CURRENT STATUS AND
FUTURE PROSPECTS OF
VEGETABLE GRAFTING
IN MALAYSIA

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INTRODUCTION
• Peninsular Malaysia - 131 598 km².
• East Malaysia - 198 069 km².
• Average daily temperature range is 27°C - 32°C.
• Humidity around 80%.
• Average rainfall 2,500 mm
• Day length about 12.5 hours.
• Malaysian agricultural sector largely produces cash crops and little food.

• The palm oil industry is the largest agriculture sector and utilizes more than 70% of the country's agricultural land (Euromonitor International, 2014)

• Cost of producing food crops such as rice and vegetables is high in Malaysia - not competitive

• Malaysia imports temperate vegetables from China, India, U.S.A, Thailand and Australia at US$796,000 in 2013 (MOA, 2013)
• Area planted with vegetables is about 71,460 ha in 2014

• Production at 1,452,000 million metric tons

• Per capita consumption of vegetables is currently at 57.3kg/year in 2013.
Popular vegetables grown in the lowlands (2014)

- leaf mustard - 15,997 ha,
- cucumber - 4,661 ha,
- spinach - 4,386 ha,
- water spinach - 3,962 ha,
- long bean - 3,918 ha,
- chili - 3,582 ha,
- lady’s finger - 3,120 ha,
- Chinese kale - 1,481 ha,
- loofah - 1,279 ha,
- french bean - 1,105 ha.

Popular vegetables grown in the highlands (2014)

- Cabbages - 7,937 ha,
- lettuce – 3,127 ha,
- tomato – 1,948 ha
- Malaysia is a small-scale crop farming country with an average farm size of between 0.5 and 1.0 ha

- Risk of vegetable production - unfavorable soil, environmental conditions includes abiotic (drought, extreme temperature, salinity and flooding) and biotic (soil and airborne pests and diseases)

- Monoculture and continuous cropping in the same plot aggravates this situation.
• Genetic breeding cannot always provide efficient solutions

• Vegetable grafting has rapidly developed over the last 50 years, mainly to induce shoot vigor and to overcome soil borne diseases in susceptible crops

• The use of grafted seedlings for vegetable production has become a common practice in many countries of the world, especially in Asia such as China, Taiwan, Korea and Japan
Main purpose of vegetable grafting

To overcome limitations of scion and rootstock

• Crops that are susceptible to soil-borne diseases (Fusarium, Verticillium, Ralstonia) or pest like nematodes

• Cross resistance strain with pest sensitive crop if resistance to the pest problems can be identified. Crossing process is time consuming and there is no guarantee of success

• A more rapid approach to produce pest resistant crops is through grafting technology- use the pest resistant rootstock and high quality and/or high yield scion
Grafting has the potential to employ rootstocks that can improve the crop’s tolerance to environmental stresses.

Grafting is used to enhance the tolerance against abiotic stresses: saline soils (Colla et al., 2010), soil-pH (alkalinity) stress, nutrient deficiency, and toxicity of heavy metals (Savvas et al., 2010).
Main purpose of vegetable grafting

To improve yields and quality

- Grafting may also increase the vigor of the crop, yielding earlier or higher yields, and superior quality

- Plants grafted onto vigorous rootstocks also use irrigation water and fertilizers more effectively for producing marketable fruit yields

- Recent research has addressed the growth and yield performance of grafted plants in response to different levels of water or nutrients (Colla et al., 2010, 2011; Rouphael et al., 2008)
CURRENT STATUS OF THE VEGETABLE GRAFTING IN MALAYSIA
• Currently, most grafting works done in Malaysia were on fruit trees to induce fruiting without going through the juvenile phase.

• Juvenility is the natural state through which a seedling plant must pass before it can become reproductive. In some tropical fruits e.g. Mangosteen, juvenility may be prolonged for up to 15 years.

• Grafting of mature scions onto rootstocks can result in fruiting in as little as two years. In jackfruit, grafted trees will bear fruit in two to three years after planting and have a more spreading and open canopy than seedling trees.
• The development of cleft grafting technique for durian, jackfruit and chempedak has not only saved considerable amount of time and costs in the nursery stage but also produced good quality planting materials with minimum root problems.

• For mango, most cultivars do not produce true-to-type seedlings. Therefore, grafting is often necessary to overcome this problem.

• Grafting also means that trees produce uniform yield, fruit size and quality.
Vegetable grafting is similar to grafting of fruits trees in the way that the rootstock is selected for vigor and disease-resistance, and the scion is selected for its fruit quality and taste.

Grafted vegetables have been cultivated in Asia for decades however; it is not popular in Malaysia.

Unlike fruits, only limited varieties of vegetables can be used as a rootstock.

There is no commercial vegetable grafting nursery in Malaysia and, in terms of research, only a few researches have been done for the past 50 years.
Past researches

• Tomato cultivation mainly confined to areas of higher altitudes like the Cameron Highlands.

• Cultivation of tomatoes in the lowlands has been limited by the widespread incidence of bacterial wilt.

• The extremely high temperatures in the lowlands further aggravate the disease situation, where totals crop loss is not uncommon.

• Research done using local brinjal varieties 'Hitam Bulat' or 'Sabah Common' as rootstocks consistently reduced the incidence of bacterial wilt to below 10% in fields where ungrafted tomato cultivars suffer total loss (Lum and Wong, 1976).
Another research was on *Solanum lasiocarpum* Dunal (Terung Asam Sarawak) is a special plant of Sarawak.

- The fruit has a unique sour taste and is a favorite among the locals as vegetable and flavoring in many local dishes.
- The fruit can be processed into various products such as dehydrated slice, jam, juice etc.
• Unfortunately, its planting is hindered in particular by soil-borne pathogens such as bacterial wilt, *Fusarium* wilt and Phytophthora.

• Dayod and Lim (2015) found graft compatibility on *Solanum lasiocarpum* as scion and *Solanum torvum* as rootstock.

• *S. torvum* was reported to be resistant to Verticillium and bacterial wilt, root-knot nematode and mycoplasma (Collonnier *et al.*, 2001; Kashyap *et al.*, 2003).
FUTURE PROSPECTS OF VEGETABLE GRAFTING IN MALAYSIA
• In Malaysia, farmers generally have very small land areas or greenhouses and they often encounter increasing populations of pathogens that threaten their crops due to continuous cropping.

• With limited space and the need to grow vegetables in the same place each year, grafted vegetables offer disease resistant roots and provide earlier and higher-yielding crops.

• Grafting is nowadays regarded as a rapid alternative tool to the relatively slow breeding methodology aimed at increasing environmental-stress tolerance of fruit vegetables (Flores et al., 2010).
• Grafting is not associated with the input of agrochemicals to the crops and is therefore considered to be an environmentally friendly operation of substantial and sustainable relevance to integrated and organic crop management systems (Rivard and Louws, 2008).

• There are some problems that limit the wide use of grafted vegetables, including:
  • Lack of information and exposures,
  • lack of multi-disease-resistant rootstocks,
  • labor cost,
  • not fully known rootstock-scion interaction mechanism on plant growth, development, tolerance and fruit quality.
• Thus, identification of compatible multi-disease-resistant rootstocks with tolerance to abiotic stresses (drought, salinity, heat) is a basic requirement for continued success.

• Primarily, grafting solves problems related to infections by soil-borne pathogens.

• Tomato is one of the potential vegetable crop in Malaysia that were mainly cultivated in the highland and the cultivation has been limited by the widespread incidence of bacterial wilt when planted in the lowland.
• Evaluation on tomato variety such as MT1 that highly tolerances to bacterial wilt which however has small fruit size (Melor, R. 1986) could be potentially used as a rootstock other than local brinjal varieties.

• Proper selection of rootstocks activates plant growth and increases the crop yield.

• When pest and/or disease resistant cultivars are obtainable, but with limited yield or with no commercial value, these can be used as rootstock cultivars onto which the commercially-producing cultivars can be grafted.
Furthermore, a major goal of research in vegetable grafting should be gaining understanding about the:

- physiological and genetic interactions and the agronomic performance of rootstock traits in order to establish efficient rootstocks
- grafting technologies and management practices for different horticultural species and specific environments.

- In the future, technologies suitable for stable, large scale, year round, and economical production of grafted seedlings in nurseries.
• In order to allow further development, important research efforts must be made to improve grafting use efficiency through decreasing costs (both grafting process and seeds), crop management optimization (plant, nutrients, water, fumigants, energy) and training farmers.

• Widely exposures and information, with grafting operations and the healing of grafted plants become easier, grafted vegetable crops may become popular in Malaysia
CONCLUSION
• The use of grafted vegetables is not common in Malaysia, but it has encouraging prospects due to the expansion of private farms those intended to sell the produces to local and export market.

• Continuous cropping in greenhouses and open field condition results in nutrient depletion and development of soil borne diseases that ultimately lower the productivity of the crops, producers are forced to use chemicals which are expensive and contain persistent pollutants.

• Hence, grafting can be used as alternative way to tackle the biotic and abiotic stresses of plants.
Vegetable grafting is regarded as a quick and efficient alternative to breeding to secure food production through a socio-economic environmentally sustainable agriculture.

Sharing knowledge and enhancing scientific and technical collaboration will surely fill knowledge gaps in the area of vegetable grafting.
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