

The Rose Program and Research on Rose Viruses at FPS

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Foundation
Plant
Services

<http://fps.ucdavis.edu>

Foundation Plant Services
UCDAVIS

FOUNDATION PLANT SERVICES



FPS
National Grapevine Importation
& Clean Stock Facility

FPS: A MISSION OF SERVICE

**Produce and
maintain
Foundation Stock**



**Virus testing
and
elimination**



**Distribution of
Foundation
plant materials**



**Grapevine
importation
services**



CROP PROGRAMS AT FPS

⌘ Grape

⌘ Rose

⌘ Strawberry

⌘ Sweet potato

⌘ Tree

⌘ Pistachio



GRAPES

CALIFORNIA REGISTRATION & CERTIFICATION PROGRAMS



FRUIT & NUT TREES



STRAWBERRIES





Roses &

“ROSE MOSAIC VIRUS”



Prunus necrotic ringspot virus
(PNRSV)

Apple mosaic virus (ApMV)

Prune dwarf virus (PDV)

Arabis mosaic virus (ArMV)

others

MULTIFLORA INDEX

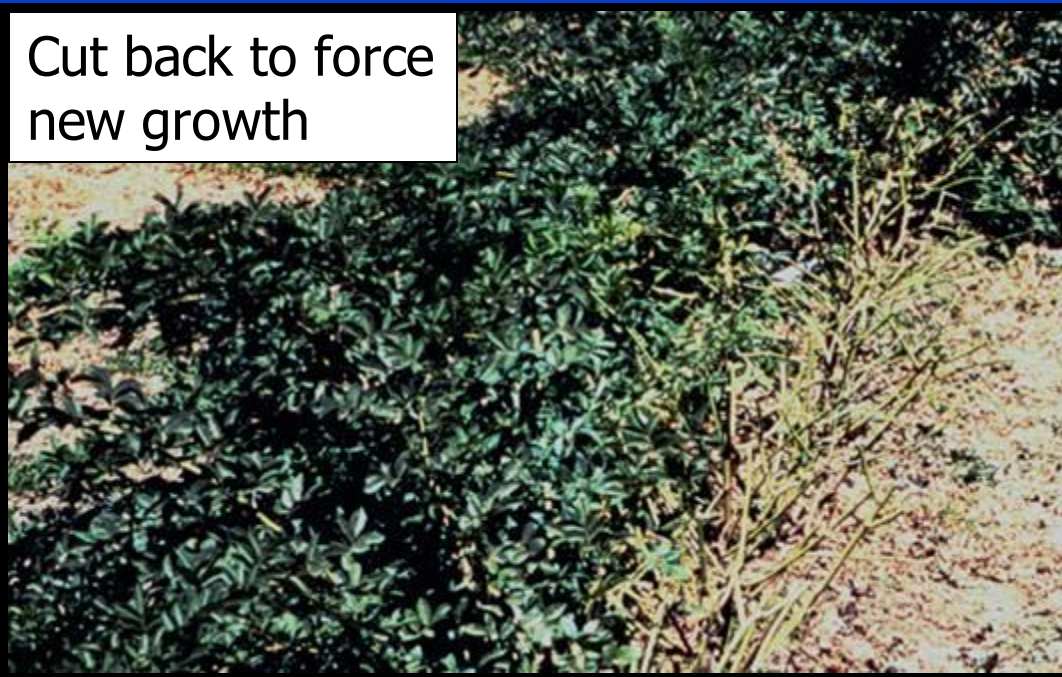
Candidate
budded to
multiflora rose



Virus symptoms on
multiflora rose



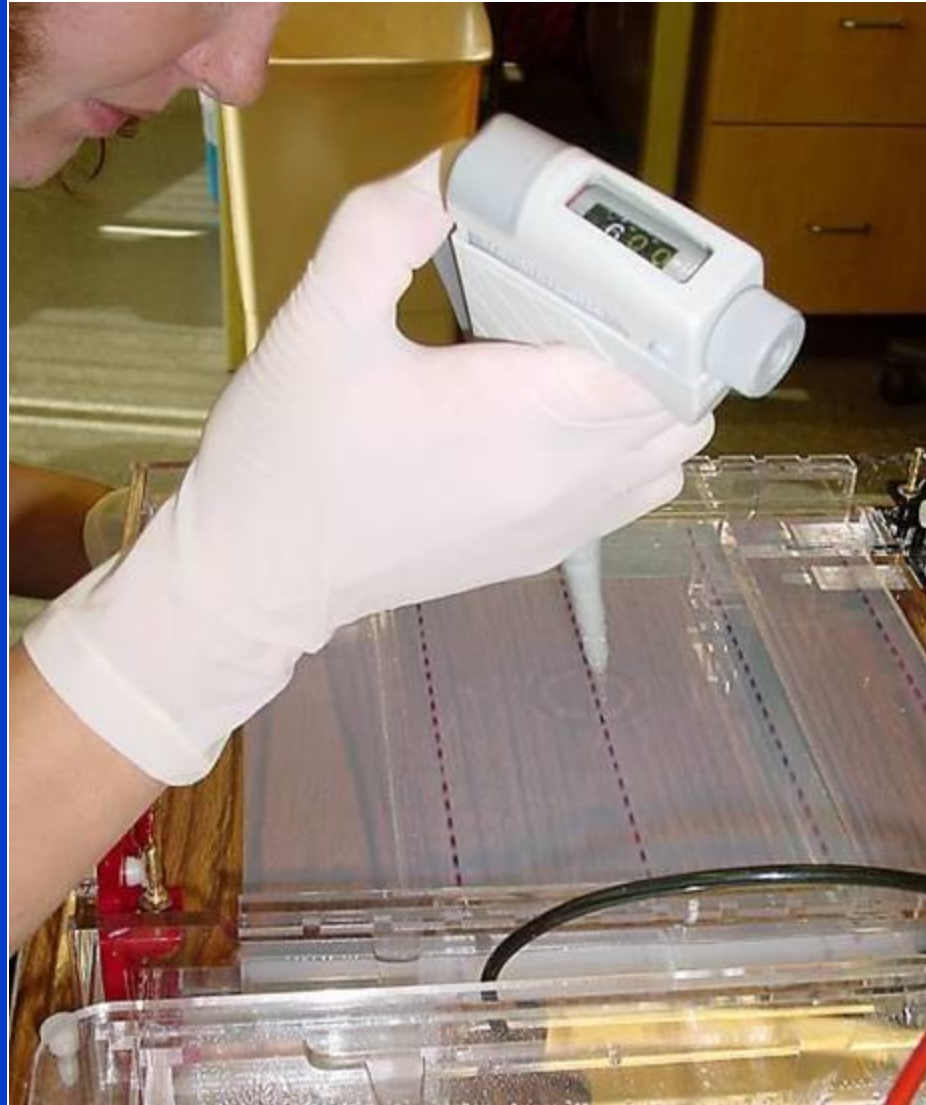
Cut back to force
new growth



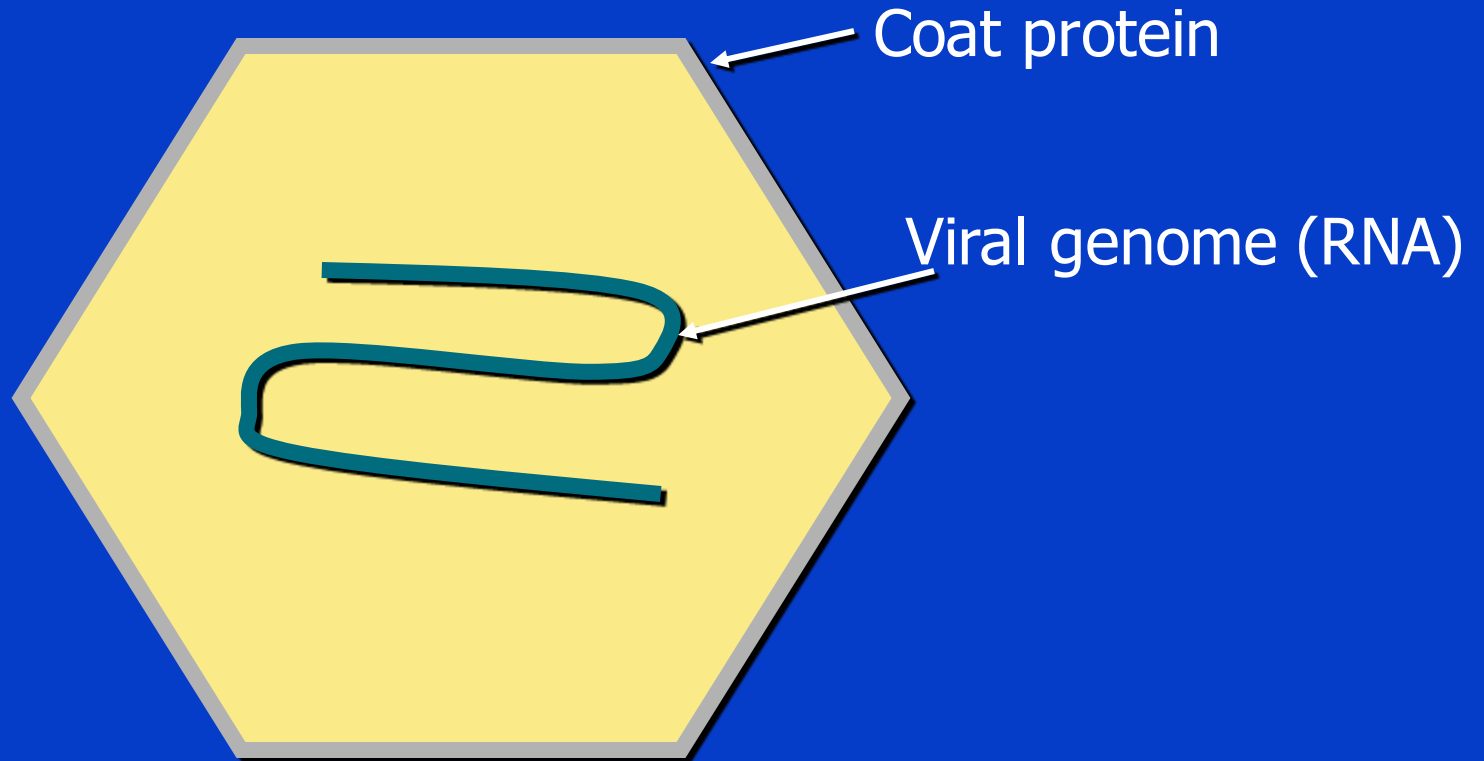
Reading the virus symptoms on the multiflora rose index



Laboratory Pathogen Detection Technology

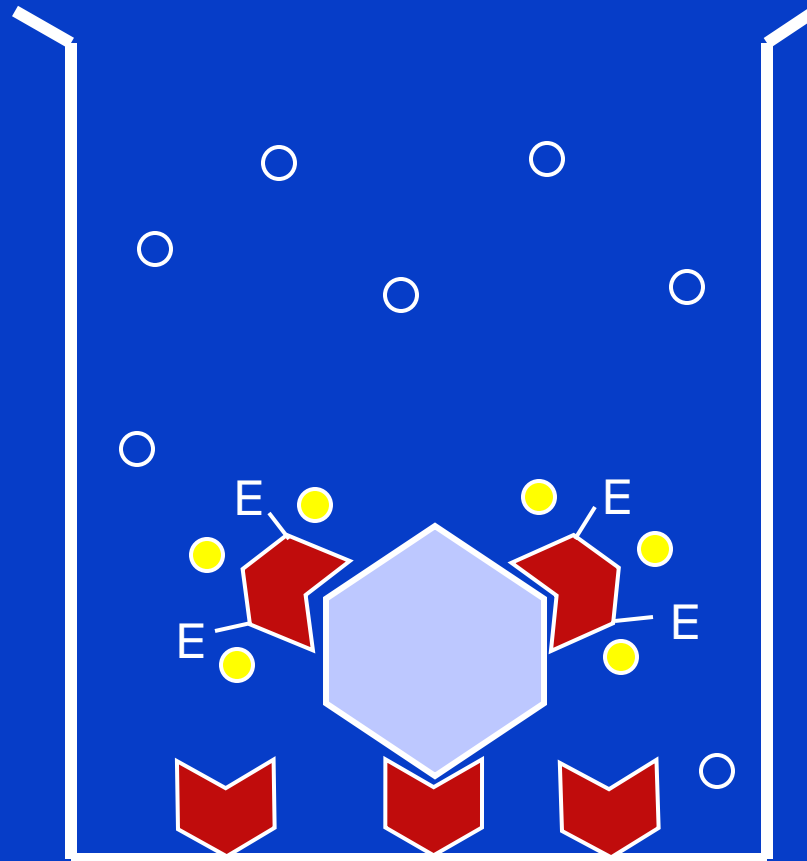
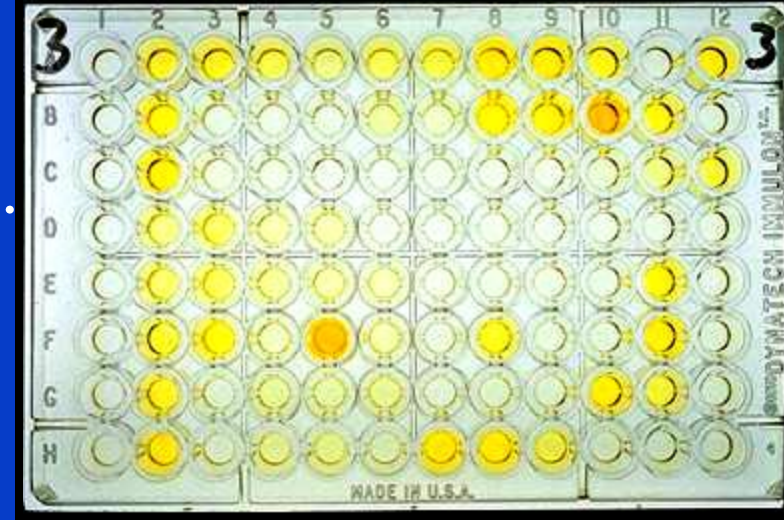


Anatomy of a Virus



- ELISA TESTING -

1. Specific antibody adsorbed to plate.
2. Add test samples containing virus.
3. Add enzyme-labeled specific antibody.
4. Add enzyme substrate.



PCR

Polymerase Chain Reaction



PCR : Polymerase Chain Reaction

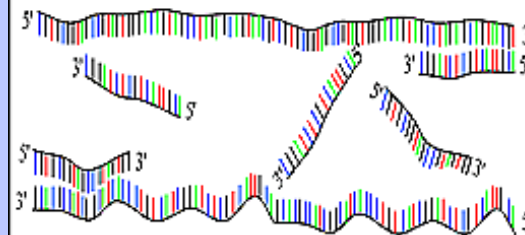
30 - 40 cycles of 3 steps :

Step 1 : denaturation



1 minut 94 °C

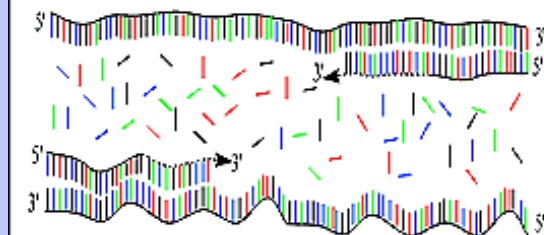
Step 2 : annealing



45 seconds 54 °C

forward and reverse
primers !!!

Step 3 : extension



2 minutes 72 °C

only dNTP's

(Andy Veenstra 1999)

SHOOT TIP CULTURE FOR VIRUS THERAPY



ROSE PLANTS FROM TISSUE CULTURE



FPS Rose Nursery



View of the Foundation Rose Block showing rootstock and scion varieties



FPS ROSE BUDWOOD FOR SHIPMENT



TRANSMISSION OF ROSE MOSAIC VIRUSES



❧ Objectives ❧

➤ **Pollen Transmission** - Determine if pollen from virus-infected rose bushes can transmit PNRSV and ApMV to healthy rose bushes.

✕ **Seed Transmission** - Determine whether seed transmission of PNRSV and ApMV occurs in roses.

✕ **Mechanical Transmission** - Determine if mechanical transmission of PNRSV and ApMV occurs from rose to rose on pruning and cutting implements.

✕ **Rootgrafting Transmission** - Determine if root grafting could account for transmission observed in mechanical transmission experiments

∞ Objectives ∞

⇒ **Pollen Transmission** - Determine if pollen from virus-infected rose bushes can transmit PNRSV and ApMV to healthy rose bushes



POLLEN TRANSMISSION TRIAL

PROCEDURE:

Harvested pollen
from virus-infected
bushes; dried
overnight and used
within 2 days.



Transferred pollen to
receptive flowers on
healthy bushes.



POLLEN TRANSMISSION TRIAL

- 3 varieties pollinated: Proud Land, Sunflare, Playboy
- 3 pollen treatments
 - – pollen from infected Paul Neyron (ApMV + PNRSV)
 - – pollen from infected Pink Flower Carpet (ApMV + PNRSV)
 - – no pollen applied (control)
- 224 plants total;
- pollinated in 2000, 2001, 2002
- ELISA tested all bushes, spring, 2003 & 2004 for ApMV & PNRSV



POLLEN TRANSMISSION TRIAL

Results: All bushes ELISA tested negative in 2003 & 2004. No symptoms were observed.

Conclusion: Pollen transmission is not a major source of virus infection within roses.



✧ Objectives ✧

✧ **Seed Transmission** - Determine whether PNRSV and ApMV are transmitted to seedlings in roses



Viruses Known to Be Transmitted by Seed in Fruit Trees

- * Prunus necrotic ringspot virus (PNRSV)
- * Apple mosaic virus (ApMV)
- * Prunus dwarf virus (PDV)



PRUNUS NECROTIC RINGSPOT VIRUS
-Tatter leaf symptoms on cherry

SEED TRANSMISSION TRIAL

PROCEDURE:

Hips harvested in 2000 and 2001 from 7 virus-infected sources:

Arizona

Queen Elizabeth

Proud Land

Cl. Don Juan

Fourth of July

Red Fountain

Earth Song



SEED TRANSMISSION TRIAL

Seeds cleaned, cold-stored, and germinated spring 2001 and 2002

'Red Fountain' seed from virus-infected plant sown after chilling



SEED TRANSMISSION TRIAL

Plants ELISA tested, spring, 2002 & 2003,
for ApMV & PNRSV

RESULTS : 643 plants ELISA tested – all tested negative
10 plants weak and sickly-looking, tested
negative on herbaceous host, fall, 2002, died over winter



❧ Objectives ❧

❧ **Mechanical Transmission** - Determine if mechanical transmission of PNRSV and ApMV occurs from rose to rose on pruning and cutting implements



MECHANICAL TRANSMISSION TRIALS

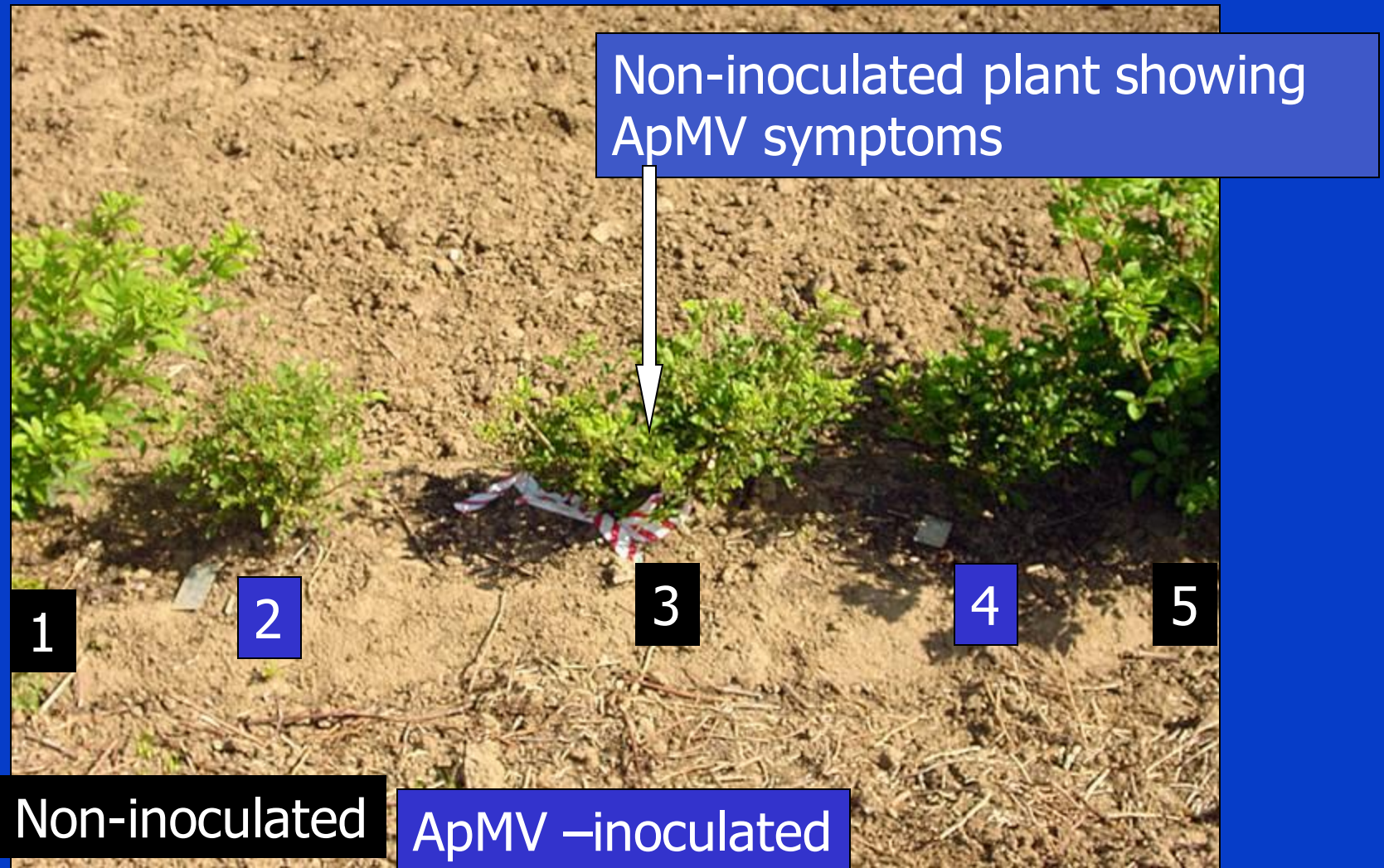
Multiflora, 1999

Hedged with gas-powered trimmer 4 - 6 times during season, 2000, 2001, 2002, 2003.

ELISA tested and symptoms observed 2001, 2002 , 2003.



Mechanical Transmission, Multiflora



Conclusion: Average 10% spread/year from inoculated to non-inoculated plants.

∞ Objectives ∞

∞ **Rootgrafting Transmission** - Determine if root grafting could account for transmission observed in mechanical transmission experiments. 1) Roundup® 2) Co-POT



ROOT GRAFTING TRIALS

1. Multiflora
2. 3 Scion varieties
3. Dr. Huey
4. Roundup® Trials
5. Potted plants



Multiflora Root Grafting Trial

PROCEDURE:

Planted 320 VI multiflora roses, in 2001.

Graft inoculated in August, 2001, alternate plants with one of 5 virus treatments:

PNRSV - ROS70.7

PNRSV - ROS90.7

ApMV - ROS98.36

ApMV & PNRSV - ROS98.27

APMV & PNRSV - ROS99.82



Multiflora Root Grafting Trial

Allowed to grow during season to allow root grafting, not hedged.

Pruned in winter, disinfecting shears between each plant with 20% bleach to reduce size.

Observed symptoms and ELISA tested new growth, spring 2003 and 2004.



Multiflora Root Grafting Results

		Number of Non- inoculated plants that tested ELISA +	
Treatment	Virus	2003 (21 mo.)	2004 (33 mo.)
1	PNRSV	1	5 (PNRSV)
2	PNRSV	16	30 (PNRSV)
3	PNRSV + ApMV	8	16 (9 PNRSV, 5 both, 2 ApMV)
4	ApMV	0	1* (PNRSV)
5	PNRSV + ApMV	6	12 (10 PNRSV, 2 both)
Total		31/160	64/160
Percent		19%	40%

Conclusion: In third year of growth with no hedging we got an average 40% virus spread from inoculated to non-inoculated plants.

Scion Root Grafting Trials

PROCEDURE:

Planted 300 each of Iceberg, Queen Elizabeth and Double Delight, 2002.

Graft inoculated alternate plants with 3 virus treatments, fall, 2002.

Allowed to grow unhedged during 2003.

ELISA tested spring, 2004.



Scion Root Grafting Trials

Number of Non-inoculated plants that tested ELISA +

	Adjacent Virus Treatment			
Variety	PNRSV	ApMV	PNRSV & ApMV	Total
Double Delight	2	7	7	16 (11%)
Iceberg	3	11	5	19 (13%)
Queen Elizabeth	0	3	4	7 (5%)
Total	5 (3%)	21 (15%)	16 (11%)	42/434 (10%)

Results: In second year of growth with no hedging we got an average 10% virus spread from inoculated to non-inoculated plants.

ROOT GRAFTING TRIALS

Dr. Huey Root Grafting

PROCEDURE:

Planted 600 Dr. Huey, fall,
2002.

Graft-inoculated alternate
plants with 3 virus
treatments, fall, 2003.

RESULTS: 18% spread or
40/217 uninoculated
plants tested positive
spring, 2005.



Roundup® Experiments

PROCEDURE

- Roses planted in various spacing.
- Let grow 1 to 3 years.
- Cut back to 1 foot.
- Apply Roundup to cut stems of alternate plants.
- Observe for symptoms on adjacent plants.



Roundup® Experiments

- 100% Roundup® **carefully** applied with paintbrush or sprayed depending on plant spacing.

Paintbrush application for plants at 1-foot spacing

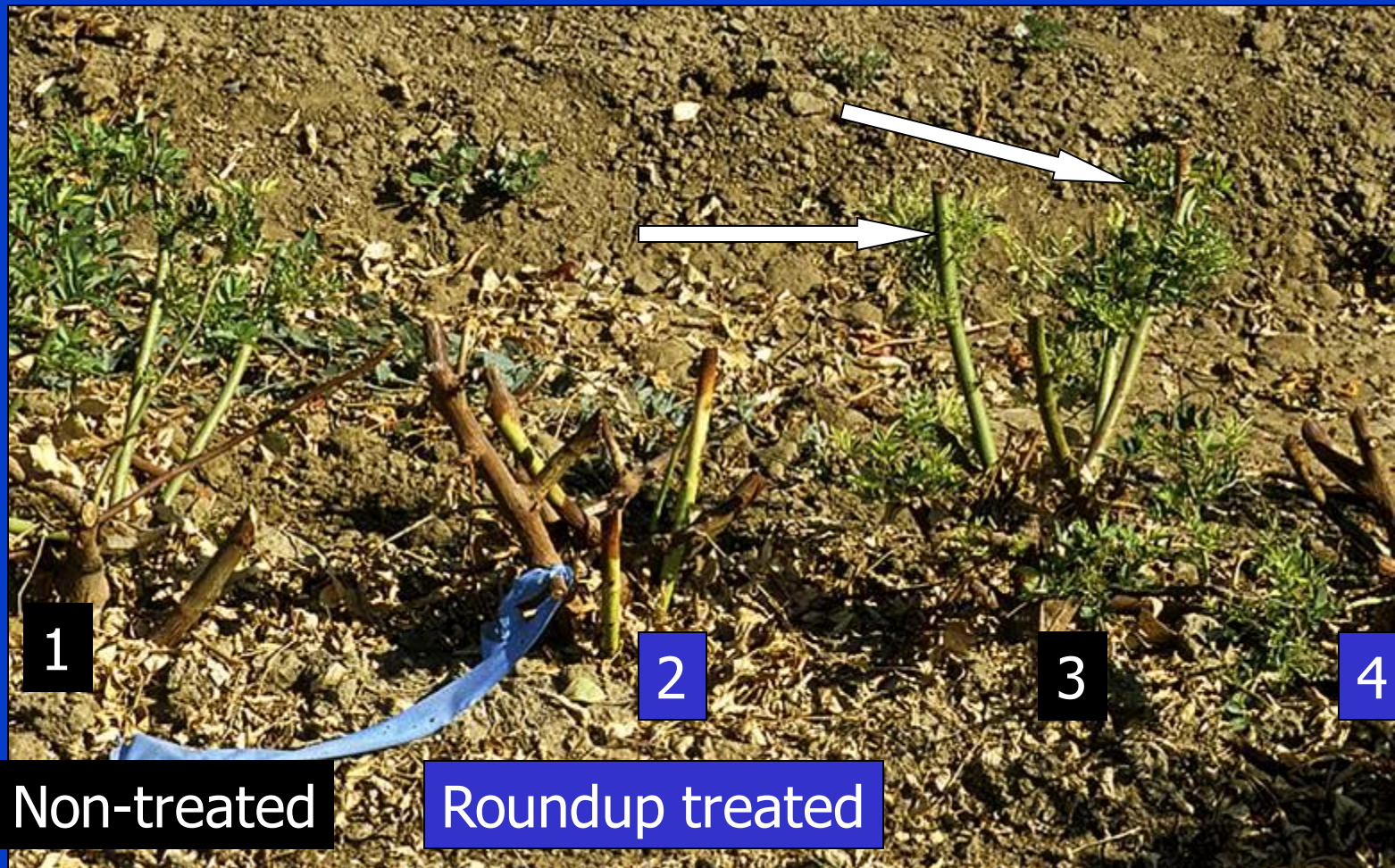


Spray application with
box protector for plants
at 3-foot spacing



Multiflora Roundup® Results:

Treated plants died in 3 wks (blue flag); 50% of untreated plants show Roundup symptoms (arrows).



Roundup® Experiments – Results

Variety	Plant age	# plants in experiment	# untreated plants with Roundup symptoms/# untreated plants
Multiflora	1 yr	200	49/100 (49%)
Multiflora	2 yrs	274	56/130 (46%)
Dr. Huey	1 yr	74	4/37 (11%)
Dr. Huey	2 yrs	74	5/37 (13%)
Sunflare	5 yrs	98	5/50 (10%)

Conclusion: 10 - 50% plants were rootgrafted with adjacent plants.

Roundup® Experiments

Multiflora

Roundup® Volatility trial

100% Roundup® applied to wooden stakes placed 1 foot away from row on both sides of row.

Results:

0/90 showed symptoms. All plants were negative.

Conclusion: Volatility not a factor in causing herbicide symptoms in rootgrafting trials.



ROOT GRAFTING TRIALS

Potted plants

PROCEDURE:

Plant a virus-infected and healthy plant together in same pot.

Plant virus-infected and healthy plants in separate pots to isolate root systems. Arrange foliage so they have contact with each other.

ELISA test and observe for symptoms on healthy plants at 6 months, 1 year, 2 years, etc.

Co- POT Trial

OBJECTIVE: to determine whether virus is spread from virus – infected to healthy plants by root grafting in potted plants.



Co- POT Trial

120 virus – infected plants (40 each of 3 virus accessions)
& 120 healthy plants in 4 inch pots



Doubles – 2 plants / pot



Singles – 1 plant
/pot

ELISA test and observe for symptoms on healthy plants at 6 months, 1 year, 2 years, etc.

C0-POT Trial:

- 3 virus treatments of Dr. Huey:
 1. single infection of ApMV
 2. single infection of PNRSV
 3. mixed infection of APMV + PNRSV
- Total of 180, 2 gallon pots of Dr. Huey
- 1 virus treatment of multiflora
mixed infection of APMV + PNRSV
- Total of 60 pots of multiflora

ELISA tests scheduled spring, 2006.





Thank you

