TRANSMISSION OF ROSE MOSAIC VIRUSES

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FOUNDATION PLANT SERVICES
“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

- **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
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.
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
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

Conclusion: Pollen transmission is not a major source of virus infection within roses.
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
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
1. Multiflora
2. 3 Scion varieties
3. Dr. Huey
4. Roundup® Trials
5. Potted plants
PROCEDURE:
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

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Virus</th>
<th>2003 (21 mo.)</th>
<th>2004 (33 mo.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PNRSV</td>
<td>1</td>
<td>5 (PNRSV)</td>
</tr>
<tr>
<td>2</td>
<td>PNRSV</td>
<td>16</td>
<td>30 (PNRSV)</td>
</tr>
<tr>
<td>3</td>
<td>PNRSV + ApMV</td>
<td>8</td>
<td>16 (9 PNRSV, 5 both, 2 ApMV)</td>
</tr>
<tr>
<td>4</td>
<td>ApMV</td>
<td>0</td>
<td>1* (PNRSV)</td>
</tr>
<tr>
<td>5</td>
<td>PNRSV + ApMV</td>
<td>6</td>
<td>12 (10 PNRSV, 2 both)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>31/160</td>
<td>64/160</td>
</tr>
<tr>
<td>Percent</td>
<td></td>
<td>19%</td>
<td>40%</td>
</tr>
</tbody>
</table>

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 +

<table>
<thead>
<tr>
<th>Variety</th>
<th>PNRSV</th>
<th>ApMV</th>
<th>PNRSV &amp; ApMV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Delight</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>16 (11%)</td>
</tr>
<tr>
<td>Iceberg</td>
<td>3</td>
<td>11</td>
<td>5</td>
<td>19 (13%)</td>
</tr>
<tr>
<td>Queen Elizabeth</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>7 (5%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5</td>
<td>21</td>
<td>16</td>
<td>42/434 (10%)</td>
</tr>
</tbody>
</table>

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

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

**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.
CO-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

# Co-pot Results, 2009

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Virus</th>
<th>Singles</th>
<th>Doubles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Huey</td>
<td>ApMV</td>
<td>17/20</td>
<td>19/20</td>
</tr>
<tr>
<td>Dr. Huey</td>
<td>Healthy</td>
<td>0/20</td>
<td>0/20</td>
</tr>
<tr>
<td>Dr. Huey</td>
<td>PNRV</td>
<td>10/20</td>
<td>8/15</td>
</tr>
<tr>
<td>Dr. Huey</td>
<td>Healthy</td>
<td>0/20</td>
<td>0/15</td>
</tr>
<tr>
<td>Dr. Huey</td>
<td>ApMV &amp; PNRV</td>
<td>20/20</td>
<td>20/20</td>
</tr>
<tr>
<td>Dr. Huey</td>
<td>Healthy</td>
<td>0/20</td>
<td>2/20</td>
</tr>
<tr>
<td>R. multiflora</td>
<td>ApMV &amp; PNRV</td>
<td>18/20</td>
<td>18/20</td>
</tr>
<tr>
<td>R. multiflora</td>
<td>Healthy</td>
<td>0/20</td>
<td>4/20*</td>
</tr>
</tbody>
</table>

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

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