AN OVERVIEW: TECHNICAL APPLICATION AND ECONOMIC BENEFITS OF GLOBAL VEGETABLE GRAFTING

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FFTC & Tainan-DARES International Workshop
Grafting Purposes

- To improve crop quality, yield and better adaptation
- To be used for integrated pest management
- To reduce the application of pesticides and soil fumigants (Lee 1994)

(Photos Courtesy M. Edelstein, Hartmann et al. 2011)
Common Grafting Methods Used for Cucurbits and Solanaceous Vegetables

Hole insertion grafting

Tongued approach grafting

(Illustrations courtesy R. L. Hassell, Hartmann et al. 2011)
One cotyledon grafting
(a form of splice grafting)

(Illustrations courtesy R. L. Hassell, Hartmann *et al.* 2011)
Healing and Acclimatization for Grafted Plants
Graft Incompatibility and Graft Flaws

Adverse physiological responses, genetic limits between the grafting partners, disease, anatomical aberration, or human negligence (Hartmann et al. 2011)

(Photo courtesy M. Edelstein, Hartmann et al. 2011)
## Recommended Scion and Rootstock Combinations Used for Vegetable Grafting

<table>
<thead>
<tr>
<th>Scion</th>
<th>Rootstock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watermelon (<em>Citrullus vulgaris</em> syn. <em>C. lanatus</em>)</td>
<td>Bottle gourd (<em>Lagenaria siceraria</em>)</td>
</tr>
<tr>
<td></td>
<td>White gourd (<em>Benincasa hispida</em>)</td>
</tr>
<tr>
<td></td>
<td>Pumpkin / Winter squash (<em>Cucurbita</em> spp.)</td>
</tr>
<tr>
<td></td>
<td>Pumpkin / Winter squash (<em>C. moschata X C. maxima</em>)</td>
</tr>
<tr>
<td>Melon (<em>Cucumis melo</em>)</td>
<td>White gourd (<em>Benincasa hispida Cogn.</em>)</td>
</tr>
<tr>
<td></td>
<td>Pumpkin / Winter squash (<em>Cucumis</em> spp.; <em>Cucurbita</em> spp.)</td>
</tr>
<tr>
<td></td>
<td>Pumpkin / Winter squash (<em>C. moschata X C. maxima</em>)</td>
</tr>
<tr>
<td>Cucumber (<em>Cucumis sativus</em> L.)</td>
<td>Figleaf gourd (<em>Cucurbita ficifolia</em>)</td>
</tr>
<tr>
<td>Balsam pear / Bitter gourd (<em>Momordica charantia</em>)</td>
<td>Sponge gourd (<em>Luffa cylindrica</em>)</td>
</tr>
<tr>
<td>Aubergine / Eggplant / Brinjal (<em>Solanum melongena</em> L.)</td>
<td>Chinese scarlet eggplant / Tomato-fruit eggplant (<em>Solanum integrifolium</em>)</td>
</tr>
<tr>
<td></td>
<td>Wild eggplant / Thai pea-eggplant (<em>Solanum torvum</em>)</td>
</tr>
<tr>
<td></td>
<td>Aubergine / Eggplant / Brinjal (<em>Solanum melongena</em> L.)</td>
</tr>
<tr>
<td>Tomato (<em>Lycopersicon esculentum</em>)</td>
<td>Tomato (<em>Lycopersicon esculentum</em>)</td>
</tr>
<tr>
<td></td>
<td>Aubergine / Eggplant / Brinjal (<em>Solanum melongena</em> L.)</td>
</tr>
</tbody>
</table>

*Passam (2003) with some modification*
Grafting Automation

EMP 300
Conic System, Spain

ISO graft 1200
ISO Group, Holland

GRF800-U
Iseki, Japan

GR-800CS
Iseki, Japan

Helper Robotech, S. Korea

Solanaceae
Iseki, Japan

Cucurbits
Iseki, Japan

(https://cals.arizona.edu/grafting/grafting-robots)
Chemical Application

- **Methyl bromide**: The most consistently effective way to kill nematodes, fungi, insects and weeds for cucumber, tomato and peppers (Rosskopf *et al.* 2005), but being banned for environmental issues (Meadows 2013).

- **Fatty alcohol**: Giving contact kill onto tobacco suckers, controlling the regrowth of shoot apical meristems of the rootstock (Daley and Hassell 2014), and inhibiting redundant axillary shoots of the target buds (Eguchi and Kubota 2015) to reduce transplant production cost and labor during the grafting procedure.
Effects of Watermelon Grafted onto Various Commercial Rootstock Squash F1 Cultivars

Mohamed et al. (2012)
Effects of Seedless Watermelon Grafted onto Various Commercial Rootstock Cucurbit Cultivars

Watermelon ‘Knight’  Bottle Gourd ‘S-1’  Squash ‘Strong Man’  Non-grafted

A  B  C  D
Rootstock Cultivars Bred by Known-You Seed

Sponge Gourd ‘Companion’

Sponge Gourd F-1560

Figleaf Gourd ‘White Skin’

Squash ‘Strong Man’

Bottle Gourd ‘S-1’

Squash ‘Tetsukabuto’

Watermelon ‘Knight’

Cucurbit Rootstocks
Rootstock Cultivars Bred by Known-You Seed

Solanaceous Rootstocks

Eggplant ‘Fond May’
Eggplant F-1954
Tomato T-3047
Data compiled from Raymond (2013)
Annual Quantity of Rootstock Squash Seeds Sold to The Middle East, Taiwan, China and Europe

Data compiled from Known-You Seed Co., Ltd.
Annual Quantity of Sponge Gourd Seeds Used for Rootstocks Sold to Taiwan and China

Seed Quantity

<table>
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<tr>
<th>Year</th>
<th>Taiwan</th>
<th>China</th>
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<tbody>
<tr>
<td>2006</td>
<td>300,000</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>600,000</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>900,000</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1,200,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taiwan</td>
<td>China</td>
</tr>
</tbody>
</table>

Data compiled from Known-You Seed Co., Ltd.
Annual Quantity of *Solanaceae* Seeds Used for Rootstocks Sold in Taiwan

Data compiled from Known-You Seed Co., Ltd.
Chia-Hwa Nursery Co., Ltd., Taiwan
Fu-Chen Nursery, Taiwan

A

B

C
Shang-Ming Nursery, Taiwan
Nursery in Thailand

(Photos courtesy Known-You Seed (Thailand) Co., Ltd.)
Tomato Greenhouse Production in Turkey
Nursery in Jordan

A

B

C
Nursery in Tunisia
Summary

- Grafting acts synergistically on the rootstock-scion relationship and thus has greater benefits than the sum of its parts.

- Any new rootstocks engaged with given scions rest on repeated trial-and-error processes.

- Grafting automation can alleviate labor shortage for the vegetable nursery industry during the peak season. Ultimately, affordable equipment should expand future grafting possibilities.
For more info, visit our website at www.knownyou.com

Thank You