Adopting slight changes in agronomic practices targeting larger impacts on yield and yield quality: hybrid seed production of *Platycodon grandiflorus* under tropical greenhouse conditions as an example

G D Kapila Kumara (PhD)
Faculty of Agricultural Sciences
Sabaragamuwa University of Sri Lanka
Sri Lanka
Socio-economic zoning - traditions, contemporary state and problems
Challenges....

- Poor income distribution across the regions
- Migration for better prospects
- Poorly-sustained rural socio-economy
Challenges.....

- Traditional technology
  - Low productivity & quality
  - No anticipated results due to incompatibility with prevailing conditions

- Contemporary issues
  - Blanket recommendations of modern agriculture
Solutions.....

Role of our University:

✓ Tailor-made solutions to regional environmental, agricultural and socio-economic issues

✓ “Future-crops” and improving adoptability of crops to face climate change

✓ Empowerment of rural community to face current and future challenges
Adopting slight changes in agronomic practices targeting larger impacts on yield and yield quality: hybrid seed production of *Platycodon grandiflorus* under tropical greenhouse conditions as an example
**Introduction**

- **Scientific Name:** *Platycodon grandiflorus*
- **Family:** Campanulaceae
- **Called as** "Balloon Flower"
- **Bushy, clump-forming perennial plant**
- **Native to Asia**
- **Cold climates or droughts**
Introduction cont...

- Commercial hybrid flower seed production
- A profitable
- Developing business with a high potential return

- One and only private company involved

Hayleys Quality Seed Company → F₁ hybrid seeds from various plants → Platycodon F₁ hybrid seeds
Introduction cont...

Artificial cross-pollination

Production of F₁ hybrid seeds

- The better knowledge of the floral biology of parent lines
  - Flowering behavior
  - The time period of anthesis
  - Pollen viability
  - Receptive stage of the stigma
  - Best receptive time of the day for pollination
Problem Justification

**The producers** do not have clear idea of best maturity stage of the stigma of Platycodon

The incorrect maturity of stigma

Poor timing of pollination

Less chance for seed Formation (40-50 seeds/pod)

- A waste of money
- time
- planting materials
- other resources

&

Difficult to sustain
Objective

To determine the best maturity stage of stigma and time of the day for pollination to improve quality and yield of *Platycodon grandiflorus* hybrid seeds under tropical greenhouse conditions.
Materials and Methods

Experimental Conditions

**Location:** Hayleys Quality Seed Company Private Limited, Oluganthota (Latitude: 6°49’44″N, Longitude: 80°53’39″E)

**Duration:** from December, 2017 to March, 2018

**Temperature & RH (inside the greenhouse):**

- Morning: 19-22 °C and 80-90%
- Afternoon: 27-30 °C and 65-75%
Experimental Design

Completely Randomized Design with fifteen replicates for each treatment

**Factor 1- Maturity stage of stigma**
1. Artificial Pollination after 3 days of emasculation
2. Artificial Pollination after 4 days of emasculation
3. Artificial Pollination after 5 days of emasculation
4. Artificial Pollination after 6 days of emasculation
5. Artificial Pollination after 7 days of emasculation

**Factor 2- Time of the day for pollination**
A. Pollination at 8.45 a.m. - 9.00 a.m. time period (Morning)
B. Pollination at 1.30 p.m. - 1.45 p.m. time period (Afternoon)
### Materials and methods cont...

#### Treatments

<table>
<thead>
<tr>
<th>Control (Self-pollination)</th>
<th>Pollination in the morning</th>
<th>Pollination in the afternoon</th>
</tr>
</thead>
<tbody>
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<td>Artificial pollination after 3 days of emasculation</td>
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<td>Pollination in the afternoon</td>
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<tr>
<td>Artificial pollination after 7 days of emasculation</td>
<td>Pollination in the morning</td>
<td>Pollination in the afternoon</td>
</tr>
</tbody>
</table>

T0  
T1 (3M)  
T2 (3AF)  
T3 (4M)  
T4 (4AF)  
T5 (5M)  
T6 (5AF)  
T7 (6M)  
T8 (6AF)  
T9 (7M)  
T10 (7AF)
The environmental temperature and relative humidity were measured in every morning and afternoon during the pollination.

Materials and methods cont...

Greenhouse No: 05

Control (Separated from other plants)

Other flowers were randomly selected from plants in this area

Other flowers were randomly selected from plants in this area
Materials and methods cont...

Experimental Materials

- Platycodon flower buds – 200
- Wool from different colors (To tag selected flower buds)
- Tweezer
- Pollen cup and brush
- Analytical digital balance
- Thermo-Hygro meter (To measure temperature and humidity)
- Trays with soil (for germination test of seeds)
- Polythene
Selection of uniform size flower buds randomly and Emasculation

Collection of pollen from flowers in male line

Application of pollen onto the stigma of selected flowers

Data Collection

Data Analysis
Materials and methods cont...

Selection of flower buds

Emasculation

Pollination

Pollen Collection
Materials and methods cont...

Data Collection

- Number of quality seeds per pod
- Weight of dried seeds
- Germination rate of seeds
Data Analysis

- Analysis of variance by GLM procedure in Statistical Analysis Software (SAS) v 9.0.
- Means were compared using Duncan’s multiple range test
- Microsoft Excel was used for graphical illustration of data
Results and Discussion

1. Mean number of quality seeds per pod

Values with different superscript letters are significantly different (p<0.05)
Results and Discussion cont...

T1 (3M) < T6 (5AF) in terms of yield

- Opening of stigma
  - T1 (3M)
  - T6 (5AF)

- Increasing surface area
- Better pollen retention
- Higher seed setting
Related past findings...

The anther opening and pollination condition during the blossom period of Platycodon showed that the different growth period of pistil and stamen in the same flower caused to the low seed setting rate by self-pollination (Ji-ri et al., 2005)
Related past findings...

The considerable lower number of seeds per fruit when pollination was made just after emasculation: at time of emasculation, stigma was capable of receiving pollen but all the ovules were not ripe in hybrid tomato (Yogeeshha et al., 1999).

Also may be:

- Low yield at initial stage — late ripening of ovule
- High yield at later stage — better ovule ripening stage (best stigma receptive stage)
Results and Discussion cont...

- Seed setting were not observed in the control treatment (self-pollination)
- Pre-maturation of stamen may be the reason
Results and Discussion cont...

2. Mean seed weight

Values with different superscript letters are significantly different (p<0.05)
3. The correlation between the mean seed weight and the mean number of quality seeds per pod

* A negative (inverse) relationship (-0.765)
According to that,

- Number of seeds per pod
- Resource acquirement
- Limitation of resources
- Small seeds

Results and Discussion cont...
Results and Discussion cont...

Related past findings...

The seed weight-number trade-off changes, because of there are some mechanisms to enhance resource acquirements during the fruit developments.

Therefore the limitation of resources caused for the inverse relationship between the seed weight and the seed number of fruits (Meng et al., 2014).
### 3. Germination Percentage

<table>
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<tr>
<th>Treatment</th>
<th>Total number of quality seeds of each treatment</th>
<th>Germination Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1&lt;sub&gt;(3M)&lt;/sub&gt;</td>
<td>248</td>
<td>34</td>
</tr>
<tr>
<td>T2&lt;sub&gt;(3AF)&lt;/sub&gt;</td>
<td>380</td>
<td>32</td>
</tr>
<tr>
<td>T3&lt;sub&gt;(4M)&lt;/sub&gt;</td>
<td>400</td>
<td>50</td>
</tr>
<tr>
<td>T4&lt;sub&gt;(4AF)&lt;/sub&gt;</td>
<td>554</td>
<td>57</td>
</tr>
<tr>
<td>T5&lt;sub&gt;(5M)&lt;/sub&gt;</td>
<td>1036</td>
<td>80</td>
</tr>
<tr>
<td>T6&lt;sub&gt;(5AF)&lt;/sub&gt;</td>
<td>1212</td>
<td>85</td>
</tr>
<tr>
<td>T7&lt;sub&gt;(6M)&lt;/sub&gt;</td>
<td>1087</td>
<td>66</td>
</tr>
<tr>
<td>T8&lt;sub&gt;(6AF)&lt;/sub&gt;</td>
<td>1125</td>
<td>72</td>
</tr>
<tr>
<td>T9&lt;sub&gt;(7M)&lt;/sub&gt;</td>
<td>1191</td>
<td>68</td>
</tr>
<tr>
<td>T10&lt;sub&gt;(7AF)&lt;/sub&gt;</td>
<td>1178</td>
<td>70</td>
</tr>
</tbody>
</table>

The germination rate was 61.0%-87.0% (Li and Hua, 2014)
Conclusion

Pollinating *Platycodon grandiflorus* flowers either in the morning or in the afternoon, 5-7 days after emasculation gives a higher yield of quality seeds (two times higher yield) under tropical greenhouse conditions.
Reference


THANK YOU for Your Attention

G D Kapila Kumara (PhD)
Faculty of Agricultural Sciences
Sabaragamuwa University of Sri Lanka
Sri Lanka
gdonkk@yahoo.com