



## Micropropagation of Jujube (*Ziziphus jujuba*)

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Received: 25-09-2013

Accepted: 16-03-2015

**Introduction:** Jujube (*Ziziphus jujuba*) is one of the most important fruit trees in Asia which has been planted from 3,000 years ago in China for medicinal purposes. Jujube belongs to the Rhamnaceae family. The Jujube fruit is used in fresh and dry forms. The fruit is full of vitamin C and has anticancer and medicinal effects. This tree can grow on salty and dry lands in Iran. Therefore, increasing the cultivation area of Jujube can be effective for soil conservation. In the last 20 years, cultivation of Jujube is considerable in Iran specially in the South Khorasan Province and 98 % of total production of Jujube in Iran belongs to this province. The low rate of seed germination and low production of shootlets are the most important problems in Jujube proliferation, so micropropagation of this plant through tissue culture was considered.

**Materials and Methods:** In this study, Cangan ecotype of Jujube was used for multiple shoot regeneration. At the end of May, apical buds of shoots were cut from mature trees of the Research Collection of Jujube at Sarbishe, Birjand, South Khorasan Province in Iran. The buds were disinfected with 70% ethanol for 1 min and 2% sodium hypochlorite for 25 min. Then the buds were rinsed with distilled water for 25 min completely. Apical buds were placed on Murashige and Skoog (MS) medium supplemented with different concentrations of BA (0.5, 1, 1.5, 2 mg/L) in combination with IBA or NAA (0, 0.1, 0.2, 0.4 mg/L). After one month, the shoots with 3-5 cm length were transferred to rooting media ( $1/2$  MS + IBA or IAA : 0.5, 2, 5, 10 mg/L). The data were recorded after shooting and rooting and were analysed in the factorial experiment.

**Results and Discussion:** The results of variance analysis and mean comparisons showed that there are differences between different levels of IBA and BA alone for the number of shoots and their length ( $P < 0.01$ ). Their interaction effect was also significant. Based on the results, the highest number of shoot inductions (4.25 shoots per explant) was obtained on a medium containing 0.2 mg/L IBA + 1 mg/L BA. The longest shoots (5.12 cm) were also observed in MS medium supplemented by 0.2 mg/L IBA and 1 mg/L BA. Increasing the ratio of BA to IBA more than 5 times, caused decrease in shoot production. Totally, the ratio of auxin to cytokinin and also their concentration can determine the success of shooting; because when the BA increased to 2 mg/L and the IBA was 0.4 mg/L the ratio was 5 times, but the shooting decreased. NAA (0.4 mg/L) + BA (1 mg/L) was the best hormonal combinations for high shoot regeneration (3.75 shoots per explant) and its length (5.87 cm). In most studies on *Ziziphus* genus, the combination of NAA and BA is preferred for shooting at in vitro culture. Regenerated shoots were rooted on  $1/2$ MS medium supplemented with different levels of IAA and IBA (0.5, 2, 5 and 10 mg/L). The highest number of root inductions (7 roots per shoot) were observed on  $1/2$ MS with 2 mg/L of IAA and it was not significantly different from 2 mg/L of IBA. The longest roots (5.25 cm) were observed in  $1/2$  MS medium supplemented by 2 mg/L of IBA and it was not different from 2 mg/L of IAA. So, there is no difference between IBA and IAA for rooting because both of them induced suitable roots for adaptation. IBA is synthetic auxin and is not sensitive to light; so its use is preferred for commercial micropropagation. The rooted shoots were rinsed by water to remove the residual of medium, and then they were transferred to pots containing vermiculite and soil (1:1). Acclimation of shoots was good with 92% survived shoots in the greenhouse.

**Conclusion:** The results of this study showed that the equal ratio of auxin and cytokinin caused a decrease in shooting and high callusgenesis. The produced shoots have suitable length and appearance. According to the results, a combination of BA (1 to 1.5 mg/L) with low concentration of IBA (0.2 mg/L) or NAA (0.4 mg/L) has the best shooting, and a weak auxin such as IBA or IAA with low concentration is good for rooting. So, this method can be used for micropropagation of Jujube in commercial scale in our country.

**Keywords:** Plant growth regulator, Regeneration, Rooting, Tissue culture, *Ziziphus jujuba*

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## Effect of Sodium Chloride Concentrations and Its Foliar Application Time on Quantitative and Qualitative Characteristics of Pomegranate Fruit (*Punica granatum L.*) CV. “Malas Saveh”

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Received: 26-09-2013

Accepted: 29-10-2014

**Introduction:** Pomegranate (*Punica granatum L.*) belong to Punicaceae family is native to Iran and grown extensively in arid and semi-arid regions worldwide. Pomegranate is also important in human medicine and its components have a wide range of clinical applications. Cracking causes a major fruit loss, which is a serious commercial loss to farmers. Fruit cracking, seems to be a problem that lessens the marketability to a great extent. Fruit cracking is one of the physiological disorders wherever pomegranate trees are grown. It may be due to moisture imbalances as this fruit is very sensitive to variation in soil moisture prolonged drought causes hardening of skin and if this is followed by heavy irrigation the pulp grows then skin grows and cracks. Many factors i.e., climate, soil and irrigation, varieties, pruning, insects and nutrition statuses influence the growth and production of fruit trees. Deficiencies of various nutrients are related to soil types, plants and even to various cultivars. Most nutrients are readily fixed in soil having different PH. Plant roots are unable to absorb these nutrients adequately from the dry topsoil. Foliar fertilization is particularly useful under conditions where the absorption of nutrients through the soil and this difficult situation to be present in the nutrients such as calcium. Since the calcium element is needed, so spraying them at the right time is correct way to save the plant requirements. Therefore, a research conducted on effect of sodium chloride concentrations and its foliar application time on quantitative and qualitative characteristics of pomegranate fruit (*Punica granatum L.*) CV. “Malas Saveh”.

**Materials and Methods:** An experiment conducted at Jarghoyeh, Esfahan, Iran in 2012. The factors were Sodium chloride (0, 5 and 10 g/L) and times of spray (15, 45 and 75 days before harvest). The study was factorial experiment in the base of randomized complete blocks design with three replications. The measured traits were cracking and sun scald percentage, seed dry and fresh weight, total fruit weight, vitamin C and titratable acidity (TA) using titration method, total soluble solids (TSS) using hand refractometer, skin fruit firmness using hand penetrometre, pH using pH meter and dry material. Data analyzed using SAS and MSTAT-C statistical program and means compared using an LSD test ( $p < 0.05$ ).

**Results and Discussion:** Analysis of variance showed that calcium chloride had significant effect on creaking percentage. Mean comparison was conducted using LSD range test (at 5% level). Sodium chloride decreased cracking percentage compared to control. Different stages of sodium chloride application show significant effect on cracking percentage. Sodium chloride decreased the cracking rate by increasing of its concentrations. Effect of calcium chloride was significant on sun scald. The lowest sun scald occurred inthe second time and the highest in the third time of calcium chloride spraying. The effects of sodium chloride at different stages and concentrations were significant on the total fruit weight and seed fresh weight. The highest total fruit weight and seed fresh weight obtained in the first time and the lowest in the third time of calcium chloride spraying. The effects of sodium chloride at different stages and concentrations were significant on the skin firmness. The highest skin firmness obtained in the third time of calcium chloride spraying and 10 sodium chloride concentrations and the lowest in the first time of calcium chloride spraying and control. The time of calcium chloride spraying had significant effect on total acidity, pH and vitamin C. The highest and lowest fruit total acidity and pH obtained in first and third time of calcium chloride spraying, respectively. However, the highest and lowest fruit vitamin C observed in third and first time of calcium chloride spraying, respectively. Fruits treated with Sodium chloride showed a reduction in vitamin C and fruit firmness, but increased total soluble solids (TSS). In fruit traits increased by higher sodium concentration and earlier spraying time. In addition, later spraying time increased fruit skin firmness conclusion sodium chloride decreased cracking and

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sun scald percentage Quantitative.

**Conclusion:** In conclusion, higher sodium chloride concentration reduced fruit creaking and sun scald. In addition, earlier time and higher sodium chloride concentration caused improve quantitative fruit traits. Finally, skin firmness increased with higher sodium chloride concentration and later spraying time.

**Keywords:** Creaking, Malas Saveh, *Punica granatum* L., Sodium chloride



## Effect of Seed Priming Treatments on Germination Traits of Two Mustard Cultivars (*Brassica campestris* var. parkland and Goldrash)

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Received: 28-09-2013

Accepted: 22-04-2015

**Introduction:** *B. campestris* is an old plant that commonly grows in arid and semi-arid areas. It has mucilage in the epidermal cells of canola seeds, a considerable variation in growth form and characteristics across the many cultivars. These species have in general, a flat root without an elongated crown, with stems that typically grow 30 to 120 cm tall. The leaves are large, soft, smooth or soft-hairy. The yellow flowers are small, usually less than 2 cm long (24). Seed priming is a procedure in which seed is soaked and then dried back to its original water content. Hydropriming uses only water in the process of controlled imbibitions, but osmopriming simply means soaking seeds in an osmotic solution. Seed priming is a technique of controlled hydration and drying that results in more rapid germination when the seed is reimbibed. Priming can be a valuable process for improving germination and uniformity of heterogeneously matured seed lots. Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops, particularly vegetables and small seeded grasses. Seed priming is a presowing strategy for influencing seedling development by modulating pregermination metabolic activity prior to emergence of the radicle and generally enhances germination rate and plant performance. Fast germination and uniform emergence assist the farmer to “catch up” on the time lost to drought (17, 18). This research aimed to study the effect of the best treatments of osmopriming and hydropriming on varieties of mustard seed germination traits was conducted.

**Materials and Methods:** The present research was conducted under laboratory conditions of the Ferdowsi University of Mashhad, Iran, during 2012 to determine the seed priming effects on germination traits of two cultivars of mustard. The experiment was in completely randomized design with six treatments. Seeds of two mustard cultivars including Goldrash and Parkland (*Brassica campestris* var.) were subjected to hydro priming and osmotic priming (-4 and -16 urea and Zinc sulfate solution with osmotic potential MPa) in laboratory conditions. Then germination performance was studied. To calculate the germination percentage and rate, mean germination time (MGT) and seed vigor, were used according to equation 1, 2, 3 and 4 (11).

1: Germination percentage =  $(n / N) \times 100$

$$GR = \sum_{i=1}^n \frac{gi}{di}$$

2:

3: MGT =  $\frac{\sum(n_i \times t_i)}{\sum n_i}$

where  $n_i$  is the number of newly germinated seeds at time of  $t_i$  after imbibing, and  $n$  = total number of emerged seeds.

4: Seed vigor = Germination percentage \* dry weight

The soft ware macro, and charting in Excel software were used to analyze the data and LSD test at the 5% level was used for means comparison.

**Results and Discussion:** Priming treatments impressed radicle and plumul length, germination percentage and rate, mean germination time and seed vigor at the 5% level (Table 3). As maximum germination percentage and rate at the control and hydropriming treatments and at least 16 MPa at osmopriming zinc were (respectively 6/14 and 92/0% for Parkland and 6/82, and 15% for Goldrash)(Tables 1, 2). Given that most of micronutrients such as zinc, copper, cobalt that are also classified as heavy metals when their concentrations in soil and plant tissues above the plant are sufficient to cause poisoning, affect yield and plant growth (19). It seems, the Goldrash compared to Parkland with imbibitions less metabolic activity has shown better and more tolerance to stresses caused by the toxicity of zinc. Hydropriming partially hydrated seeds and cellular turgescence occurs. In this experiment when compared to osmopriming, hydration process was accelerated in hydropriming treatment and germination indices were better. Bennett and Waters (3) reported no germination at osmopriming treatment for

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largeseed crops (such as corn and soybeans). This method can possibly include other osmotic elements uptake by seeds and create toxicity and reduced oxygen uptake at low osmotic potential was noted.

**Conclusion:** In this experiment, the priming process could increase seed vigor and seedling growth of cultivars. It seems that the use of zinc as a heavy metal toxicity in plant tissues and plant growth is reduced. The damage was more severe with increasing concentrations of heavy elements. But the Goldrash compared to Parkland has shown more tolerance and Goldrash has shown better results in hydroponic conditions.

**Keywords:** Germination, Hydro priming, Mustard, Osmopriming



## Effect of IBA and Medium on Rooting of Two New Selected Peach × Almond Hybrids Cuttings

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Received: 28-10-2013

Accepted: 27-04-2014

**Introduction:** Potential almond rootstock and thus main genetic sources for the breeding of its new rootstocks are almond itself, peach and plum, and these species cross-breeds Almond is a source of resistance to limestone and to drought because of its roots, which reach deep layers of soil; it is also more resistant than peach to Na and Bo. Asexual or vegetative propagation is a heritable characteristic and this paper is a review of sources available on this character for almond rootstock breeding. The bibliographic reference regarding this species, vegetative propagation is very poor. Stem cutting is considered the most simple and economical method of propagation. It is important, particularly in horticulture for mass production of improved material within a short time and to perpetuate the characteristics of the parent plant.

**Materials and Methods:** In this study the effects of different concentrations of indole-3- butyric acid (IBA) and medium type on rooting of hardwood stem cuttings of two rootstocks natural hybrids of almond × peach and the clone of G.F.677(as control) was investigated in plastic greenhouse with bottom heat, In this research 4 levels of IBA (0.3000,6000 and 9000 mg/l) and three levels of bed (perlait, cocopeat and, mixtures of 2 perlite + 1cocopeat) on rooting of hardwood cuttings of two almond × peach natural hybrids and control was used in a split plot based on a randomized complete blocks design with three replications. Hardwood cuttings were prepared in Department of Horticultural Sciences of Ferdowsi University of Mashhad at January 2011. The basal one inch of cuttings was treated with IBA solution for five seconds at 3000, 6000 and 9000 ppm. the following components were determined, the rooting percentage of cuttings, number of root, length of roots, roots fresh and dry weight and volume of roots.

**Results and Discussion:** Results showed that effects of different concentrations of IBA, on the rooting percentage of cuttings were significantly different at the %1 level compare with control. In this case were observed the highest of rooting percentage (40.9) at concentration of 3000(mg/l) and the lowest percentage (12.7) in control. The observations showed that treating almond hardwood cuttings with 3000 ppm IBA gave the highest significant rooting percentage compared with other treatments. Furthermore, results of many investigations indicated that, IBA increased rooting percentage, number of roots/cutting, length and fresh weight of roots. Also on the trait there were significant differences in the %1 level between the growing Media. Rooting percentage of cuttings expanded by bed of perlait. Results showed that effects of different rootstocks on the rooting percentage of cuttings were significantly different at the %1 level. In this trait observed the highest of rooting percentage at G.F.677 and there was no significant difference between the two other rootstocks. Treated with control rootstock with IBA at 3000 mg/l and Perlait resulted in the highest rooting percentage, the maximum number of roots and root length. In the traits rooting percentage, number of roots and root length was interactions between, concentrations × bed × rootstocks significantly different at the %1 level. The result was better than Gf677× 3000 ppm of IBA × perlite bed. Also effect of treatments concentrations on root volume was significant at the %5 level. Highest root volume obtained in a concentration of 3000 mg/l of IBA.

**Conclusion:** From our preliminary results, it could be inferred that there is a correlation between types of rootstock, concentrations of IBA and media in rooting ability of hardwood cuttings rootstocks of almond × peach. In this study, the desired result was obtained from the interaction between treatments concentration of 3000 mg per liter of IBA in perlite media and GF677 rootstock.

**Keywords:** Almond rootstocks, Auxin, Cocopeat, Hardwood stem, Perlite

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## Effect of Organic and Biological Fertilizers on Growth and Yield of Tomatoes (*Lycopersicon esculentum* Mill.) and Bacterial Colonization

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Received: 02-11-2013

Accepted: 19-04-2015

**Introduction:** In recent decades, excessive use of chemical fertilizers causes environmental problems such as water resource pollution and decrease in soil fertility. Organic matters are excellent sources of plant-available nutrients and their addition to soil could maintain high microbial populations and activities. In crop studies, Prabha et al. (2007) reported that there was excellent plant growth as well as yield in garlic plants that received vermicompost as nutrient in the field (28). Recent studies confirmed that, a number of bacterial species mostly associated with the plant rhizosphere, are found to be beneficial for plant growth, yield and crop quality. Therefore, the objective of this study is to investigate the growth promoting effects of organic and bio-fertilizers on tomato growth and yield.

**Materials and Methods:** A factorial experiment in randomized complete block design with three replications was conducted at the College of Agricultural, University of Shahrood in 2011. Geographically, the site is located in Bastam (36° 25'E, 54° 58'N, 1349 m a.s.l.). The climate of this region is semi-arid. Treatments included three levels of organic fertilizers: vermicompost (1300 kg ha<sup>-1</sup>), cow manure (3350 kg ha<sup>-1</sup>), and control, biological fertilizer in four levels (Pseudomonas putida, Pseudomonas fluorescens, Azotobacter chroococcum and control). The bacterial suspension for each species was applied at a rate of 3 liters per hectare. Metribuzin herbicide (wetable 80% powder) was used at a rate of 1000 gr. ha<sup>-1</sup>. Petopride No. 2' variety of tomato (*Lycopersicon esculentum* Mill.) was used in the present experiment. At the time of harvesting, the plant characteristics namely lengths and diameter of stem, number and weight of fruit, weight of stem and leaf were also registered. Statistical analyses of data were performed with statistical software Mstat. Significant differences between means refer to the probability level of 0.05 by LSD test.

**Results and Discussion:** There results showed that main interaction effects of bio and organic fertilizers were significant ( $P < 0.05$ ) on bacterial colonization. The bacterial population increased with application of vermicompost and biofertilizers than other treatments significantly (Figure 1). Chemical analysis showed that vermicompost had a lower pH, and higher amounts of nitrogen, phosphorous and organic matter compared to the cow manure and soil (Table. 1). Thus, it seems that vermicompost has been able to provide an appropriate bed for the growth of bacteria. The results indicated that the dry weight and height of tomato stems was improved by 28.5 and 4.7 percent, respectively by application of vermicompost compared to the control treatment (Table 4). The number of tomato fruits increased by the application of vermicompost and cow manure by 29.2 and 19 percent compared to the control, respectively. Also, the yield of tomato was increased by 15 and 10 percent compared to the control treatment by the application of vermicompost and cow manure, respectively. Federico et al. (2007) reported that the yields of marketable tomato fruits per plant increased by 1.8-times in response to a 1:1 vermicompost to soil mixture compared to the control treatment (10). An excreta of earthworm is rich of micro-organisms, especially bacteria and contain large quantities of plant hormones (auxin, gibberellin and cytokinin) that in low concentrations significantly affect plant growth and development (3). Phosphorus is an essential nutrient for plant growth and development and is one of the most important elements in crop production. Despite its wide distribution in nature, it is a deficient nutrient in most soils, especially in soils which have a high P fixation capacity. Since a substantial amount of any applied P fertilizer is rendered unavailable frequent applications of soluble forms of inorganic P are needed to maintain adequate P levels for plant growth. It is a well-known fact that a considerable number of bacterial species, mostly those associated with the plant rhizosphere, are able to exert a beneficial effect upon plant growth. Phosphate solubilizing microorganisms render these insoluble phosphates into soluble form through the process of acidification, chelation and exchange reactions. In our experiment, probably increasing the availability of P and N fertilizers has improved the growth and yield of tomato plants. *Azotobacter chroococcum* increased dry weight and height of stem and yield of tomatoes by 32.14, 7.23 and 21.2 percent, respectively compared with the control treatment (Table 2). In similar results, the use of

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N<sub>2</sub>-fixing bacterial stimulated yield and quality parameters of sugar beet and barley (8). The positive effects of Azotobacter bacteria on the yield and growth of tomatoes were explained by promoting abilities of these bacteria for auxin and cytokinin production, N<sub>2</sub>-fixation, phosphate solubilization and antimicrobial substance production (8). The yield and plant growth enhancement effects of *A. chroococcum* used in this study on tomato could be explained by similar reasons.

**Conclusion** The results of the present study suggested that inoculation of tomato with biofertilizers and the use of organic fertilizers such as vermicompost and cow manure have a potential to increase the growth and yield of tomatoes. Considering environmental pollutions with excessive use of synthetic fertilizers and high costs in the production of N and P fertilizers, the bacteria tested in our study maybe a promising alternative as a bio-fertilizer for fruit and vegetable production in sustainable and organic agricultural systems.

**Keywords:** *Azotobacter chroococcum*, Cow manure, Pseudomonas, Vermicompost





## Effect of Postharvest Oxalic Acid and Calcium Chloride on Quality Attributes of Sweet Cherry (*Prunus avium* L.)

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Received: 18-12-2013

Accepted: 19-04-2015

**Introduction:** Fruits and vegetables have special importance as a very important part of the human food supply. And from the beginnings of life, man has used these products to supply a part of his food. Nowadays, horticultural products are widely used in the diet. Cherry is one of the deciduous trees in the temperate regions, which is potassium rich. Use of Oxalic acid significantly reduces frost injury in pomegranate fruits during storage at a temperature of 2° C. In fruit trees, the importance of calcium is due to a delay in fruit ripening process and this way products have better portability.

**Materials and Methods:** Firmness test was measured using the FT011 model of penetrometer. For determination of titratable acidity, the 0.1 N sodium hydroxide (NaOH) titration method was used. Total Soluble solids content (SSC) of fruit was measured by a digital refractometer (PAL-1). For determination of vitamin C in fruit juices, titration method with the indicator, 2,6-di-chlorophenolindophenol was used. Fruit juice pH was measured using pH meter model HI 9811. In order to investigate the effect of postharvest soaking treatment with Oxalic acid on the qualitative specifications and storage life of single grain sweet cherry fruit a research was conducted. This experience was conducted in a completely randomized design with 3 replications separately for the two materials. In this experiment Oxalic acid, in four levels (0, 4, 6 and 8 mM) and Calcium chloride in four levels (0, 40, 55 and 70 mM) were applied on the single grain sweet cherry fruit in the form of soaking and samples with 7-day intervals for a period of 28 days from the fridge out and quantitative and qualitative traits such as stiffness, weight loss, Titratable acidity, total soluble solids, vitamin C and pH were measured.

**Results and Discussion:** The results showed that compared with control ones all of the concentrations of Oxalic acid and Calcium chloride caused significant differences in the amount of weight loss, firmness, Acidity, TSS, vitamin C and pH, so that weight loss rate on the fourth week for control samples was 39/79%, for samples treated with 8mM oxalic acid, 22/77%, and for 70 mM Calcium chloride, 21/19%; total soluble solids weight on the fourth week for control samples was 24/53%; for samples treated with 8mM Oxalic acid 21/43% and for 70 mM Calcium chloride 21/13%; and vitamin C weight on the fourth week for control samples was 2/65; for samples treated with 8mM Oxalic acid 3/06 and for 70 mM Calcium chloride 3/16; also firmness and acidity were more than that of control.

**Conclusion:** In fruits treated with different concentrations of calcium chloride, the amounts of firmness, acidity and vitamin C were significantly higher than that of control. Also in treated fruits, the amounts of weight loss, total soluble solids and pH during storage were significantly lower than that of control. In fruits treated with different concentrations of Oxalic acid in fruits, the amounts of firmness, acidity and vitamin C were significantly higher than that of control. And in fruits treated with different concentrations of Oxalic acid, the amounts of weight loss, total soluble solids and pH were significantly lower than that of control. According to the results of this test calcium chloride treatment was better when compared with Oxalic acid.

**Keywords:** Calcium chloride, Oxalic acid, Postharvest, Sweet Cherry

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## Study of the Biochemical Responses and Enzymatic Activity of GF677 (Peach and Almond Hybrid) Rootstock to In Vitro Salinity Stress

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Received: 30-12-2013

Accepted: 10-08-2014

**Introduction:** Salinity is the most significant abiotic factor limiting crop productivity and several physiological responses, including modification of ion balance, water status, mineral nutrition, stomatal behavior, photosynthetic efficiency and so on. The GF677 (*Prunuspersica*×*Prunusamygdalus*) is widely used as a rootstock for peach and almond. It is mainly used as a rootstock because of its resistance to drought, calcic soil and Fe deficiency. Nowadays, using tissue culture techniques is very popular for the selection of plant resistant to abiotic stress (in vitro salinity); because in vitro conditions are more controllable than in vivo conditions and the large number of genotypes can be evaluated in a limited space. For example, in the field, plants are exposed to variable biological and climatic conditions which result in some interaction effects. In other words, the nutrition and climatic effects are easily controllable in the in vitro conditions all over the year. The objective of this study is to identify biochemical markers of salinity stress of GF677 rootstock under in vitro conditions.

**Materials and Methods:** Plantlets of GF677 rootstock were subcultured into the Murashige and Skoog (MS) proliferation medium containing 1 mg/l BA (6-Benzyladenine) and 0.1 mg/l NAA (naphthalene acetic acid) with different concentrations (0, 40, 80 and 120 mM) of sodium chloride (NaCl) with four replicates. Cultures were transferred to the growth chamber with temperature of 25±2°C, relative humidity of 70%, under a 16/8 h (day/night) photoperiod. Data were collected at the end of the experiment (6<sup>th</sup> weeks). Antioxidant enzymes activity (catalase and peroxidase), total protein content, proline content, soluble sugars, and Na and Cl were measured. The experiments were set up in a completely randomized design (CRD) with four replicates (a vessel in each replicate) and statistical analysis was performed using MSTAT-C program. Means were separated according to the Duncan's multiple range test (DNMRT) at 0.05 level of probability.

**Results and Discussion:** After six weeks, the results showed that by increasing salinity levels in the culture medium, antioxidant enzymes activity (catalase and peroxidase), total protein content, proline content and soluble sugars increased significantly. The antioxidant enzyme activities (catalase and peroxidase) were increased significantly in the GF677 rootstock by increasing salinity levels. Catalase activity increased with increasing salinity levels, such that the maximum value (0.61 [abs/min /mg protein (f.m)]) was observed in 80 mM sodium chloride treatment. The lowest catalase activity (0.11 mg [abs/min /mg protein (f.m)]) was observed in 120 mM. The highest of peroxidase enzyme activity (0.109 and 0.105 [abs/min /mg protein (f.m)]), was obtained in 80 and 40 mM, respectively. Also, by increasing the salinity level, total protein content increased significantly in GF677 plantlets. The highest total protein was observed in 80 mM sodium chloride. By increasing salinity levels, proline content increased compared to the control at the GF677 rootstock, but no significant difference was observed between salinity levels. The highest accumulation of proline was obtained in 80 and 120 mM, respectively, while the lowest proline was obtained in control. By increasing salinity levels, soluble sugars increased in GF677 rootstock. The highest accumulation of soluble sugars was obtained in 80 mM. By increasing salinity levels in the cultural medium, the uptake of sodium (Na<sup>+</sup>) and chlorine (Cl<sup>-</sup>) significantly increased in GF677 rootstocks over the six-week culture period. The highest uptake of Na and Cl ions in plant tissue was observed in 4<sup>th</sup> week. The results showed that with increasing salinity levels (80 to 120 mM), leaf chlorophyll index (SPAD unit) decreased in GF677 rootstock. The lowest chlorophyll index was observed in 120 mM treatment, while the highest leaf chlorophyll index was obtained in the control treatment.

**Conclusion:** According to the results and analysis of biochemical and enzymatic responses, it can be concluded that GF677 is a concentration tolerant to salinity up to 120 mM. The highest amount of biochemical responses and enzymatic activity was observed at 80 mM, where the continued growth of the plant was in terms of salinity. The rootstock was due to antioxidant defense mechanisms such as antioxidant systems, osmotic

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adjustment by proline and soluble sugars and increasing protein synthesis can sustain growth even under salinity conditions, as a tolerant rootstock was used for peach and almond cultivars.

**Keywords:** Antioxidant enzymes, GF677 rootstock, Oxidative stress, Proline, Salt stress



## Effects of Different Sources of Nutrition on Quantitative and Qualitative Characteristics of *Lycopersicon esculentum* under Ecological Cropping System

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Received: 26-01-2014

Accepted: 05-01-2015

**Introduction:** Increasing usage of chemical fertilizers imposes irreparable damages to the environment. Disadvantages of chemical fertilizers has led to more attention to the application of organic fertilizers and manures. The use of organic fertilizers and livestock, especially in nutrient poor soils, it is necessary to maintain soil quality. Plant growth promoting rhizobacteria (PGPR) occupy the rhizosphere of many plant species and have beneficial effects on the host plant. They may influence the plant in a direct or indirect manner. A direct mechanism would be to increase plant growth by supplying the plant with nutrients and hormones. Indirect mechanisms on the otherhand, include, reduced susceptibility to diseases, and activating a form of defense referred to as induces systematic resistance. Examples of bacteria which have been found to enhance plant growth, include *Pseudomonas*, *Enterobacter* and *Arthrobacter*. Biofertilizers contain organic compounds that increase soil fertility either directly or as a result of their decay (9, 10). Tomato (*Lycopersicon esculentum* L.) belongs to the nightshade family, Solanaceae. The plant typically grow 1-3 meters in height and a weak stem. It is a perennial in its native habitat, although often grown outdoors in temperate climates as an annual. An average common tomato weighs approximately 100 grams. Tomatoes contain the carotene lycopene, one of the most powerful natural antioxidants. In some studies, lycopene, especially in cooked tomatoes, has been found to help prevent prostate cancer. Lycopene has also been shown to improve the skin's ability to protect against harmful UV rays. Tomatoes might help in managing human neurodegenerative diseases. The lycopene has no effect on the risk of developing diabetes, but may help relieve the oxidative stress of people who already have diabetes. The purpose of this study was the possibility of replacing chemical fertilizers with biofertilizers, reducing production costs and increasing product quality.

**Materials and Methods:** In order to study the effects of different fertilizers on the quantity and quality characteristics of tomato (*Lycopersicon esculentum* Mill.), a split plot experiment based on RCBD design with three replications was conducted in 2009-10 growing season in research farm of Ferdowsi University of Mashhad, Iran. Two levels of poultry manure (zero and 20 ton ha<sup>-1</sup>) and five different fertilizers (nitroxin (A), phosphate solubilizing bacteria (B), A+B, nitrogen and phosphorous chemical fertilizers and control) were considered as the main and sub factors, respectively. Studied traits were fruit number and weight per plant, total yield, marketable yield, spad number, brix index, c vitamin and lycopene content.

**Results and Discussion:** The results showed that poultry manure increased total yield of tomato compared with control. Chemical fertilizers led to the production of highest total yield. Biophosphorous+nitroxin and biophosphorous increased marketable yield by 17 and 11 percent compared to control, respectively. The highest and the lowest contents of vitamin C were observed in nitroxin and chemical fertilizer, respectively. Biofertilizers and chemical fertilizers increased lycopene content compared with control, so that the maximum content of lycopene was obtained in the biophosphorous with 2.38 mg per 100 g sample. Also, the fruit yield of tomato was more in the first stage of harvesting rather than the second stage. It seems organic fertilizers and biofertilizers increased morphological characteristics and yield of tomato due to provide better conditions to absorption and transportation of nutrient to the plant. It has been reported that this ecological inputs provide favorable conditions for plant growth and development through improvement of physical, chemical and biological properties of the soil, therefore, it can be concluded that improvement of most of studied traits in the present study were due to use of organic fertilizers and biofertilizers.

**Conclusions:** The cost of this study has been funded by Research and Technology Deputy of Ferdowsi University of Mashhad, Faculty of agriculture, the financial supports is appreciated.

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**Keywords:** Biophosphorous, Market yield, Lycopene, Nitroxin, C vitamin



## The Effect of Green Pruning on the Yield and Fruit Quality of the Crawling Grape Vines Cultivar Keshmeshy in the Climatic Conditions of Shirvan

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Received: 02-02-2014

Accepted: 22-04-2015

**Introduction:** Green pruning or summer pruning completes winter pruning, and it is conducted during the growing season. The purpose of green pruning is to maximize yield of high quality grapes. Green pruning in fruit trees improves light penetration and increases the quality of fruits. The objectives of this research were to determine the influence of green pruning on fruit quantitative and qualitative attributes in grapevine cultivar 'keshmeshi'.

**Materials and Methods:** The present research was undertaken in Shirvan, Northern Khorasan province. The vines were highly uniform, 17 years old and all had equal vegetative growth strength. The planting distances were 3 × 3 m. The present study was conducted on cultivar 'Keshmeshi' that is considered to be one of the best grapevine cultivars mostly used for raisin production as well as table fresh fruits. In order to evaluate the effect of green pruning on different quantitative and qualitative attributes of fruits in cultivar "keshmeshi", the experiment was carried out in two way randomized complete block design with 12 treatments and three replications. Vines were pruned three times including full bloom, two weeks after full bloom and veraison (eight weeks after full bloom). Pruning was carried out in three levels including tipping after two, four or six nodes above the final cluster. The characteristics studied were cluster weight, berry weight, cluster length and width, berry length and width, number of cluster and berry, vine yield, leaf area, soluble solid, total acidity, pH, berry color, berry sunscald and number of shot berry. The SAS software (SAS, version 9.1) was used for statistical analysis of the recorded data. The mean comparison was performed based on Duncan's multiple range tests at %5 and %1 levels.

**Results and Discussion:** The results of this study indicate that the severity of green pruning has no significant effect on the number and width of berries. This treatment also had no significant effect on the number of cluster. However, there were some significant effects on the TSS ( $P < 0.05$ ) and on other attributes at  $P < 0.01$ . The time of green pruning had some significant effects on almost all attributes at  $P < 0.01$  and on cluster weight, pH and berry color at  $P < 0.05$ ; but it showed no significant effect on the number of clusters, TSS and TA. The results showed the reciprocal effect of treatments had a significant impact on the length and width of clusters and the length of berries, weight of clusters and berries, number of berries and shotberries, leaf area and pH ( $P < 0.01$ ). The reciprocal effect of treatments caused a significant effect on the TSS and berry color at  $P < 0.05$ ; but it showed no significant effect on yield, number of clusters, TA and the percentage of sunburn. The maximum length of clusters (31.47 cm) and berries (16.80 mm), width of cluster (12.98 cm), weight of cluster (344.33 g) and berry (1.85 g), number of berries/cluster (233.53) and leaf area (193.20 cm<sup>2</sup>) was observed following six-nodes pruning at veraison stage compared to other treatments. The treatment of two and four nodes at full bloom and two weeks after that, reduced the leaf area and also the rate of photosynthesis, and the amount of carbohydrates will be decreased. Subsequently yield component will be decreased.

**Conclusion:** According to the result of this study, green pruning improved fruit juice quality and increased grapevine yield. Six-nodes-pruning at veraison stage did not have any negative influence on yield compared to other treatments and increased the fruit quality compared to control. Two and four-nodes-pruning in full bloom decreased the yield components but increased soluble solid, pH and improved berry color.

**Keywords:** Green pruning, Full bloom, Quantitative and qualitative attributes, Soluble solid, Total acidity

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## Evaluation of Some Agroecological Characteristics of Basil (*Ocimum basilicum* L.) as Affected by Simultaneous Application of Water-Saving Superabsorbent Hydrogel in Soil and Foliar Application of Humic Acid under Different Irrigation Intervals in a Low Input Cropping System

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Received: 16-02-2014

Accepted: 09-12-2014

**Introduction:** Basil (*Ocimum basilicum* L.) is an annual herbaceous plant that belongs to lamiaceae family. This plant is native of India country and other countries in south of Asia. Nowadays, the use of water superabsorbent polymers is increased in agriculture and their role in reducing the drought stress and increasing the crops production has been demonstrated in many researches. Superabsorbent polymers can absorb lots of water and keep it in their structure and give it to plant under drought stress conditions (9). Humic substances are a group of heterogeneous molecules that are bonded together by weak forces, therefore they have high chemical stability. Humic acid comprise 65 to 80 percent of total soil organic matter (6). According to medicinal importance of Basil and its roles in the food and pharmaceutical industries, beside the limited water resources and need to increase water use efficiency through using ecological inputs, this study designed and conducted aimed to evaluate agroecological characteristics of Basil as affected by application of water-saving superabsorbent and humic acid under irrigation intervals.

**Materials and Methods:** In order to evaluate the effects of different amounts of water-saving superabsorbent and foliar application of humic acid and irrigation intervals on some quantitative characteristics of basil (*Ocimum basilicum* L.), a split strip plot experiment was conducted based on RCBD design with three replications at The Research Farm of Ferdowsi University of Mashhad, Iran during growing season of 2012-13. Experimental factors included three levels of water-saving superabsorbent (0, 40 and 80 kg ha<sup>-1</sup>) as the main plot factor, two levels of humic acid (0 and 3 kg ha<sup>-1</sup>) as the sub plot factor and two levels of irrigation interval (5 and 10 days) as the strip plot factor. Studied traits were seed number and weight per plant, plant height, number of lateral branches per plant, seed yield, biological yield and harvest index.

**Results and Discussion:** The results showed that interaction of superabsorbent and humic acid had a significant effect on seed yield ( $p \leq 0.05$ ), as the highest seed yield (2638.8 kg ha<sup>-1</sup>) obtained from application of 40 kg ha<sup>-1</sup> superabsorbent without humic acid. Evaluation of the superabsorbent and irrigation intervals interaction revealed that in all levels of superabsorbent, dry matter yield under irrigation interval of 5 days was more than irrigation interval of 10 days, so that dry matter yield at irrigation interval of 5 days and 0, 40 and 80 kg ha<sup>-1</sup> levels of superabsorbent increased 13, 50 and 17% compared to irrigation interval of 10 days, respectively. Seed number per plant significantly was affected by interaction effects of humic acid and irrigation interval, so that in condition of using of humic acid in irrigation interval of 10 days, seed number per plant increased by 26% compared to control. The triple interaction of superabsorbent, humic acid and irrigation interval had significant effect on branch number per plant, as in irrigation interval of 5 days, in both conditions of application and no-application of humic acid, the highest branch number per plant observed in 40 kg ha<sup>-1</sup> level of superabsorbent. In general, the combined use of 40 kg ha<sup>-1</sup> water-saving superabsorbent and humic acid in different levels of irrigation, particularly under drought stress condition, while improved quantitative characteristics of basil, played an effective role in alleviation the devastating effects of drought stress. It seems that the appropriate level of water-saving superabsorbent (40 kg ha<sup>-1</sup>) increased morphological characteristics and seed yield of Basil through the absorption of water (4) and improvement of soil physical characteristics. It seems that humic acid increased quantitative characteristics of Basil by increasing activity of growth hormones

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such as auxin and improving nutrient uptake. In most of the studied traits, efficiency of humic acid improved in conditions of superabsorbent application and the plant could use the humic acid more efficient.

**Conclusions:** The cost of this study has been funded by Research and Technology Deputy of Ferdowsi University of Mashhad, Faculty of agriculture, the financial supports is appreciated.

**Keywords:** Drought stress, Dry matter yield, Ecofriendly inputs, Food health, Medicinal plants





## Effect of Salinity Stress on Concentrations of Nutrition Elements in Almond (*Prunus Dulcis*) 'Shokofeh', 'Sahand' Cultivars and '13-40' Genotype Budded on GF677 Rootstock

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Received: 15-03-2014

Accepted: 29-10-2014

**Introduction:** Almond (*Prunus amygdalus* B.) is one of the most important crops consumed as a dry fruit and it is mainly adaptable to arid and semi-arid regions mostly suffering from salinity stress (8). Soils with dry humidity regime are dominant in Iran and in the world at large and mostly include regions with more evaporation than precipitation. This in turn leads to increased salinity of the soil (9 and 10). Based on available reports, roughly 12.5% of land areas in Iran are saline, which overwhelmingly contain sodium, while more than 800 million hectares of land area on the earth (6% of overall global land area) are affected by salinity (9 and 10). Therefore, compound of rootstock and scion may be used as one of the influence factors in sensitivity or tolerance to salinity of planted fruit trees including almonds (8 and 11). In recent years, for various reasons including the uniformity of trees, instead of sexual rootstock, vegetative rootstock is used. Rootstock GF<sub>677</sub> an inter-specific hybrid (Almond× Peach) is propagated asexually as clone (8). It has been reported that rootstock GF<sub>677</sub> is tolerant to salinity while rootstock nemagard (*P. persica* X *P. davidiana*) is sensitive to salinity (16). It has been reported that rootstock GF<sub>677</sub> tolerated salinity (5.5 ds/m), (19) or 5.2 ds/m (17 and 14). However, as plant species and different cultivars within the same plant species vary considerably in their tolerance to salinity (10), properly selecting plants and/or cultivars that can be grown well under adverse conditions, created in the root zone by salinization, is the most efficient and environmentally friendly agricultural practice for a more permanent solution of the problem of salinity (10). Despite the presence of information on the effect of salinity on concentration of nutrition elements of almond cultivars leaves and roots, tolerant scion/rootstock combinations have not been introduced for this plant. Therefore, the aim of the present study is to evaluate the effects of salt stress on concentration of nutritional elements of selected almond genotypes leaves and roots, grafted on GF<sub>677</sub> rootstock and introducing most tolerant genotypes to it.

**Materials and Methods:** In this research, the effects of salinity stress were investigated on nutrient of almond leaves and roots by a completely randomized design (CRD), with two factors, genotype (in the four levels) and irrigation water salinity (in the five levels) with tree replications in the research greenhouse of Seed and Plant Institute in the year 2013. Studied Genotypes included 'Shokofeh', 'Sahand' and '13-40' budded on GF<sub>677</sub> and 'GF<sub>677</sub>' (none budded as control) and irrigation water salinity included 0, 1.2, 2.4, 3.6 and 4.8 g/l of natural salt (whose electrical conductivity are equal to 0.5, 2.5, 4.9, 7.3 and 9.8 ds/m, respectively). Nutrition elements such as K<sup>+</sup>, Ca<sup>++</sup>, Mg<sup>++</sup>, P, Na<sup>+</sup>, Cl<sup>-</sup>, Zn<sup>++</sup>, Cu<sup>++</sup>, Fe<sup>++</sup>, Na<sup>+</sup> to K<sup>+</sup> ratio, Na<sup>+</sup> to Ca<sup>++</sup> ratio, Na<sup>+</sup> to Mg<sup>++</sup> ratio, Na<sup>+</sup> to P ratio, were investigated in selected almond genotypes leaves and roots. Then salinity stress was applied.

**Results and Discussion:** The results showed that type of scion and level of salinity had affected nutrient concentration of leaves and roots. Evaluation of nutrition elements concentration in leaves and roots showed that in the total studied genotypes, the highest percentage of Na<sup>+</sup>, Cl<sup>-</sup>, Na<sup>+</sup> to K<sup>+</sup> ratio, Na<sup>+</sup> to Ca<sup>++</sup> ratio, Na<sup>+</sup> to Mg<sup>++</sup> ratio, Na<sup>+</sup> to P ratio and the lowest percentage of Ca<sup>++</sup>, Mg<sup>++</sup>, P and concentration of Cu<sup>++</sup> in leaves and roots and the lowest concentration of Zn<sup>++</sup> in leaves were observed in treatment 9.8 ds/m. The result showed that the type of scion was effective in obstruction of Na<sup>+</sup> absorption by the roots and their transportation to leaves. Percentage of Na<sup>+</sup>, Cl<sup>-</sup>, Na<sup>+</sup> to K<sup>+</sup> ratio and Na<sup>+</sup> to P ratio in levels of salinity 3.6 and 4.8 g/l and Na<sup>+</sup> to Ca<sup>++</sup> ratio, Na<sup>+</sup> to Mg<sup>++</sup> ratio in level of salinity 4.8 g/l in 'Shokofeh' cultivar were significantly less than other genotypes. Also, this cultivar could compare with control plants at levels of salinity 3.6 and 4.8 g/l by increasing the percentage of K<sup>+</sup> and concentration of Fe<sup>++</sup>, and it could tolerate the harmful effects of Na<sup>+</sup> more than other genotypes.

**Conclusion:** Overall, the results showed that both rootstock and type of scion were effective in tolerance to

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salinity. GF<sub>677</sub> rootstocks (non-budded) tolerated salinity of 2.4 g/l (4.9 ds/m), but with increasing salt concentration, plants were severely damaged. The results showed that the type of scion affected tolerance to salinity. In this research, at base concentration of nutritional elements, 'Shokofeh' cultivar was the most tolerant cultivar against salinity stress. This cultivar could well tolerate salinity of 3.6 g/l (7.3 ds/m) and partly salinity 4.8 g/l (9.8 ds/m). In contrast, Sahand cultivar was the most sensitive cultivar to salinity stress. These cultivars as GF<sub>677</sub> rootstocks (non-budded as control) only could tolerate salinity of 2.4 g/l.

**Keywords:** Almond, GF<sub>677</sub>, Macronutrients, Micronutrients, Salinity stress, Shokofeh



## Effect of Salinity on Seed Germination and Seedling Growth of Native Populations of Tall Fescue in Iran

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Received: 21-04-2014

Accepted: 19-04-2015

**Introduction:** Worldwide, more than one-third of irrigated land is salinized, and in many regions, fresh water shortage has resulted in restrictions on the use of potable water for landscape irrigation. On the other hand, rapidly expanding population growth is occurring in many arid regions, where soil and water salinity are problems and there are increased demands on limited fresh water resources (9). In the turf grass industry, with the increased use of saline and non-potable water, the development of turf grass landscapes in arid and seashore regions where saline soil is common, and with the use of salt for deicing roadways, the need for salinity tolerant turf grasses is very important (16). Seed germination and early seedling growth is usually the most critical stage in plant establishment, and determining successful crop production (23). Tall fescue (*Festuca arundinacea* Schrub.) is an important perennial cool-season grass in temperate regions and it is widely used for both forage and turf purposes (25). There is no study on the evaluation of salinity on tall fescue native populations in Iran. The major objective of this study is to determine the relative salt tolerance and growth response of native populations of tall fescue to salinity in germination stage.

**Materials and Methods:** In this experiment, seeds of some native populations of tall fescue (TF) (*F. arundinacea* Schreb) including: Semirom, Mashhad, Sanandaj, Sanajan, Yasuj, Yazd Abad, Daran, Kamyaran, Gandoman, Borujen, Nasir Abad, Alborz and commercial TF (C. TF) seeds were used. Four replicates of 25 seeds were germinated on filter papers with 5 ml of NaCl concentrations placed in 9 cm Petri dishes. NaCl concentrations included: 0, 45, 90 and 135 milimolar. The Petri dishes were transferred to germinator at 23°C. Germinated seeds were counted on the 3rd, 5th, 8th, 11th and 14th days. Germination was considered to have occurred when the root length was 2 mm long. The seedling with short, thick, and spiral formed hypocotyls and stunted primary root were considered as abnormally germinated. Then, the total germination percentage, germination rate, root length and shoot length were calculated on Day 15. The vigor index was calculated as  $VI = (RL + SL) \times GP$ , where for the VI, RL is the root length, SL is the shoot length and GP is the germination percentage. Root length and shoot length were measured manually with a ruler. The experimental design was a completely randomized design with 4 replications and 25 seed per replicate. The data were statistically analyzed by JMP 8.0. The difference between the means was compared using LSD values ( $P < 0.01$ ).

**Results and Discussion:** The results indicated that the increase of salinity level leads to a significant decrease in germination percentage, germination rate, length of shoot, root and vigor index in all genotypes. Also, interaction of salinity and genotype was significant for germination percentage, germination rate, and vigor index. The highest germination percentage was related to Mashhad population at 45 milimolar, and Daran population at 90 and 135 milimolar. Also, the lowest germination percentage was related to Kamyaran population at 45 and 90 milimolar and Commercial tall fescue at 135 milimolar. Mashhad population at 135 milimolar, Daran population at 90 and 135 milimolar had the highest germination rates. The lowest germination rate was recorded at 45, 90 and 135 milimolar in Commercial tall fescue, Kamyaran and Sanandaj populations, respectively. The highest root length was seen in Commercial tall fescue at 90 and 135 milimolar, and Mashhad population at 45 milimolar. For shoot length factor, Mashhad population, Commercial tall fescue and Mashhad population had the highest lengths at 135, 90 and 45 milimolar, respectively. The highest vigor index was related to Mashhad, Daran and Mashhad populations, at 45, 90 and 135 milimolar, respectively. NaCl has an inhibitory effect on seed germination and its effect on germination showed time course dependence for absorption of Na and Cl by the hypocotyls (28). Increasing salinity levels caused delays in seedling emergence as a result of reducing cell division and plant growth metabolism (28). The negative effect of salinity on seed germination and

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early growth could be due to the toxic effects of NaCl on seeds, or to the osmotic effect, that prevents the seeds from imbibitions (21).

**Conclusion:** Major grasses mentioned above could tolerate 45 milimolar salinity without noticeable changes in germination traits. Mashhad and Brujen populations were least affected by 135 Mm Nacl at germination rate and percentage. Also, Daran and Mashhad populations were least affected by different salinity levels in all germination factors compared to other populations and could be suggested as salt-tolerant genotypes at germination stage.

**Keywords:** Germination rate, Length of root, Length of shoot, Vigor index



## The Role of Rootstock in Antioxidant Activity of Citrus Fruit: Comparison of Antioxidant Activity of The Fruits of Two Commercial Citrus Varieties With The Fruits of Four Different Rootstocks

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Received: 23-04-2014

Accepted: 10-08-2014

**Introduction:** all fruits that called citrus are from rutaceae family and aurantioideae subfamily. This subfamily have more than 33 different genus that only three of its genus (citrus, poncirus and fortunella) have economic aspects and in citrus producing country are important. It's reported that orange skin has a phenolic compounds which play a role in natural defense mechanism. Also various compounds of phenolic and antioxidant have a major role in fruit tolerance to stressful condition such as cold and drought. Metabolites found in citrus fruits have antioxidant properties and it's very useful in pharmaceutical, food and cosmetics industries. Oranges, like other citrus fruits, are an excellent source of vitamin C; Vitamin C is a powerful natural antioxidant. Consumption of foods rich in vitamin C helps the body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals from the blood. Various factors such as rootstock type can effect on quality and quantity of citrus fruits. Also, the usage of rootstock causes the change in plant characteristics such as flowering time, ripening time, fruit quality and antioxidant characters of the fruits. Other factors except the rootstock such as scion, geographical and climate factors are effective on producing secondary metabolites. Also active substances or secondary metabolites are producing by the conduction of genetic processes, but their production are being effected by other factors obviously. The aim of this study is to investigating the biochemical changes grafted tree fruit that affected by rootstock with study the correlation between grafted tree and rootstock changes.

**Materials and Methods:** This study was done to compare the amount of total phenol, total flavonoids and antioxidant features of fruit flesh and skin with investigating the effect of cultivar and rootstock on these parameters based on completely randomized factorial design with three replications. For this purpose total phenol, total flavonoid and antioxidant activity in two citrus cultivar (morro and mars) that grafted on four rootstock (yuzu, citrumelo, sour orange and shel mahalleh) with seedling rootstocks fruit were studied in fruit skin and flesh. Fruits were harvested in the middle of December according to their total soluble solid materials (TSS) which was 10 and then transferred to the researching laboratory in Gorgan Agricultural Science and Natural Resources University. Antioxidant properties using DPPH method in 517 nm wavelength, total amount of phenol using folin siocalteu method in 765 nm wavelength and the total amount of flavonoid were done using the aluminum chloride method in 415 nm wavelength and they were measured using spectrophotometer.

**Results and Discussion:** the result showed that the two factors consisting rootstock and scion have significant effect on the amount of total phenol, total flavonoid and antioxidant properties of extracts of citrus skin and flesh. The greatest amount of phenolic compounds was produced in the skin of morro cultivar that grafted on shel mahalleh rootstock and the lowest amount was observed in the flesh of yuzu seedling rootstock. Total flavonoid was affected by fruit tissue, cultivar and rootstock. The maximum amount of that was seen in the skin of morro and mars cultivar that was grafted on yuzu rootstock and the minimum amount was recorded in the flesh of morro cultivar that grafted on sour orange rootstock. Also the highest antioxidant activity was produced in skin of citrumelo seedling rootstock and the lowest amount was seen in flesh of yuzu seedling rootstock. The investigation on citrus rootstock showed that, antioxidant activity, total phenol and total flavonoid had

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significant effect in different rootstock and cultivar fruit. These compounds were affected by climatic condition. Because the light is effective in biosynthesis of phenolic compounds, in fact, these substances have a protective role against the light, especially short wavelengths. Therefore their more accumulation is in skin. The results of this experiment and also the results of the other researcher show that the rootstock effect is related to the quality of grafted species with the species, rootstock type and their interaction.

**Conclusion:** Based on these experiments, there was significant difference between antioxidant compounds of grafted tree fruit with rootstock fruit but there wasn't a clear relationship between them. It seems this difference was due to combination and physiological characteristic of each fruit. It seems that the accumulation of chemicals in citrus fruit superior than every factors depends on genetic characteristics and inherent abilities. So that some factors specially rootstock has an important and determinant role in accumulation of these substances.

**Keywords:** Antioxidant, Citrus, Grafted tree, Secondary metabolites



## Effects of Phosphorus Solubilizing Bacteria and Nitrogen on the Qualitative and Quantitative Properties of Tuberose (*Polianthes tuberosa*)

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Received: 04-05-2014

Accepted: 05-01-2015

**Introduction:** In Iran, tuberose is ranked the fourth after gladiolus, rose and carnation. These flowers are known as high quality products among which maximum exportation belongs to tuberose and gladiolus. In plant cultivation and development, adequate provision of nutrients is of crucial importance. Tuberose needs plenty of nutrients to obtain the desirable quality and flowering. Hence, tuberose balanced nutrition can play an important role in increasing the yield and quality of its flowers. Nitrogen is a deciding factor for the plant growth and physiology. This nutritional element contributes to the formation of amino acids, proteins, nucleic acids and other cellular components that are required for the construction of new cells. Bio fertilizers containing phosphate solubilizing bacteria (bacillus and pseudomonas) have microorganisms which are beneficial to the soil; these bacteria are conducive to the production of biological materials and as a consequence to plant development. According to a report by Rawia Eid et al., (2009) the application of phosphate solubilizing bacteria increased the growth rate of matthiola cut flower and improved its quality. In another study on soybean, it was observed that the application of phosphate solubilizing bacteria led to a rise in the plant dry matter content. Considering the contributory role of nitrogen and phosphorous in increasing the yield and quality of ornamental plants, the aim of this research was to examine the impact of different nitrogen levels and phosphate solubilizing bacteria on the yield and qualitative properties of tuberose cut flower.

**Materials and Methods:** This research was carried out in a greenhouse in the city of Zanjan in Iran in 2011 through a factorial-form experiment based on a randomized complete block design with three replications and twelve treatments performed on tuberose double cultivar. The treatments included bio fertilizer containing phosphate solubilizing bacteria at three levels (0, 5 and 10 kg ha<sup>-1</sup>) and nitrogen at four levels (0, 50, 100 and 200 kg ha<sup>-1</sup>) taken from urea source. Before cultivation, the bulbs, which were supposed to be inoculated with the mentioned bacteria, were placed in dense suspension (4g L<sup>-1</sup>) containing phosphate solubilizing bacteria for some minutes. After germination of the bulbs and formation of the actual leaves, the first stage of nitrogen consumption was performed during the growing season. The second stage of N consumption began 20 days after the first stage. At the end of the experiment, such parameters as flower vase life, Leaf area per plant, percentage of simultaneous opening of the florets, relative water content percentage, leaf chlorophyll index, plant biomass, dry matter percentage and leaf nitrogen and phosphorous percentages were measured. For means comparison, data variance analysis was carried out by SAS software and Duncan's multiple-range test.

**Results and Discussion:** According to data variance analysis, different levels of nitrogen had a significant impact on all properties except for flower vase life and leaf P percentage at the probability level of 1%. Also, phosphate solubilizing bacteria left a significant effect on all properties except for flower vase life and leaf N and P percentages at p=1%. The interactive effect of nitrogen and the bacteria on such traits as percentage of simultaneous opening of the florets, flower vase life, dry matter percentage and plant biomass was significant at p=1%. Also, with rise in N levels and in bio fertilizer containing phosphate solubilizing bacteria, there occurred an increase in leaf area, relative water percentage, leaf chlorophyll index, leaf N percentage, dry matter content and plant biomass as well. The results showed that a rise in the application of nitrogen up to 200 kg ha<sup>-1</sup> led to an increase in leaf area in bush, relative water percentage, leaf chlorophyll index, leaf N and P percentages, biomass per plant and the percentage of bulb dry matter as well. In contrast, it led to a decline in flower vase life, percentage of simultaneous opening of the florets and leaf P percentage. Maximum values for these properties were obtained when nitrogen was consumed at the level of 50 kg ha<sup>-1</sup>. The treatment of bio fertilizer containing phosphate solubilizing bacteria at the level of 10 kg ha<sup>-1</sup> resulted in an increase in leaf area, relative water percentage, leaf chlorophyll index, leaf P percentage, plant biomass in bush and plant dry matter percentage.

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According to the results from this work, a consumption of 200 kg ha<sup>-1</sup> nitrogen accompanied by 10 kg ha<sup>-1</sup> bio fertilizer containing phosphate solubilizing bacteria is recommended.

In their study on matthiola cut flower, Rawia Eid et al., (2009) showed that a rise in nitrogen level caused a reduction in the percentage of simultaneous opening of the florets, which is in accordance with our results. After examining the effects of N and P levels on tuberose single cultivar, Patel et al., (2006) reported that an application of 200 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> fertilizer and 400 kg ha<sup>-1</sup> nitrogen resulted in a maximum production of plant biomass. The presence of nitrogen and phosphate solubilizing bacteria in bio fertilizers is crucial for the production of a desirable biomass and for the attainment of maximum economic yield. Sirvastava et al., (2005) conducted a research on the impact of phosphate solubilizing bacteria on gladiolus cut flower and showed that high concentration levels of the bacteria reduced the percentage of simultaneous opening of the florets.

**Keywords:** Nitrogen, Phosphorus solubilizing bacteria, Tuberose (*Polianthes tuberosa*)





## Effect of Organic Manure Mixture on growth and yield of Radish (*Raphanus sativus* L.)

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Received: 02-04-2014

Accepted: 26-11-2014

**Introduction:** Today, production of organic farming and gardening is rising. The use of organic fertilizers such as animal manure has a long history. In recent years, the use of fertilizers and manure for providing the nutritional needs of plants, improve soil physical and chemical structure and reduce the environmental issues have been observed. Animal manures can increase soil organic matter and nutrients, improve soil structure and water-holding capacity which in turn increase the quality and quantity of the product to follow. Manure is a valuable source of biological, ecological and environmental benefits is positive and its main use is for agricultural use. Radish is an important root vegetable that belongs to the cruciferous (Brassicaceae). Value radish on high levels of dietary is related to soluble fiber and antioxidants. Radish is a native plant to Asia, China and Europe. The oral part of the botanical garden radish is important and that kind of traditional varieties have long hypocotyls include root and hypocotyls made. The purpose of this test is to evaluate the different mixture amount of animal fertilizers on the growth and yield of radish plants and compare them to each other.

**Materials and Methods:** In order to study of different manure effect on radish growth and yield, an experiment carried out in 2012-2013 in the greenhouse of Gonbad- Kavos University with geographical characteristics 37.16 degrees north, 55.12 ° east and with a height of 45 meters above sea level in a completely randomized design with four replications. Soil and fertilizers used to this experiment were made of the soil and livestock of Gonbad- Kavos University. Soil texture was Clay loam and pH was 7.7 obtained from soil analysis. To obtain the required levels of fertilizer treatments (25, 50, 75, 100), a measure was considered as the basis of each treatment on the basis of the ratio were calculated. The treatments included control (soil), 25 percent cow manure+ 75 percent soil, 50 percent cow manure + 50 percent soil, 75 percent cow manure + 25 percent soil, 100 percent cow manure, 25 percent sheep manure+ 75 percent soil, 50 percent sheep manure + 50 percent soil, 75 percent sheep manure + 25 percent soil, 100 percent sheep manure, 25 percent poultry manure+ 75 percent soil, 50 percent poultry manure + 50 percent soil, 75 percent poultry manure + 25 percent soil, 100 percent poultry manure. Plant height, leaf length, tuber length, tuber diagonal, tuber weight, leaf weight, leaves dry weight and hollow bulb grade were studied. The experiment was conducted under weed control, lack of water restriction and control pests and diseases. To achieve maximum plant growth, we harvested on 2th April 2013 and plant height, leaf length, bulb length, diameter of the bulb, wet bulb, wet leaves and leaf dry weight was measured. After traits recorded, leaves isolated and dried in in oven at 72 degrees for 24 hours and dry matter content was determined. Statistical analysis and data analysis was performed with SAS and Excel computer programs were used to mean comparing with the LSD test at the level of 5 percent.

**Results and Discussion:** Variance analysis results showed that measured traits affect by manure using significantly ( $P < 0.01$ ). Among the treatments, 100 percent cow manure had the most effect on tuber weight, leaf dry weight, leaf length growth, tuber length and diagonal and the least amounts linked to 50 percent poultry manure. The optimum of quantify yield and low hollow bulb grade of tuber gained at 100 percent cow manure. 50 percent of poultry manure treatment with the average tuber weight was less than 1.83 gr. The treatment poultry manure with a high nitrogen content by several ways effects on soil physical characteristics that include an increase in soil temperature, water absorption rate of several times, its weight, helping to form aggregates and nutritional effects that can increase the performance of treatment, rather than 25 percent of poultry manure to the property. Tuber weight of tuber is an important factor in increasing yield of radish that increases it by increasing the amount of tuber weight. The results of this study showed that the application of fertilizers and amount of fertilizers and animal manure, traits showed significant difference compared to the control treatment. Between treatments, the treatment 100 percent cow manure and poultry manure (25 percent) had the greatest impact. To obtain the best yield with best quality (less tuber hollow degree) among the treatment 100 percent cow manure

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was the best.

**Keywords:** Organic manure, Quantities traits, Qualities' traits, Radish

## The Effects of Organic Fertilizers and Mycorrhizae Inoculation (*Glomus mosseae* and *G. intraradices*) on Quantitative and Qualitative Yield of Dwarf Chicory (*Cichorium pumilum* Jacq.) in Different Cuttings

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Received: 25-06-2014

Accepted: 05-01-2015

**Introduction:** In recent years many farmers in Iran interested in to cultivate and produce different medicinal plants which are so important in traditional agriculture in Iran. In order to reduce the environmental impacts of using chemical inputs and also to increase the quality of plant secondary metabolite components, the emphasis is on sustainable agriculture base on using of organic and biological fertilizer. Dwarf chicory (*Cichorium pumilum* Jacq.) is an annual plant from Asteraceae family. Dwarf chicory is classified by jacq as subspecies of the cultivated species *Cichorium endeva* which consumed for healing a variety of diseases such as bacterial infection, poisoning and rheumatism. The use of organic fertilizer in the form of humic acid and fulvic acid play an important role in sustainable agriculture. Humic substances can be added to the soil for improvement the crop yield. A benefit of humic acid due to its ability to complex metal ions and form aqueous complexes with micronutrients and also may form an enzymatically active complex, which can be carry on reactions that are usually assigned to the metabolic activity of living microorganisms. In additional of using organic fertilizers, the biological fertilizer like mycorrhiza fungi is a good approach in agriculture. Mycorrhizal fungi have been used to enhance the plant growth and yield of medicinal crops and to help maintain good soil health and fertility that contributes to a greater extent to a sustainable yield and good quality of the products. The present study was conducted to evaluate the effects of organic fertilizers and mycorrhizae inoculation on quantitative and qualitative characteristics of dwarf chicory (*Cichorium pumilum* Jacq.) in different cuttings.

**Materials and Methods:** The experiment was carried out in a factorial layout based on randomized complete block design with three replications at Research Station, Faculty of Agriculture, Ferdowsi University of Mashhad (59°28 E and 36°15 N ) in 2012-2013 growing season. The experimental treatments were all combination of organic fertilizers in four levels (cow manure, humic acid, fulvic acid and control) and three levels of Mycorrhiza inoculation (*Glomus mosseae*, *Glomus intraradices* and no inoculation) and The collected data were analyzed as split- plot in time based on randomized complete block design (due to having two cuttings during growing season) compared. The 12 fertilizer treatments and two cuts were considered as main and sub plots, respectively. The plots were 2.5\*5 m (12.5 m<sup>2</sup>). The soil of the experimental field was silty loam with pH 8.09, contains total N (0.08 %), available P (10.25 ppm), and available K (286 ppm) with an EC of 1.26 dsm-1. The parameters measured were such as: leaf weight per plant, stem weight per plant, leaf/stem ratio, the leaf area index, fresh yield, dry matter yield and the poly phenol content. The poly phenol content was determined based on Wojdylo et al. (2007) method. The results were analyzed using SAS statistical program and MSTAT-C. The mean comparisons were performed using least significant difference (LSD) test.

**Results and Discussion:** The results showed that the highest (4544 kg.ha<sup>-1</sup>) and the lowest dry matter (1739 kg.ha<sup>-1</sup>) yield were obtained in second and first cut, respectively. The results indicated that inoculation with mycorrhizal species increased the leaf area index, dry matter yield and leaf weight per plant compared with control treatment. However, there was no significant difference between *G. mosseae* and *G. intraradices* in terms of former mentioned criteria. The results showed that using organic fertilizers improved leaf area index, dry matter yield and leaf weight per plant. The highest dry matter yield (3470 kg/ha), leaf area index (1.01), stem weight per plant (11.50 g) and leaf weight per plant (0.72 g) were obtained in humic acid treatment. Studied treatments and also different cutting had no significant effect on poly phenols contents of leaves. In generally, our results showed that application of biological and organic fertilizers improved the most of studied traits of dwarf chicory and *G.mosseae* + humic acid treatment was the best.

**Conclusion:** In this paper we have shown that yield contributing characters were significantly influenced by

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different treatment combinations of humic acid and mycorrhizal fungi and became maximum when humic acid and *Glomus mossae* were applied. In order to minimize contamination of the environment and sustainable agriculture, using biological and organic fertilizers can lead to reduction of chemical fertilizers application in agro ecosystems.

**Keywords:** Cutting period, Fresh yield, Humic acid, Medicine plant



## Study on the Effect of Combined Application of Manure and Chemical Fertilizers on Some Properties of Thompson Novel Orange Juice

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Received: 21-01-2015

Accepted: 08-06-2015

**Introduction:** Citrus are one of the important orchard fruit production that after banana is second in production at the world level and every year, Chemical fertilizers having most important role in increasing crops productions, but in long application of fertilizers cause soil destructions and polluting underground water. Also soils of dry regions are very poor in organic matter level. Nowadays in most countries, climatically condition and poor management cause poor organic matter content of soils. In Iran more than 60 percent of cultivated lands having less than 0.5 up to 1 percent organic matter. This may be due to intensive cultivation and poor managements For this reason if we have combine applications of manure and chemical fertilizers, the results would be much better. The aim of this research was to evaluate suitable ratio of manure and chemical fertilizer in order to reduce the chemical fertilizer use in citrus orchard in north of Iran.

**Materials and Methods:** This experiment was conducted in one of the orchard at Sari district with low organic C. This research carried out on five years old citrus threes. This experiment carried out as factorial experiment on the base of complete randomized block design with 9 treatments and three replications. Treatments included three manure levels (0, 6 and 12 kg per tree) and three levels of macro fertilizer including potassium sulphate, ammonium sulphate and super phosphate triple (0, 30 and 60 percent on the bases of soil test). Total treatment were 27 plots, (each plots were includes two threes).all treatments were applied at March. All analysis was done with standard methods. This experiment was done as factorial on the bases of complete randomized block design with 9 treatments and three replications. The treatments were as follows:

T<sub>1</sub>: Zero percent chemical fertilizer and zero kg manure

T<sub>2</sub>: 30 percent chemical fertilizer (potassium sulphate 50 kg ha<sup>-1</sup>, ammonium sulphate 30 kg ha<sup>-1</sup> and super phosphate triple 45 kg ha<sup>-1</sup>) and zero kg manure.

T<sub>3</sub>: 60 percent chemical fertilizer (potassium sulphate 100 kg ha<sup>-1</sup>, ammonium sulphate 60 kg ha<sup>-1</sup> and super phosphate triple 90 kg ha<sup>-1</sup>) and zero kg manure.

T<sub>4</sub>: Zero percent chemical fertilizer and 6 kg manure

T<sub>5</sub>: 30 percent chemical fertilizer (potassium sulphate 50 kg ha<sup>-1</sup>, ammonium sulphate 30 kg ha<sup>-1</sup> and super phosphate triple 45 kg ha<sup>-1</sup>) and 6 kg manure.

T<sub>6</sub>: 60 percent chemical fertilizer (potassium sulphate 100 kg ha<sup>-1</sup>, ammonium sulphate 60 kg ha<sup>-1</sup> and super phosphate triple 90 kg ha<sup>-1</sup>) and 6 kg manure.

T<sub>7</sub>: Zero percent chemical fertilizer and 12 kg manure

T<sub>8</sub>: 30 percent chemical fertilizer (potassium sulphate 50 kg ha<sup>-1</sup>, ammonium sulphate 30 kg ha<sup>-1</sup> and super phosphate triple 45 kg ha<sup>-1</sup>) and 12 kg manure.

T<sub>9</sub>: 60 percent chemical fertilizer (potassium sulphate 100 kg ha<sup>-1</sup>, ammonium sulphate 60 kg ha<sup>-1</sup> and super phosphate triple 90 kg ha<sup>-1</sup>) and 12 kg manure.

All data analysis was done with MSTATC software and mean data comparison done with Duncan test levels at 1 or 5 percent levels.

**Results and Discussion:** The results of analysis of variance showed that simple effect of manure and fertilizers and their interactions had no significant effect on TSS, but simple effect of fertilizer and their interactions between them had significant effect. The simple effect of chemical fertilizer and its interaction with manure were significant at 1 percent level on titration able pH of fruit juice and the simple effect of manure effect on fruit juice pH were significant at 5 percent level. The simple chemical fertilizer effect on C vitamin was not significant but simple effect of manure and its interaction effect with chemical fertilizer were significant at 5 percent level. The analysis of variance showed that simple effect of chemical fertilizer on fruit juice potassium were not significant, but simple effect of manure and its interaction with chemical fertilizer were significant at 5 percent level. Analysis of variance showed that simple effect of manure and fertilizer on the fruit juice calcium

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was significant at 1 percent level but their interactions were significant at 5 percent level. Simple effect of manure and fertilizer and their interactions on the fruit magnesium, iron manganese, zinc and copper were significant at 1 percent level. Analysis of variance showed that simple effect of manure and fertilizer and their interactions on the fruit juice magnesium, manganese, iron and copper was significant at 1 percent level, but simple effect of manure on fruit juice zinc were significant at 5 percent level.

**Conclusion:** In this study the treatment with combined application of 30 percent and 12 kg manure had highest Ca, Mg, Fe, Mn and zinc concentration in fruit, also combined application of 60 percent fertilizer and 12 kg manure had effect on pH and potassium of fruit juice.

**Keywords:** Chemical fertilizer, Citrus, Fruit quality manure