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Investigating the effect of grafted watermelon on tolerance to drought and salinity

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ABSTRACT: In this experiment was carried out in Bandar Abbas the effect of grafting watermelon (*Charleston Gray*) to pumpkin (*Cucurbita pepo*) and its effect on tolerance to drought and salinity has been studied and the proximity grafting method was used to grafting and water with a conductivity of 6.5 and 10 mS with irrigation interval of 2 days-4 days-8 days-10 days was considered for salinity and drought treatment and attributes such as the number of leaves, wet and dry weight and depth of rooting were investigated. LSD test was used for mean comparison, the results showed that grafted plants are more drought tolerant as compared to control and also there was significant results on attributes such as the number of leaves and root length but about wet and dry weight the results were not significant. The effect of salinity (6.5 mgS) showed that on the number of leaves and wet weight there was significant difference between grafted plants and non-grafted plants but there was no significant difference on salinity 10.5 mS, also there was no significant difference between grafted plants and control on root length and dry weight on salinity 6.5 mS, but there was significant difference on salinity 10.5 mS.

***Keywords*:** grafting, drought, salinity, watermelon, pumpkin.

INTRODUCTION

In our country the extent and distribution of saline soil is very wide, from 165 million hectares of arable land, 24 million hectares are saline soils. Soil and water resources are national assets that belong to all generations, today the issue of increased yield or enhance the production per unit area for drinking water is essential, so due to the fact that our country located on arid and semiarid area, this is essential and there is more limitations land and water resources compared to other countries. On arid and semiarid areas in addition to the salinity, the shortage of water is another limiting facto for preservation and development of agriculture, in these areas plants are often under salt stress and dehydration, simultaneously. Since high quality water resources for crops irrigation is low, so use of saline and little saline water for agriculture is necessary(5). The use of resistant cultivars to salinity and drought is now one of the most effective methods to the exploitation of salty water. Grafting is one of the new and effective strategies to increase the tolerance of plants including vegetables and herbs to deal with salinity and drought in advanced countries and is expanding(1,4). The graft of vegetables on pumpkin (*Cucurbitaceae*) family for the first time was started on 1920 by South Korea and Japan researchers with grafting watermelon to squash. Grafting vegetables is a relatively new issue in Iran and little research has been done about it, so due to the increasing use throughout the world, especially in East Asia need for comprehensive research in this field, and apply it to farmers by researchers at the market gardening part is more crucial than ever, and choosing the appropriate root stock with known characteristics is a key priority in market gardening. Cucurbitaceae family cultivated in most areas, and in our country, there's high genetic diversity of such plants. There are different races of pumpkin that can be used as the basis for watermelon and other plants of this group. Several methods have been used to grafting vegetables, most of these methods have common general principles: including implementation of grafting operation in the early stages of plant development, cotyledon stage or completion of the first true leaf, Keep seedlings in controlled conditions of temperature and humidity during graft charisma, Callus formation, grafting bridge, adapting grafted seedlings to environmental conditions (3,4). In herbaceous plants such as cucurbitaceae family and eggplant family the grafted alliance between the root stock and the scion take place through the formation of parenchymal callus tissue and the

formation of cambium tissue, which resulted in the construction of the timber and rinse vascular, and finally the conjunction of basic and scion vascular bundles. The grafting charisma process should be under conditions of high humidity and specified temperature range, desired charisma temperature for Cucurbitaceae family is between 25 and 30 ° C. The primary source of watermelon with the scientific name of Citrullus lanatus of Cucurbitaceae family is Africa and some source referred to India as its second source(6). For the first time watermelon wad imported from India to Iran. In terms of watermelon cultivated area in Asia, China is in first and Iran in second place but in terms of production Iran is ranked thirteenth place. Watermelon is of herbaceous species with one year old that in which there may be perennial species. The hot and dry weather with a temperature of 23-30 ° C is preferred by this plant. Watermelon, among other cucurbits has the largest area under cultivation that this is because of high economic efficiency, large ecological range, ease of cultivation and its work, and its good ability to transport and storage. This plant is sensitive to cold, and its growth period depending on the climate is 80 to 120 days. This product has very high water and sugar (93% water, 7.5-7% sugar) and contains vitamins A, B, C. This plant is sensitive to cold, and its growth period depending on the climate is 80 to 120 days. This product have very high water and sugar (93% water, 7.5-7% sugar) and contain vitamins A, B, C. Research shows that dehydration greatly reduces the watermelon performance. In this fluctuation of the water or soil salinity at growth stages the fruit or calcium deficiency is often caused Blossom End decay, Charleston Gray figure is susceptible to the anomaly, which is the most dominant and well-fed and have most cultivated area in the world. The purpose of this study was to investigate the effect of grafting watermelon to pumpkin on tolerance to drought and salinity.

MATERIALS AND METHODS

This research was started in Bandar Abbas, to start first some tests were carried out on water and soil to determine the EC; PH, also to determine used soil texture. To measure the PH of the soil first the saturated soil samples had to be prepared, and then kept for 24 hours in the laboratory and soil PH is measured .PH meter device was used to measure the PH which the soil PH was 7.92 and 7.54. To measure soil EC, we should provide extract from that saturated soil using extractor and after that the amount of its salinity should be measured with the EC gauge device. The soil EC with temperature correction was 2.32mS and water EC was 0.26 mS. Hydrometric method was used to determine soil texture and after that soil texture was determined using class triangle that was Sandy loam soil which was soil with light texture. Watermelon seeds due to having hard shell than pumpkin and slow germination, to comply with pumpkin seeds were planted a few days earlier. As well as seeds to accelerate the germination, were soaked in lukewarm water. Seeds were planted in plastic pots to a depth of 12 cm and a diameter of 15 cm, in each pot 2 watermelon seeds and 2 pumpkin seeds were planted to a depth of 2 cm. After seedlings emerge and grow up to 2 and 3 leaf stage , grafting performed on them, for this work we used of proximity grafting, in this method, the graft of both plants located on its origins, after callus formation and callus tissue arose, the welded graft on the upper and lower part of scion will be cut. The proximity grafting as scarf joint with simple cutting using razor-sharp is done. After grafting each of plastic pots was place inside nylon to maintain high humidity, because that during grafting the humidity must be high, by this the grafting success will be high. For drought treatments with 4 repeat and its control with 4 repeat with irrigation period 2 days 4 days 8 days 10 days were considered and two treatments with 4 repeat and two control with 4 repeats that were irrigated by waters with salinity of 10.5 and 6.5mS. Non-grafting plants were considered as control group. The reason for selecting the watermelon scion of Charleston Gray type was its high cultivated area and cultivated area and its economic importance in our country, and for pumpkin the reason was its most compatibility and easy availability of its seeds. After about two weeks of grafting operations traits were measured, a caliper in cm was used to measure root length, and a digital scale (in grams) with 0.01 accuracy was used to measure wet and dry weight. The averaging was done using LSD test.

RESULTS AND DISCUSSION

Results:

drought

According to result, non-grafted plants in all studied traits compared to plants decreased, that in number of leaves and root length compared by LSD test results were significant, but there was no significant difference in the results of wet and dry weight. These traits 32% and 17%, 20% and 10% decreased, respectively, between these traits the number of leaves has more loss of function, means the grafted plants have produced more leaves.

Table 1. Comparison of drought effects

	The number of leaves	Root length	Dry weight	Wet weight

Treatment	11.75*	6.8*	4.45ns	32.68ns
control	6	4.75	3.6	26.68

*There is a significant difference at 5%
Ns: There is no significant difference.

root stock on the table above it can be seen that the average number of leaves (grafted plants) decreased from 11.75 to 6 (non- grafted plants) as well as in root length from 6.8 to 4.75, indicating that the grafted plants have more rooting than non-grafted plants, also in wet and dry weight, it declined from 4.45 to 03.06, from 32.67 to 26.68, respectively.

Salinity

The mean comparison of the effect of salinity

	The number of leaves	Root length	Dry weight	Wet weight
Treatment1	10.5*	6.45ns	5.57ns	30.8*
Control1	7.75	5.07	4.42	21.67
Treatment2	9ns	5.85*	5.07*	24.57ns
Control2	7.25	4.27	3.52	21.6

*There is a significant difference at 5%
Ns: There is no significant difference.

The effect of salinity (6.5 mS) showed that there was significant difference in the number of leaves and wet weight between grafted and non-grafted plant, but there was no significant difference in salinity 10.5 mS. There was no significant difference in root length and dry weight in salinity of 6.5mS between grafted plants and controls, but there was significant difference in salinity of 10.5mS between grafted plants and controls. Although grafted plants have significantly better growth than non- grafted plants, which reflects the strong performance of the pumpkin root stock for watermelon. If we want to compare the two the amount of salinity and watermelon traits performance we can say that by increasing salinity the performance levels decreased, but this performance was not significant. Treatments compared to controls have shown the loose of function in all traits(4,2).

Analysis of variance salinity effects

Change Sources	Degree of freedom	The number of leaves	Root length	Dry weight	Wet weight
Treatment	3	25.25	13.72	10.61	198.3
Error	12	18.5	12.95	9.65	188.5
Total	15	43.75	26.68	20.26	386.8
Coefficient of Variation (CV%)		14%	19%	19%	15%

Discussion

Most of the growth characteristics of watermelon were affected by root stock and grafted plant than non-grafted plant has more and better growth. This growth can be justified such that, there is certain physiological differences on root structure between root stock plant and scion. Pumpkins roots are strong and deep and form wide root zone than watermelon, and this facilitate the absorption of minerals and nutrients by roots that this result in rapid growth of shoots, especially the plant stem, and this growth causes better tolerance to stress conditions. The effect of salt stress can reduce photosynthesis and leaf water potential, osmotic potential, turgor pressure and thus reduce the number of leaves and leaf size and plant height that this causes the growth and crop yield be reduced(7). Physiological damage caused by the toxicity of ions and disturbances in the absorption of nutrients, the disturbances in plant nutrients is as a result of salinity effect on the availability of nutrients and competition in recruiting and transferring or assigning (6,8). Also salinity through reduced availability of phosphate in the soil resulted in reduction of phosphate uptake and accumulation in plants. Salinity not only can reduce calcium available, but it reduce its transport and mobility in plant, for example, sodium reduces potassium absorption and chlorine reduces nitrate absorption(3).

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