

The slope of yield loss was 49.02 for each unit of electrical conductivity of nutrient solution and the salt tolerance threshold of this cultivar was less than 2 dS/m based on total fruit yield and biomass.

Conclusion: Overall, based on the findings of this research, the "Aromas" cultivar was strongly influenced by the electrical conductivity of the nutrient solution and its morphological, physiological, biochemical and yield properties changed significantly. Based on the observations, it seems that Aromas cultivar is not able to withstand high electrical conductivity of the nutrient solution and to achieve optimal performance of this cultivar, nutrient solutions with electrical conductivity of less than 2 dS/m should be used.

Keywords: Carbohydrate, Fruit weight, Peroxidase, Proline, Salinity, Small fruit



Changes in yield, vegetative, physiological and biochemical characteristics of strawberry cv. Aromas under effect of electrical conductivity of nutrient solution caused by sodium chloride

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Abstract

Background and Objectives: The most regions of Iran are arid and semi-arid and electrical conductivity of irrigation water in these regions is high and often is salty. The improvement of saline water and soils is costly and time-consuming and it is practically impossible. Therefore, it is necessary to evaluate the tolerance of various plant species and cultivars to salinity for cultivation in these areas. Strawberry is one of the small fruits which has a high demand in the market due to high nutritional value and favorable taste. Strawberry has various cultivars with different yield and sensitivity to stress. Therefore, this research evaluated the sensitivity of "Aromas" cultivar to different levels of electrical conductivity of the nutrient solution.

Materials and Methods: In order to evaluate the effect of different levels of electrical conductivity of nutrient solution on morphological, yield, physiological and biochemical characteristics of "Aromas" cultivar of strawberry, an experiment was performed as pot based on the completely randomized design in the Research Center of Strawberry Breeding and Improvement of the University of Kurdistan. The culture media was cocopeat perlite with equal ratio and the nutrient solution was modified Hoagland. Different levels of electrical conductivity of a nutrient solution (0.7, 2, 3, 4 and 5 dS/m) were prepared by adding sodium chloride. Frozen leaf samples were used for physiological and biochemical evaluations. Then, at the end of the experiment period, the functional characteristics of plants were measured and the obtained data were analyzed by SAS software and mean comparison was done by the LSD method.

Results: The results of variance analysis showed that the electrical conductivity of the nutrient solution had a significant effect on all of the measured traits. The highest mean number of leaf, leaf area, leaf dry weight, root volume, root dry weight, number of crown, crown dry weight, dry weight of whole plant, number of fruit, single fruit weight and total fruit yield belonged to control plants (irrigated with nutrient solution with electrical conductivity of 0.7 dS/m) and with increasing electrical conductivity of nutrient solution, the amount of mentioned factors decreased. Moreover, the highest relative water content of leaf, membrane stability index, total soluble proteins, chlorophyll, carotenoids and potassium of leaf belonged to 0.7 dS/m treatment. While the highest total soluble carbohydrates, proline, hydrogen peroxide, the activity of peroxidase and superoxide dismutase enzymes, malondialdehyde and sodium of leaf were observed in plants that received a nutrient solution with electrical conductivity of 5 dS/m.

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the highest sulfur and silicon concentrations in S_0Si_2 . The application of $S_{15}Si_4$ treatment also resulted in the highest amounts of magnesium production, which was at a statistical level with S_0Si_4 , $S_{15}Si_0$ and $S_{30}Si_2$ treatments. The highest level of antioxidant activity was related to $S_{15}Si_2$ treatment. Also, the highest total phenol was obtained by S_0Si_2 treatment. Maximum content of total flavonoid was observed in $S_{30}Si_2$ treatment. The highest amount of caffeic acid was obtained in S_0Si_0 , $S_{15}Si_0$ and $S_{30}Si_0$ treatments with 20.9, 20.2 and 20.2 mg/kg dry weight, respectively; which had no significant difference with S_0Si_4 and $S_{30}Si_2$ treatments.

Conclusion: Application of sulfur ($S_{15}Si_0$) has been successful in most of the indicators related to yield and yield components. The treatment was also favorable for carbon dioxide absorption, total flavonoid and caffeic acid. Therefore, it can be advisable in general that balanced sulfur nutrition alone can, to a large extent, respond to the quantitative and qualitative growth of the garlic product. At least in non-stress conditions, there is little need to feed the silicon to garlic.

Keywords: Antioxidants, Caffeic acid, Flavonoid, Garlic, Silicon, Sulfur



Investigating the effect of sulfur and silicon on some morphological and phytochemical properties of garlic

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Abstract

Background and Objectives: Garlic is one of the excellent medicinal plants, used thousands of years ago. In addition to essential oils and valuable secondary metabolites, this plant contains elements such as sulfur and silicon. These elements, in addition to creating favorable drug properties, cause the plant to resist biological and non-biological stresses. Therefore, the use of these elements can have beneficial effects on the yield and medicinal properties of this plant. In the present study, the effect of sulfur and silicon on yield, yield components, photosynthetic parameters, nutritional elements and some phytochemical parameters of garlic plant were investigated.

Materials and Methods: This experiment was conducted as factorial based on randomized complete blocks design with two factors of sulfur (at three levels of zero (S_0), 15 (S_{15}) and 30 (S_{30}) liters per hectare) and silicon (at three levels of zero (Si_0), 2 (Si_2) and 4 (Si_4) liters per hectare) with three replications. The treatments were applied as fertigation with intervals of 7-day, three times. At the end of experiment, traits such as yield, single garlic bulb weight, clove weight, length and width of bulb and clove, number of cloves, photosynthetic parameters (includes percentage of leaf relative humidity, transpiration velocity, stomatal conductance, stomatal conductance versus water vapor, carbon dioxide uptake ratio, photosynthetic active radiation of below and above the leaf, and photosynthetic active radiation of the environment) were recorded. Also, phytochemical properties (including antioxidant activity, total phenol, total flavonoid and caffeic acid) were evaluated. Data analysis was performed using SAS software and mean comparisons were done through Duncan's multiple range test at 1 and 5 percent probability level.

Results: The results showed that the use of fertilizer treatments (sulfur and silicon) in comparison to control (non-fertilizer application) increased in all studied traits. Application of $S_{15}Si_0$ treatment had a superiority in evaluating yield and yield components, or didn't show significant differences with treatments having higher sulfur and silicon content. The highest amount of photosynthetic active radiation of the below the leaf, environment and above the leaf were obtained in $S_{15}Si_4$ treatment. The rate of carbon dioxide absorption in the $S_{15}Si_0$ treatment was highest, and at the same level with $S_{30}Si_2$, statistically. The highest rate of transpiration was achieved with application of $S_{30}Si_2$ treatment. Also, the use of $S_{30}Si_4$ treatment increased the amount of water vapor and relative humidity of the plant. In the case of nutrition elements, it can be concluded that the highest amount of nitrogen were obtained from $S_{30}Si_2$ treatment, the highest amount of phosphorus, potassium and calcium were obtained from S_0Si_4 treatment and

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compared to control treatment. The highest amount of malondialdehyde ($2.5 \mu \text{ mol g}^{-1} \text{ DW}$) in salinity treatment, 15 (dS/m) No application of zinc sulfate in the rootstock of Badami Zarand, all treatments were observed.

Conclusion: The results indicated a positive effect of zinc on increasing plant resistance and better control of free radicals in salinity stress particularly at levels of 10 and 15 (dS/m). The rootstock texture of Qazvin compared to the Badami Zarand has a higher concentrations of sulfohedril groups (Badami zarand 113.33%, Qazvini 191.83%). And the ionic leakage is lower (Zarand $15.87 \mu \text{g.g}^{-1} \text{ root 4h}^{-1}$, Qazvini, $4.61 \mu \text{g.g}^{-1} \text{ root 4h}^{-1}$). Accordingly, Qazvini rootstock is more stable than the Badami Zarand rootstock because it has the highest level of malondialdehyde in leaves, it is more resistant to sodium chloride stress and Qazvini rootstock can be introduced to the salt stress according to the climatic conditions of each region as a stable base.

Keywords: Salinity stress, Sodium chloride, Zinc



Effect of interaction of zinc sulfate treatment and sodium chloride oxidative stress on two rootstock of Qazvini and Badami Zarand Pistachio

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Abstract

Background and Objectives: Soil salinity due to sodium chloride is one of the problems in pistachios in the country and this problem with the shortage of water supplies is intensifying. In this case using the resistant rootstock and proper nutrition plays an important role. The role of nutrition with zinc compounds in reducing oxidative damage in salinity stress in plants is not clearly understood. The nutritional effects of zinc containing compounds on the growth rate of some Plant species exposed to salinity are reported by various researchers. But little information is available on its effect on the various characteristics of pistachio rootstocks. The present study aimed to investigate the effect of zinc sulfate treatment on some physiological, biochemical and pistachio growth factors under salinity stress and its goal is to reduce the harmful effects of salinity stress in the soil.

Materials and Methods: The experiment was conducted as a factorial with three replications in the Research greenhouse of the park organization of Qom municipality in 2017-2018. Number of 1512 pistachio seeds of Badami Zarand and Qazvini from Pistachio Research Institute of Iran were prepared and germinated. For accurate monitoring, Nutrition with zinc sulfate on seedlings was fed with Hooglund's 50 percent solution in greenhouse conditions and hydroponic culture until it reached height and growth. Grown seedlings were exposed to four levels of salinity including zero (control), five, 10, 15 (ds/m) sodium chloride and three levels of zinc sulfate from the source of $ZnSO_4 \cdot 7H_2O$ containing zero (control), one and five mM. The seedlings were transferred to Bu-Ali Sina University's Department of Horticulture. Seedlings height, leaf fresh weight, calcium molar fraction in root, root sulfohydryl groups, root membrane permeability, zinc ion leakage and malondialdehyde levels in leaf were evaluated.

Results: Increased sodium chloride concentration up to 15 (ds/m) No application of zinc sulfate Reduced traits of seedlings height (Badami Zarand, 64.2%, Qazvini 53.3%), The fresh weight of leaf (Badami Zarand 64.7%, Qazvini 55.5%), Fraction of calcium molar in the root (Badami Zarand 54.5%, Qazvini 50%), and roots of sulfohydryl root (Badami Zarand 29.6%, Qazvini 14.3%) compared to control treatment. With increasing salinity levels up to 15 dS/m permeability of root membrane, zinc Ion leakage and the level of malondialdehyde increased in the leaf. The consumption of zinc sulfate increases the fresh weight of the leaf, seedlings height, calcium molar fraction in the root and concentration of sulfohydryl groups in the roots. The application of zinc sulfate resulted in the lowest permeability of root membrane among all treatments in Qazvin (53%). The interaction of zinc sulfate treatment 1 mM and salinity stress of five (ds/m) would reduce zinc ion leakage (Badami Zarand 14.3%, Qazvini 2.2%)

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appropriate plan, we can reduce the water use from 181.52 mm (control) to 44.59 mm (5 bar) during the vegetative stage and 159.23 mm to 41.40 mm for reproductive stage. Overall because of moderate tolerance of *Verbascum* toward water stress, this ornamental-medicinal plant could be recommended as a new plant to landscape design in order to optimize the efficiency of irrigation management.

Keywords: Antioxidant enzymes, Growth stages, Landscape design, *Verbascum thapsus*, Water deficient stress



Evaluation of tolerance of *Verbascum thapsus* toward water stress in order to introduce it as a water stress ornamental plant in landscape

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Abstract

Background and Objectives: Due to the lack of water in different regions of Iran, the introduction and use of indigenous species with valuable ornamental features such as mullein like other ornamental plants, can be affected by water stress in the green space. Drought is an environmental stress that induces adverse effects on most stages of growth, structure and activities of plants. The response of plants to environmental stresses is different in morphological, cellular and molecular levels. Therefore, the present study was conducted to investigate the effect of water stress on morphological, physiological and biochemical characteristics of *V. thapsus* during two stages of vegetative and reproductive growth.

Materials and Methods: In the present study, the reaction of *V. thapsus* to drought stress and its effect on vegetative and reproductive stages were investigated. The experiment was carried out as factorial in a completely randomized design with two factors as water stress in 5 levels (control (0.3), 2, 5, 10 and 15 bar) and plant growth stages at two levels (vegetative and reproductive). For this purpose, shoot and root fresh weight, burn and wilt condition, leaf chlorophyll, activity of antioxidant enzymes and proline were measured.

Results: The highest and lowest irrigation interval in both vegetative and reproductive stages was respectively found in 15 bar and control. The water volume used in vegetative stage was higher than reproductive stage. Shoot and root fresh weight in vegetative stage was more than reproductive stage. The highest fresh weight of shoots was reported under blue tension in control and 2 bar and the lowest amount was observed in 15 bar, but the highest root fresh weight was observed in 5 bar. The highest percentage of leaf burns and wilt was observed in treatment of 15 bar × reproductive stage and its lowest in the treatments of control × vegetative stage and control × reproductive stage. Total chlorophyll in reproductive stage was more than vegetative stage. Also, the highest total chlorophyll was observed under water stress in control and 2 bar and the lowest was found in 15 bar. The highest activity of superoxide dismutase and catalase was observed in 15 bar × reproductive stage and its lowest value was recorded in control × vegetative stage. Proline in reproductive stage was greater than the vegetative stage. The highest and lowest amount of proline was observed in 15 bar and control, respectively.

Conclusion: The results of the research showed that the water stress up to 5 bar did not cause significant changes in the plant, but increasing the intensity of water stress from 5 bar to 10 bar induces the significant change of most traits in the plant. Therefore, with applying an

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Conclusion: The overall results of this study showed that there is a great diversity among the studied populations based on morphological and functional traits. According to the results of D, E, MS, SH, SP, and TF populations, they have desirable traits and proper yields and were identified as the most desirable populations in this research, which indicates high genetic potential among different populations and which can be considered as superior populations in breeding projects in order to create high quality and desirable food industries and the medicine was used.

Keywords: Cluster analysis, *Glycyrrhiza glabra* L., Morphological diversity, Principle coordinate analysis



A survey of genetic diversity of Iranian *Glycyrrhiza glabra* L. some populations using morphological and phytochemical characteristics

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Abstract

Background and Objectives: The licorice is a perennial herb of the Fabaceae family, which is native to the Mediterranean, south of Russia and Asia, but is now cultivated throughout Europe, the Middle East and Asia. This plant grows in different regions of Iran. Although, from north to south of Iran, licorice carcasses come to the car, but since this plant is extracted from the ground, it gradually decreases in nature, so that in southern provinces of the country, especially the provinces of Fars and Kerman, this plant danger of extinction, so special attention is increasingly given to maintaining the heritable reserves of this plant more and more. Quantitative and qualitative study of this plant in the natural habitats of different regions of the country has a significant role in identifying the best ecotypes for cultivation and domestication of this medicinal plant.

Materials and Methods: In order to study the diversity of morphological and functional traits of different populations in Zanjan climate, after collecting populations in autumn, they were cultivated in a randomized complete blocks design with 5 replications. Morphological and functional traits of different populations were evaluated late in the growing season. Plant height, plant width, leaf length, leaf width, leaf number, leaf length, leaflet width, lateral branch, main stem diameter, fresh shoot weight, root fresh weight, shoot dry weight and root dry weight, ratio Root to shoot, shoots yield, root yield, total phenol, total flavonoid and Glycyrrhizic acid were investigated. Data were analyzed using SAS and SPSS software. For cluster analysis, the cluster analysis was performed by input method and factor analysis was done using the Variomax rotation method.

Results: The results of analysis of variance showed that there was a significant difference among 22 licorice populations for all studied traits at 1% level. The highest plant height in population AH (9 cm) was the highest plant width in population E (86.6 cm), the highest fresh weight in the population D (400.4 gr/plant), the highest root fresh weight in population E (356.2 gr/Plant) had the highest shoots yield in the population D (643.75 gr/m²) and the highest root yield in population E (692.25 gr/m²) and the highest percentage of Glycyrrhizic acid in population D (8.3%). The root yield was significantly correlated with plant height, plant height, main stem diameter, leaflet length, lateral branch number, fresh weight of shoot, root fresh weight, dry shoot weight, root dry weight, shoot yield, total phenol, total flavonoid and glycyrrhizic acid. There was a positive and significant correlation between dry weight ratio of root and shoot in 5% probability level, but no significant correlation was observed between leaf length, leaf width, leaf number and leaf width. Based on the results of cluster analysis, 22 populations were divided into four main groups. Factor analysis showed that the first four factors were able to justify 84.184 percent of the total variance.

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Effect of bacterial inoculation on grain of linseed (*Linum usitatissimum* L.) and soil nutrient elements under different irrigation levels

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Abstract

Background and Objectives: Oil of linseed are used in various industries. Drought is one of the factors that reduces the crop production in most part of the world. These days several techniques are used in order to increasing plants tolerance to drought. One of these methods is seed pretreatment with plant growth promoting bacteria. These bacteria through mechanisms such as phosphate and potassium dissolution, nitrogen fixation, production of siderophore and growth regulators, production of hydrolytic enzymes and exopolysaccharides increase tolerance and yield of crops under stressful conditions. Since water deficit is one of the main limiting factor of production in Iran and the use of chemical fertilizers caused much environmental pollution, so this study was conducted to investigate the effect of bio fertilizers as plant growth promoting bacteria on linseed under water deficit condition.

Materials and Methods: This study was carried out in split plot experiment based on randomized complete blocks design with three replications in 2015 at the research farm of Shahrekord university. Factors were irrigation in three levels (full irrigation, 75 and 50 percentage of full irrigation) and bacteria in seven levels (control, *Bacillus* sp strain1, *Bacillus* sp strain2, *Bacillus amyloliquefaciens*, *Azotobacter Chroococcum*, *Pseudomonas putida* and *Azospirillum lipoferum*). Applying of stress began from stem elongation. In ripening stage, grain yield and amount of P, Fe and Zn nutrients in grain were measured. After crop harvesting EC, pH, P, Fe and Zn of soil also were measured. Analysis of variance and correlation between traits used by SAS software, means comparison by LSD and interaction were carried out by slicing.

Results: Interaction of irrigation and bacterial inoculation on grain yield, P percentage and concentrations of Fe and Zn in grain and soil EC were significant. Bacterial treatments in three irrigation levels showed the highest grain yield, P percentage in grain, concentrations of Fe and Zn in grain and soil EC while control treatments showed the lowest amount. Amount of nutrients in soil increased by increasing stress levels. Also, bacterial treatments had the lowest nutrients of soil in comparison with control treatment. Among bacterial treatments *Bacillus* sp strain1, *Bacillus amyloliquefaciens* and *Azotobacter Chroococcum* were more effective while *Azospirillum lipoferum* was not. Significant negative correlation between P percentage in grain and concentrations of Fe and Zn in grain with concentrations of P, Fe and Zn in soil was observed.

Conclusion: The use of plant growth promoting bacteria by increasing nutrients absorption from soil can increase grain yield. In fact, growth promoting bacteria by absorbing soil nutrients and contributing their absorption by plant may reduce the amount of soil nutrients.

Keywords: Microorganisms, Nutrient Elements, Oil, PGPR, Production

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Prediction of climate change effects on vegetable production and yield in Hormozgan Province (Case study: Onion and tomato)

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Abstract

Background and Objectives: The agriculture section as a subsection of our economy receives the most impact under the climate fluctuations. Climate change is an unsustainable factor affecting the yield of agricultural crops. Therefore, recognition of climate parameters and their effect on crops is one of the most important factors in increasing yield. Vegetable production globally, as a wage-earning profession, is very effective in improving the general public's economy. The inadequate use of potential climatic facilities causes the destruction of natural resources and the wasting of the national capital. The purpose of this study was to evaluate the yield and production of onion and tomato products due to climate change and its prediction for 2025-2100 in Hormozgan Province.

Materials and Methods: In order to more accurately estimate the function of the reaction of the yield of horticultural products to the climatic components, the climatic indices of Hormozgan province were divided into two climatic regions. Region (1) includes Minab, Hajiabad, Rudan and region (2) includes Bandarlenghe, Band-Abbas, Qeshm and Jask. The yield function of two products, onion and tomato, in the two regions under study was estimated using panel data and Eviews software. Then, using the weather forecasting scenarios, the yield and production of vegetables (onion and tomato) for the years 2025 to 2100 were predicted. Agricultural and climatic data were collected during the years 2003-2017.

Results: Results showed that the temperature has an opposite effect and rainfall and humidity has a direct effect on the yield of onion and tomato. The most important factor affecting onion production in both regions is the temperature. On the tomato production, the humidity factor in the region (1) and the factor of temperature and humidity in the region (2) are almost the same in terms of effect level. The difference is that the temperature has a negative effect and the humidity has a positive effect on the performance. The negative effect of temperature on the onion yield was higher than that of tomato. The negative effect of temperature on onion production in the region (2) has a higher intensity than the region (1). Performance prediction up to 2100 showed that yield of onion reduce more than yield of tomato. The yield reduction in the region (2) is higher than the region (1). In contrast, the tomato production in the region (1) is higher than the region (2). According to the decline in the yield of two products, the production cuts for both products has been predicted in both regions until the year 2100.

Conclusion: According to the negative effects of climate change on the products under study, we should provide solutions to avoid the harmful effects and to adapt to the climatic conditions. This includes changing the region's cultivation pattern, managing optimal resources and producing climate change resistant seeds. Therefore, it can be concluded that the region (1) has a comparative advantage in the production of onion and the region (2) in the production of tomato.

Keywords: Climate factors, Climate prediction scenario, Functional reaction function, Panel Data

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Effect of salicylic acid application on some growth traits of lemon verbena (*Lippia citriodora*) under salinity stress

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Abstract

Background and Objectives: The *citriodora Lippia* is a shrub of the Verbenaceae family which cultivated in many countries due to its high economic importance. The leaves of this plant as usable part of the plant have essential oils and very valuable compounds that are used as a herbal tea. One of the problems in Iran's soils is the presence of salt stress, which is one of the major limiting factors for agricultural production. Due to the economic significance of Lemon verbena, and the salinity problem that could restrict the cultivation of this plant, this study was conducted.

Materials and Methods: In this study, the effect of different concentrations of salicylic acid on salinity tolerance of Lemon verbena were investigated. Factors included salinity in four levels (0, 50, 100 and 150 mM sodium chloride) and salicylic acid at three levels (0, 0.5, 1 mM) with 3 replications. Parameters of leaf dry weight, stem height, leaf relative water content, ion leakage, chlorophyll content, total carbohydrate, proline, antioxidant enzymes and essential oil percentage were measured in plants.

Results: The results showed that salinity effect on all parameters was significant except for the relative water content of leaves. The effect of salicylic acid on all parameters except leaf dry weight, leaf relative water content and activity of peroxidase enzyme was significant. In salinity stress conditions, leaf dry weight, stem height, chlorophyll content decreased significantly. The percentage of weight loss of dry leaf in treatments 50, 100 and 150 mM was 10.36, 24.4 and 30.12%, respectively. The highest amount of proline, carbohydrate, antioxidant enzymes and ion leakage was observed in severe stress treatments. So that the highest ion leakage (78.77%) belonged to salinity 150 mM and the lowest amount (52.55%) was obtained in no salinity conditions. Application of salicylic acid increased stem height, activity of antioxidant enzymes, chlorophyll, carbohydrate, proline and essential oil percentage. The concentration of 1 mM salicylic acid significantly increased stem height, soluble sugars, chlorophyll content and proline and reduced the amount of ion leakage of seedlings in Lemon verbena compared to non-foliar application. The highest activity of catalase (95.09 u / mg.fw⁻¹) and peroxidase (26.47 u / mg.fw⁻¹) was observed in salinity of 150 mM and concentration of 1 mM salicylic acid. In terms of essential oil content, the results showed that with increasing salinity up to 100 mM, the percentage of essential oil increased.

Conclusion: In general, salicylic acid spraying, especially concentration of 1 mM, could reduce the effect of salinity stress on Lemon verbena seedlings.

Keywords: Antioxidant enzymes, Electrolyte leakage, Lemon Verbena, Proline

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Chemical weed control in foxtail millet (*Setaria italica* L.)

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Abstract

Background and Objectives: Foxtail millet (*Setaria italica* L.) is cultivated world wide for human and animal consumption. Because of drought and salt tolerance, millets can be cultivated in the areas affected by drought and salt stress conditions in the country. Weeds are the major obstacles in increasing the productivity of millets. Since now, there has been no remarkable research and suitable herbicides available for weed control in foxtail millet fields during the post-emergence stage. In the present study, we investigated the efficacy of some herbicides on weeds grown in the field and their safety on foxtail millet simultaneously.

Materials and Methods: A field study was conducted to evaluate the efficacy of herbicides for weed control in foxtail millet (*Setaria italica* L.) in Agricultural and Natural Resources Research and Education Center of Khorasan Razavi Province, in Mashhad in 2012 growing season. The experiment was conducted in a completely randomized blocks design with four replications. Treatments were consisted of the post emergence application of dual purpose herbicides including: metsulfuron-methyl+ sulfosulfuron (Total[®] WG) 32 g active ingredient (a i) ha⁻¹, sulfosulfuron (Apirus[®] WG) 19.95 g a i ha⁻¹, oxadiazon (Ronstar[®] SC) 1000 g a i ha⁻¹, mesosulfuron+ idosulfuron (Atlantis[®] OD) 18 g a i ha⁻¹, isoprotron+ diflophenican (Panther[®] SC) 1100 g a i ha⁻¹, anilofus+ ethoxysulfuron (Sunrice Plus[®] EC) 945 g a i ha⁻¹, oxadiargyl (Topstar[®] 30 EC) 1200 g a i ha⁻¹, and grass killers including: fenoxaprop-p-ethyl (Puma Super[®]) 55.2 g a i ha⁻¹, diclofop-methyl (Illoxan[®] EC) 867.5 g a i ha⁻¹, pinoxaden (Axial[®] 100 EC) 150 g a i ha⁻¹, clodinafop (Topik[®] 240 EC) 192 g a i ha⁻¹, pinoxaden+ clodinafop (Traxos[®] EC) 300 g a i ha⁻¹ plus hand weeding and weedy checks.

Results: Results showed *Amaranthus retroflexus* (L.) *Chenopodium album* (L.), *Portulaca oleracea* (L.) were dominant broadleaved weed species and *Echinochloa crus-galli* (L.) P.Beauv. and *Setaria viridis* (L.) P.Beauv. were dominant narrowleaved weed species in the field. Density and dry matter of dominant weed species were significantly decreased by dual purpose and grass killer herbicides. Because of severe damage on foxtail millet, application of fenoxaprop-p-ethyl, diclofop-methyl, pinoxaden, clodinafop, pinoxaden+ clodinafop, metsulfuron-methyl+ sulfosulfuron, sulfosulfuron, mesosulfuron+ idosulfuron are not recommended to be used for weed control in foxtail millet fields.

Conclusion: Application of oxadiargyl, oxadiazon, isoprotron+ diflophenican, and anilofus+ ethoxysulfuron showed suitable weed control and caused no adverse effect on biological and grain yield of foxtail millet and therefore can be recommended to be used for weed control in foxtail millet fields.

Keywords: Crop injury, Herbicides, Oxadiargyl, Oxadiazon, Yield loss

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was observed between the genotypes of tea, but this diversity was not such as to be able to disrupt the genotypes of different regions. It seems that this separation could be achieved by increasing the number of primer combinations and using other markers such as SSR and SNP. Also, the results of this study showed that Iranian tea genotypes have high genetic variation because they are mostly reproduced sexually.

Keywords: *Camelia*, Cluster Analysis, Genetic diversity, Polymorphic Information Content (PIC), Primer



Usage of morphological and ISSR markers for investigation of Tea genotypes

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Abstract

Background and Objectives: Tea (*Camellia sinensis* (L.) O. Kuntze) is one of the most important crops in north of Iran. Today, many tea plants are being destroyed for various reasons, so having information about their genetics is helpful in designing breeding programs to reach appropriate plants for specific purposes. Therefore, in this research, the genetic diversity of some tea genotypes were identified in major cultivation regions of this crop in north of Iran with comparison by eight imported clones.

Materials and Methods: In this study genetic diversity of 42 tea plants were investigated by using of two morphological and ISSR markers. Morphological study was performed by descriptor that registered form for tea and 31 traits were checked out. After selecting young and well expanded leaves, their genomic DNA were extracted and 10 ISSR primer were used for investigation of genetic relationships between 42 tea genotypes. Collected data was analyzed by Euclidean distances for morphological markers and SM similarity coefficient for ISSR and clusters were designed based on UPGMA algorithm. PCA analyzed were done by SPSS.

Results: Comparative analysis on 31 morphological characteristics in tea genotypes and clone showed moderate variations and showed a narrow range. In cluster analysis at a difference of 6.6, the samples were divided into six groups; the main group consisted of the sixth group, which contained 88% of the samples. The results of PCA on morphological characters showed that the first, five principal components accounted for 54.21% of the total variance. Ten ISSR primers yielded a total of 92 scorable fragments that could be scored, of which 72 were polymorphic, with an average of 78.26%. The PIC analysis showed ranging from 0.43 to 0.50. cophenetic test showed that SM similarity coefficient and UPGMA algorithm was the best for cluster analyses. According to ISSR data calculated similarity were range between 0.28- 0.93. In cluster analyses, samples at similarity 0.55 divided to four group that fourth group was the main created group and covered 66.66% of samples. The results of PCA on ISSR data showed that the first, five principal components accounted for 72.98% of the total variance.

Conclusion: A significant variability was observed in the selected tea genotypes at morphological and molecular levels. Morphological study showed that distribution of tea plant in the past, although based on desirable characteristics, but due to the limited initial source of this plant, there is little variation among the genotypes of the regions. In relation to the ISSR marker, the polymorphism percentage and polymorphic information content from the primers used in this study indicate the ability of these markers to differentiate the tea genotypes. From these results it could be understood that these series of characters and primers can distinguish genetic differences very well. Using these markers, genetic variation

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The nutritional evaluation of almond gardens using diagnostic recommendation integrated system (DRIS) method in Chaharmahal Va Bakhtiari Province

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Abstract

Background and Objectives: Almond is one of the most important orchards products of Chaharmahal va Bakhtiari Province that the most production is in saman area. The objective of this research was nutritional evaluation of almond gardens using DRIS (Diagnostic Recommendation Integrated System) method. Accurate and balance nutrition of almond are the important factors that improve quality and quantity of yield. Regarding sand texture of soil in almond gardens of region and around average of rainfall, leaching of nutrients around the root, is one of orchards problem in this province. Proper management of fertilizers is one of the factors that can increase the quantity and quality of almond fruit be effective. So, the aim of study was the nutritional evaluation of almond gardens using diagnostic recommendation integrated system (DRIS) method in Saman area of Chaharmahal Va Bakhtiari Province.

Materials and Methods: In order to evaluation of almond nutritional requirements an experiment was conducted using of Diagnostic Recommendation Integrated System (DRIS) method in the gardens of zayandeh roud river in a length of 60 kilometers and a data bank was provided. In current research 36 gardens were selected and the leaf samples were prepared. The selected leaf samples were washed and grinded for laboratory analysis. The high yield gardens were selected for preparing reference values at the end of growth season and in this case 30 percents of high yield gardens were chooses. The Diagnostic Recommendation Integrated System (DRIS) indexes were estimated and the nutritional requirement orders were determined.

Results: The results showed that the order of nutritional requirements of the trees were in the following order: Zn>CU>Mn>S>Cl>Ca>B>N>P>Fe>Mg>K>Mo. According to the results, zinc has the most deficiency in almond trees studied. Then there are copper, manganese, sulfur, chlorine, calcium, boron, nitrogen, phosphorus, iron, magnesium and potassium elements, respectively. In other words, the highest amount was obtained for molybdenum, potassium, magnesium, iron, phosphorus, nitrogen, boron, calcium, chlorine, manganese, copper and zinc respectively.

Conclusion: According to the results of the DRIS method and the balance index, the almond gardens studied were not balanced in terms of nutritional status in this study. Among nutrients, micronutrients are scarce due to less use of fertilizers containing it and factors such as steep slope, lightness of soil texture and calcareous of them. So, it is necessary to consider and apply necessary measures in order to nutrition needs of almond trees in this area. These actions include: the application of animal fertilizers, the use of a variety of micro-nutrient fertilizers, the use of acidic substances with irrigation water, preferably drip irrigation to improve the calcareous properties of soils and consequently, to increase the absorption capacity of micronutrients. Finally, it can be said that the DRIS method is an effective method for determining the nutritional needs of almond gardens in these areas and is applicable.

Keywords: Almond, DRIS, Nutritional balance

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Study of morphological variation of some olive genotypes of Gorgan region

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Abstract

Background and Objectives: Local genotypes and wild species are regarded as national genetic resources of plants in each country and much effort should be made to preserve and prevent their extinction. Given that Iran is one of the origin area of olive in the world, identifying and protecting the olive resources, identifying the old orchards and organizing the genotypes have special importance. So, this study was conducted to investigate the morphological variation of some olive genotypes of Gorgan region.

Materials and Methods: In this study, 32 genotypes were evaluated using morphological markers according to the standard methods of the International Olive Council, which was approved by the Seed and Plant Registration and Certification Institute. This method comprises 33 morphological traits for leaf, stone and fruit. Of these, 11 quantitative traits and 22 qualitative attributes were studied. Quantitative traits were determined in 30 fruits and stones and 15 leaves. The cluster analysis, grouping and factor analysis and principle component analysis were performed.

Results: The results showed that there were some significant differences at 0.1% probability level among the genotypes studied in terms of fruit weight, fruit length, fruit diameter, fruit length to diameter ratio and flesh percentage and stone weight, stone length, stone diameter and stone length to diameter ratio. The highest fruit weight was observed in genotype I7 (3.88 g). The highest fruit lengths were in genotypes B13 (25.28 mm) and F1 (25.15 mm). The highest fruit diameter was in genotype I7 (16.48 mm). Also, the highest stone weight was seen in genotypes G4 (0.95 g) and the highest stone length was related to F1 (21.55 mm). The genotype F12 had the highest leaf length (65.66 mm), but did not have any significant difference with genotype D2, F9, D10, A12 and A10. The genotype F12 had the highest leaf width (14.77 mm). In evaluating the qualitative traits of fruit, most genotypes had symmetrical shape and about one third of genotypes were partly symmetric, while there was not seen any asymmetric shape among genotypes. Correlation analysis showed that there is a significant correlation between the majorities of measured traits. According to the results, the highest correlation was observed between stone weight and stone diameter ($r = 0.86$). In cluster analysis, 32 genotypes were divided into six main clusters in the distance of 0.68. Based on the factor analysis, the data of this study have four main factors, in which justified about 91% of the total variance. Analysis of the principle component confirmed the existence of high morphological variability among the genotypes.

Conclusion: According to the results of this study, there was a highly genetic diversity among olive genotypes located in Hashemabad Gorgan, therefore they could be promising genotypes in propagation programs, breeding, and development of olive commercial orchards and cultivar selection in Golestan province.

Keywords: Cluster analysis, Factor analysis, Morphological markers, Olive, Principal component Analysis

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on GF677 respectively. In all grafted and non-grafted plant, by increase in the salinity levels up to 4 dS.m⁻¹, the amount of phenol was increased and reached to their maximum level, but farther increase in the salinity level (up to 8 dS.m⁻¹) significantly reduced their phenol content.

Conclusion: Based on the results, it can be concluded that among the rootstock/scion compositions and the studied rootstocks, Shahrood 12 cultivar grafted on GF677 rootstock was the most susceptible compound to salinity stress and the same cultivar, which was grafted to the Bitter Almond Seedling, was the most sensitive combination.

Keywords: Carbohydrate, Genotype, Malondialdehyde, Phenol, Protein, Salinity



Effect of base type on morphological and biochemical traits of salt stress tolerance in almond cultivar Shahroud-12

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Abstract

Background and Objectives: Salt stress is one of the serious threat to agricultural productivity. Salinity stress can affect the morphological and biochemical properties of plants. Several studies have shown that the tolerance threshold for most of the stone fruits, including almond, is low in salinity stress, so that in salinity of 2.8, 4.1 and 7 dS/m, respectively, 25, 50 and 100 percent of its yield decreases. In almond, as with other fruit trees, the choice of tolerant rootstock and scions is a very suitable strategy to reduce the effects of salinity, especially in the arid areas. The aim of this study was to investigate the morphological and biochemical characteristics of several rootstock and scions compositions in comparison with the without rootstocks to find the most tolerance rootstock and scions combination in comparison with the without rootstocks to salinity stress.

Materials and Methods: In this research, the effects of salinity stress on the biochemical properties of almond (Shahroud 12) grafted on some of the *prnns* rootstocks (Bitter Almond Seedling, Tetra, GF677 and GN15) and non-grafted rootstocks under salt stress. Experiment was carried out in a factorial experiment based on a completely randomized design with two factors including 8 levels of rootstocks and rootstock and scion compositions (non-grafted rootstocks including Bitter almond, Tetra, GF677 and GN15 and grafted Shahroud 12 on these 4 rootstocks) and 5 levels of salinity (0.3, 2, 4, 6 and 8 dS.m⁻¹) were performed in three replications in the greenhouse of institute of horticulture of Karaj.

Results: The results showed that by increase in the salinity level from 0.3 to 8 dS.m⁻¹, the amount of necrosis and leaves falling were increased. At the salinity level of 8 dS.m⁻¹, the lowest (2.66%) and the highest (7.66%) of necrosis was observed in Shahroud 12 grafted on GF677 and Shahroud 12 graft on Tetra, respectively. Maximum (10.3%) and minimum (2.25%) of leaves falling at salinity level of 8 dS.m⁻¹ was observed in Shahroud 12 graft on Tetra and non-grafted bitter almond, respectively. The results also showed that biochemical traits were affected by salinity stress, so that the highest amount of proline (67.91 μmol.g⁻¹ fresh weight) was obtained in Shahroud 12 grafted on GF677 at 8 dS.m⁻¹ salinity, which was significantly different with other rootstock/scion composition (almond shahroud 12 on other rootstocks) and the studied rootstocks. With increasing salinity from 0.3 to 8 ds.m⁻¹, the highest (112%) and lowest (41.6%) aldehyde was observed in the Bitter Almond Seedling and shahroud 12 grafted

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The effect of different nutritional systems on yield and yield components of sesame (*Sesamum indicum* L.) in competition and non-competition with weeds

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Abstract

Background and Objectives: Sustainable agriculture, with respecting ecological principles, can increase the efficiency of resources use and provide a longer-term benefit to humans, while providing a balance in the environment. The application of organic fertilizers with a view of replacing or significantly reducing the use of chemical fertilizers increases the quality and quantity of plants yield. Sesame is one of the most important oily and pharmaceutic seeds in agricultural areas, which is due to its high oil and protein content and antioxidant content in food, food supplements, medicine and industry. Therefore, this study was conducted to evaluate the various organic and biological nutrient systems on yield and yield components of sesame under competition and non-competition with weeds.

Materials and Methods: This experiment was conducted as a split plot in a randomized complete blocks design in three replications in Sari Agricultural Sciences and Natural Resources University in 2015. The treatments consisted of: competition between plants and weeds (weedy and weed free) as a main factor, and sub factor was fertilizer sources include sheep manure, pigeon manure, vermicompost fertilizer, bio-fertilizer (Nytrukara), sheep manure + biofertilizers, pigeon manure + biofertilizers, vermicompost + biofertilizer, urea fertilizer and control (no fertilizer). The studied traits included yield and yield components of sesame, weed density and weed biomass and competitive indices.

Results: The results showed that the highest yield per unit area (2992 kg ha⁻¹) was observed in the integrated treatment of sheep manure and Nytrvkara and the maximum harvest index (44 percent) was in integrated treatment of vermicompost and Nytrvkara in weed free condition, while, the lowest ones was at control in weed infestation. Also, nitrogen sources showed significant differences in weed density and biomass compared to control. In examining the ability to withstand competition (AWC), the results showed that the ability to compete with weeds tolerant, pigeon manure treatment had the highest ability to compete with weeds, while, after a pigeon manure, integrated managements enhance performance, as well as increased competitiveness.

Conclusion: Finally, based on the results of this study, it can concluded that the combined use of fertilizers, with increasing sesame growth and no environmental side effect, reduces dry weight of weeds, reduces weed damage and also reduces the use of herbicides. So, it is a suitable method for the healthy and sustainable production of these products.

Keywords: Biofertilizer, Competitive stress, Fertilizers organic, Sesame

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Conclusion: According to the results, it can be concluded that the combination of three rows of onions with chamomile and ajwain, having the proper density of each plant, provides better use of plants from environmental resources and improves the attraction of insects, improves pollination of onions flower and increase the yield of all three plants.

Keywords: Biodiversity, Insects, Medicinal plants, Pollination



Onion (*Allium cepa* L.) seed yield improvement by intercropping with ajwain (*Carum copticum* Heirn) and chamomile (*Matricaria chamomilla* L.)

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Abstract

Background and Objectives: The cultivation of medicinal and aromatic plants has a special status in Iranian traditional agricultural system due to the different weather conditions and the history of the use of medicinal herbs. These systems play an important role in creating diversity and stability. In this regard, this study was carried out to investigate the effect of ajwain and chamomile as two insect attractive plants on improvement the yield of onion seed production under intercropping systems.

Materials and Methods: The experiment was conducted on a field located in 10 kilometers west of Shirvan, North Khorasan province, Iran as randomized complete blocks design with ten treatments in three replications. Treatments were including of sole sowing of ajwain, one row intercropping of onion and ajwain, two row intercropping of onion and ajwain, three row intercropping of onion and ajwain, sole sowing of chamomile, one row intercropping of onion and chamomile, two row intercropping of onion and chamomile, three row intercropping of onion and chamomile, sole sowing of onion by free pollination and sole sowing of onion under cage. The measured criteria for onions were plant height, number of umbrellas per square meter, number of fertilized capsules in umbrella, number of infertile capsules, number of seeds per capsule, number of flowering stems, 1000 seed weight, seed yield per hectare and harvest index. The onion seeds were harvested manually. Characteristics such as plant height, 1000 seed weight, seed yield per hectare, biological yield and harvest index were recorded for ajwain, and for chamomile, traits such as plant height, dry inflorescence yield per hectare, biological yield per hectare and harvest index were measured.

Results: The results showed that the maximum number of inflorescence (32.46 per m²), seed yield of onion (462kg/ha) and biological yield (9973 kg/ha) were obtained in sole sowing of onion by free pollination and the maximum harvest index for seed (7.001) and bulb (95.31) were observed in sole sowing of onion by self-pollination. However, the maximum number of fertile capsules in onion inflorescence was obtained in three row intercropping of onion with ajwain and chamomile (151.57 and 154.36, respectively) and thousand seed weight of onion (4.82 g) was observed in three row intercropping of onion and chamomile. The highest thousand seed weight of ajwain (1.33 g) was obtained from three row intercropping by onion while the highest seed yield (2001 kg/ha) and biological yield (2915 kg/ha) were obtained in sole sowing of ajwain. We observed the highest chamomile dry weight of plant, dry flower and harvest index (358.6, 164 and 45.84, respectively) in sole sowing and then in three row intercropping by onion. The maximum amount of LER was obtained in three row intercropping of onion by ajwain and chamomile (1.16 and 1.15, respectively) that it shows this pattern of intercropping superiority to sole sowing.

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Investigation of suitable time for removal vine protection soil to prevent frostbite damage of spring reflection

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Abstract

Background and Objectives: According to the high dependence of the proceeds from the production of grape growers in many parts of the Iran, the occurrence of spring frosts can sometimes cause considerable losses in their annual livelihoods. Due to the development of grape vines in cold regions, many farmers use ‘Kazandeh’ training system, to protect the trunks and canes from freezing damage by buried vines with soil in the fall seasons. The purpose of this investigation was to determine the best time for bringing out vines ‘Bidane Sefid’ cultivar, from the subsoil from late winter to early spring. In addition the buds have the least possible damage against the early spring frostbite.

Materials and Methods: The experiment was conducted in two years (from March 2014 to April 2016) with Randomized Complete Blocks Design (RCBD) with 5 replications and 3 treatments in Khosbijan, Shazand, Iran. The treatments consist of removing out trunks and canes from the soil at three times included Treatment 1: 16th March (Dormant bud), Treatment 2: 4th April (Swollen bud) and Treatment 3: 24th April (Woolly bud as control). In the two years of the experiment occurred spring frostbite in dates of 26th April 2015 and 3th April 2016. In addition two artificial cold stages were applied on the buds of canes at temperatures of 0, -4, -8 and -12 °C.

Results: In this research, treatment 2 showed the lowest electrolyte leakage at artificial temperatures 0 to -8 °C and sprouted buds percent was not significantly different between treatments after occurred spring frostbite. Furthermore in first year fruiting buds percent was higher in the treatment 1 compared to other treatments and in the order of time removal vines from the soil, the soluble carbohydrates decreased, proline and the percentage of water content of the buds increased. In second year after all treatment were performed, buds soluble carbohydrate had the highest amount in treatment 2. In addition, according to the results of the qualitative characteristics of this treatment, soluble solid (TSS) and percentage of organic acids (Ta) was significantly higher than treatment 1.

Conclusion: Generally the best time to removal vines from protection soil was 4th April that buds was swelling. Meanwhile, in this treatment, the percent of soluble solids (TSS) and pH in fruit was highest and the percentage of organic acids (Ta) was lowest.

Keywords: ‘Bidaneh Sefide’ cultivar, Buried vines, Electrolyte leakage, ‘Kazandeh’ training system, Sprouted buds percent

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Creening of bread wheat genotypes for identifying tolerance genetic resources to salinity

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Abstract

Background and Objectives: Salinity is one of the most important environmental stress which limits growth and yield of crops. Breeding and development of tolerant varieties is the most effective approach to confront salinity. Improvement of tolerance to salinity in crops necessitates existence of diverse genetic resources. Genetic variability for salinity tolerance has been reported. Wheat germplasm is a valuable genetic resource for tolerance to abiotic stresses including salinity. This research was performed with the objective of screening and selecting salinity tolerant genotypes in wheat germplasm.

Materials and Methods: A total of 97 bread wheat genotypes selected from previous studies along with three tolerant check cultivars of Kavir, Roshan and Mahooti were planted in research filed of Karaj (normal condition) and Meybod (saline soil and irrigation water, EC=6.55 dS/m and 5.61 dS/m, respectively) in lattice statistical design with three replications. Agronomical traits were evaluated according to international descriptor. Stress tolerances indices were calculated and the superior genotypes were distinguished by analyses of cluster and principal components. Stepwise regression was used in order to identify effective traits in tolerance to stress.

Results: Grain yield of the check cultivar Kavir was higher than Roshan and Mahooti in stress condition. A total of nine genotypes had higher grain yield in stress condition than Kavir. Genotype KC.4419 had the highest amount of grain yield in normal condition (966.67 g/plot) and the highest values for the indices STI, GMP, HM and HM. The indices STI, GMP and MP had high correlations with grain yield in both normal and stress conditions. The studied genotypes were separated in the biplot of grain yield in normal and salinity stress conditions. A total of 38 genotypes along with all three check cultivars having higher grain yield in normal and salinity stress conditions were located in Region A of biplot. The results of principal component analysis based on the evaluated traits along with STI indicated that three PCs comprised 74.79% of the total variation. While the first PC emphasized on obtaining higher grain yield in stress condition through increasing grain filling period and producing larger seeds, the second PC highlighted the accumulation of dry matter in vegetative tissues. The results of stepwise regression for STI showed that harvest index entered in both models of normal and salinity stress conditions. The trait appeared specifically in regression model of stress condition.

Conclusion: The genotypes KC.1514, KC.4382, KC.4419 and KC.4407 (from Esfahan), KC.142 (from Khoy), KC.3100 (from Mashhad), KC.1143 and KC.388 (from Iran with unknown province) and KC.106 (from USA) with higher grain yield in stress condition than check cultivars were selected as tolerant genotypes. STI, GMP and MP were suggested as the most suitable criteria for selecting superior genotypes in salinity stress condition due to their high correlations with grain yield in both normal and stress conditions.

Keywords: Gene pool, Genetic resources, Salinity, Wheat landraces

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