Effect of Grafting Between Brinjal and Tomato Crop

Introduction

Grafting is defined as the natural or artificial fusion of plant parts so that vascular continuity is established between them and resulting organism is a hybrid which functions as a single plant. Vegetable grafting was commercially originated in Japan and Korea and was practiced for about 30 years. At first the cultivation of grafted plants in vegetables was started to challenge the serious crop loss which was caused by infection of soil-borne diseases by successive and intensive cropping. Grafting has also been a common practice in fruit trees since ages, vegetable grafting is of recent popularization in a commercial scale Sakata et al., (2007). It was introduced to Western countries in the early 1990s and is currently being globally practiced by the use of local scion cultivars and introduced rootstocks. The wide use of protected cultivation using greenhouse technology for the production of vegetables in the late 1950s provided more generalized production and use of grafted vegetables. In current era of organic and sustainable agriculture generous use of synthetic pesticides and inorganic chemical fertilizers should be minimized for the production of ecofriendly produces **Davis et al.,** (**2008); Lee and Oda, (2003); Sakata et al., (2007).** Due to continuous cropping in greenhouses, which again leads to reduction in yield and quality of the produce due to the danger of soil borne pathogens and nematodes. Since soil sterilization can never be complete alone the production of repeated vegetable crops so grafting has become an essential technique for the production of repeated crops of vegetables grown in both greenhouse and open field condition. It has been well-established that the use of suitable rootstocks can reduce or control the problems associated with modern agriculture like successive cropping and different stress tolerance **Hoyos Echeverria, (2010); Lee and Oda, (2003).** Since the plants are cultivated under the protected structures year-round, they frequently are subjected to svere or extreme environmental conditions in the high tunnels during off-season cultivation **Lee, (2008)**

As a result farmers frequently encounter various problems other than soil borne pathogens caused by successive as well as off-season cropping such as low

temperatures during the winter, high humidity in the high tunnels, low or more light intensity, and lack of well-balanced fertilization. The produces grown under these heavily stressed conditions sometimes suffer from heavy incidence of soil-borne diseases, abnormal abiotic stresses which lead to physiological disorders, and deterioration in the quality of produce. For disease tolerance and high crop yields by taking of nutrients, grafting technology is also highly effective in controlling of crop losses caused by adverse environmental conditions such as low soil temperature and high soil salts, especially under protected cultivations where successive cropping or continuous farming is routinely practiced. Grafted seedlings are much favored in hydroponics farming systems where the chances of spread of dangerous diseases is rapid and once infected, the spread become high.

Problem Background

- Nematode root knot is a soil borne disease in tomato crop which is the major problem
- Wilting disease is also another major problem in tomato crop
- Abiotic stresses like adverse climatic conditions, temperature, light intensity etc
- Less tomato plant vigour which causes less yield .

Review of literature

Abadelhafeez et al., (1975); Abdelmageed and Gruda, (2009) It has also been recorded that grafting of tomato onto brinjals reduced electrolyte leakage under high temperature stress, indicating a higher ability to retain solutes , water and less membrane damage.

Matsuzoe et al., (1993) stated that Solanum toxicarium was found to be resistant to five diverse (termed I to V) Ralstonia solanacearum strains whereas S. sisymbriifolium was only resistant to strain III and S. torvum was resistant to strain I, II and V.

Oda, (1995) revealed that Solanum torvum (Turkey berry) is commonly used as rootstock for brinjals, accounting over 50% area of grafted brinjals in Japan.

Ruiz et al., (1997); Pulgar et al., (2000); Rouphael et al., (2008) revealed that grafting influences absorption and translocation of phosphorus, nitrogen, magnesium and calcium.

Criddle et al., (1997) stated that the temperature limit for growth of most of the chilling sensitive fruit vegetables, such as pepper, brinjal, cucumber, tomato and melon is about 8–12 ◦C .

Holbrook et al., (2002) staeted in his grafting experiments with ABA deficient mutants of tomato showed that stomata can close independently of the leaf water status suggesting that there is a chemical signal produced by the roots that controls stomatal conductance.

Black et al., (2003) stated that the AVRDC (Asian Vegetable Research and Development Center) recommends brinjal rootstocks for tomato production for bacterial wilt resistance and in cases when flooding may occur, otherwise H7996 is recommended.

Bletsos et al.,(2003) stated that brinjal rootstock was also observed to be providing greater resistance for this pathogen than S. sisymbriifolium.
Bletsos et al., (2003) & Lee, (1994) stated that the mechanisms of grafting to combat Verticilliumin the infested soils includes increased root vigor and biomass and associated increased water and nutrient uptake.

Lee and Oda, (2003) stated that similar yield increase have been reported by other researchers on watermelon,cucumber, melon, pepper, and brinjal.

Lee and Oda, (2003) revealed that in a general conclusion by many researchers the changes in the scion are controlled by the rootstock mainly through controlled uptake, synthesis, and translocation of different minerals and plant hormones .

Wang et al., (2003) concluded that high temperatures above the optimal range required for plant growth leads to a series of complex morphological, physiological, biochemical and molecular changes that affect plant growth and productivity adversely by different means such as growth reduction, decrease in the photosynthetic rate, increase in respiration, assimilate partitioning towards the fruits, osmotic and oxidative damage, reduced water and ion uptake/movement, cellular dehydration etc.

Rivero et al., (2003) stated that grafting tomato onto a heat tolerant rootstock (L. esculentum cv. RX-335) resulted in a decreased hydrogen peroxide concentration indicating the lower oxidative stress.

Bloom et al., (2004) stated that in contrast, cold-tolerant tomatoes, such as S. habrochaites, decline the stomatal conductance resulting in a stomatal closure, while the stomata of cold-sensitive species remain open until chilling temperatures of 5 ◦C, due to which, they became flaccid and suffered damage .

Miguel et al., (2004) stated that the rootstock ‘Shintoza’ is preferred in Spain because of its effectiveness against all races of Fusarium and yield stability contribution as compared to the non-grafted plants.

Garibaldi et al., (2005) stated that in Italy, S. torvum rootstocks offered control of root knot nematode but was not effective against Verticillium pathogen after repeated cropping cycles .

Passam et al., (2005); Pogonyi et al., (2005) revealed that similar results showing increased fruit size were also observed in case of brinjal and tomato, respectively.

Venema et al., (2005) stated that below this limit,(8–12 ◦C) vegetables originating from tropical or subtropical areas suffer from different disorders (leading to distortion or death of plant parts), depending on the interval and intensity of exposure to cold .

Gousset et al., (2005) revealed that S. torvum rootstock also conferred resistance to F. oxysporum f. sp. melongenae limiting fusarium wilt incidence in brinjal scions.

Bilotto et al., (2006) , Gousset et al., (2005) stated that S. torvum was the most effective rootstock for brinjal in Italy and is considered tolerant to pathogen strains.

Bletsos, (2006) revealed that in case of grafted brinjal plants with S. torvumas rootstock, suppressed Verticillium infection allowing only some mild symptoms; increased root biomass in the grafted treatments, and produced higher yields comparable to methyl bromide sterilized treatments .

.,QI et al., (2003) stated that one of the most important physical quality, fruit size was reported to be increased in the grafted plants, as they were resistant to soilborne disease, having strong root systems and increased photosynthesis.

Hu et al., (2006) It has been suggested that improved nutrient uptake in grafted seedlings increases photosynthesis, which is particularly noticeable under less than optimal growing conditions such as low sunlight and CO2 concentration especially in protected structures .

Xu et al., (2006,a, b) it has been suggested that these conditions allow grafted plants to produce higher yields compared to ungrafted plants, sometimes with improved sugar contents . Lycopene concentration was related to the high K concentration in the fruit in tomato. It is also known as an anti-cancerous compound.

Wang et al., (2007) stated that testing brinjals grafted onto a heat-tolerant rootstock (cv. Nianmaoquie) seemed to be promising and resulted in a prolonged growth stage and yield increase .

García-Sánchez et al., (2007); Satisha et al., (2007) stated that reducing the yield loss and improving the water use efficiency in the drought prone areas, use of moisture stress tolerant rootstocks in grafting can be a viable option.

Chungand Lee, (2007) stated that similar results were obtained with tomato, where 54% increase of marketable yield was obtained with 'Kagemusia' and 51% with 'Helper' rootstocks .

Sakata et al., (2007) stated that grafting to tackle or control soil borne diseases has rapidly expanded its horizon to different solanaceous and cucurbit vegetables. The contributing factors that have led to such increased expansion of grafting include: increased pathogen population densities due to intensified production systems, heavy reliance on susceptible but popular cultivars to meet specific market demands arising of new major pathogen through introduction or minor pest resurgence or entry, the rapid adoption of green/polyhouse production, growing demand for organic food, and the loss of methyl bromide as a broad spectrum soil fumigant to manage soil borne pathogens and pests.

Proeti et al., (2008) demonstrated that mini-watermelon grafted onto the commercial hybrid rootstock 'PS 1313' (C. maxima × C. moschata) increased the lycopene concentration by 40% than the fruits from ungrafted plants.

Venema et al.,(2008) stated that tomato grafted onto a cold-tolerant rootstock revealed a higher capacity to adjust their root/shoot ratio to suboptimal root-temperature .

Davis et al., (2008); Lee and Oda, (2003) and Lenz, (1970); Hu et al., (2006) have also suggested that improved nutrient uptake in grafted seedlings increases photosynthesis under week sunlight conditions and such conditions generally prevails during rainy season under south Gujarat conditions.

crunk et al., (2009) revealed that brinjal grafted onto S. torvum had a wilt incidence of 20%compared to 97% wilt in non-grafted plants. S. torvum was again observed to minimize disease incidence and increase yield under the combined pressure of Verticillium and Meloidogyne .

Liu et al., (2009) stated that the Verticillium wilt resistant tomato rootstock, 'Lydl', when grafted with brinjal scions, eluted or extracting or emitted of some chemicals of allelopathic nature that inhibited mycelial growth of V. dahlia. The root exudate

profile emitted from plants grafted with rootstock was distinctly different than from non-grafted roots providing details about specific constituents having some role in suppression of the pathogen .

Rodríguez et al., (2009) revealed that S. torvum and S. peruvianum also offer resistance to Meloidogyne incognita . Root knot nematode management in brinjal has been accomplished or completed with the interspecific hybrid rootstock 'Brigeor' and S. torvum .

Abdelmageed and Gruda (2009) stated that brinjals are better adapted to tropical hot conditions with better tolerance against high soil temperature, the use of brinjals as rootstocks for tomato at higher temperature seemed to be more promising (although it lead to decreased total fruit dry weight.

Alvarez-Hernandez et al., (2009) stated that tomato grafted onto wild Solanum selections also have been observed to reduce the incidence of the sweet potato whitefly (Bemisiatabaci), potato psyllid (Bactericeracockerelli) and aphids (Aphis gossypii).

Rodríguez et al., (2009) stated that Meloidogyne incognita, M. arenaria, M. javanicaand M. hapla are the four main species affecting different crops causing too much loss to farmers. These are disseminated through contaminated soil, plant root debris or infected plants. S. torvum and S. peruvianum also offer resistance to Meloidogyne incognita .

Louws et al., (2010) stated that Fusarium species have a prolific capacity to recolonized is infested soils and can be readily re-introduced into production areas on contaminated soil, equipment and plant tissue .

Dor et al., (2010) stated that Orobanche species like Orobancheaegyptiaca and O. ramosa prominent on tomato fields of Mediterranean countries, were found to be controlled by grafting on a resistant rootstock .

Bogoescu and Doltu (2015) stated that the not grafted brinjals variant yield (Aragon F1) harvest was only of 44.6t/ha, with over 15t less than the registered yield of grafted brinjals variant .

Purposed Research Objectives

- Grafting against tolerance to soil borne biotic stress
- Grafting against disease control
- Grafting against root knot nematodes
- Grafting against pests
- Grafting for quality improvement
- Grafting against Abiotic Stres
- Grafting for yield increase

Research Methodology

Experiment site:- This experiment is conducting at lovely professional university, Phagwara in Hi-tech polyhouse.

Experiment Detail :-

Rootstock of brinjal and scion of tomato is used for grafting experiment to improve the parameters and disease resistant against nematode and other diseases in the grafted plant and fruit .

A) Layout of the Experiment :

➢ Variety	Hybrid Tomato (Abhilas), ▪ Brinjal (Shamli)
➢ Seedling Tray	1
➢ No. of Plants	18
➢ Cocopeat : Vermicompost : Perlite	3:1:1
➢ No. of Clips used	18
➢ Grafting time	2nd week of November,2017
➢ Tieing material	Grafting polythene

B) Observations :

1. Germination percentage
2. Plant height
3. Leaf area
4. Days to first flowering
5. Days to first fruiting
6. Total no. of fruits

7. No. of fruits per cluster
8. Fruit weight
9. Fruit equatorial height
10. Frit polar height
11. Fruit diameter
12. Fruit pericarp thickness
13. TSS in fruit
14. pH of fruit
15. Fruit acidity
16. Fruit yield (kg/plant)

C) Material Required After Transplanting :

1. FYM
2. Vermicompost
3. No. of irrigation

Expected Result Outcome

- Control of wilt attack
- Control of nematode & pest attack
- Increased plant vigour
- More yield
- Quality improved

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SYNOPSIS

SUBMITTED BY

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In partial fulfilment for the award of the degree
Of
Master of science in Horticulture
(Vegetable Science)

Under Guidance
of
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Assistant Professor
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Phagwara – 144411 Punjab, India
27th November, 2018

DECLARATION

I hereby declare that this synopsis entitled ***" Grafting between Brinjal and Tomato (Solanum melongena and Solanum lycopersicum) "*** *is an authentic record of my work carried out at Lovely Professional University as requirement for degree of* ***Master of science*** *in discipline of* ***Horticulture (vegetable science).*** *Under the guidance* ***of Dr. Rajni Tiwari Assistant Professor , Department of Horticulture, School of Agriculture*** *and no part of this Synopsis has been submitted for any other degree.*

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