TECHNICAL, BUSINESS ISSUES AND CHALLENGES OF FRUIT-VEGETABLE (Cucurbitaceae and Solanaceae) GRAFTING IN THE PHILIPPINES

Niña R. Rosales 1

1 Research Division, Bureau of Plant Industry-Los Baños National Crop Research, Development and Production Support Center (BPI-LBNCRDPSC),
Los Baños, Laguna, Philippines
Email: nrsls@yahoo.com

ABSTRACT

Grafting technology on fruit-vegetables in the Philippines gained its importance because the country is vulnerable to weather disturbances like heavy rains, typhoons and flooding that favor the spread of soil-borne pathogens that affect off-season crop cultivation.

Several studies were conducted since 1998 when AVRDC—The World Vegetable Center introduced the grafting technology on tomato and eggplant. This was then followed by projects funded by the Philippine government that used the technology to augment fruit-vegetable production especially during off-season planting. Some of the promising results are the identification of bacterial and fusarium wilt resistant rootstocks of eggplant, hot pepper, wax gourd, sponge gourd, bottle gourd and squash that can be readily available to stakeholders. Effective and easy-to-do grafting techniques like tube grafting for Solanaceous species and hole insertion method for Cucurbits were developed. The feasibility of using the technology is high since it increases the yield of crops and lowers the damage losses by 18% as compared to non-grafted plants with 23 to 30% damage losses.

At present, commercialization of grafted fruit-vegetables is still low. Government institutions that conducted researches on this believe that, grafting technology is still in its promotional stage. Training and information dissemination activities are needed to be done in order to promote grafting technology. One private company in the Philippines is commercializing grafted bitter gourd at 15 to 18 pesos per seedling which is considerably expensive for the farmers thus, hindering them from using the technology. As a response, the government is aiming to lower the price of the grafted seedlings to make it affordable for farmers.

The biggest challenge for the technology is on the adoption and commercialization aspects, since this technology is virtually unfamiliar to most of the Filipino farmers. Enhanced technology information dissemination by concerned government institutions need to be done in order to encourage the farmer stakeholders to use grafted fruit-vegetables during off-season planting. The production of grafted vegetable seedlings mainly depends on the demand of farmers who are willing to use the technology. Moreover intensive training and skills development should be conducted in order to sustain the use of grafted seedlings.

INTRODUCTION

The Philippines, being located in the Asia-Pacific Region, is vulnerable to different weather disturbances that affects crop productivity especially fruit-vegetables of Solanaceous and Cucurbits species. Soil-borne diseases such as bacterial and Fusarium wilt significantly lowered the yield of vegetables during off-season planting. Moreover most of the farmer’s varieties of Cucurbits and Solanaceous were less tolerant to water-logged condition during rainy months.

Strong seasonality affects the availability, prices and consumption of vegetables in the country (Virtucio, 2002). For instance, during the dry season in the Philippines there is an abundant supply of tomatoes that occur in contrast to the wet season, where yield is severely affected. This results in limited supply in the market and poor quality of produce that contribute to severe price fluctuations (Aganon, 2003).

The seasonality problem was thought to be solved by generating technologies and management practices responsive to stressful environmental changes in order to sustain year-round production. This grafting technology was seen to be one of the possible solutions. Off-season grafted tomato planting and marketing can result in profitable tomato production during the hot-rainy periods in the Philippines, (Boncato et al., 2015).

Bacterial wilt is most severe in tropical and subtropical countries. In the Philippines, particularly in Central Luzon, losses in eggplant production due to bacterial wilt were estimated at 30 to 80% in 1949. In 1969, an average of 10% crop loss in eggplant production was reported due to this disease. And in 1998, the disease caused 15% crop loss in Batangas, 40% in Nueva Ecija, and 30% in Pangasinan (IPM-CRSP 2007).
The purpose of grafting is to physically combine the desirable characteristics of two separate plants into one plant, the grafted plant, in this case to provide a flood and bacterial wilt resistant rootstock to high yielding scion (tomato) (Aganon et al. 2004).

TECHNICAL, BUSINESS ISSUES AND CHALLENGES

The technical side

Technically, only few researches using grafting technology on fruit-vegetables were conducted in the Philippines. Most of them were on technology adoption and verification.

Grafting on fruit-vegetables is one of the introduced technologies in the country to augment the off-season stage. In 1998, grafting of tomato onto resistant eggplant rootstock was brought in the country through the Manila Peri-urban Project of Asian Vegetable Research and Development Center (AVRDC)—The World Vegetable Center funded by the Government of Germany (GTZ) in collaboration with the Bureau of Plant Industry and Central Luzon State University.

Studies on compatibility of scion and stocks were conducted as well as trials using different locally available materials to replace the imported grafting tube were done. Field trials in different parts of the island (Luzon) were also conducted to determine feasibility of the technology. In 2002, Central Luzon State University proposed the commercialization of grafted tomato (Papломatas et al., 2002).

In 2012 to 2015, a project was implemented by the Bureau of Plant Industry- Los Baños National Crop Research, Development and Production Support Center (BPI-LBNCRDPSC) funded by the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) to adopt grafting techniques on cucumber, bitter gourd, sweet pepper and eggplant for year-round production.

In the Philippines, cucumber and bitter gourd are considered high value crops due to their increasing demand. Cucumber is widely used in culinary and beauty product industries. On the other hand, medicinal value of bitter gourd in the treatment of infectious diseases and diabetes is attracting the attention of scientists worldwide.

Sweet pepper, although not a priority crop in the country, garnered a high demand due to the growing population of fast food restaurants and super markets all over the country. Large volume of production is required by companies that use sweet pepper as ingredient in their main dishes. Supermarkets, for example, require 200 to 2,500 kilograms of sweet pepper per month (Manalili, 2004). Likewise, eggplant is also considered as a popular crop in the market for the ease in preparing it into various dishes.

Various constraints have been encountered in producing the above mentioned crops. Year-round supply is not sustained due to common diseases such as Fusarium wilt in cucurbits and bacterial wilt in Solanaceous crops hence the project aimed to select and recommend lines/varieties of selected Cucurbits and Solanaceous as disease-resistant rootstock against bacterial and Fusarium wilt; evaluate compatibility of recommended commercial varieties for scion to identified resistant rootstock; identify the best grafting technique; conduct training on vegetable grafting; and produce Information Education and Communication (IEC) materials on technology for promotion.

Among its notable results were the identification of different lines of cucurbits and Solanaceous species resistant to bacterial and Fusarium wilt. Among those are three hot pepper, three eggplant, one wax gourd, four sponge gourd, two squash and two bottle gourd lines which exhibited varying levels of resistance and were identified as disease-resistant rootstocks for grafting which are available and can be propagated in the country. The disease screening process was an important tool in identifying potential resistant lines and accessions.

On the other hand, the project was able to identify the easy and effective techniques among the several methods of grafting used for fruit-vegetables such as the tube grafting for Solanaceous species and hole insertion method for cucurbits.

In terms of advantage over normal crops, 15 to 18% damage losses were noted in using grafted plants in contrast to the 23 to 30% in non-grafted plants obviously showing yield advantage when using the technology when verified in the farmers field as shown in Table 1. However, the technology is recommended for off-season production.
Table 1. Yield, percent disease damage losses and production cost of different grafted and non-grafted vegetables in Brgy. San Pedro, Tiaong, Quezon, Philippines

<table>
<thead>
<tr>
<th>CROP</th>
<th>GRAFTED</th>
<th>NON-GRAFTED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield (kg)</td>
<td>Disease damage losses (%)</td>
</tr>
<tr>
<td>Bitter gourd</td>
<td>1.200 18</td>
<td>18,806.00</td>
</tr>
<tr>
<td>Cucumber</td>
<td>1.280 15</td>
<td>18,406.00</td>
</tr>
<tr>
<td>Eggplant</td>
<td>1.440 18</td>
<td>15,998.00</td>
</tr>
<tr>
<td>Sweet pepper</td>
<td>0.800 17</td>
<td>17,596.00</td>
</tr>
</tbody>
</table>

Business issues

At present, commercialization of grafted fruit-vegetables is still low. Government institutions that conducted researches on grafting technology believe that said technology is still on its promotional stage thus requiring excessive effort on the conduct of trainings and information dissemination activities.

One private company in the Philippines is presently commercializing grafted bitter gourd selling it for 15 to 18 pesos per seedling which is much costly for the farmers thus hindering them to adopt the technology in the field.

Government research institutions aim to lower the price of the seedlings to make it affordable for the common farmers. The conduct of a series of training for the farmers and for other agribusiness entrepreneurs was undertaken to develop their skills in fruit-vegetable grafting so that they can also sell grafted seedlings to other farmers. This also became part of the scheme to address the problem aside from encouraging business venture of producing fresh fruits from grafted plants.

Moreover, fruit-vegetable grafting is found to be a feasible technology in terms of yield advantage and disease prevention as compared with non-grafted plants. This result was reflected in the cost benefit analysis done by Rosales et al. of the Bureau of Plant Industry-Los Baños in 2015 (Table 2a and 2b).

Table 2a. Cost benefit analysis in the production of selected vegetables from grafted seedlings.

<table>
<thead>
<tr>
<th>BUSINESS PRODUCT (FRESH)</th>
<th>INVESTMENT (P/1,000 M²)</th>
<th>GROSS INCOME (P1,000 M²)</th>
<th>NET INCOME (P1,000 M²)</th>
<th>MARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber</td>
<td>23,008.00</td>
<td>33,680.00</td>
<td>10,672.00 (46.38%)</td>
<td>Local market Supermarket Hotels Restaurants</td>
</tr>
<tr>
<td>Bitter gourd</td>
<td>23,508.00</td>
<td>51,000.00</td>
<td>27,492.00 (116.95%)</td>
<td>Local market Supermarket</td>
</tr>
<tr>
<td>Sweet pepper</td>
<td>21,998.00</td>
<td>45,000.00</td>
<td>23,002.00 (104.56%)</td>
<td>Local market Supermarket Hotels Restaurants</td>
</tr>
<tr>
<td>Eggplant</td>
<td>19,998.00</td>
<td>46,802.00</td>
<td>26,802.00 (134.09%)</td>
<td>Local market Supermarket</td>
</tr>
</tbody>
</table>

Note: Based on off-season farm gate price
Table 2b. Cost benefit analysis of producing selected grafted fruit-vegetable seedlings.

<table>
<thead>
<tr>
<th>BUSINESS PRODUCT (GRAFTED SEEDLINGS)</th>
<th>INVESTMENT (1000 SEEDLINGS)</th>
<th>GROSS INCOME (1000 SEEDLINGS)</th>
<th>NET INCOME (1000 SEEDLINGS)</th>
<th>MARKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grafted seedlings of sweet pepper, tomato or eggplant</td>
<td>3,800.00</td>
<td>5,000.00 (P5.00/pc)</td>
<td>1,200.00 (31.58%)</td>
<td>Local Farmers Private farm owners</td>
</tr>
<tr>
<td>Grafted seedlings of cucumber or bitter gourd</td>
<td>5,200.00</td>
<td>10,000.00 (P10.00/pc)</td>
<td>4,800.00 (92.31%)</td>
<td>Local Farmers Private farm owners</td>
</tr>
</tbody>
</table>

Challenges

The biggest challenge for the technology is on the adoption and commercialization aspects. These should begin with thorough technology information dissemination by concerned government institutions in order to encourage the farmer stakeholders to use grafted fruit-vegetables during off-season because the production of grafted vegetable seedlings mainly depends on the demand of the farmers who are willing to use the technology.

Moreover, facilities used in grafting such as humidity chamber should be easily fabricated, improvised and duplicated by the stakeholders. Imported materials like grafting tube and clips are already available in the local market. More local suppliers are needed for easy procurement of the said products by farmers.

Grafting skill is also a challenge for farmers and for those who want to venture into the grafted seedling production business. Training on skills development is very much important. Moreover, higher production inputs are required, thus the technology is recommended for off-season production when prices of fruit-vegetables are much higher in order to gain good profit.

CONCLUSION

Fruit-vegetable grafting is a promising technology that has yet to gain wide acceptance in the Philippines. The said technology has to be promoted in order to augment or improve production of Cucurbits and Solanaceous during off-season planting. It is a feasible technology that increases the yield and income of farmers based on the results of studies and on-farm verification trials conducted in the country. In terms of business, only a few ventured or invested in grafting technology due to lower demand of grafted seedlings.

Unlike other countries, commercialization of grafting technology in the Philippines is still a big challenge. Government institutions have to exert more effort in encouraging more stakeholders to use the grafted seedling during off-season planting. Promotion and education campaigns need to reach concerned clienteles such as farmers and traders not only to create awareness of the technology advantages but also to encourage them in applying or using such in their fields.

REFERENCES


