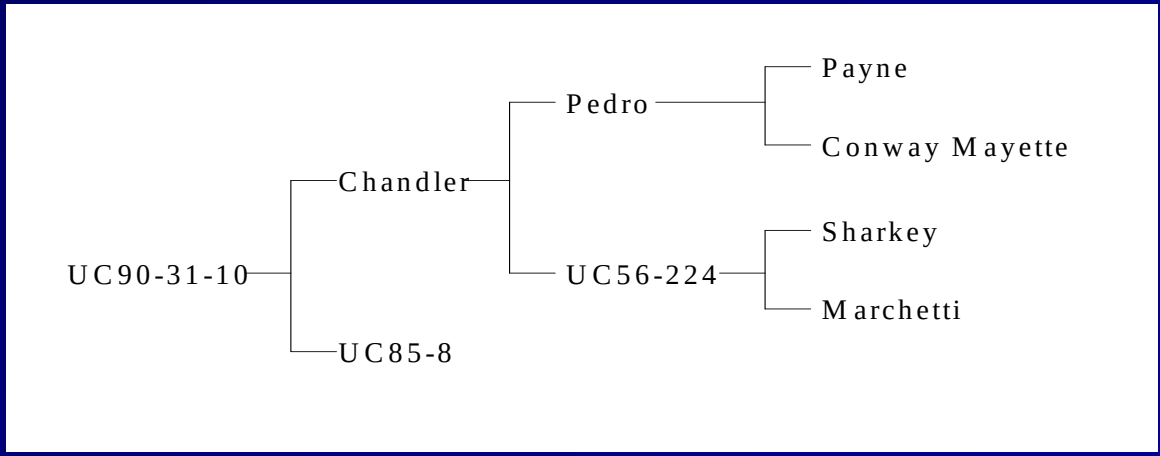
Felix Gillet

Sexton (90-31-10)



Precocity, yield, blight resistance

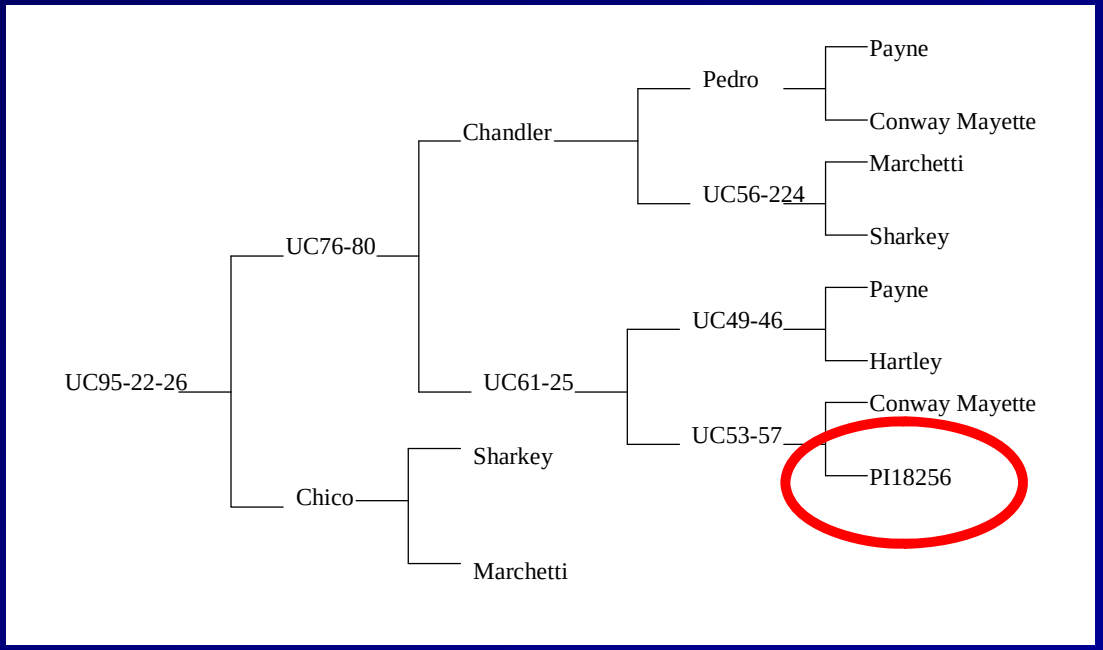
Sexton (90-31-10)



Sexton (90-31-10)

- Leafs – Payne time
- Harvests – Week before Chandler
- Yield – excellent; very precocious
- Blight - low
- Kernel – 53%, 8.6g, mostly light
- Nut – smooth, round
- May be good in hedgerows
- Growth habit – spurs, narrow forks

Gillet (95-22-26)



Ginko biloba

Frank Meyer
USDA
1905- 1908
China

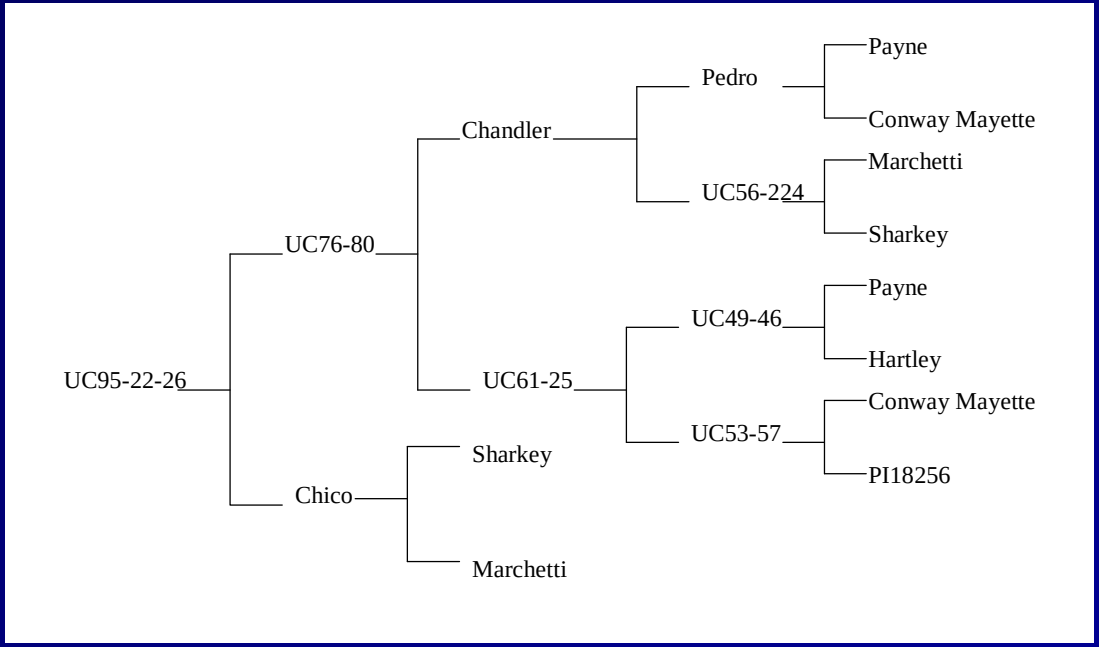
PI 18256

Blight Resistance

Meyer lemon

Soybeans

Gillet (95-22-26)



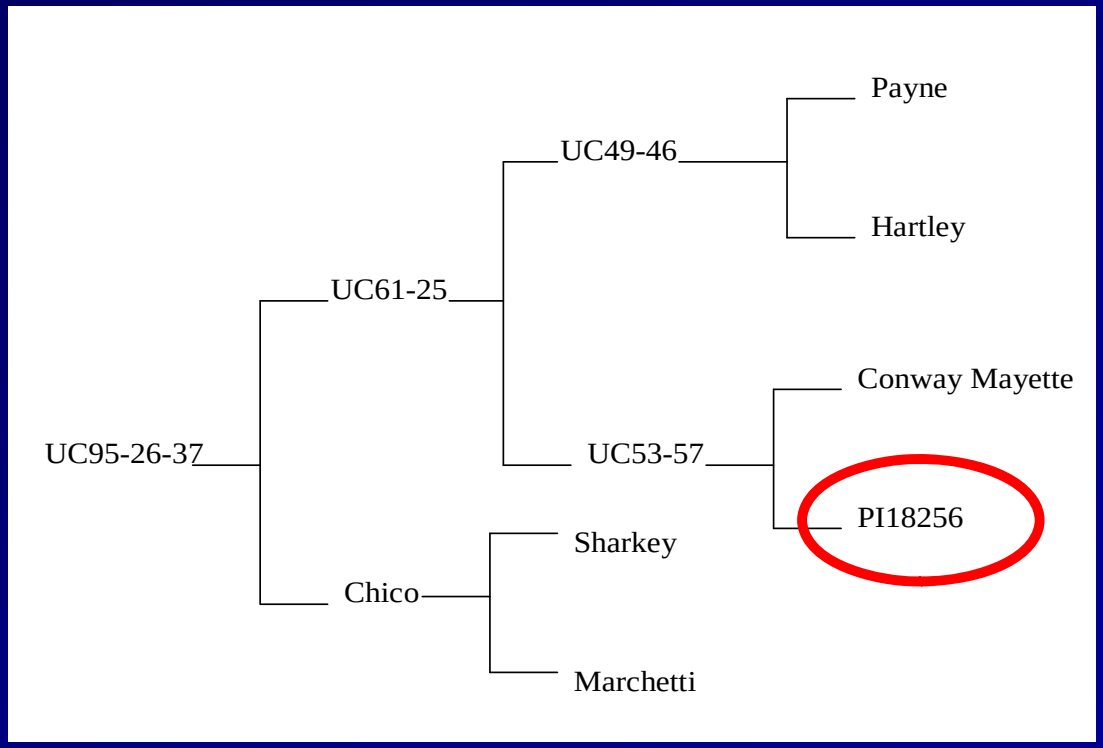
Gillet (95-22-26)

- Leafs – Payne time and a little later
- Harvests – 2 weeks before Chandler
- Yield – excellent
- Blight - low
- Growth habit – Large vigorous tree
- Kernel – 51%, 8.0g, light, easy halves
- Nut – relatively weak seals

UC Walnut Variety Trial
Stanislaus County
Kathy Kelly Anderson

Variety	Mean yield (lbs/tree)	Mean yield (tons/acre)	Harvestable Date
Gillet	53.49	2.41	9/22
Tulare	49.69	2.24	9/30

Forde (95-26-37)



Forde (95-26-37)

- Leafs – a week or more after Payne
- Harvests –close to Chandler
- Yield – excellent
- More precocious than Chandler
- Blight - low
- Nut – round, smooth
- Growth habit – moderately vigorous
- Kernel – 53%, 8.6g, light, easy halves, plump, absence of shrivel or veins

Chico


Payne chico
Hartley chico
Vina chico
Chandler chico
Tulare chico
Serton chico
Gillet chico
Ford chico
90-27-21 chico
90-27-23 chico

Davis


Cisco
NSB
Tulare
NSB
Fernette
NSB
Sexton
D-SBB
Gillet
D-SBC
Forde
D-SBB
Ivanhoe
D-SBB
90-27-21
D-SBA
90-057-23
D-SBA

Woodland


chandler
5505
Howard
5505
Sexton
5505
Gillet
5505
Forde
5503
45-11-14
5505
59-124
5505
90-022-21
5505
91-073-6
5505
95-087-13
5505

Average Weight, Color, and Shrivel Data for Walnut Varieties

Variety	Nut wt	Kernel wt	% kernel		Ex Light	Light	Light Amber	Amber		Tip shrivel	<50% shrivel	>50% shrivel
Chandler	13.4	6.6	49.2		53	41	5	0		30	3	2
Howard	14.7	7.5	51.1		16	63	20	1		3	1	1
Tulare	14.3	7.7	54.0		4	77	18	0		6	4	3
Sexton	16.1	8.5	52.8		19	60	20	1		13	4	1
Gillet	15.6	8.0	51.2		15	73	12	0		10	2	0
Forde	16.2	8.6	53.0		34	56	10	0		3	0	1

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Sexton	16.1	8.5	52.8		19	60	20	1		13	4	1
Gillet	15.6	8.0	51.2		15	73	12	0		10	2	0
Forde	16.2	8.6	53.0		34	56	10	0		3	0	1

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Gillet	15.6	8.0	51.2		15	73	12	0		10	2	0
Forde	16.2	8.6	53.0		34	56	10	0		3	0	1

Jerry Moore - Tulare County

Ivanhoe

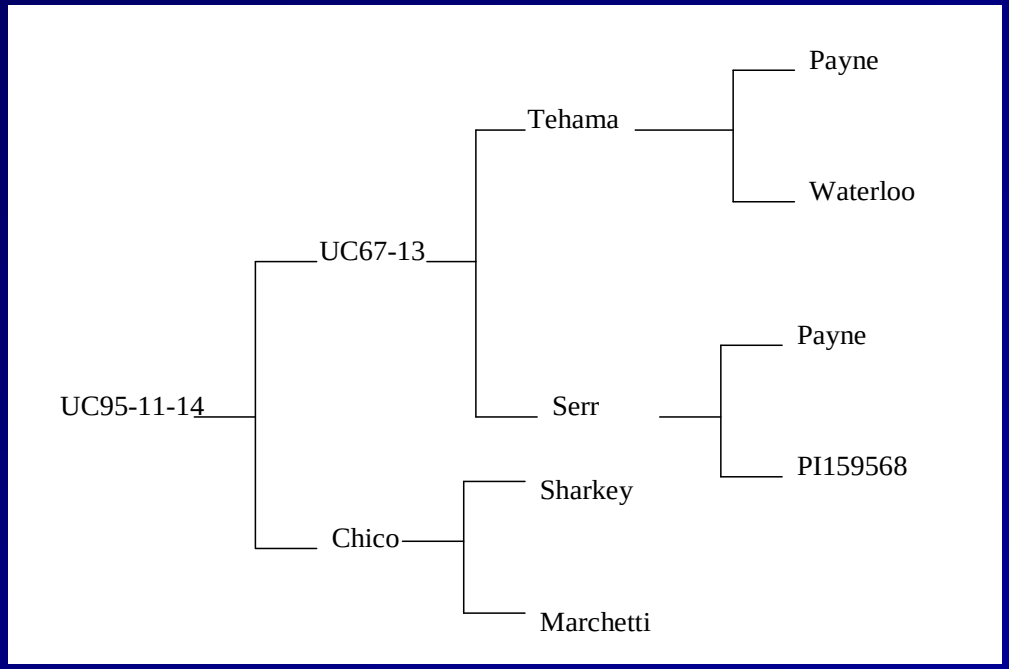
(95-011-14)

New Release !

Payne harvest date

Light colored kernels

Ivanhoe (95-011-14)



Ivanhoe (95-11-14)

- Very early harvest date (Payne/Serr)
- Light kernel color
- High yield
- Blight susceptible
- Nut –smooth shells, watch size
- Growth habit – small stature, may stress
  Grow on Paradox
- Kernel – 57%, 7.6g, easy halves

Field Data Comparison

Trait	Ivanhoe	Serr	Chandler
Leafing date	3/19	3/18	4/03
Peak female	3/28	4/06	4/22
Peak male	4/08	3/31	4/11
Harvest	9/13	9/17	10/07
Yield	7	5	7
Blight	*		

Nut Data Comparison

Trait	Ivanhoe	Serr	Chandler
In shell wt. (g)	13.3 g	14.6	13.4 g
Kernel wt (g)	7.6 g	8.2	6.7 g
Percent kernel	57 %	56.1%	49 %
% Extra light	41 %	7%	53 %
% Light	51 %	70%	41 %

Ivanhoe 2009

1st Shake:

Edible: 55%
RLI: 54.0

2nd Shake:

% Edible: 53.4%
RLI: 52.3
Jumbo sound: 93%
ExL: 33%
Light: 45%
Nut wt.: 13.2 g

Butte Co.

Davis

Cisco NSB
Tulare NSB
SEXTON D-SBB
Gillet D-SBC
Forde D-SBB
IVANHOE D-SBB
90-27-21 D-SBA
90-027-23 D-SBA

KAC


IVANHOE
KAC
90-027-21
KAC
90-027-23
KAC
91-077-6
KAC
91-77-40
KAC
91-090-41
KAC
92-070-12
KAC
92-028-20
KAC
94-019-29
KAC
94-019-45
KAC

Woodland


Chandler
G505
Howard
G505
Sexton
G505
Gillet
G505
Forde
G505
95-11-19
Harrison
G505
59-124
G505
98-122-21
G505
91-072-6
G505
95-087-18
G505

Grower Trial - Woodland - 2009

Variety	**Sexton**	**Gillet**	**Forde**	**Ivanhoe**	**Chandler**
Edible Yield	47.5	50.5	54.3	53.7	48.6
RLI	54	54	53.5	54	53.8
% Jumbo Sound	95.3	93.9	95.2	95.9	94.8
% Extra Lt kernels	52	74	53	74	48
% Light	38	8	26	13	44
% Lt Amber	10	13	17	9	8
% Amber	0	5	4	4	0
Avg nut weight (grams)	16.5	13.3	15.0	11.9	14.2

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Gillet	15.6	8.0	51.2		15	73	12	0		10	2	0
Forde	16.2	8.6	53.0		34	56	10	0		3	0	1
Ivanhoe	13.3	7.5	56.6		41	51	7	1		1	0	2

Ivanhoe
(95-011-14)

Released: January 2010

Nurseries are licensed to sell

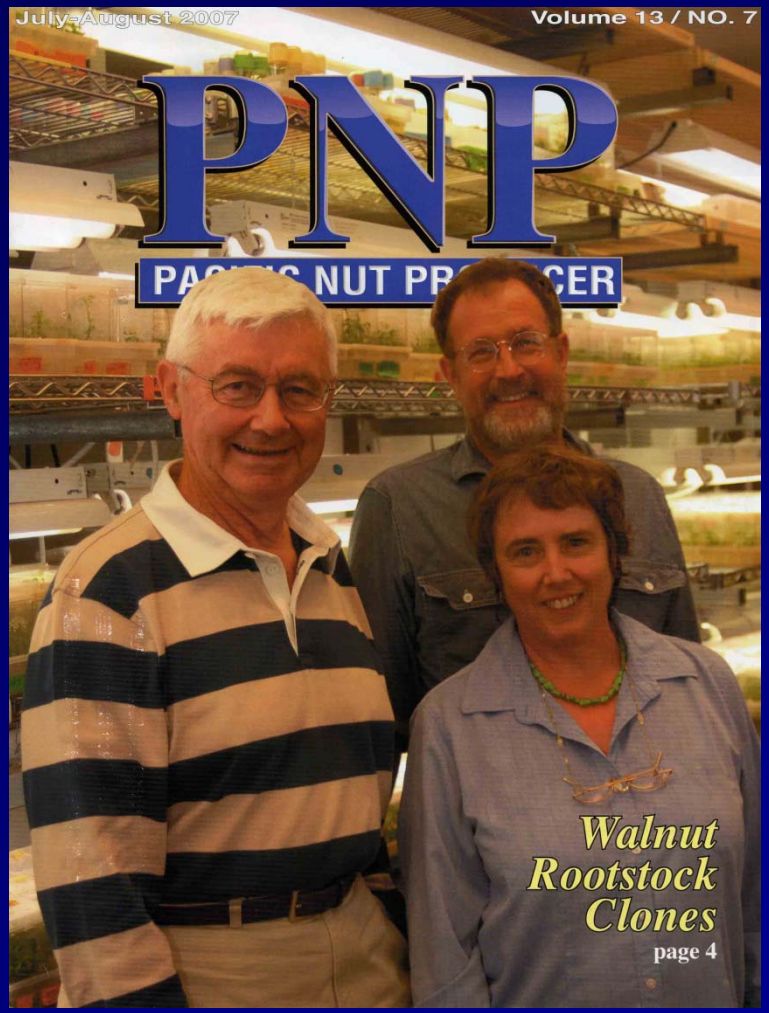
Pollenizers

Sexton	Sexton , Howard, Tulare
Gillet	Payne, Serr, Vina, Sexton
Forde	Sexton, Ivanhoe, Howard, Tulare
Ivanhoe	Serr, Payne

95-011-16

93-028-20

Clonal Rootstocks



Crown Gall resistance

Nematode tolerance

Phytophthora resistance

High Vigor

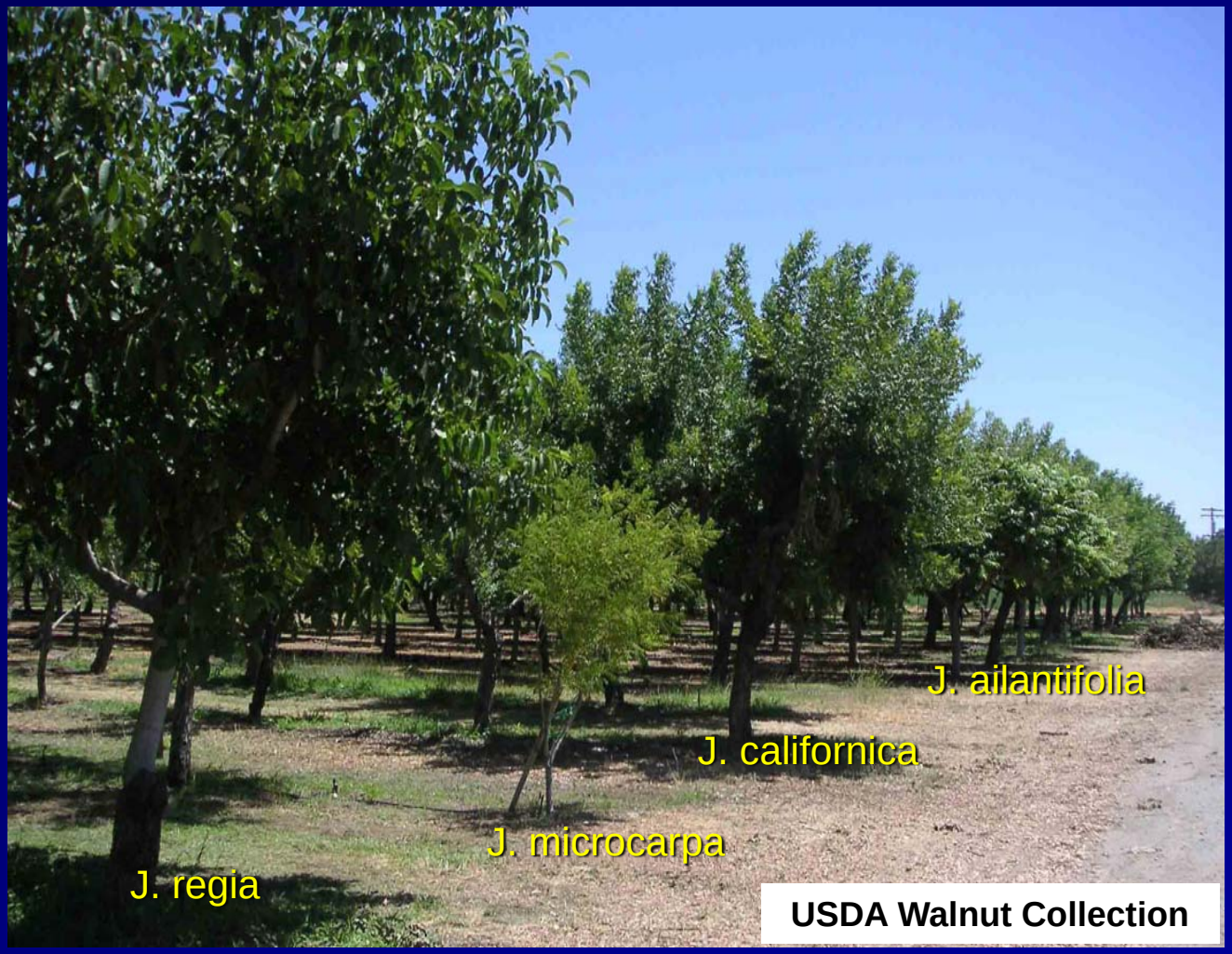
Micropropagation

Nursery Growth and Grafting

Rootstock Field Trials

Crown Gall Screening

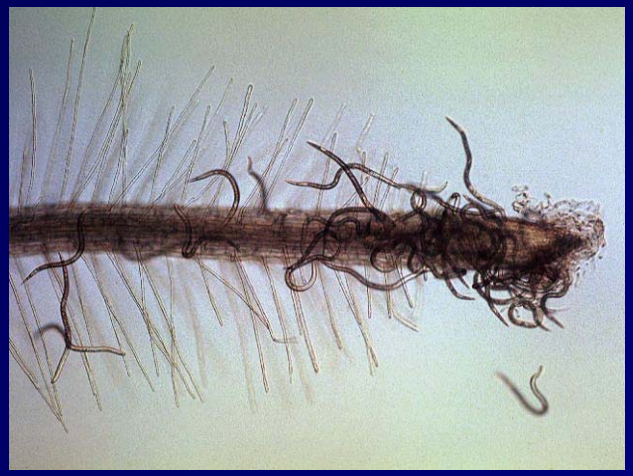
McKenna (UCD), Hasey (UCD)
Kluepfel (USDA)

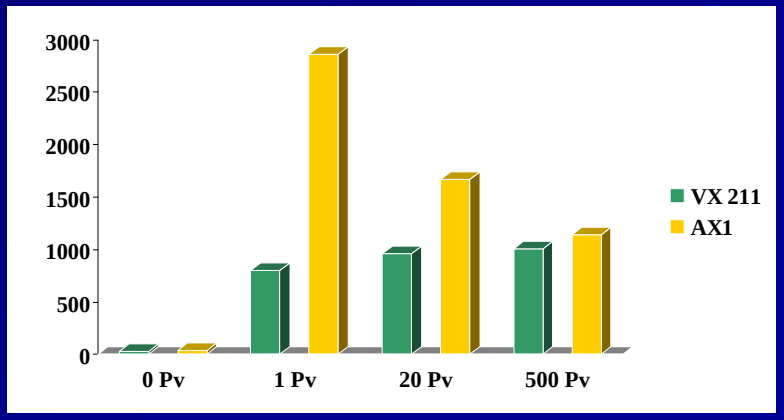


One or two clones appear to have some resistance in greenhouse trials.

Screening for Nematode Resistance

Mike McKenry – UC Riverside

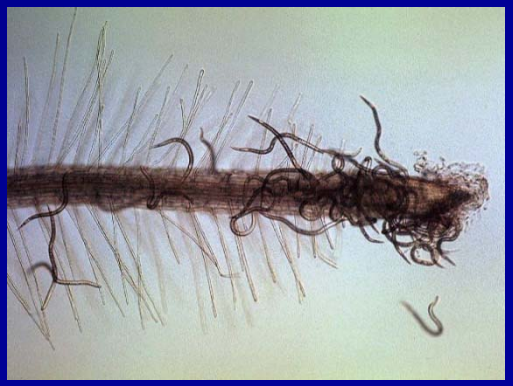




VX211

Paradox
(Northern California Black x English)

- Exceptional vigor
- Tolerance to nematodes
- Some resistance to Phytophthora
- Excellent survival in orchard replant trials
- New large scale trials are in progress
- VX211 is commercially available

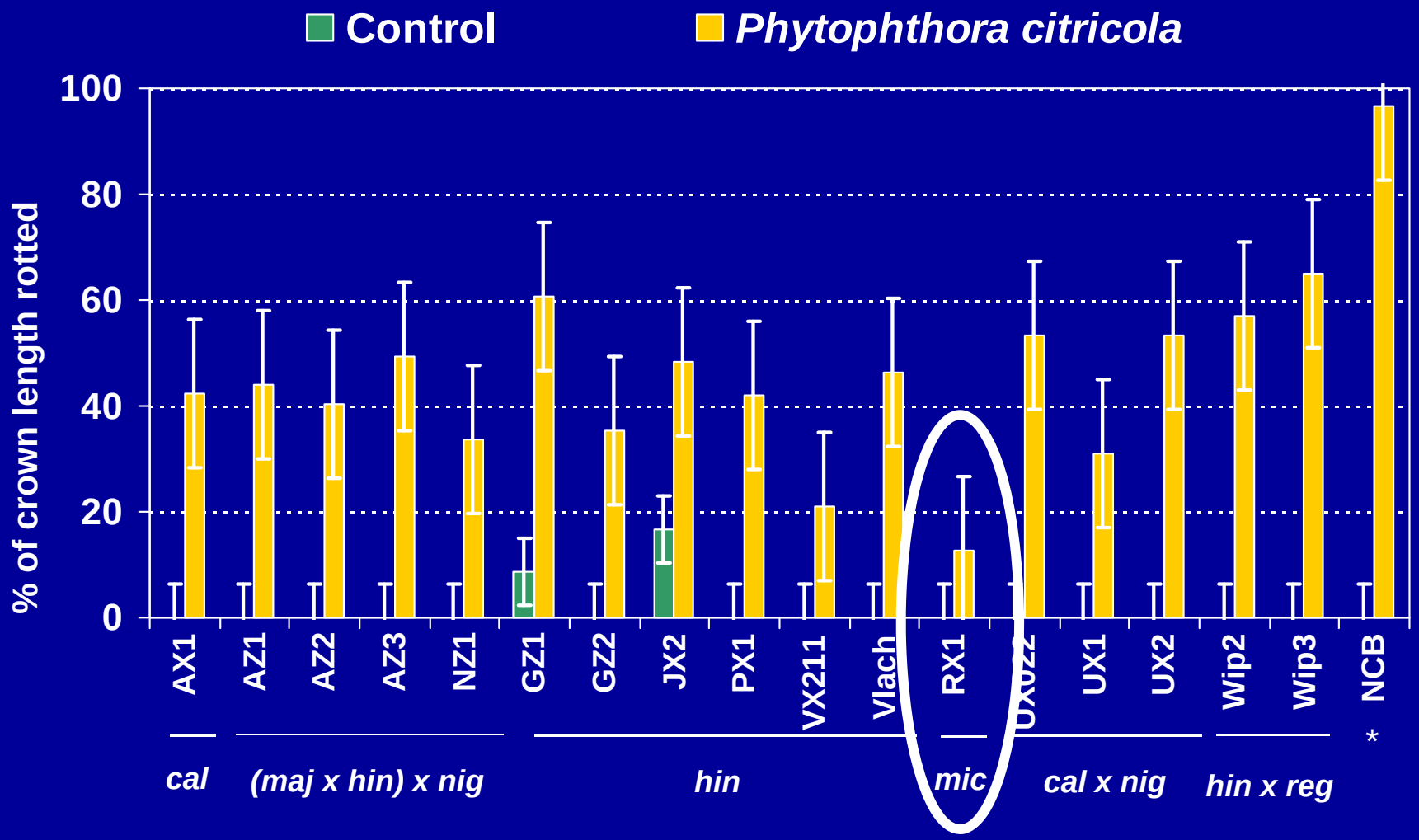


Phytophthora screening

Greg Browne, USDA/ARS

Phytophthora citricola

Greenhouse Evaluation



RX1 Field trial: wet site, *Phytophthora cinnamomi*

Photo courtesy of Joe Grant

RX1

Texas black X English

- Resistance to *Phytophthora P. citricola* and *P. cinnamomi*
- Smaller tree, less vigorous than VX211
- Excellent survival in orchard replant trials
- New field trials are underway
- RX1 is commercially available

Vlach

- One of the first Paradox clones to be micropropagated
- 7-10 years in growers fields
- Is commercially available

Clonal Rootstocks Status

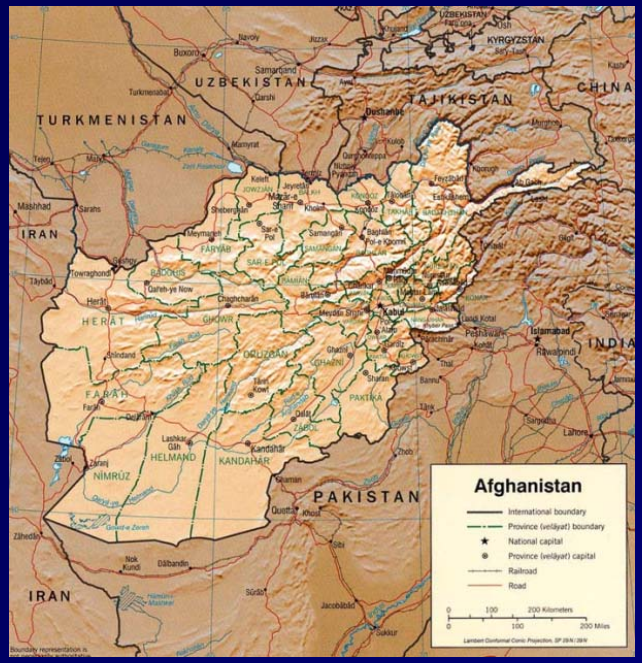
- Crown gall – in the testing process
- VX211 – performs well in nematode screens
- RX1 – performs well in Phytophthora screens
- Vlach – longest field experience

Robert Livermore

Evaluating Potential for Pistillate Flower Abscission

Table 5. 2009 Pistillate Flower Abscission counts following either pollen application or natural pollination controls.

			Artificial Pollination			Natural Pollination		
Variety	Pollen Date	Count Date	Total Flowers	Flowers Dropped	% Dropped	Total Flowers	Flowers Dropped	% Dropped
Gillet	4/2	4/23	100	7	7	100	5	5
Ivanhoe	3/28	4/18	100	22	22	92	22	24
Sinensis 5	3/26	4/16	100	24	24	100	45	45
Forde	4/7	4/28	100	30	30	100	23	23
Sexton	4/8	4/29	104	38	37	98	6	6
85-8	3/26	4/16	100	41	41	96	21	22
Tulare	4/13	5/4	100	46	46	100	24	24
0-20-1072	4/13	5/4	100	48	48	98	47	48
Marchettti	4/12	5/3	102	60	59	100	37	37
Sunland	4/12	5/3	104	75	72	98	29	30
Eureka	4/12	5/3	90	65	72	92	40	43
PI 159568	4/10	5/1	42	34	81	46	25	54
Payne	4/11	5/2	100	81	81	104	27	26
Cheinovo	4/13	5/4	98	86	88	100	70	70
Serr	4/8	4/29	102	98	96	100	70	70



PI 159568

Large plump kernels

Blight resistance

Parent of: Serr, Sunland

Grandparent of : Tulare, 67-13

Great-grandparent of: Ivanhoe

USDA Collection - Afghanistan - 1937

Blackline Tolerant Rootstock

Black X English

Paradox X English

BC1 seedlings X English

Tolerant Rootstock

BC2 seedlings X English

BC3 seedlings X English

BC4 seedlings X English

Resistant Cultivars

Blackline Tolerant Rootstock

- 7 Selections
- 2 Field trials
- Trees available for more trials


J1 20A
IV/WHITE
10/31/08
J1 20A
IV/WHITE
10/31/08

Woodland


Chandler
5505
Howard
5505
Sexton
5505
Gillet
5505
Forde
5505
95-11-19
Hartley
5505
59-124
5505
98-122-21
5505
91-072-6
5505
95-042-18
5505

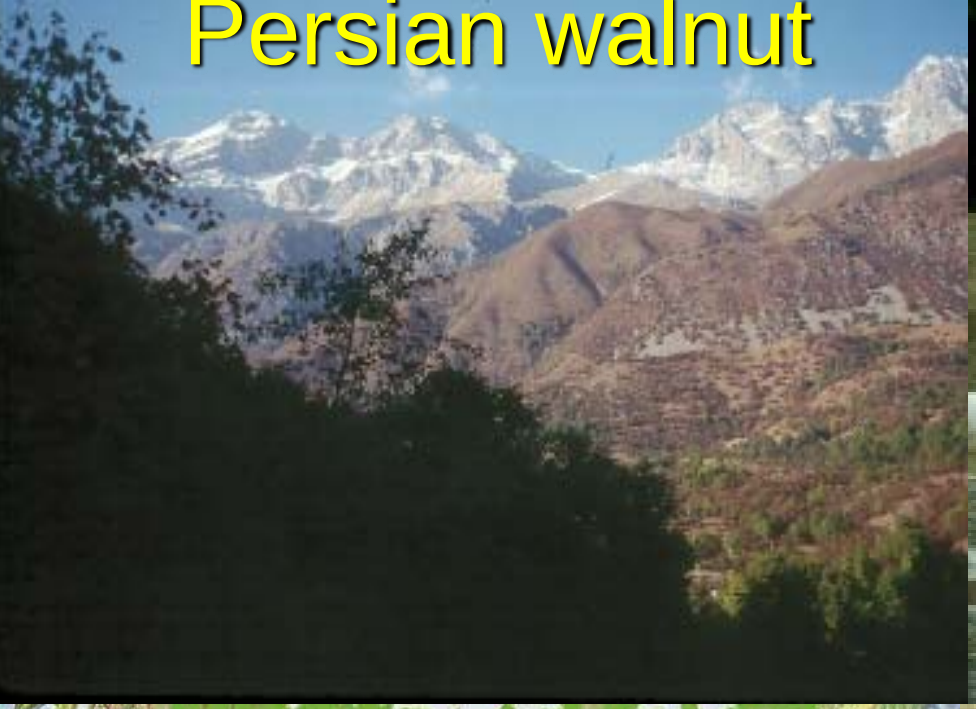
KAC

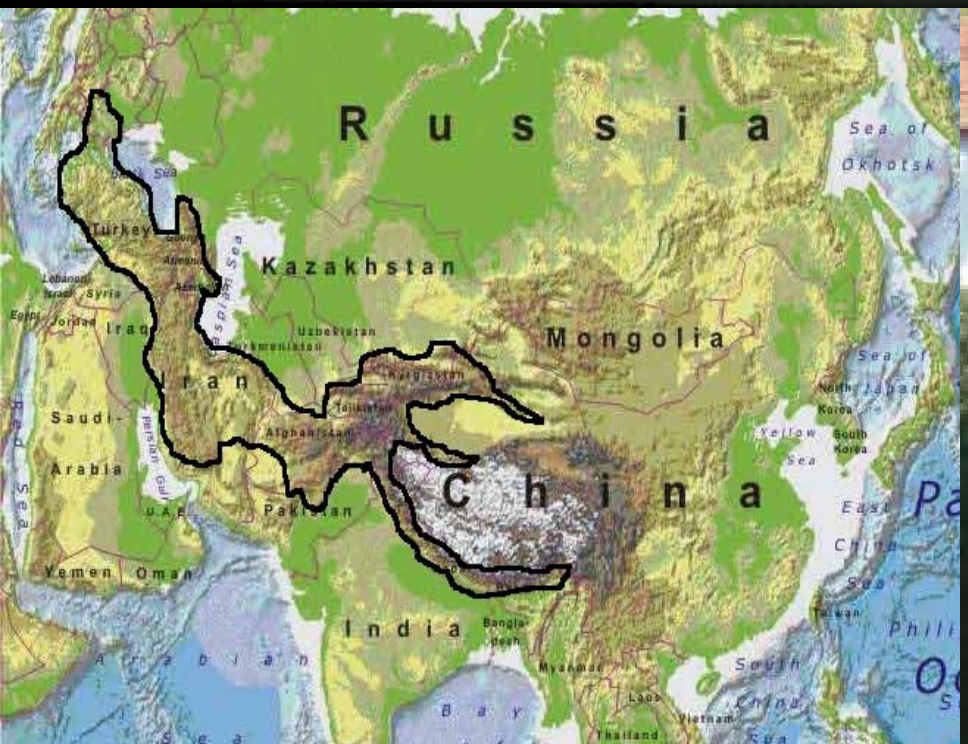

PAYNE KAC
HARTLEY KAC
VINA KAC
SERR KAC
CHANDLER KAC
HOWARD KAC
TULARE KAC
SEXTON KAC
WIRTZ KAC
FORNEY KAC

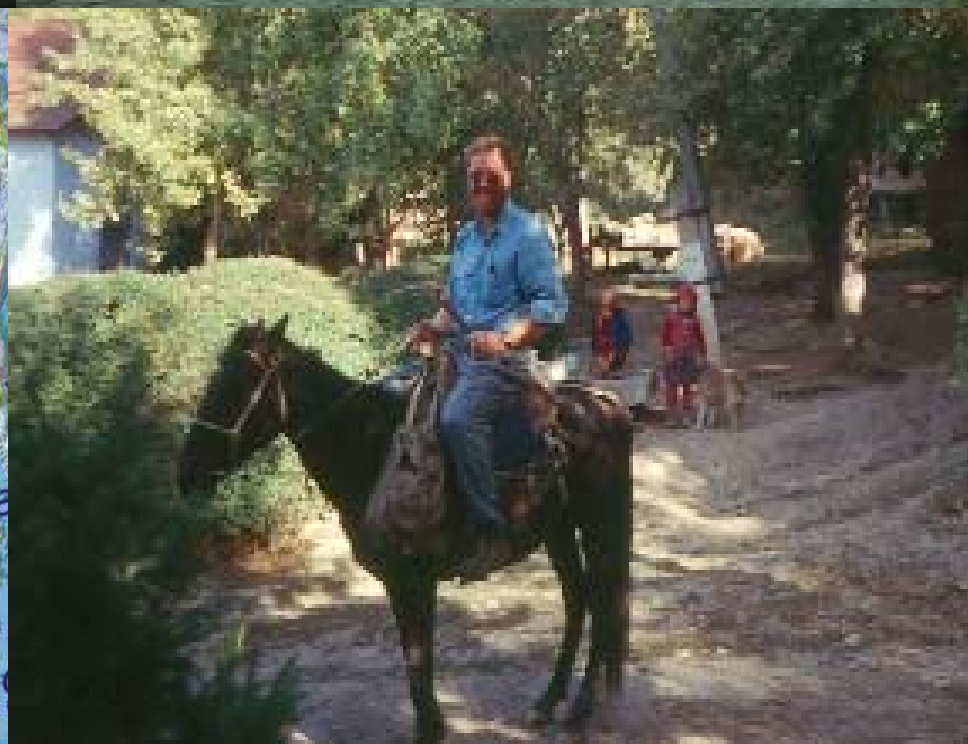
Juliet


Conant Chandlers
Conant Howard
Conant Bulaich
Conant's Gillet
Conant's Juliet
Conant
Conant
Conant

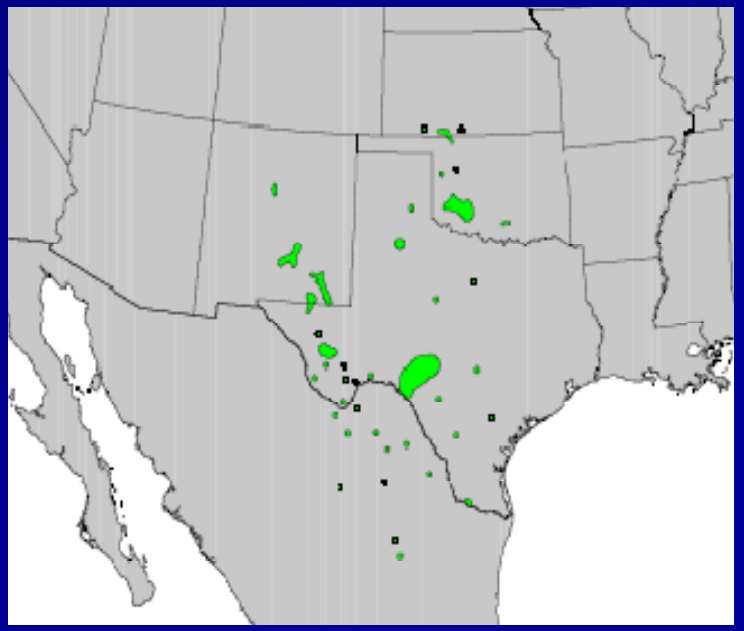
Persian walnut







Texas Black Walnut (*J. microcarpa*)



Northern California Black (*J. hindsii*)