

Morphological Changes on Scions due to Grafting Eggplant *Lycopersicon Lycopersicum* (L) and Pepper *Capsicum Annuum* (L) onto Tomato (*Solanum Melongena* L) as (Rootstock).

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Abstract— these experiments were conducted in Singa Forests National Corporation nursery, Sennar State, Sudan, during the period 2011-2012. The study aimed to test the hypothesis that, grafting of eggplant *Lycopersicon lycopersicum* (L) and pepper *capsicum annuum* (L) as Scions onto Tomato *Solanum melongena* (L) as rootstock, has ability to influence and change leaf and flowers morphology of eggplant and pepper. Five replicates were used; each replicate represents ten plants of each species. Splice grafting was conducted using polythene bags, filled with sand and clay soil, with ratio 1 to 2 respectively. The same replicates and treatments were applied with tomato as scion and pepper as rootstock. The seedlings were placed in a greenhouse designed especially for the experiment, with 50% shade. Observations were used to determine the healing in seedling stages and morphological changes on the leaf and flowers of grafted plants (Scions) in the both seedling and field stages. Data were recorded and analyzed. The results showed that the success of healing was ranged between 70 - 96% and the overall mean percentage was 84%. The leaf shape of grafted eggplant (Scions) was completely different from the origin (control) which seems to be more similar to tomato leaflet, with lobes and serrated edges with change percentage 82%, while the flower of the grafted eggplant was also changed, exhibited white aggregate (group) flowers that emerged from peduncle, rather than a colored solitary one, as in the original eggplant. The change percentage was 80%. The pepper (scion) leaf shape was transferred from simple, as in the control, to compound, as in tomato leaf, but without lobes and serrate margin in the leaflets, with a 76 % change. The modifications that occurred, in the emerged leaves and flowers of eggplant and pepper scions, reflect the remarkable effect of rootstock (tomato) on scion. This result concluded that, grafting of eggplant and pepper seedlings onto tomato seedlings, have a positive effect on morphological change on leaves and flowers of both plants. These findings will flourish production in horticultural sector and hence boost farmers' income in rural areas.

Index Terms— Grafting, eggplant, tomato, morphological changes.

I. INTRODUCTION

Asexual reproduction known as vegetative propagation is widespread in plants. In vegetative propagation apportion of one plant gives rise to a completely new plant. Both plants have identical gene. Asexual reproduction has a great commercial importance. Once a plant variety with desirable characteristics has been developed through vegetative propagation, the new plant can be applied by gardeners and farmers. Cutting can be taken from a plant and the cut can be treated to encourage it to grow roots or a cutting can be grafted as a form of grafting most often used commercially. In this procedure the axillaries buds are grafted onto the stem of another plant. It is quicker and easier to test for protoplasts instead of entire plants, for desired characteristics such as resistance to bacteria and fungi, high temperature and drought. Protoplast can be made to fuse together. In one experiment a potato and tomato protoplasts were fused and the hybrid plant was eventually grown perhaps protoplast fusion will eventually allow botanist to alter the genetic makeup of a variety of plant [1]. Graft methods can be classified into three categories, bud graft, branch graft and stem graft, the plant tuber root suitable for distant grafting as rootstocks such as ginger, lily, sweet potato, potato and yam. Other plants with thick stem are also appropriate for grafting as rootstocks such as castor, sunflower, sesame, maize and sorghum According to the graft mode of stock and scion can be divided into plug graft, clef graft and splice graft [2]. Grafting use as a means to improve quality, It has been reported that grafting can affect pH, sugar, color, texture, carotenoid content and flavor [3]. Initiation of morphogenic Scions by grafting induces morphological changes on leaves, flowering and fruits due to genetic changes that have potential in genetic improvement [4]. Grafting of tomato as rootstock and potato as scion resulted in changing leaf shape, showed a graft-transmissible RNA from the tomato rootstock can change leave morphology of potato scion [5]. Using hetero-grafting techniques with cucumber as scion and pumpkin as stock, showed evidence of selective system for the delivery of specific RNA molecules into developing tissues of

scions through the sieve element [6, 7, 8 & 9]. Several phloem proteins having a wide RNA-binding activities are able to move through inter-generic grafts from melon (*Curcumas melon L*) to pumpkin. It has long been believed that a long Grafting *Acacia senegal* onto *Acacia mellifera* is possible in young seedling using splice grafting, the union percentages ranged between 60 to 80% within 6 to 8 weeks. Grafting has significant effect on growth performance of plant [14]. The world population was 1550 billion as estimated total in the year 1900, while in 2000 the total population was come to 6280 billion. At present more than two of every three people on this earth not get enough food daily to enable them to live a completely healthy and contented life. According to recent United Nation statistics, the population increase by more than 13 million persons every year [15]. In Sudan tomato is one of the most important culinary vegetable fruits for Sudanese citizens as it is frequently present on their tables, in view of the fact that of its nutritive value and savory favor, Tomato is not available all through a year due to its propensity and that produced during the off season appeared with high-priced rate.

II. MATERIALS AND METHODS

The study was conducted in the Forests National Corporation nursery, in Singa town during the period July 2011-2012. Seeds of eggplant and tomato were procured from Singa market. At first of July seeds were sown separately in polythene bags filled with clay and sand soil with 2:1 ratio respectively. Watering was done frequently every two days.

distance signal, named florigens is transported from leaves to the apex [10] the scion characteristics can be change by grafting [11] and [12]. Some of these changes might be responsible for the transport of the gene transcript [13]. When seedlings reach three weeks old splice grafting treatments was used. The treatment was done as follows; the shooting tips of young seedlings of eggplant were cut below the leaf number three from the tip of each seedling downwards then scabbled from one side and prepared as scions (50 pieces). The same treatment was applied for tomato 50 seedlings were prepared (scions) of tomato. The scabbled scions of eggplants were spliced with tomato stock, where tomato stock was scratched on one side also; the spliced parts were wrapped scotch tapes and covered them with transparent plastic tubes. (Fig. 1) the same reciprocal treatment was done using the same steps for eggplant as scion and tomato as stock. The two cloven-shoots for each species were left for a week after covering with plastic tubes and placed on the seedling bed with 50% shading. Irrigation was done every two days by the use of flooding. The healing of scions was observed, and then removals of plastic tubes were conducted. The grafted seedlings of both species i.e. tomato onto eggplant and eggplant onto tomato were nursing in the nursery for two weeks before transferring to the field, where 30 seedlings of each treatment were planted. Observations were recorded on the morphological changes, flowering and fruiting. Data were analyzed to determine the percentages in morphological changes.



Figure 1: Shows the method of treatment, where plastic cover used in the first day of splice grafting (left) and removal done after the two grafted plants growing together and unified, forming one plant (right).

III. RESULTS AND DISCUSSIONS

The results showed that healing rate between the treated specimens was ranged between 70 to 90% which reflect a high success of union (**Table. 1**). The leaf shape of eggplant (scions) grafted onto tomato (rootstocks) gave entirely different shape compared with the origin (control) where the leaf become visible very resembling to tomato leaf, lobes and serrated leaf observed (**Fig. 2 left and middle**). The flowers emerged takes

the same shape of scion (eggplant) flower, but with different color and in the form of clusters (group), similar to that produced by original tomato (**Fig. 2 middle**). No changes observed in the fruit produced by scion in color (**Fig. 4**). These results indicated that genetic change was happened due to grafting process which in line with what was reported by [4].

Leaves changes observations and evidences in scion

The results showed that, the grafted emerged leaves of scions (eggplant and pepper) that grafted onto tomato, took the shape of tomato and pepper leaves (**Fig. 3**). This may help in increasing the production through enlarging the leaves for more photosynthesis and hence more yield will be expected, this finding supported by [15], who reported that changes in the scion are controlled by the rootstock through controlled uptake, synthesis, and translocation of water, minerals and hormones. The changes that occurred on the leaves of scions, due to grafting techniques, confirmed the effect of grafting on morphological changes. The result coincided with result that

stated by [16] on morphological changes on potato scion, when grafted onto tomato rootstock. The changes were observed also on the leaf of pepper (scion), when grafted on tomato as rootstock. The observation showed that the leaf of scion (pepper) emerged exhibited compound leaf, instead of simple one as shown in the origin (**Fig. 3 middle**), but it looks as if it is a leaf of tomato (compound leaf) (**Fig. 3 left and right**). This imitation indicated that, rootstock has a great influence, to change leaf morphology of scion due to grafting. This is in line with [7, 8 & 16] who stated that the scion is affected by mRNA and protein migrating from the root stock.

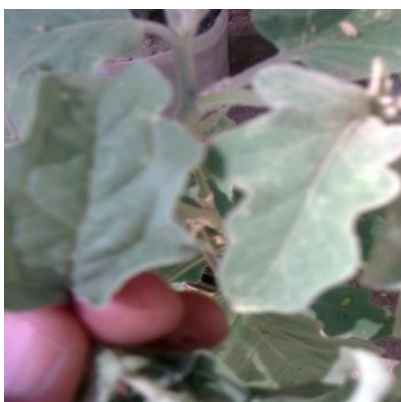
Table 1.

Type of treatment, Percent success of grafting *Eggplant, Pepper and Tomato with reciprocal treatments.*

Treated species	Type of treatment	Number of treated seedlings	Number of healed seedlings	Percent (%) success
<i>Eggplant onto tomato</i>	Splice	50 onto 50	48× 48	96
<i>Tomato onto Eggplant</i>	splice	50 onto 50	45 × 45	90
<i>Pepper onto Tomato</i>	Splice	50 onto 50	40x40	80
<i>Tomato onto pepper</i>	splice	50 onto 50	35×35	70
<i>Over all mean..</i>	splice	50 onto 50	42x42	84



Figure 2. Shows morphological changes on eggplant leaves (Scion) .when grafted onto tomato as rootstock (left).



The leaf of original tomato in comparison to grafted emerged leaf from eggplant as scion (Middle).



The healing parts (union) of tomato (rootstock) and Eggplant scion (right).



Figure 3. Shows the compound leaf that emerged from grafted pepper when pepper grafted as scion onto tomato rootstock (left).



The original simple leaf of pepper, in comparison to compound leaf emerged from the grafted pepper scion (middle).



Healing parts (union) between pepper as scion and tomato as stock (right).

Flower change observations in scion and fruiting stage

The results of grafting eggplant onto tomato, showed that the effect of grafting on flowers that emerged from scion (**Fig. 3 middle and right**) were significant, different in number and color from the control (**Fig. 3 left**). The change percentage in scion was 88% in eggplant and 78% in pepper (**Table 2**), the fruits formed also in groups, but took the same shape and colors. (**Fig. 4a&b**) Which conflicting to what was reported by [4] on fruits produced by scions. This result reflected that grafting has ability to effect on morphological changes of scions, which supported by [4 and 10] who stated that the initiation of morphogenic scions by grafting, induce morphological changes on leaves, flowers and fruits due to genetic changes, that have potential in genetic improvement. While it was reported by the: <http://www.google.com> and 9=Angela+Penelope+R.and =2070+graft [8] that color can be affected by grafting and the type of rootstock used. This in conformity with [10] in inter-generic grafting from melon to

pumpkins. Beside that the result coincided with [1] in grafting as a vehicle that can be used for genetic makeup, to improve variety, and in line with in delivering RNA to scion from rootstock through sieve cells. The increase in the number of flowers in eggplant and leaf size answering the question that grafting effect is beneficial and not deleterious. As reported by [18] the agricultural resource base in Sudan can provide for sustainable agricultural growth and food security for itself and for others in the region. Its malfunction to do so in the past comes from several motives and circumstances that are controllable. These include ill-advised agriculture policies, poor infrastructure, low-level of technology use, recurring droughts, decades of civil conflict that have ravaged traditional rain-fed agriculture, and over taxation of agriculture commodities. To surmount these tribulations, this experiment can provide virtuous foundation and lay concrete way to lessen rural poverty, boost food security, and incomes of farmers.

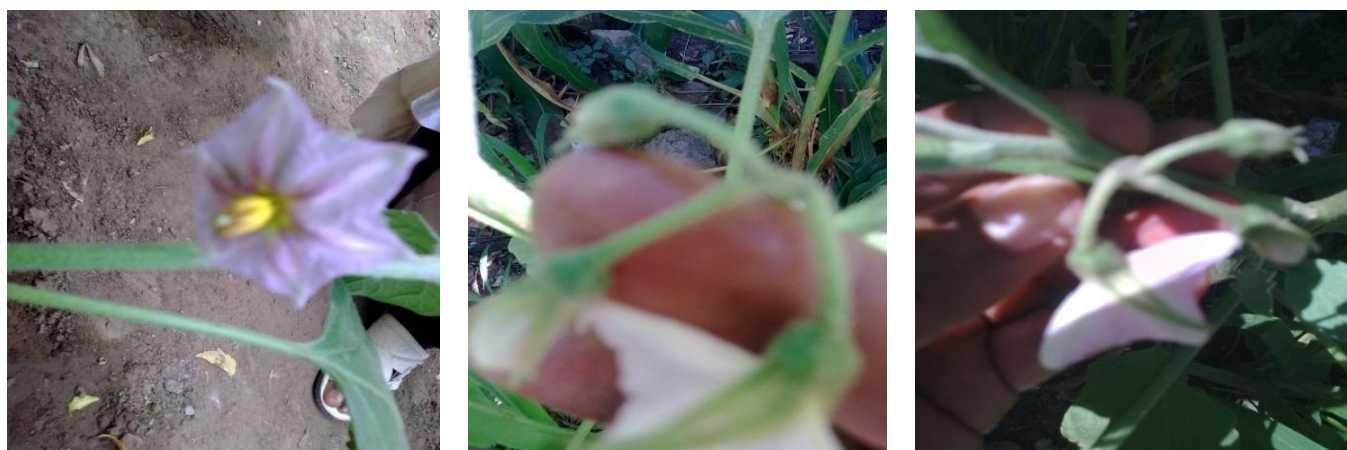


Figure 4a. Shows obviously the original solitary colored flower of eggplant(left) and the aggregated white colored flower emerged from eggplant scions after grafting onto tomato as rootstock (middle and right) .onto eggplant as scion (right).



Figure 4b. Shows fruit in early stage, two fruits emerged from the same peduncle (left).



The fruit produced by grafted scion takes the same shape and sable color (right).

Table 2.

Treated species, Type of treatment, number of transplanted treated seedlings, number of plant leaf and flower morphological changes and changes percentage of grafting *Eggplant*, *Pepper* and *Tomato*.

Treated species	Type of treatment	Number of transplanted treated seedlings	Number of plant leaf and flower morphological changes	Percent (%) morphological changes on scions (leaf)	Percent (%) morphological changes on scions (flower)
<i>Eggplant onto tomato</i>	Splice	50	45.00-40.00	96.00	88.00
<i>Eggplant</i>	(control)	50	0.00-0.00	00,00	00.00
<i>Pepper onto Tomato</i>	Splice	50	38.00 -30.00	76.00	78.00
<i>Tomato (control)</i>	Splice	50	0.00-0.00	00.00	00.00
<i>Pepper</i>	(control)	50	0.00-0.00	00.00	00.00
<i>Over all mean..</i>	splice	50	41.50-35.00	84--82	83.00

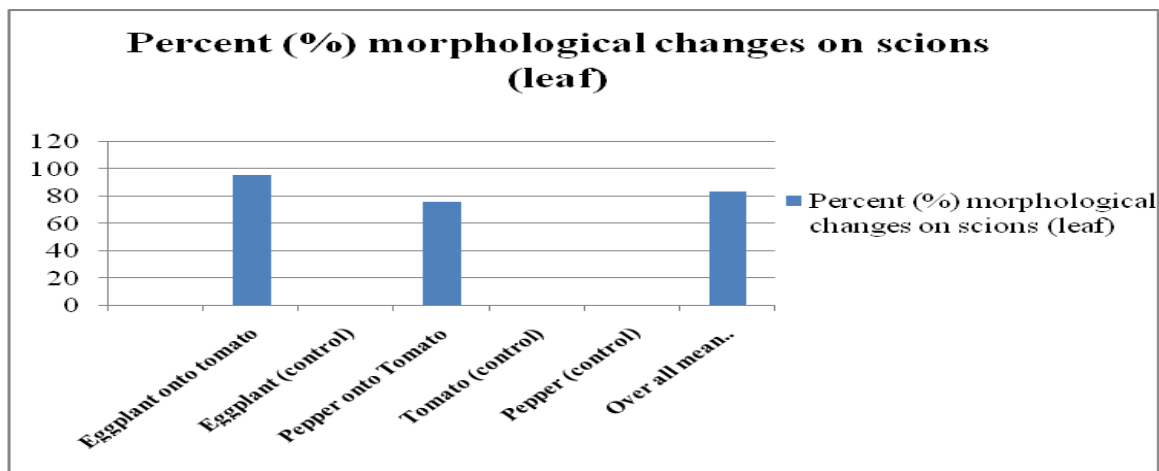


Figure 5. Shows the rate of morphological changes on leaves (scions) of eggplant and pepper when grafted onto tomato as scion.

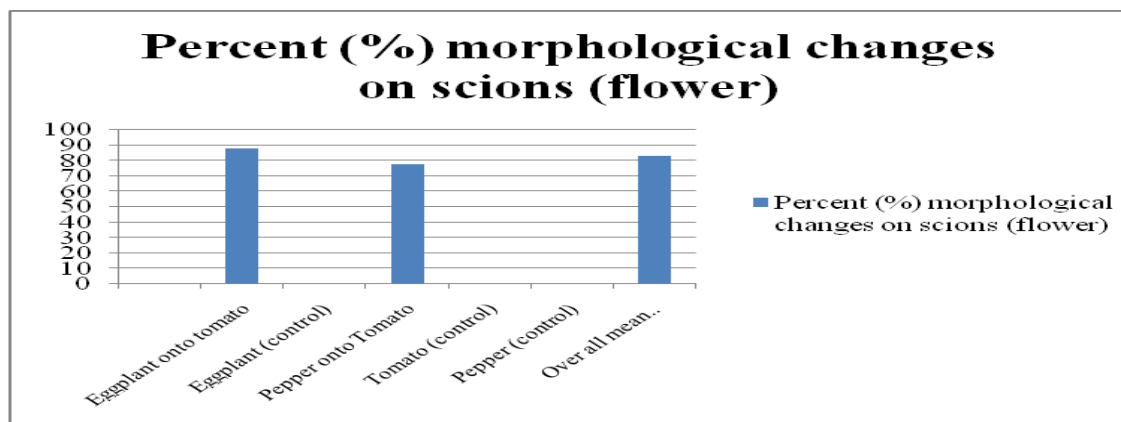


Figure 6. Shows the rate of morphological changes on (scions) of eggplant and pepper when grafted onto tomato as scion.

IV. CONCLUSION

The results of this study revealed that, grafting of eggplant and pepper as scions, onto tomato as rootstock produced eggplant and pepper with morphological changes on leave shape, flowers color and shape. These changes in morphology have a positive impact on productivity (yield) of eggplant and also tomato in the reciprocal treatments. This change of leaves and flowers implies genetic change, which may open the door widely, for producing tomato that it may have ability, to produce fruit throughout the year, resolve the problems of scarcity, during the off season, in the normal production. Further study is needed, to test the behavior of progeny (seeds), that in term of productivity and tolerances for diseases, drought and salinity.

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