



Study the bulbing date and morphological characters of landrace populations and onion commercial cultivars in Khuzestan Region

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Abstract

Background and Objectives: Onion is one of the most important vegetable in Iran. Harvested area of onion is 63685 hectares. Significant amount of short day onion seed is imported to Iran that caused genetical depression of landraces onion. However, high diversity have been reported in Iranian landraces onion. Populations that produced high yield, exhibited long storability and resistant to pests have been observed in landraces onion. Therefore, study the qualitative and quantitative characters of landraces onion is very important. This research was conducted to study bulbing date, morphological characters and correlation coefficient among characters in landraces onion of southern Iran and commercial cultivars.

Materials and Methods: This research was conducted in randomized complete blocks design including eight populations (Behbahan, Padook, Ramhormoz, Iranshahr and Borazjan landraces, Texas early Grano and Primavera cultivars and Behbahan bred onion) with four replications at Behbahan Agriculture Research Station for two years (2012-14). Seeds were sown in nursery in early October and seedling transplanted (at two or three leaf stage) in mid November. Earliest time of bulbing was estimated using bulbing ratio and cumulative sums. Bulbs were harvested when 50-80% of foliage top had fallen and collapse. Results were analyzed by MSTATC statistical software and comparison of means were done using Duncan's Multiple Range Test.

Results: In the first year of experiment, bulbing occurred from photoperiod of 11 h and 56 min (19 March) to 12 h and 5 min (22 March). Bulbing dates were from photoperiod of 12 h and 32 min (31 March) to 13 h and 5 min (18 April) in the second year. The highest total yield were produced by Padook landrace and Texas early Grano cultivar in the first and second year respectively. Primavera cultivar produced the highest marketable yield. Bolting was not observed in Primavera and Texas early Grano cultivars. Primavera cultivar and Borazjan landrace showed the highest and lowest doubling bulb respectively. Also, The highest bulb dry matter percentage belong to Behbahan bred onion. Results of correlation coefficient indicated total and marketable yield exhibited significant negative correlation with bolted plants and doubling bulb. Bulb dry matter percentage had positive and significant correlation with total soluble solid percentage.

Conclusion: Bulbing occurred on short day in all studied populations. According to results Texas early Grano is the best cultivar for onion production in Khuzestan province. Among landrace populations, Behbahan bred onion in regard to low sensitivity to doubling bulb and high bulb dry matter percentage is superior population.

Keywords: Bolting, Correlation coefficient, Doubling bulb, Yield

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Agronomical strategy of plant density and nitrogen on winter rapeseed (*Brassica napus* L.) yield in interference with lepyrodiclis (*Lepyroclis holosteoides* Fenzl.) population

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Abstract

Background and Objectives: Rapeseed management for achieving maximum grain yield and quality is dependent on monitoring nutritional status of plant specially nitrogen accessibility during growth season, determining optimum density and controlling weeds. In recent years, lepyrodiclis (*Lepyroclis holosteoides* Fenzl.) has been privilege in rapeseed fields as an invasive weed. Despite rapid privilege of this invasive weed there is no research record on evaluating the competitive potential of lepyrodiclis with rapeseed in Iran. Current research was conducted to assessing competitive potential of lepyrodiclis with rapeseed under different nitrogen regimes and density levels.

Materials and Methods: A factorial experiment was laid out based on RCBD design with three replications in research field of higher education center of Imam Khomeyni in Karaj, during 2015-2016 cropping year. Treatments were consist of nitrogen in form of urea (%46 nitrogen) in four levels 0, 50, 100 and 150 kg ha⁻¹, rapeseed (*Super Star*) density in two levels 70 and 90 plants per m² and lepyrodiclis density in four levels zero, 5, 10 and 15 plants per m².

Results: Interactive effects of rapeseed density and nitrogen levels indicated that maximum pod per plant, grain per pod and grain yield were obtained when rapeseed density was 90 plants per m² and 100 and 150 kg N ha⁻¹ were applied. Interactive effects of rapeseed lepyrodiclis and nitrogen levels revealed that the highest grain yield (3335 kg ha⁻¹) was observed in 150 kg N ha⁻¹ treatment in absence of lepyrodiclis. Also, rapeseed grain yield showed 8, 14 and 28% reduction as lepyrodiclis density increased to 5, 10 and 15 plants per m² respectively.

Conclusion: It could be concluded that up to 100 kg per ha⁻¹ nitrogen application and 90 plants per m² rapeseed density not only can improve the grain yield and yield components of rapeseed but also can enhance the competitive ability of rapeseed against lepyrodiclis.

Keywords: Grain yield, Harvest index, Number of pod in plant, Weed

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The effect of growth regulators on micropropagation of GF677 rootstock under liquid medium conditions

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Abstract

Background and Objectives: GF667 is a hybrid of *Prunus Amygdalus* × *Prunus persica* and is the most commonly used rootstock for peach, nectarines and almonds. Due to low efficiency of propagation through cutting, tissue culture is a good and fast method for propagation of GF667. In the liquid medium, contact between the plant tissue and the medium is better, propagation is accelerated, and cost of production is reduced. Therefore, the aim of this study was to optimize micropropagation methods for GF677 rootstock by using liquid culture system.

Materials and Methods: In this study, sterile nodal explants were cultured on different media include Murashige and Skoog (MS), Woody plant medium (WPM) and Gamborg (B5) supplemented with various concentrations of BA (benzyl adenine) at concentrations of 0.25, 0.5, 1, 2 and 4 mg/L and IBA (indole-3-butyric acid) at concentrations of 0, 0.1, 0.25 and 0.5 mg/L. Elongated shoots of GF677 were cultured on MS medium supplemented with 0.25, 0.5, 1.0 and 2.0 mg/l IBA and 0.0, 0.1, 0.2 and 0.5 mg/l BA for rooting. Factorial analysis of variance was carried out and differences between means were scored with LSD tests.

Results: Effect of different culture media (MS, B5 and WPM) and growth regulators (BA and IBA) on number of shoots per proliferated explant of GF-677 showed that the maximum number of shoots (2.44 shoots) was obtained in WPM medium at a concentration of 1 mg / l BA and the highest shoot length was obtained with 1 mg / l BA and 0.25 mg / l IBA in medium B5. As concentration of BA increased to 1 mg/l, the number of shoot also increased. It sounds that there is a positive correlation between concentration of BA and number of shoot to a certain concentration of BA, so that number of shoot reaches its peak at concentration of 1 mg/l BA. At concentrations higher than 1 mg/l BA decrease in number of shoots can be seen. It shows that when concentration of BA was in excessive amount, it resulted in decrease of shoot number. One of the possible reason can be reductive effect of higher concentrations of BA. Apparently a certain amount of BA is required to obtain the best effect. Higher concentrations of BA brought about formation of high amount of callus which is not appropriate in tissue culture. On MS medium containing 1.0 mg/L IBA and 0.5 mg/l BA, a maximum rooting efficiency was obtained. Rooted plants were transferred in terrestrial environments combination of perlite, sand and soil in the ratio of 1: 2: 1 respectively. Results showed that rooted plantlets were successfully acclimatized and transferred to potting mix with 90% survival and grow naturally after strengthening and transferred to soil.

Conclusion: The shoot multiplication of GF677 was influenced by the media (MS, B5 and WPM) and growth regulators. The WPM medium at a concentration of 1 mg/l BA gave the best results (2.44 shoots) for the proliferation of cultures from explant among the tested media.

Keywords: Culture medium, Growth regulator, Micropropagation, Vegetative rootstock

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Effect of explant types and growth regulators on callus induction and secondary metabolites of chicory (*Cichorium intybus* L.)

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Abstract

Background and Objectives: Chicory (*Cichorium intybus* L.) is an important medicinal plant with valuable metabolites. Chicory callus can be a good source for the production and extraction of secondary metabolites of this plant. Concentration of growth regulators and type of explants are the main factors affecting the production of chicory callus. The aim of this study was optimization of the callus and secondary metabolites production in chicory using the different concentration of growth regulators and explant types.

Materials and Methods: The effect of different concentration of Benzyladenine (BA) (0, 0.5, 1 and 2 mg/L and Naphthale acetic acid (NAA) (0, 0.5 and 1 mg/L) and explants (petiole, stem and Leaf) on callus formation, phenolic and flavonoid production in chicory was investigated in a factorial based on completely randomized design experiment with three replications. First, the seeds were surface sterilized and then, they were cultured in MS medium to produce sterile seedlings. After 4 to 5 weeks, Leaf, petiole and stem explants were prepared from seedlings in sterile conditions. The explants were cultured in tissue culture medium containing different concentrations of BA and NAA. After 4 weeks, calluses obtained from sterile explants were used to measure the percentage of callus production, fresh and dry weight, dry matter percentage, callus relative water content, phenolic, flavonoid and antioxidant activity.

Results: Based on the results of variance analysis, the interaction of all treatments showed a significant difference at 1% level as compared to the control. The comparison of interactions between treatments showed that petiole explant had the highest callus production in the medium supplemented with 2 mg/L BA with 1 mg/L NAA. On the other hand, the highest callus fresh weight was obtained in leaf explant in treatment of 0.5 mg/L BA with 0.5 mg/L NAA. In addition, the highest callus dry weight was obtained in petiole and stem explants in treatment of 1 and 2 mg/L BA with 0.5 mg/L NAA. The highest percentage of callus dry matter observed in petiole explant in the medium supplemented with 1 mg/L BA and 0.5 mg/L NAA. The highest phenol and flavonoid content observed in petiole explant in the medium supplemented with of 0.5 mg/L BA alone. The callus produced from the stem explant showed the highest antioxidant activity in the treatment of 1 mg/L BA and 1 mg/L NAA.

Conclusion: Overall, the best explant for callus production was petiole in combination with treatments of 2 mg/L BA and 1 mg/L NAA or the medium containing 0.5 mg/L BA without NAA. Moreover, the above treatments produced the highest levels of phenol and flavonoids, which had the most antioxidant activity too.

Keywords: Benzyladenine, Callus, Flavonoid, Naphthale acetic acid, Phenol

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Investigation on genetic diversity of some unknown genotypes of citrus in Iran according to morphological and molecular characteristics based on ISSR and PCR-RFLP markers

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Abstract

Background and Objectives: Citrus germplasm has an extensive diversity in Iran which is due to cross pollination, long history of seed propagation and abundance of genetic variations. For determining the classification status, the phylogenetic relationships and the genetic distance between members of this valuable genetic reserve, it is necessary to use of morphological characters along with DNA-based molecular markers. In the present study, to obtain information on the degree of genetic affinity between 79 unknown citrus biotypes in Kotra Citrus Research Station and determining their relative distance from 18 commercial cultivars, three types of markers (morphological, ISSR and PCR-RFLP) were used.

Materials and Methods: The present study was carried out as a three-year research to obtain passport data for 79 biotypes and 18 commercial cultivars (check) of citrus trees, recognition of phylogenetic relationships and determination of genetic distance between these genotypes. This study was conducted on the basis of a comparative study of 19 vegetative and 40 reproductive traits and the analysis of chloroplast DNA based on ISSR and PCR-RFLP markers of leaf samples. The three-year average of morphological traits according to standard citrus descriptor were recorded. In order to perform molecular investigations, DNA extraction from the leaf samples of each genotype was performed and DNA was quantified using UV-visible spectrophotometer (nano-drop) at 260 nm. Cluster analysis of morphological and molecular data was performed based on the unpaired pairs (UPGMA) and Jaccard's similarity coefficient and differences between genotypes were determined by coding and ranking of them.

Results: Obtained results from cluster analysis of morphological and molecular data with NTSYS-pc and POPGENE software, using the UPGMA method with Jaccard's coefficient of similarity showed that all genotypes can be categorized according to morphological traits, ISSR and PCR-RFLP markers into 12, 9 and 5 main groups in the 40%, 53% and 60% similarity coefficient respectively. According to morphological traits, the first cluster (A) can be divided into two subgroups which there are three lemon varieties in one of them. Another group (B) contains all sweet orange and mandarin cultivars and the third group (C) was incorporates three genotypes including Citron, Pomelo and Duncan grape fruit. The use of ISSR marker showed that polymorphism of examined genotypes was varied from 92% to 53% for N10 and N1 markers, respectively and a significant number of them had close affinity to sweet orange. The results of this study also showed that kumquat, based on molecular characteristics and apparent traits, is a distinct genus of citrus family and should be placed in separate group. On the other hand, sweet oranges, grapefruits and pomelos were all in the same group which is consistent

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with the fact that grapefruits are hybrids of sweet oranges and pomelo. In this way, the degree of similarity of the local unknown genotypes was determined to each other and to the commercial varieties (check samples). Also, the differentiation of three species (*C. reticulata*, *C. medica* and *C. maxima*) was possible.

Conclusion: The data obtained from the measurement of morphological and molecular characteristics of unknown citrus genotypes could obtain a passport data for each biotypes and determine the phylogenetic relationships of biotypes with each other and with commercial cultivars. Obtained results could determine the genetic distance of biotypes from each other as well as from commercial varieties. In this way, in the future, parents can be efficiently chosen to perform corrective breeding programs for creating of new varieties.

Keywords: Cluster analysis, Genetic resources, Molecular markers, Morphological characters



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Assessment of phenotypic and genetic diversity and relative nuclear DNA content in *Festuca arundinacea*

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Abstract

Background and Objectives: *Festuca* species grow in Iran and widespread occurrence of polyploidy has an important role in the evolution of this group. *Festuca arundinacea* belong to the grass family and include different species that used as forage, turf grass and for soil conservation. The aim of this work was the study of changing in DNA content morphological and phenological traits in different genotypes of *F. arundinacea* which collected from different regions.

Materials and Methods: This experiment was conducted using a complete blocks design with 3 replications. Genetic parameters were estimated for all traits including day to head emergence, flowering date, plant height, number of stem per plant, spike length, 1000-seed weight, Germination percentage, Germination rate, Germination vigor, Stability, Forage yield, seed yield, seed weight per stem, harvest index, number of seed per plant. Three-week-old plants, fluorochrome DAPI and *Hordeum vulgare* L. cv. Sultan (2C=11.12 pg) as an internal standard for DNA content measurement were used.

Results: Evaluation of genetic parameters indicated that the difference between PCV and GCV was low for days to head emergence, flowering date, number of stem per plant, germination percentage, number of seed per plant, 1000-seed weight, germination rate, germination vigor and plant height, which clearly indicated the role of genetic variance was higher than the environmental variance. On the other hand, heritability was ranged between 66-95%. High broad-sense heritability was also observed for all the characters except spike length which indicate selection-based methods have high efficiency for these traits. Due to the low difference between PCV and GCV, high heritability and high genetic advance for days to head emergence, flowering date and germination vigor, it can be concluded that these traits are controlled by additive genetic action and can be improved through selective breeding programs. ANOVA results for relative nuclear DNA amount showed a significant difference between studied genotypes which suggest there is a high intraspecies variation for various genotypes in the different regions. The results of mean comparison showed that the genotypes can be categorized into 7 separate groups. The highest and lowest relative amount of nuclear DNA was in (G13, G20, G21) and (G22, G16) genotypes, respectively. According to previous studies, the change in the relative amount of nuclear DNA can be attributed to the presence of chromosome B and change the length of the chromosome.

Conclusion: It is suggested that day to head emergence, flowering date and germination vigor traits to be used for plant breeding programs. Moreover, the change in relative DNA content and morphological-phenological traits can be considered factors in the evolution of *F. arundinacea* and adaptation to varying environmental condition.

Keywords: *Festuca arundinacea*, Genetic advance, Genetic parameters, Heritability, Relative Nuclear DNA amount

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Interaction of Fe and Si on some of biochemical characteristics of chickpea (*Pisum sativum* cv. Wando) in greenhouse conditions

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Abstract

Background and Objectives: The chickpea (*Pisum sativum*) is an herbaceous annual plant, with a short growth period. Although, existence of some heavy metals like iron in soil and nutritional solution are essential for growth of plants but the high concentration of them can be an inhibitor of growth and causing toxicity by creation of oxidative stress and increasing ROS toxicity. On the other hand, silicon can increase yield and quality of the crops under stress conditions caused by the toxicity of heavy metals such as iron, manganese and aluminum in plants. In this research, the effects of silicon in presence of several iron levels on some biochemical traits in chickpea were studied.

Material and Methods: The experiment was conducted as a factorial based on a completely randomized blocks design which Si at three levels (0, 14 and 28 mg l⁻¹) from sodium metasilicate (Na₂SiO₃.5H₂O) and Fe in three levels (0.05, 0.1 and 0.3 g l⁻¹) from iron chelate used at three replications in greenhouse conditions. Hoagland's solution was used as nutritional solution, the amounts of Si and Fe were added to it and then consumed. Biochemical traits such as total chlorophyll, total soluble protein, malondialdehyde (MDA) level, hydrogen peroxide (H₂O₂) concentration, and specific activity of catalase (CAT), guaiacol peroxidase (GPX) and ascorbate peroxidase (APX) were evaluated.

Results: The results showed that the interaction of Fe and Si on total chlorophyll, protein, hydrogen peroxide, CAT and APX were significant. The increasing of Fe concentration, chlorophyll and protein reduced but Si caused increasing of them. In other words, by application of Si, the effects of stress which caused by high concentrations of Fe diminished. In the interaction of Fe and Si on H₂O₂ content, Fe raised and Si decreased it at all the levels of the treatments. Both Fe and Si treatments increased the activity of CAT and APX enzymes. On the other hand, the interaction of treatments on GPX activity and MDA content were not significant. But the simple effects of the treatments caused significant differences in GPX and MDA, so that, Fe increased both of them, but Si reduced MDA and increased GPX.

Conclusion: Based on the results, it can be concluded that high concentrations of Fe in chickpea, such as most plants, increase the oxidative stress and Si has somewhat reduced the effects of this stress. Therefore, Si can be studied and used as a useful ingredient in cutting down biotic and abiotic stresses. Based on this study, 0.1 g/l of Fe along with 28 mg/l had the best effect on improving some biochemical characteristics of chickpea.

Keywords: Biotic Stress, Elemental Toxicity, Oxidative Stress, ROS

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Validation of some molecular markers in sex determination in different kiwifruit genotypes from open pollination

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Abstract

Background and Objectives: Kiwifruit is one of the important exportable horticultural crops in Iran. Currently, international customers tend to buy novel kiwifruit with different flesh and taste has increased. Therefore, for persistence in exporting and success in export rank of Iranian kiwifruit, it is necessary to have new cultivars. One of the main limitations in kiwifruit breeding program, juvenility period is long time and it is dioecy which there is no distinguishable differences between male and female plants until flowering time. Therefore, sex determination in seedling and separation male and female plants as soon as possible is very important for accelerating kiwifruit breeding. In this study, validation of some molecular sex related markers for determination males and female plants results from open pollination.

Materials and Methods: In this study, we used two different yellow flesh kiwifruit genotypes (known as Khorshid and Navab) and one red flesh genotype, which all were belong to *Actinidia chinensis* with diploid. Extraction of genomic DNA from young leaves was carried out by CTAB method with few modifications. Spectrophotometer (Biophotometra, Plus Eppendorff) is used for determine the exact concentration of each sample DNA, and DNA concentration was measured at a wavelength of 260 nm. Polymerase chain reaction (PCR) was performed in a volume of 10 µL for each sample. For each primer program (PCR), agarose gel concentration and optimum loading time was optimized. Finally, the validation of some sex related markers includes 3 SCAR markers (SmX, SmY, SmY₁) and 3 SSR markers (A00I, A00II, A00III) in the DNA extracted from the leaves of the tested genotypes was investigated.

Results: The results of current study showed that among different SCAR and SSR markers which previously reported, some of them were not able to separate correctly male and female seedlings. Among three SCAR markers (SmX, SmY, SmY₁) were evaluated, just two markers; SmY₁ (770 bp) and SmX (950bp) markers could able to separate correctly male (without band pattern in female) and female (without band pattern in male) kiwifruit seedlings respectively. According to polymorphic bands were obtained from three tested SSR markers (A00I, A00II, A00III) for determination males and females plants, only A00II with specific bands 232bp in male and 219bp in female plants could able to separate kiwifruit seedlings. The two A00I and A00III markers exhibited the similar banding patterns in males and females which were not able to separate individuals from gender.

Conclusion: Overall, the results of this study showed that simultaneously application of SmX, SmY₁ and A00II are able to separate correctly male and female seedlings of kiwifruit during the early juvenile phase.

Keywords: Breeding, Juvenility, Sex-marker, SCAR marker, SSR marker

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The Effect of organic, biofertilizer and chemical Fertilizer on growth and yield of castor bean (*Ricinus communis*)

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Abstract

Background and Objectives: Application of chemical fertilizers besides contaminating the water and soil resources, and reducing the quality of agricultural and medicinal products has created serious environmental issues. Plant nutrients management is an important factor for increasing growth and yield of plants. In sustainable agriculture, biological and organic fertilizers are an alternative to chemical fertilizers that they can improve the quality and quantity of plants. Based on this, due to the importance of castor and its extensive use in various industries, an integrated nutrition system assessment was carried out on *Ricinus communis* L. for simultaneous use of biofertilizer, vermicompost fertilizer and nitrogen fertilizer.

Materials and Methods: The experiment was included nitrogen fertilization at three levels 0 (N₀), 75 (N₁), 150 (N₂), kg ha⁻¹, vermicompost at three levels of application 0 (V₀), 5 (V₁) and 10 (V₂) t ha⁻¹ and biofertilizer in two levels of non-inoculation (P₁) and inoculation with biofertilizer (P₂). The experiment was performed in a factorial base on randomized complete blocks design with three replications was conducted at experimental farm of Faculty of Agriculture, Azarbaijan Shahid Madani University in 2017. Parameters such as plant fresh and dry weight, height, number of leaves, leaf area, pigments content, inflorescence length and diameter, number of capsules per plant, number of seed per capsules, 1000 seeds weight, seed and oil yield and oil content were measured.

Results: The results showed that combination of non-inoculation+ vermicompost 10 t ha⁻¹+nitrogen 150, kg ha⁻¹ was the most effective treatment for increasing the plant height, number of branches, stem diameter, weight and dry weight of the plant. Also, the highest seed and oil yield were obtained in non-inoculation+ vermicompost 0 t ha⁻¹+nitrogen 150, kg ha⁻¹ and inoculation+ vermicompost 10 t ha⁻¹+nitrogen 150, kg ha⁻¹ treatments with 2824 and 1185.1 kg ha⁻¹, respectively. The highest and lowest oil content were 43.31% and 36%, in the non-inoculation + vermicompost 10 t ha⁻¹+nitrogen 150, kg ha⁻¹ and control (non-application of fertilizer) treatments, respectively. The oil yield per plant was positively correlated with number of seeds per plant ($r = 0.74$). The maximum coefficient of determination for stepwise regression was obtained for the number of seeds per plant (0.68).

Conclusion: The number of seeds per plant can be the suitable trait to achieve a higher oil yield per plant. The treatment combination of inoculation+ vermicompost 10 t ha⁻¹+nitrogen 150, kg ha⁻¹ through increasing the number of seeds per plant and the treatment combination of inoculation+ vermicompost 10 t ha⁻¹+nitrogen 0 kg ha⁻¹ through increasing the 1000 seed weight showed higher oil yield per hectare compared to other treatment combination. Therefore, the treatment combination inoculation+ vermicompost 10 t ha⁻¹+nitrogen 0, kg ha⁻¹ can be a good choice for achieving the highest oil yield per hectare in sustainable agriculture and reducing the consumption of nitrogen from chemical sources.

Keywords: Nutrition, Oil seeds, Oil yield, Vermicompost

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Investigate the effects of the benzyladenin and hydrogen peroxide on vase life of the *Anthurium andraenum*

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Abstract

Background and Objectives: *Anthurium* is belonging to the *Araceae* family. The effect of hydrogen peroxidase on vase life and postharvest quality of cut oriental trumpet hybrid lily “Manissa” showed that the lower concentrations of hydrogen peroxide (H₂O₂) increased the vase life of treated flower from 9.8 days (control) to 12.8 days in treated flowers. It’s reported that benzyladenin (BA) application delayed senescence in roses, irises and tulips and prevent leaf yellowing in stocks and gladiolus. The goal of this study was to investigate the effects and the best concentrations of H₂O₂ and BA on vase life of *Anthurium andraenum*.

Materials and Methods: In order to study the effects of various concentration of benzyladenin (1, 50, 100, 150, 200, 400 and 1000 ppm), hydrogen peroxide (5, 10, 15, 25, 35, 50 and 100 μM) on physicochemical characteristics of cut *Anthurium andraenum* flowers, three separated experiment were conducted based on completely randomized design with 5 replications. Some traits such as vase life, flower fresh weight, solution uptake rate, soluble sugar content and ion leakage were tested.

Results: The results of each 3 experiments showed that benzyladenin at rate 100 ppm significantly (P<0.05) increased flower vase life (from 15 days in control to 19.6 days in 100 ppm BA) compared to control. In the 1st experiment, 25 μM of hydrogen peroxide had significant (P<0.05) effect on vase life, solution uptake and fresh weight. Whereas, the higher concentration of H₂O₂ (50 and 100 μM) had no effect on measured traits. In the 2nd experiment, 5, 15 and 25 μM of H₂O₂ and in the 3rd experiment, all tested concentration of H₂O₂ had significant (P<0.05) effect of evaluated traits. However, in the 3rd experiment, the effects of all treatments on soluble sugar content and ion leakage were significant (P<0.05). In all 3 experiments, the effects of different concentration of hydrogen peroxide on vase life were better than control.

Conclusion: With the considering of the positive effects of the BA and H₂O₂ on solution uptake, using of these compounds can lead to preventing the water loss of the cut *Anthurium* flowers. Therefore, both compounds can positively affect the freshness and vase life of cut *Anthurium* flowers. Moreover, treatment of cut *Anthurium* flowers by various concentrations of BA and H₂O₂ showed a considerable increase in soluble carbohydrates and decrease in ion leakage. It’s found that application of 100 ppm BA and some rates of H₂O₂ (5, 10, 15 and 25 μM) are helpful to increase the freshness and vase life of the cut *Anthurium* flowers.

Keywords: Fresh weight, Ion leakage, Soluble sugar, Vase life

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Evaluation of some physiological and morphological characteristics of three genotypes of the ornamental pomegranate (*Punica granatum* L.) under salt stress

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Abstract

Background and Objectives: Pomegranate (*Punica granatum* L.), from the puniceae family, is a popular fruit of tropical and subtropical regions that is native to the area stretching from Iran to the Himalayas in northern India. Pomegranate has been widely cultivated in arid and semi-arid regions of Iran, which these areas are frequently affected by high salinity. The present study was therefore, carried out with the objective to identify and introduce the most-tolerant Iranian genotypes of ornamental pomegranate to different salinity levels of irrigation water.

Materials and Methods: A pot experiment was conducted during a six-month period in order to evaluate and compare the salinity tolerance of three Iranian ornamental genotypes of pomegranate during 2017-2018. The experiment was arranged in factorial based on the completely randomized design with two factors included water salinity in 5 levels of 1, 3, 5, 7 and 9 dSm⁻¹ and three ornamental pomegranate genotypes ('Golnar Saravan', 'Golnar Shahdad' and 'Golnar saveh') in 4 replications. The properties concerned during the experiment were vegetative growth, the fallen, chlorosis and green of leaves. At the end of the experiment, the vegetative yield and fresh and dry weight of leaves and shoots, ion leakage, relative water content and chlorophyll index were also measured. In addition, leaves were analyzed for elements such as Na⁺, K⁺, Cl⁻ and Na/K ratio.

Results: Results showed that with increasing of salinity levels in all three investigated genotypes, growth characteristics, significantly decreased, ion leakage, the relative water content of leaves and chlorophyll index significantly increased. Also with increasing of salinity levels Na⁺, Cl⁻ and Na⁺/Cl⁻ significantly increased. In all studied genotypes, plant height and leaf area decreased from salinity level of 5 and 7 dS.m⁻¹ respectively. Increasing in leaf necrosis and decreasing in percentage of green leaves and also relative water content in 'Golnar Sarvestan' were observed from salinity level of 5 dS.m⁻¹ and from salinity level of 7 dS.m⁻¹ in 'Golnar Shahdad' and 'Gonar Saveh'. Leaves falldown in 'Gonar Saveh' and 'Golnar Sarvestan' were increased in salinity level of 7 dS.m⁻¹ and in 'Golnar Shahdad' in 5 dS.m⁻¹ salinity level. In two genotypes ('Golnar Sarvestan' and 'Golnar Shahdad') the ion leakage increased in 7 dS.m⁻¹ salinity level and in 'Gonar Saveh' in salinity level of 5 dS.m⁻¹. In higher salinity levels (7 and 9 dS.m⁻¹) Na⁺, Cl⁻ and Na⁺/Cl⁻ uptake were significantly decreased in 'Golnar Sarvestan' and 'Golnar Shahdad' in compared to 'Golnar Sarvestan'.

Conclusion: Generally, among all studied genotypes, 'Golnar Shahdad' has been showed the maximum growth characteristics and the lowest appearance injury, accumulation of Na⁺, Cl⁻ in higher levels of salinity. So it seems that this genotype is the most tolerant of the salinity.

Keywords: Chlorine, Chlorophyll, Growth characterization, Sodium, 'Golnar Shahdad'

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Effect of salicylic acid on physiological N efficiency and water use efficiency of barley in irrigation stress condition

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Abstract

Background and Objectives: Drought stress has osmotic and physiological effects on plants, resulting in reduced growth, metabolic disorders and oxidative stress in plants. Different plants use several strategies to cope with drought stress. External application of different compounds such as organic solvents and minerals is a solution to increase drought tolerance in plants. Salicylic acid was recognized as a plant hormone and its role in defense mechanisms against biological and non-biological stressors is well defined. The purpose of this experiment was to evaluate the effect of salicylic acid on reducing the effects of drought stress on yield, water use efficiency and some physiological characteristics of the barley.

Materials and Methods: This study was conducted as a split plot experiment based on randomized complete blocks design with three replications in Sabzevar in 2017. The altitude of this area is 1195 m above sea level and is 36° 5' N latitude and 44° 3' E longitude. The treatments included irrigation at two levels of drought stress (irrigation cut from booting to harvesting stage) and complete irrigation and salicylic acid spraying treatment at four levels of zero (control), two, four and six mM at stage of shoots on barley. Data were analyzed with the SAS software ver 9.1 and the means were compared with LSD test.

Results: The results showed that in both conditions of irrigation and drought stress, the highest number of spikes, number of seeds, seed yield and biological yield per m² were obtained in two to six mM of salicylic acid, respectively, and the lowest was related to control treatment. The lowest water use efficiency was obtained under full irrigation conditions without salicylic acid and with the consumption of salicylic acid up to six mM, water use efficiency increased. In addition, salicylic acid spraying in drought stress conditions compared to full irrigation led to increase water use efficiency. In both conditions, full irrigation and irrigation cut, the highest and lowest grain yields were obtained from 6 mM salicylic acid and control treatments (without salicylic acid spraying), respectively. Under full irrigation and drought stress, spraying with 6 mM of salicylic acid increased the grain yield by 44% and 48% compared to control (without salicylic acid spraying). It seems that the effect of salicylic acid spraying in drought stress conditions was more effective than irrigation conditions compared to irrigation treatment. Physiological efficiency of N increased with increasing salicylic acid consumption and consumption of six milligrams of salicylic acid with ratios of 124.6 and 132.1, respectively, in both conditions of irrigation and cut irrigation, had the highest physiological N, respectively. Cut irrigation conditions increased N remobilization, also increased the physiological efficiency of N to 113.95%. On the other hand, salicylic acid reduced drought stress by increasing physiological efficiency N and N remobilization, which improved wheat grain yield under stress conditions compared to complete irrigation.

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Conclusion: The physiological efficiency of N, which was produced from the total dry matter divided by the absorbed nitrogen, in fact, indicates the relation between N and dry matter production and, irrespective of salicylic acid consumption and irrigation conditions, the physiological efficiency of N increased to about 135, water use efficiency was added linearly. Therefore, it can be concluded that the N flow within the tissue has a positive effect on the water use efficiency.

Keywords: Barely, Grain yield, Salicylic acid, Water stress



Effect of deficit stress on growth, essential oil and some physiological traits of four basil (*Ocimum basilicum* L.) cultivars

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Abstract

Background and Objectives: Drought stress, as the main non-biological limiting factor of plant growth and yield, can caused or intensify other stresses in the plant, especially the stress of nutrient deficiency. On the other hand, plants produce similar amounts of primary metabolites under water deficit stress conditions compared the to non-stress conditions. Science plant reduces its biomass under stress conditions, so higher portion of primary metabolites allocate to the production of secondary metabolites. The present study was conducted to evaluate the growth, essential oil and some physiological traits of four basil cultivars under water deficit stress condition.

Materials and Methods: The experiment was conducted as a factorial based on a completely randomized design in greenhouse in 2017. Four commercial basil cultivars (including Iranian green, Iranian violet, Genovese and Amethyst) were used as the first factor and water deficit stress at four levels (including irrigation at 100%, 85%, 70% and 55% FC) was used as second factor. Traits such as fresh and dry weight of the plant, fresh and dry weight of the root, essential oil content, essential oil yield, chlorophyll, malondialdehyde, proline, catalase, peroxidase, ascorbate peroxidase, photosynthesis, stomatal conductance and stomatal strength were measured. The data obtained from the experiment were analyzed using Minitab software and means compared on were done by LSD test.

Results: The results showed that water deficit stress decreased fresh and dry weights of the plant and photosynthesis in all cultivars. In addition, fresh and dry weights of root and stomatal conductance were reduced under drought stress. While, proline, malondialdehyde, chlorophyll and antioxidant enzymes activity were increased in response to drought stress. However, the amount of change in traits was different among the cultivars. The reduction of different traits in response to drought was mostly lower in the Genoves cultivar than the others. Iranian green and Genoves cultivars had the highest fresh and dry weight of the plant. In addition, the highest percentage of essential oil belonged to the Genoves cultivar.

Conclusion: Genoves cultivar had the highest fresh and dry weight of shoot, had the highest percentage of essential oil and the highest stomatal conductance and recommended as a resistant cultivar in order to essential oil production under drought condition.

Keywords: Essential, Photosynthesis parameters, Physiological parameters, Water deficit stress

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Effects of 6-Benzyladenine on total nonstructural carbohydrates and water-soluble carbohydrates on tall fescue leaves subjected to drought stress

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Abstract

Background and Objectives: The effects of external application of cytokinins on turfgrass leaves and their effects on mitigation of drought stress have been reported in a few studies. However, the effect of benzyl adenine on the content of non-total structural carbohydrates and water-soluble carbohydrates of tall fescue leaves (*Festuca arundinacea* Scherb.) has never been investigated under different drought stresses regime, which is our goals in this experiment.

Materials and Methods: A one-month study on tall fescue that was clonally propagated and established in greenhouse laid out based on completely randomized design with at least three replications including four levels of irrigation treatments (100%, 75%, 50% and 25% of field capacity). In addition to the mentioned treatments, pots with the same irrigation treatments, foliar sprayed by 50 μ M of 6-benzyladenine every 7 days. For comparison, in drought stressed control plants, foliar application of 6-benzyladenine did not applied.

Results: Plants grown on 25% of field capacity was surprisingly influenced by foliar application of benzyl adenine as such noticeable return of leaves to normal growth condition was seen. Looking into water-soluble carbohydrates showed a many fold increase compared to control plants. These water-soluble carbohydrates increase at 50% and 25% of field capacity is much more noticeable than the other treatments. Although foliar treatment with benzyl adenine did not reduce the increase in soluble sugars production to the level of control plants, but BA-influenced WSCs content reduced by half in 50% and 25% of field capacity treatment. Drought stress has reduced chlorophyll content and leaf starch. This chlorophyll reduction at 25% of FC, to great extent compensated with 50 μ M of 6-benzyladenine. The activity of α -amylase and β -amylase augmented upon drought stress treatment in 75% of FC followed by reduction in 50% and 25% of FC.

Conclusion: A drastic reduction in soil water content and then plant water can activate starch-degrading enzymes, leading to an increase in water-soluble carbohydrates which could either maintain leaf cell homeostasis or produce more ATP to help with drought stress tolerance. A part of starch degradation in leaves can be explained by α -amylase and β -amylase activity. The research result indicated that application of 50 μ M benzyl adenine significantly reduced the stress intensity applied to the plant. This treatment, to great extent improved chlorophyll content and photosynthesis at 25% of FC and reduced further starch degradation and its conversion to fructose, glucose and sucrose, thereby preserving the plant's carbohydrate resources.

Keywords: Cytokinin, Drought stress, Tall fescue, Water soluble carbohydrates

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Study on inheritance of resistance to leaf rust in some bread wheat genotypes by diallel cross

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Abstract

Background and Objectives: Wheat is attacked by many pathogens during the growing season, including rust. The causative agent of fungal wheat brown rust called *Puccinia recondita* f. sp. is also known as leaf rust. The most important way to control brown rust disease is to use resistant cultivars that effectively control and reduce its damage. The most important way to control brown rust disease is to use resistant cultivars that effectively control and reduce its damage. The aim of this study was to investigate the inheritance of brown rust resistance in different wheat cultivars and estimation of genetic parameters using diallel crossing.

Materials and Methods: Six bread wheat cultivars including Gonbad, Shiroudi, Darya, Atrak and Moghan 3 genotypes with susceptible Bolani cultivar and 15 F₁ progenies from one-way diallel crosses were studied. This study was conducted as a randomized complete blocks design with three replications in field and greenhouse conditions. Traits included infection type, severity of infection, area under disease progression curve and incubation period. Data analysis was performed using SAS ver. 9.1 and Excel software and estimation of genetic parameters and heritability of traits were studied by diallel analysis using Griffing's second method with fixed model and Jinks and Hayman method.

Results: Analysis of variance showed that there was a significant difference among genotypes for all traits, indicating genetic variation for these traits and thus genetic analysis could be performed. The mean squares of general and private combining ability were significant for all traits, indicating the importance of both enhancing effects and dominance of genes in inheriting these traits. The Baker ratio indicated the same importance of additive effects and dominance for the incubation period and for the other traits indicated greater importance of additive effects. Estimation of genetic parameters by Jinks and Hayman method showed that for all four traits, the amount of D component was lower than the dominance components (H₁ and H₂), indicating that the dominance component was more important than the additive component in controlling these traits. The sign of F was positive for all traits, so the frequency of dominant alleles was higher than that of recessive alleles. Wr-vr statistic was significant for all studied traits, indicating the presence of inorganic effects (epistasis). In other words, the significance of this statistic indicates the inaccuracy of the additive-dominance model for traits.

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Conclusion: Based on the traits evaluated in field, Atrak cultivar and in greenhouse, Gonbad cultivar had good resistance to brown rust. Narrow-sense heritability of traits was estimated to be between 51 and 86%. Estimation of genetic parameters showed that additive-dominance model was not sufficient. In other words, at least resistance is predictable in resistant cultivars.

Keywords: Diallel Cross, General combining, Leaf rust, Specific combining, Wheat