

# TRANSMISSION OF ROSE MOSAIC VIRUSES

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# FOUNDATION PLANT SERVICES



**FPS**  
**National Grapevine Importation**  
**& Clean Stock Facility**



# “ROSE MOSAIC VIRUS”



Prunus necrotic ringspot virus  
(PNRSV)

Apple mosaic virus (ApMV)

Prune dwarf virus (PDV)

Arabis mosaic virus (ArMV)

others

# Rose Mosaic Symptoms

ringspot



mottling



# ∞ Objectives ∞

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⇒ **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 ∞

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



# POLLEN TRANSMISSION TRIAL

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## 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

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- 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

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**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 ∞

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

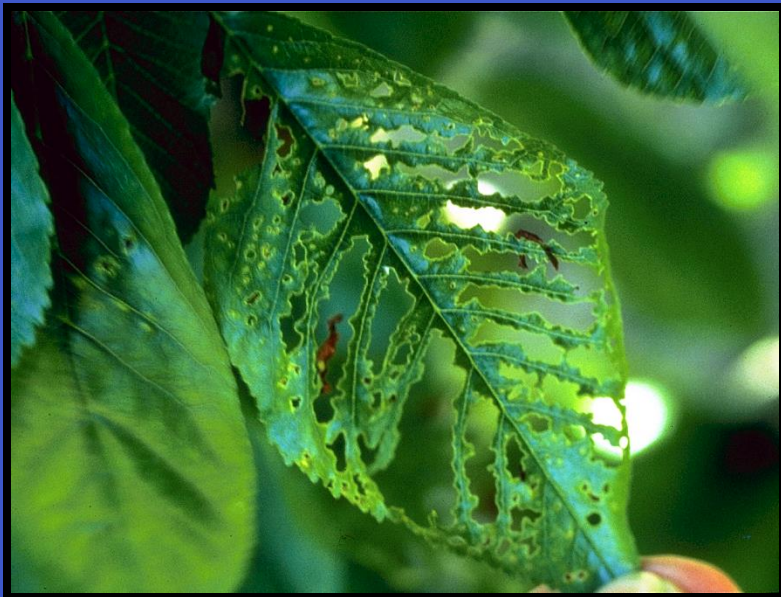




# Viruses Known to Be Transmitted by Seed in Fruit Trees

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- \* 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

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## 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

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

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



# SEED TRANSMISSION TRIAL

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

RESULTS : 643 plants ELISA tested – all tested

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





# ❧ Objectives ❧

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



# MECHANICAL TRANSMISSION TRIALS

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## **Multiflora, 1999**

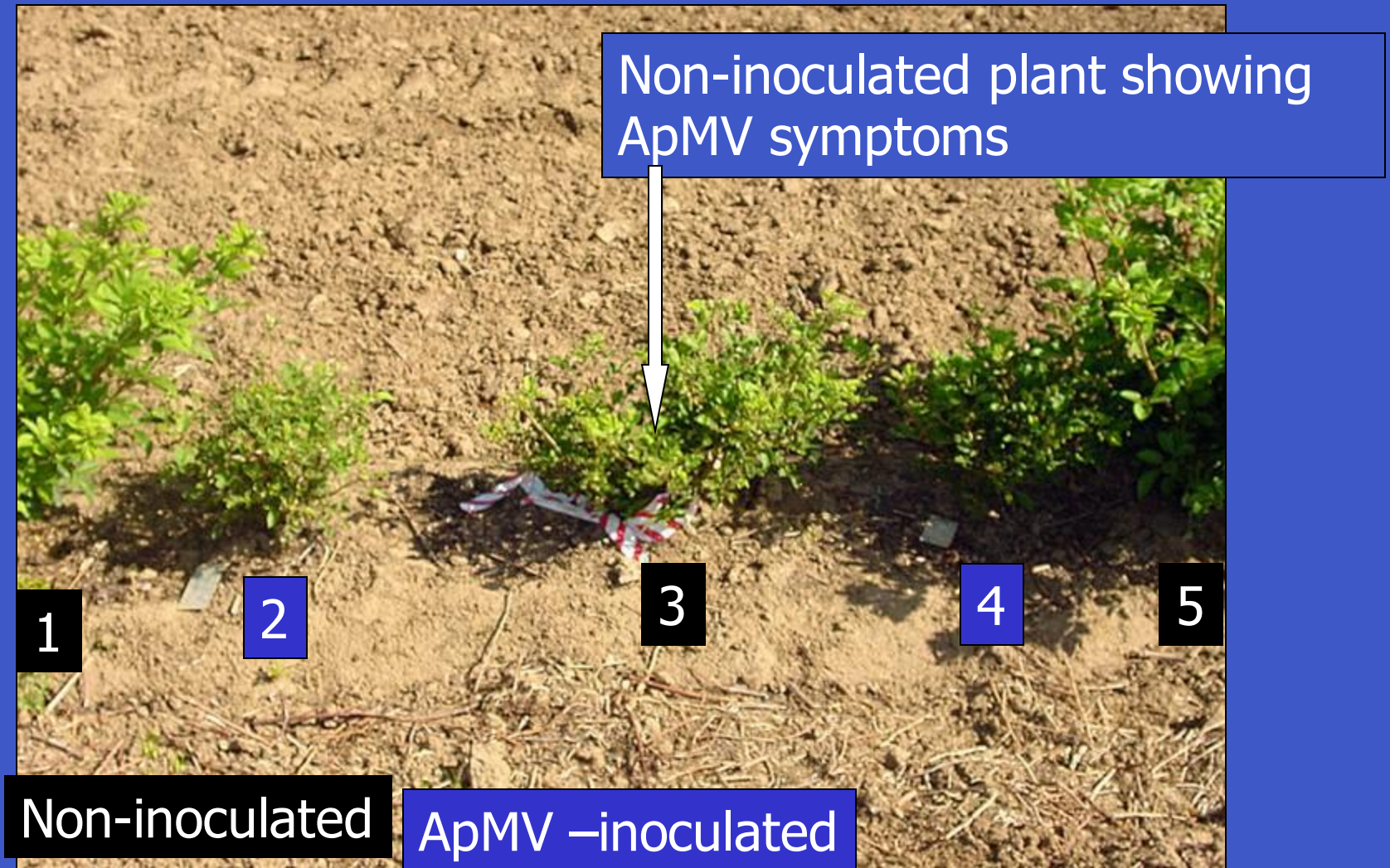
Hedged with gas-powered trimmer 4 - 6 times during season, 2000, 2001, 2002, 2003.

ELISA tested and symptoms observed 2001, 2002 , 2003.





# Mechanical Transmission, Multiflora



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



# ∞ Objectives ∞

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





# ROOT GRAFTING TRIALS

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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

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## **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



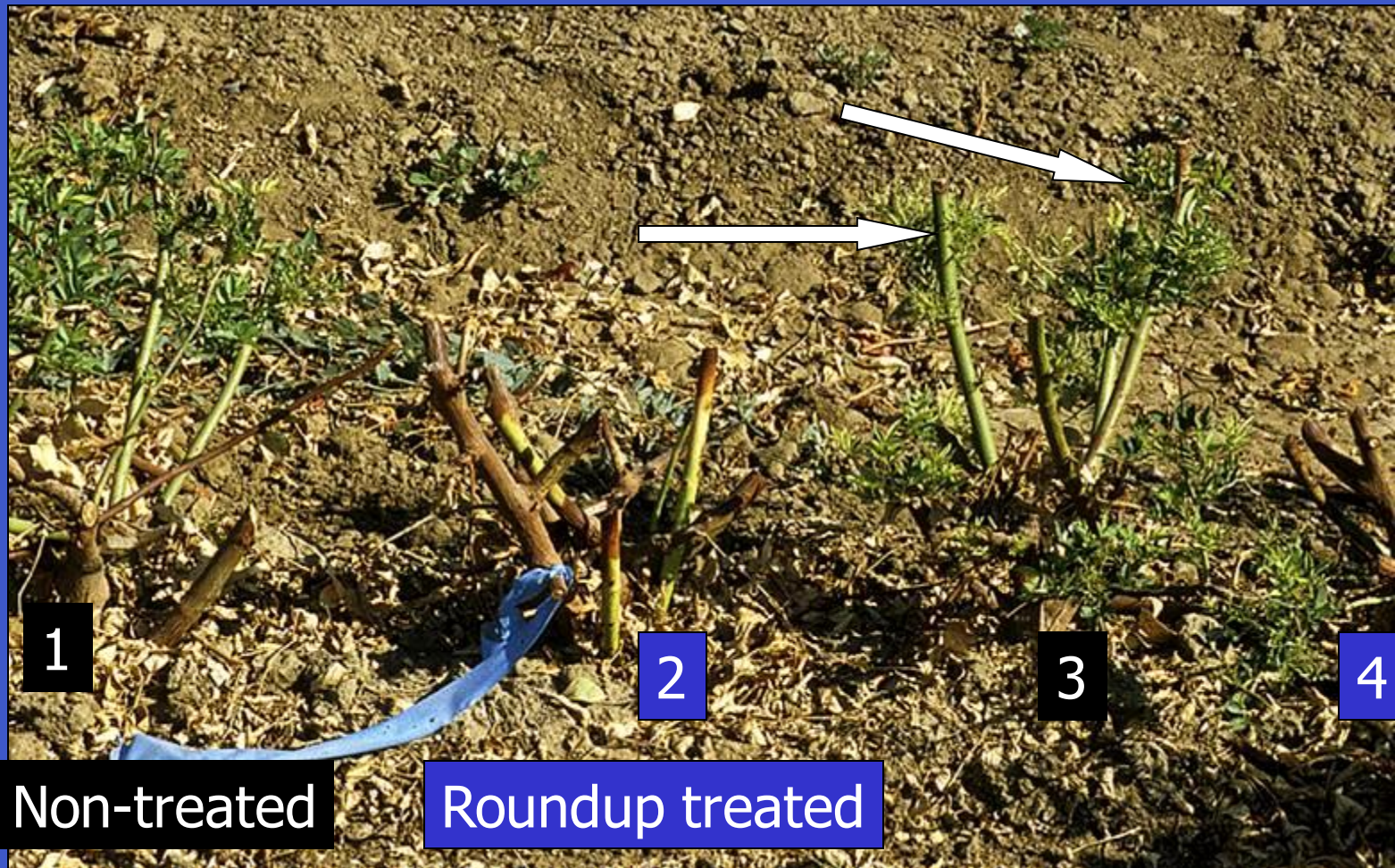
Spray application with box protector for plants at 3 foot spacing





## 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

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## 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 spring, 2006, 2007, 2008,  
2009.



















# Co- pot Results, 2009

# ELISA positive/ # tested			
Cultivar	Virus	Singles	Doubles
Dr. Huey	ApMV	17/20	19/20
Dr. Huey	Healthy	0/20	0/20
Dr. Huey	PNRV	10/20	8/15
Dr. Huey	Healthy	0/20	0/15
Dr. Huey	ApMV & PNRV	20/20	20/20
Dr. Huey	Healthy	0/20	2/20
R. multiflora	ApMV & PNRV	18/20	18/20
R. multiflora	Healthy	0/20	4/20*

\* In 2007, 0 tested positive; in 2008, 2 tested positive; in 2009 the number positive may be 5, pending retesting.



# ROOT GRAFTING TRIALS

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## **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.



# ROOT GRAFTING TRIALS

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## Preliminary Conclusions:

1. Root grafting can occur in closely planted vines of Multiflora rose.
2. Root grafting is far less common for the most frequently used rootstock Dr. Huey.







Thank you,  
Garden Rose Council  
&  
California Association of  
Nurseries and Garden Centers