

conventional system and conventional farming system. Due to the current state of the soil in the region, in terms of organic matter, part of the carbon stored in the plant organs can return to soil and improve soil fertility. On the other hand, reducing carbon emissions will improve air quality and prevent the negative effects of greenhouse gas emissions. All these results depend on the maintenance of crop residue in soil surface, that the most of these residue are burned in conventional cropping system, therefore this potential is not used.

**Keywords:** Carbon Sequestration, Conservation cropping system, Plant organs, Soybean



## **Comparison of carbon sequestration potential of soybean in conventional and conservation cropping systems (Case study: Gorgan township)**

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### **Abstract**

**Background and Objectives:** Carbon sequestration in plant tissues is one of the most important ways to reduce atmospheric CO<sub>2</sub> and also to reduce greenhouse effect and climate change. In order to investigate the effect of conventional and conservation cropping systems on carbon sequestration potential in soybean plant organs as an ecosystem service, a study was conducted.

**Materials and Methods:** A surveyed research was conducted based on a completely randomized unbalanced design in agricultural lands of Gorgan township, during 2016-2017. In this study, 48 fields were selected in the main directions of Gorgan township, where 38 fields under conventional cultivation and 10 fields under conservation cultivation and samplings were carried out using W method during physiological ripen stage (late November). A combustion method was used to determine the amount of stored carbon. The stored carbon content was determined individually in soybean organs including root, stem, leaf, pod and seed. The weight of each plant organ was estimated per unit area, then using the carbon sequestration coefficient, the total amounts of carbon sequestration per unit area was determined.

**Results:** The average amount of carbon in soybean plant was determined as 3281.4 kg/ha under the conventional cropping system and 3176.1 kg/ha under conservation cropping system. The reason for this result was the higher of plant biomass in conventional cropping system. Similar results were found for plant organs, so that the average amount of carbon were 1181.6 and 1249.3 kg/h in seed, 792.19 and 710.27 kg/ha in leaves, 968.61 and 888.85 kg/ha in stem, 69.20 and 87.12 kg/ha in pods and 269.81 and 249.57 kg/ha in roots under conventional and conservation cropping systems, respectively. Results showed that there was a significant different between the amounts of carbon sequestration in the above ground and below ground tissues of soybean. The carbon sequestration amounts were about 2993.8 kg/ha in above ground tissues and about 265.59 kg/ha in the below ground organs.

**Conclusion:** In the study of the effect of two conventional and conservation cropping systems, it has been found that the potential of carbon sequestration in plant organs is similar in

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**Conclusion:** Use of the improved seed rootstocks affected significantly the growth of vegetative traits decreasing the tree heights, length of the rootstocks and consequently increased the rootstocks diameter causing a reduced canopy size. Contrarily, the controls induced significantly the scion tree size by production of more lateral branches. Gami almasi seed mass induced higher control of scions tree vigor and so smaller crown size and higher rootstocks diameter in "Red Delicious". Azayesh, Zinati and Morabbaei seed sources showed a vast dwarfing effect on whole studied cultivars, probably for the influence of their crab parents. Low vigor cultivars on such dwarfing seed rootstocks may be used for intensive fruit growing. So, it is possible to control fruit tree size and production of uniform plant using all benefits of the seed rootstock.

**Keywords:** Seed rootstock Improvement, Tree vigor control, Uniform trees



## Investigation of improved seed rootstocks efficiency on tree growth control in some apple cultivars

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### Abstract

**Background and Objectives:** Distinction of the best seed masses with highest genetic purity will permit the control of scion tree vigor as well as production of trees with uniform size and shape. In a 5-Year-trial in the experimental orchard located in Samirom-Isfahan, in order to improve seed rootstocks used for production of uniform trees, 7 scion cultivars were grafted on 4 preselected seed masses obtained from dwarf maternal parents, beside controls as 2 impure seed populations current in Iranian nurseries. The effect of improved Half-Sib seed masses was examined on the trend of scion tree vegetative growth through a group of traits as vigor components of scion trees compared to the 2 controls.

**Materials and Methods:** In the first 2 years, 2010-2012, the inductive effect of the preselected seed masses on the height of 2-Year-old of 7 scion trees were studied compared to the 2 impure populations as control characterized with high genetic variability in Dastgerd Hort. Research Station (Isfahan). The root length of the all treatments was recorded before transfer of the plant material in Samirom Research Station. In the next 3 years, 2013-2015, more vegetative traits of 5-Year-old trees including tree height, number of lateral branches; crown shading area, annual branch growth, rootstock and scion diameter and length of scion trunk were recorded within 42 scion-rootstock combinations (42 : 2+4×7). A factorial design within completely randomized blocks with two replications was conducted. The first factor as seed stocks in 4 levels contained Gami almasi, Zinati, Morabbaei and Azayesh and 2 levels of controls; the second factor including 7 levels of fruit scions as Red Delicious, Golden Delicious, Golab kohanz, Braeburn, Granny Smith, Fuji and Gala.

**Results:** No significant difference was found for root length between the 4 improved rootstocks and control despite of less developed tap root of the 2 controls. The scions tree height with moderate growth showed no significant differences on seed sources of Azayesh and Zinati compared to the Control. "Red Delicious" and "Golden Delicious" showed both the highest rates of scion height as 107.2 cm and 105.3 cm, related to the other combinations. Vice versa, the shortest scion length was registered in "Fuji" and "Gala" on Gami almasi seed rootstocks, 70.2 cm and 68.5 cm, respectively. Both of the rootstock, scion diameters and the annual shoot growth showed increased values on the improved seed rootstocks than control. The "Fuji"-Zinati seeds combination had the largest rootstock diameter (6.1 cm). The highest growth rate of annual shoots (74.66 Cm) was noted in "Red Delicious" on Zinati seeds. The Morabbaei seed mass induced the highest shading area in "Fuji" (165 cm<sup>2</sup>). "Granny Smith"-Gami Almasi combination presented the highest scion tree height (350 cm). The control seeds – "Red Delicious" combination formed the max rate of rootstock length (18 cm). The highest number of lateral branches (8.33 and 9.33) was found in "Braeburn" on the two control seeds rootstock.

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## Spatial yield prediction of autumn rapeseed based on non-parametric methods

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### Abstract

**Background and Objectives:** Modeling the correct relationship between environmental conditions and yields is a critical step to find how crop-planting choices in different regions of Iran. Spatial modeling in GIS is one of the most important strategies that can provide a basis for measuring environmental factors and land suitability for the cultivation of a particular product by combining statistical methods and spatial data. In this research, the link between water, soil and meteorological factors and rapeseed yields investigated during the growing season in sample farms.

**Materials and Methods:** In this research, the position of 24 sample fields of rapeseed farming was recorded by Global Positioning System (GPS) and then actual yield was calculated. To explore how the environmental conditions and yields relationship has changed over space, we used ten environmental parameters influencing rapeseed productions yield, including elevation, slope, aspect, EC and pH groundwater resources, mean temperature, incoming solar radiation, potential evapotranspiration, wind exposition index, soil texture during the growing season. The values of each independent variables were extracted into samples by nearest neighbor method. Then, after normalizing the variables and taking into account the range of numbers, the samples were divided into two subsets: training (60%, 14 farms) and the testing dataset (40%, 10 farms) randomly. Two methods of nonparametric K of the nearest neighbor and random forest were then used to estimate rapeseed yield over the study area.

**Results:** The results of mean absolute error percentage in the methods used showed that K is the nearest neighbor with 26% error and random forest with 11% error. The results of Nash–Sutcliffe efficiency index for validation data set represent the value of 0.65 for K nearest neighbor and 0.82 for random forest method. In general, the results indicate that the random forest method has a lesser error than the K nearest neighbor method in estimating the yield of rapeseed productions for the study area.

**Conclusion:** Based on the results of this research, it can be concluded that among the variables used, two variables of wind supply index and average temperature had the most effect on the yield of rapeseed in comparison with other variables. Also, according to the final map, it was determined that suitable areas for rapeseed cultivation over Sabzevar region are located in the northern and northwestern regions. Low yield in the central regions of this part is mainly due to the excessive salinity of water and gypsum formations.

**Keywords:** K-Nearest Neighbors Algorithm, Random Forest Algorithm, Sabzevar region, Autumn rapeseed yield

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## Changes in morphophysiological traits and phenolic compounds of olive (*Olea europaea* L.) leaf with soil application of chemical and organic fertilizers

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### Abstract

**Background and Objectives:** Olive tree (*Olea europaea* L.) leaves are a very promising and unique herbs source which have considerable therapeutic applications. Olive leaves contain high amounts of phenolic compounds such as phenolic acids, flavonoids, phenylpropanoids and secoiridoids. Oleuropein (secoiridoid compound) is considered as the main active phenolic compound in olive leaves. Fewer studies were dedicated to the effects of fertilization on the chemical composition of olive leaves. Therefore, the current study aimed to investigate the associated changes in morphological characteristics, mineral profile and oleuropein and quercetin contents in olive leaves fertilized with chemical and organic fertilizers.

**Materials and Methods:** In order to evaluate the effect of different treatments of chemical and organic fertilizers (humic and fluvic acid) on morphological characteristics, macro- and micronutrient elements as well as phenolic compounds (oleuropein and quercetin) of Zard cultivar, two separate experiments were conducted in a randomized complete blocks design with three replications in 2013 year. The treatments included application of five levels of NPK (0, 50, 100, 150 and 200 kg ha<sup>-1</sup>) and six levels of humic acid and fluvic acid (0, 5, 7, 10, 12.5 and 15 liters ha<sup>-1</sup>).

**Results:** The results of chemical fertilizers showed that the highest plant height (117.7 cm) and number of branches (34 branches) showed in N<sub>200</sub>P<sub>200</sub>K<sub>200</sub> and N<sub>100</sub>P<sub>100</sub>K<sub>100</sub> kg ha<sup>-1</sup>, respectively. The most leaves (60 leaves) were obtained in application of 10 liters per hectare of organic fertilizers. Compared to the control, application of 100 and 200 kg ha<sup>-1</sup> NPK showed an increase of 30 and 80% of the oleuropein and quercetin content, respectively. The effect of organic fertilizers was only significant on quercetin content, and its maximum (397.7 µg g<sup>-1</sup>) was measured in 10 g liters<sup>-1</sup> treatment. Effect of chemical fertilizer levels on all measured macro- and micronutrients except potassium was significant and the highest measured values of the elements were obtained at N<sub>200</sub>P<sub>200</sub>K<sub>200</sub> kg ha<sup>-1</sup> level. The effect of organic fertilizers levels on magnesium, manganese, zinc and copper content was also significant.

**Conclusion:** The application of organic fertilizers such as humic and fluvic acid along with chemical fertilizers can improve the morphological characteristics, provide the nutritional requirements of the plant and increase the phenolic compounds of olive leaves.

**Keywords:** Fluvic acid, Humic acid, Oleuropein

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## ***In vitro* mass propagation of ‘Myrobalan 29C’ (*Prunus cerasifera* L.): a vegetative rootstock for stone fruits**

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### **Abstract**

**Background and Objectives:** *In vitro* propagation fruit tree is available way for the mass propagation. *In vitro* proliferation of woody plants has more problems than herbaceous plants. And woody plant for the *in vitro* regeneration adventitious shoot from the explant and also *in vitro* rooting are hard. Therefore, the selection of suitable culture media is necessary for inactivation regeneration of shoots from explants, proliferation and rooting for the development of a propagation system in fruit trees. The main purpose of the presented study was to investigate the techniques for *in vitro* propagation of Myrobalan 29C (a rootstock for stone trees).

**Materials and Methods:** This study was performed to determine the best culture medium and plant growth regulators in micropropagation of Myrobalan 29C in a factorial experiment on a complete randomized design (CRD) with 4 replications where each plot contained 5 explants at the Natural Resource and Agricultural Research and Educational Centre of Khorasan Razavi. In order to the proliferation used performed, in level two of culture medium including (*MS* and *QL*) and concentrations BAP and TDZ in level five (0, 1, 2, 3 and 4 mg L<sup>-1</sup>) and two kinds of culture medium including *QL* and *DKW* plant growth regulators NAA with (0, 1, 2 and 3 mg L<sup>-1</sup>) in rooting step and in the acclimatization of substrate Coco pit and Perlite (50; 50 V). The number and the length of the shoots and number leaf in proliferation phase after subculture three (21 days between each subculture) and in rooting phase number and root length, leaf number, percent root and plantlets stem length evaluated.

**Results:** The results showed that the highest shoots proliferation ratio was obtained with 3.41 in MS medium containing 2 mgL<sup>-1</sup> of BAP and also the highest plantlets lengths 2.5, 2.33 and 2.29 cm, respectively was observed in three concentrations of 1, 2 and 3 mgL<sup>-1</sup> of BAP. The highest percentage of rooting (100%) and root length (2.12 cm) were recorded in DKW medium at concentrations of 1 and 3 mgL<sup>-1</sup> NAA, respectively. The acclimatization of plantlets to greenhouse conditions was successful. The highest rate of plantlets survival (about 50%) in DKW medium with concentrations 1 mg L<sup>-1</sup> of NAA was obtained in substrate Coco peat and Perlite (50; 50 V).

**Conclusion:** The composition of the culture medium and the concentration of growth regulator effect on the proliferation and propagation stone rootstock. In this experiment, optimum BAP and NAA concentrations was 2 and 1 mg L<sup>-1</sup> for proliferation and rooting of Myrobalan 29C, respectively. It should be noted that higher concentrations of 2 mg L<sup>-1</sup> BAP and NAA are not recommended for this plant. Usually, root production is affected by the synthesis, metabolism and auxin movement in the plant. Therefore acclimatization directly related to rooting quality and the highest rooting ratio.

**Keywords:** Culture medium, Growth regulator, Proliferation, Rooting

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## Study on the adaptability of the some Greek olive varieties in Tarom region

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### Abstract

**Background and Objectives:** Olive is one of the most important fruit trees in Zanjan province. Currently, Tarom County has the highest olive cultivation area in the country. Selection of suitable and compatible cultivars is one of the most important factors in the development of fruit trees cultivation in each region. Therefore, high yielding cultivars with favorable characteristics and adaptable to a special environmental conditions can be selected by investigating the diversity among different olive cultivars. This study was carried out to investigate the compatibility of six Greek olive cultivars for Tarom region.

**Materials and Methods:** This study was implemented during 2013 to 2015 in a randomized complete blocks design with three replications and six cultivars at Tarom Olive Research Station. The tested cultivars were Amphysis, Halkidiki, Megaron, Tiaki, Agromanaki and Patrini. Vegetative and reproductive characteristics such as tree height, tree width, TCSA, inflorescences per shoot, flowers per inflorescence, percentage of perfect flowers, percentage of fruit set and fruit characteristics such as fruit fresh weight, stone weight, pulp/stone ratio for 30 fruits per tree, fruit yield and oil content were measured. Fruit oil was extracted by using Soxhlet and Diethyl ether and the oil content was determined in dry and fresh matter. Data were analyzed using SAS statistical software.

**Results:** The results showed that there was a significant difference between cultivars for all vegetative and reproductive characteristics. Tiaki and Halkidiki cultivars had the highest tree height and canopy width, while the Megaron cultivar had the lowest height and canopy width. In terms of number of inflorescences per shoot, Patrini and Megaron cultivars were superior to others. Percentage of fruit set varied depending on the cultivar and showed significant differences among the cultivars. Tiaki cultivar with 1.88 and halkidiki cultivar with 0.52 percent had the highest and lowest fruit set, respectively. Fruit fresh weight varied from 1.71 g in Tiaki to 8.38 g in Halkidiki cultivar. The highest fruit yield was obtained from Halkidiki, while Agromanaki cultivar had the lowest yield. The highest fruit yield efficiency belonged to the Megaron cultivar. Amphysis and Tiaki cultivars had the highest oil percentage in dry matter.

**Conclusion:** According to the results, Halkidiki and Megaron cultivars are suggested as dual-purpose cultivars for commercial orchards at Tarom and climatically similar conditions due to higher yields, large fruits and appropriate oil percentages. Moreover, Megaron cultivar can be suitable for high density production systems due to its moderate growth and high yield efficiency.

**Keywords:** Compatibility, Cultivar, Oil, Olive, Yield

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## Effects of municipal solid waste compost and chemical fertilizers on concentration some of nutrients in soil, yield and nitrate accumulation in lettuce (*Lectuca sativa* L.) variety of Babel

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### Abstract

**Background and Objectives:** Evaluation of the possibility of integrated use of organic and inorganic fertilizers or gradual replacement of chemical fertilizers with organic manures is necessary due to environmental issues resulted due to application of chemical fertilizers. Well as increasing its quality value. This research was conducted to evaluate the municipal solid waste compost (MSW) as compared to chemical fertilizers on concentration some of nutrients in soil, yield and nitrate accumulation in Lettuce leaf.

**Materials and Methods:** This field research was conducted with MSW at 4 levels (0, 10, 20 and 30 t ha<sup>-1</sup>) and chemical fertilizers at four levels (0, conventional farmers, based on soil test and 25% lower than the soil test), in a factorial experiment based on a randomized complete blocks design with three replications in Kermanshah region during 2014-2015. Before seed sowing, physical and chemical characteristics of experimental site soil was analyzed with standard methods. Fertilizers were mixed with surface soil, thoroughly and weed control and sprinkler irrigation was done when necessary. Soil samples at post harvesting stage from each treatment plot was collected for determining organic carbon (O.C), N, P, K, Fe, Zn, Mn, Cu, Cd and Pb. Finally, yield, nutrients concentration and leaf nitrate rate were measured with conventional methods.

**Results:** The results showed that the different amounts of MSW and chemical fertilizers on yield, nitrate rate, nutrients concentration and their interaction effects on yield, nitrate rate had a significant at 1% (P<0.01) and also on the concentration of N, Fe, Zn and Mn in leaf at level 5% (P<0.05). The highest yield (35.6 t ha<sup>-1</sup>) and nitrate rate (749 mg kg<sup>-1</sup> DM) were obtained with the application of 10 t MSW ha<sup>-1</sup> and chemical fertilizers based on conventional farmers, and lowest of them was obtained with 22.8 t ha<sup>-1</sup> and 170 mg kg<sup>-1</sup> DM with control treatment, respectively. Also, the main effects of different amounts of MSW and chemical fertilizers on the concentration of most nutrients in soil was a significant at 1% (P<0.01) and their interaction effects on the concentration of O.C, Zn, Fe and Cu at 5% (P<0.05). The highest concentration of Zn, Fe and Cu with the application of 30 t MSW ha<sup>-1</sup> and chemical fertilizers based on conventional farmers was observed that their difference compared to the control treatment was 1.28, 3.16 and 1.24 mg kg<sup>-1</sup> soil, respectively.

**Conclusion:** According to the results of this study and considering the environmental problems and nitrate rate in leaf, the combined application of 10 t MSW ha<sup>-1</sup> and chemical fertilizers 25% lower than the soil test is recommended.

**Keywords:** Iron, Nitrate, Nitrogen, Phosphorus, Zinc

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## Effect of harvest time, nitrogen and plant density on yield and some physiological traits of pennyroyal (*Mentha pulegium* L.)

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### Abstract

**Background and Objectives:** Pennyroyal (*Mentha pulegium* L.) from Labiatae family, is widely used as a vegetable and medicinal herb. This plant commonly grows in the wet soils such as ditches, riversides and ponds. It is indigenous to the Central, Southern and Western Asia, North Africa, Ethiopia and the Canary Islands. It can also be found in Alborz, north and northeast regions of Iran. The aerial parts of the plant are used as pharmaceutical and flavoring substances. The aim of this research was to find the best level of nitrogen fertilizer regime, harvesting time and plant density for pennyroyal plant in Rasht area.

**Materials and Methods:** This study was conducted as a split-plot experiment based on randomized complete blocks design with three replications in Faculty of Agriculture, University of Guilan. The main plots included two harvesting times, the subplots were four levels of nitrogen fertilizer including control (without fertilizer), 50, 100 and 150 kg ha<sup>-1</sup> nitrogen and the sub-subplots were plant density at 3 levels; 10, 14 and 18 plants m<sup>-2</sup>.

**Results:** The results showed that triple interaction of nitrogen, plant density and harvest time had significant effect on dry weight. The highest dry weight (1909 kg ha<sup>-1</sup>) were obtained by 150 kg ha<sup>-1</sup> net nitrogen with the density of 18 plants per m<sup>2</sup> for the first harvest. Moreover, 50 kg ha<sup>-1</sup> nitrogen fertilizer treatment with 10 plants per m<sup>2</sup> showed lowest amount of dry weight (396.66 kg ha<sup>-1</sup>) in the second harvest time. However, the interaction of nitrogen and planting density revealed significant effect on fresh yield and leaf area. The highest yield (8071 kg ha<sup>-1</sup>) was related to 150 kg ha<sup>-1</sup> nitrogen treatment with the density of 18 plants m<sup>-2</sup>. About physiological traits, the results claimed that treatments significantly affected the essential oil percentage, total chlorophyll, total phenol, nitrogen and calcium elements. The highest essential oil content (2.66%) was exhibited by the treatment of 150 kg ha<sup>-1</sup> nitrogen with plant density of 10 plants m<sup>-2</sup>. In addition, the essential oil yield was also influenced by the interaction effect of harvest time and planting density. The highest yield (25665.075 milliliters ha<sup>-1</sup>) was found by the plant density of 18 plants m<sup>-2</sup> from the first harvesting time.

**Conclusion:** Finally, according to our results, the best treatment was first harvesting time, 150 kg ha<sup>-1</sup> nitrogen with the density of 18 plants m<sup>-2</sup>, which can be recommended for the planting program of aromatic pennyroyal.

**Keywords:** Biomass, Essential oil yield, Total phenol

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## Effects of gibberellic-acid and salicylic-acid on phytochemical characteristics, antioxidant capacity and nutrient elements of Bidane-Sefid grape

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### Abstract

**Background and Objectives:** Grape berry is an excellent source of natural pigments and contains a large amount of different antioxidant compounds. The main characteristic of modern grape production is its compliance with the requirements of the target market, such as improved grape quality and high nutritional value. In addition, seedless grapes are important. The seedless grape varieties were greatly appreciated for their good taste and customer preference in the global market both fresh and raisin. Therefore, in order to improve the biochemical characteristics of the grape (Bidane-Sefid cultivar), effects of spraying gibberellic acid and salicylic acid on some qualitative traits, anti oxidant and nutrient elements of berry were studied.

**Materials and Methods:** This experiment in a factorial experiment was conducted based on randomized complete blocks design with two treatments and three replications to evaluate some of the qualitative traits (pH, TSS, TA, glucose, fructose, fructose to glucose ratio), antioxidant compounds (total phenol, total flavonoid, total anthocyanin, vitamin C, antioxidant activity, PAL enzyme, polyphenol oxidase enzyme and nutrient elements of berry (N-P-K-Ca- Mg-S-Fe-Zn-Cu-Mn-Br). Treatments included gibberellic acid at three levels (0, 40 and 80 mg L<sup>-1</sup>) and salicylic acid at three levels (0, 75 and 150 mg L<sup>-1</sup>).

**Results:** The results showed that the treatments and their interaction effects on the studied traits were significant. But there was no significant effect of salicylic acid on the PAL enzyme. The amount of glucose and fructose of grape berries determined by HPLC were in the range of 88.66 to 151.74 and 72.92 to 132.66 (g kg<sup>-1</sup>), respectively. The highest total phenol content (43.77 mg 1ml<sup>-1</sup> e), total flavonoid content (1.51 mg 1ml<sup>-1</sup> e) and antioxidant activity by DPPH assay (86.02%) were observed in the interaction of sprayed samples with 40 mg L<sup>-1</sup> gibberellic acid and non-use salicylic acid. The highest anthocyanin content (3.51 mg 1ml<sup>-1</sup> e) and PAL enzyme activity (7.90 n mol cinnamic acid FW min<sup>-1</sup>) were observed in the interaction of sprayed berries with 80 mg L<sup>-1</sup> gibberellic acid and 75 mg L<sup>-1</sup> salicylic acid. Also, the results showed that the highest activity of polyphenol oxidase enzyme was observed in the interaction of treatment with 40 mg L<sup>-1</sup> gibberellic acid and 75 mg L<sup>-1</sup> salicylic acid. The highest of nitrogen (0.63%), phosphorus (0.14%), potassium (1.41%) and magnesium (0.05%) elements were found in the interaction of treatment with 80 mg L<sup>-1</sup> gibberellic acid and 75 mg L<sup>-1</sup> salicylic acid.

**Conclusion:** The results showed that the biochemical properties of grape berries can be improved using gibberellic acid and salicylic acid treatments. According to the results of this study, treatments containing gibberellic acid (especially GA40SA0) had more effects on the accumulation of antioxidant compounds and antioxidant activity than salicylic acid.

**Keywords:** Antioxidant activity, HPLC, Phenolic compounds, Plant growth regulators

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**Conclusion:** According to the obtained results it can be stated that the genotypes of ATRI 3856 and Atrak, with partial disease it is possible to have specific resistance genes. Therefore, due to the probability that the resistance will break in shorter time, it is needed to be careful about using such genotypes. The genotypes of Arom, IRA9, Zare, ATRI 9717, Morvarid and Ehsan in semi-resistance group have medium resistance. Therefore, they can be introduced to perform breeding programs or supply to farmers.

**Keywords:** Area under disease progress curve, Leaf rust, Yield decrease percentage



## Evaluation of resistance to leaf rust at adult stage in some bread wheat cultivars

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### Abstract

**Background and Objectives:** Among the important fungal diseases of wheat worldwide, there are three black, yellow and brown rusts that reduce its performance. Leaf rust caused by *Puccinia triticina* Eriks is one of the most destructive wheat diseases in some areas of the world including Iran, which in addition to reducing grain yield, also causes a quality deterioration. The purpose of this study was to evaluate a number of bread wheat cultivars based on traits and indices of leaf rust resistance due to the wheat yield at adult stage.

**Materials and Methods:** In this study, 41 bread wheat cultivars with susceptible Bolany cultivar was assessed under disease stress and non-stress conditions in the field of agricultural research center of Gorgan, Golestan. The experiment was evaluated under both without fungicide protection (stress) and with fungicide protection (non- stress) environments using a randomized complete blocks design with three replications, under mist irrigation. Resistance indices including infection type and area under disease progress curve (AUDPC) and morphological traits including spike length, No. spikelet per spike, No. grain per spikelet and 1000-grain weight, were evaluated under disease stress conditions and both conditions respectively.

**Results:** The analysis of variance showed that there was a significant difference among investigated cultivars this proved to be genetic variation and can be selection for leaf rust resistance. The results of composite analysis indicated that the leaf rust disease significantly affected spike length, No. grain per spikelet and 1000-grain weight. There was a positive and significant correlation (0.98) between infection type and AUDPC. The No. grain per spikelet percentage losses and 1000-grain weight percentage losses had positive correlation with resistance indices (infection type and AUDPC). Cluster analysis categorized the genotypes into four distinct groups. The resistance group consisted of ATRI 3856, Atrak. The semi-resistance group consisted of Frontana, ATRI9717, Gimaza, Arom, IRA9, ATRI 3315, Navid, Zare, 01C0204936, Morvarid, Ehsan and Gonbad. The semi-sensitive group consisted of TRI 15593, ATRI 15657, Yavaros, ATRI 537, ATRI 525, SARC 6W, ATRI 527, ATRI 23666 and Tajan. The sensitive group consisted of other genotypes. Based on resources, semi- resistance and semi- sensitive groups can be introduced in order to increase resistance to disease. 3-D plots among AUDPC, decrease percentage of No. grain per spikelet and 1000-grain weight distinguished genotypes of ATRI 9717, Arom, IRA9, Zare, Morvarid and Ehsan as the most resistant genotypes and the least yield decrease percentage in the semi- resistance and semi-sensitive groups.

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## **Evaluation of climate change effects and adaptation strategies on grain yield and water use efficiency of irrigated wheat (*Triticum aestivum*): A case study in Khorasan Razavi province**

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### **Abstract**

**Background and Objectives:** Among the field crops in Iran, wheat is one of the most importance crops and it is anticipated that country demand to this crop will be increased in the future. On the other hand, to improve the resilience and efficiency of agricultural systems, it seems to be urgent to anticipate the effects of climate change (changes in CO<sub>2</sub>, temperature and rainfall) on crops particularly on wheat in arid and semi-arid regions. So, this study was conducted to simulate yield and water use efficiency of wheat in four locations in the future (2050).

**Materials and Methods:** In this research, future projection (2050) was conducted in four locations in Khorasan Razavi province (Ghoochan, Gonabad, Sabzevar and Torbate Heydariyeh), Iran by using long term climate data at baseline (2010-1980) under two emission scenarios (RCP4.5 and RCP8.5). Future climatic scenarios were produced using the delta scenario of the CMIP5 General Circulation Model (GCM) and the climate scenario generation tools in R as introduced in the Agricultural Model Inter comparison and Improvement Project (AgMIP). A Global Circulation Model (MPI-ESM-MR) was applied. APSIM-Wheat model was used to simulate growth, yield and water use efficiency of wheat. Regarding CO<sub>2</sub> concentration, two scenarios were considered: CC scenario (climate change along with increasing CO<sub>2</sub> concentration) and FC scenario (climate change without increasing CO<sub>2</sub> concentration).

**Results:** Simulated results showed that average of growth season temperature in study locations in future will be increased by 1.6 °C and rainfall will be decreased by 5.85 percent, in comparison with baseline. In CC, the average of yield increased 4.91 percent under RCP4.5 and 4.77 percent under RCP8.5. However, in FC the average of yield decreased (except Gonabad) 4.98 and 7.56 percent under two RCPs, respectively. In addition, water use efficiency in CC increased by 12.21 and 15.35 percent for RCP4.5 and RCP8.5, respectively. However, under FC, WUE increased 0.33 percent for RCP4.5 and decreased 0.41 percent for RCP8.5. Also, the finding of this study suggested that changing sowing date as two weeks earlier in Gonabad and Sabzevar will increase yield and water use efficiency and two weeks later in Torbate Heydariyeh will relief the decreased yield.

**Conclusion:** Results of the current study showed that if the climate change accompanied with increasing CO<sub>2</sub> concentration, the negative effect of climate change on wheat growth and yield would be compensated. Also, changing sowing date in future will have further positive impacts on wheat yield and water use efficiency.

**Keywords:** AgMIP, APSIM-Wheat, Climate change, Sowing date

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## The effect of grapevine training systems on grape yield quality and quantity of *Vitis vinifera* cv. Red Sultana (A five years record)

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### Abstract

**Background and Objectives:** There are various grapevine-training methods in the world because of the high formability of grapevine. These methods are vary depending on the variety, type of use, climatic conditions of the area, mechanization and economic issues in each region. Some studies have shown that the type of training system affects the quantitative and qualitative yield of grape varieties. The aim of present study was to determine the effect of training systems on the yield quantitative and qualitative of grapevine cv. Red Sultana.

**Materials and Methods:** Eight grapevine training systems including High Cordon, Medium Cordon, Low Cordon, Geneva, Guyot, Traditional, Head and Wye (Y) were considered. The research was carried out in a randomized complete blocks design with three replications and six plants per plot for five years at Takestan grape research station. Quantitative and qualitative traits of the fruit, such as yield, raisin yield, cluster around, cluster diameter, cluster length, berry length and berry width, pH of the fruit extract, total soluble solids (TSS) and titrable acidity of fruit extract (TA) were recorded. Graphical analysis technique was used to determine the best training system.

**Results:** Yield, berry diameters, TA, TSS, raisin yield and ripening were significantly more affected by the type of training system than other traits ( $P < 0.05$ ). The highest fruit yield (19.8 kg/plant) and raisin yield (6.9 kg/plant) were obtained in high Cordon training method. The highest average length and width of the berry were in the high Cordon system. The highest (24.6 degrees of Brix) and lowest of TSS (21.9 degrees of Brix) were recorded in low Cordon and traditional systems, respectively. The total acidity of the fruit juice was the highest in the high Cordon system and lowest in the traditional systems. The highest rate of sugar/acid was in the traditional system. Y and low Cordon systems were the earliest and traditional system was the longest of the fruit ripening point of view. High Cordon training system was the closest system to the optimum point of all studied traits.

**Conclusion:** The results of this study showed that the type of grapevine training system affected the fruit and raisin yield, the berry diameter, the TSS and TA of the fruit juice and the ripening. Therefore, the yield and quality of the fruit can be managed by choosing the appropriate grapevine training system, which high Cordon system was the best system for grapevine cv. Red Sultana training in the Takestan region.

**Keywords:** Cordon, Grape, Ideal system, Principle components

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## Investigating the effect of glycine betaine and humi-forthi on morpho-physiological and biochemical properties *Pelargonium graveolens* under water stress

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### Abstract

**Background and Objectives:** *Pelargonium graveolens* is a medicinal plant used in the medical, cosmetic and food industries. On the other hand, the water shortage and its impact on plants is an eminent environmental factor. In this regard, the disadvantages of water stress can be alleviated by growth and bio stimulators. The aims of this study was to evaluate the effect of glycine betaine and humi-forthi on morpho-physiological and biochemical properties of *Pelargonium graveolens* under water stress.

**Materials and Methods:** For this purpose, water stress was applied in three levels (100% field capacity (FC), 70% FC and 40% FC) and foliar application used in five levels (control, 2.5 mg/l humi-forthi, 5 mg/l humi-forthi, 50 mM glycine betaine and 100 mM glycine betaine) as factorial based on completely block design in three replications. The traits investigated in the study were plant height, root/shoot ratio, canopy temperature, chlorophyll content, SOD activity, proline, essential oil percent, yield and composition.

**Results:** Analysis of variance showed that the simple effect of water stress and foliar application was significant on all traits including plant height, root/shoot ratio, canopy temperature, chlorophyll content, SOD activity, proline, essential oil percent and yield. However, the interaction of water stress and foliar application was significant on root/shoot ratio, canopy temperature, SOD activity and essential oil yield. Also, 40% FC significantly decreased plant height, chlorophyll content, essential oil percent and yield. In contrast, canopy temperature, SOD activity and proline increased by applying 40% FC. Foliar application with 100% glycine betaine increased plant height, essential oil percent and yield, while decreased proline. The main essential oil compositions were  $\beta$ - citronellol, citronellyl formate and geraniol.

**Conclusion:** The interaction of 100% FC and glycine betaine was selected as the most appropriate treatment in improving the morpho-physiological and biochemical properties of *Pelargonium graveolens* under water stress. Although humi-forthi is a combination of some free amino acids, it could not have a significant impact relative to glycine betaine. Finally, we can maintain the water need of plant up to 70% FC and use the glycine betaine 100 mM to reduce the adverse effects of high water stress.

**Keywords:** Essential oil, Foliar application, Irrigation, Medicinal plant

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## Ultrasonic waves effect on germination, $\alpha$ amylase activity, antioxidant enzymes, sugars and chlorophyll on *Echinacea purpurea* L.

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### Abstract

**Background and Objectives:** coneflower seeds germination is low and non-uniform. One reasons for low germination of coneflower seeds is low permeability of internal membranes. Seed priming is very simple procedures which can improve germination and seedling establishment. One of the biophysical ways of seed priming is pretreatment of seeds with ultrasound waves. Continuing wave beating increases the permeability, enhances water absorption and temperature of seeds. Increasing imbibition rate accompanies with speedy changes in seed metabolism. This experiment was aimed to study the ultrasonic wave's effect on germination,  $\alpha$  amylase activity, sugars, chlorophyll, hydrogen peroxide and some antioxidant enzymes in germination and seedling stages of coneflower.

**Materials and Methods:** The experiment was conducted as completely randomized design with 5 treatments and 4 replications in Agriculture Faculty of Shahrood University of Technology in 2017. Treatments were ultra-sonic wave durations including 0, 10, 15, 20 and 25 min by ultra-sonication device, Then germination percentage, germination rate ( $R_{50}$ ), seed reserve use efficiency (SRUE), seedling dry weight,  $\alpha$  amylase activity, total sugar, reducing sugars, non-reducing sugars, ratio of non-reducing to reducing sugars, electrical conductivity, hydrogen peroxide, CAT, GPX, PPO, G-ST and Chl a and b measured.

**Results:** The highest amount of germination percentage from 15 min and the maximum of  $R_{50}$  from 15 and 25 min seed pretreatment by ultra-sonic waves obtained. All treatments increased  $\alpha$  amylase activity, total sugar and non-reducing sugars concentration compared to the control. The highest amount of the SRUE in 15 and 10 min pretreatment with mean about 0.80 mg and the lowest of it in control treatment with mean of 0.59 mg in seed observed. The highest amount of seedling dry weight in 15 min with average of 0.665 g and the lowest of it in control treatment with average of 0.0467 g obtained. Reducing sugars in treatment of 25 min with average of 405.5  $\mu$ g per g was at first level and control with mean of 318  $\mu$ g per g was at second level. The highest amount of non-reducing sugars in treatment of 15 min with average of 43.5 and the lowest of it in control with average of 16.9  $\mu$ g per g of FW obtained. Seed pretreatment with ultrasonic wave cause to increase electrical conductivity and hydrogen peroxide concentration in 15, 20 and 25 min than to control. In order to eliminate hydrogen peroxide CAT, GPX, GST and PPO activity in most treatments increased. The highest amount of GPX activity in 15 and 25 min obtained. The highest amount of CAT and PPO activity in 15 min obtained. The highest amount of GST activity in 15, 20 and 25 min obtained.

**Conclusion:** Coneflower seeds pretreatment with ultrasonic waves increased  $\alpha$ -amylase enzyme activity and then sugars concentration in most treatment increased. Continuous impact of ultrasound waves on seeds increased electrical leakage of seeds membranes and hydrogen peroxide concentration in 15, 20 and 25 minutes, in order to eliminate this stress CAT, GPX, GST and PPO activity in most treatment increased, which ultimately ultrasonic waves increased germination percentage,  $R_{50}$ , seedling dry weight and SRUE in most treatment compared to control.

**Keywords:** Chlorophyll, Seedling dry weight, Seed Reserve Use Efficiency, Sugars

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## Effect of light intensity in response to cold stress on morphological and physiological traits of stevia (*Stevia rebaudiana* Bertoni) medicinal plant

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### Abstract

**Background and Objectives:** Temperatures between 0 to 15 °C can cause physiological injury in plants. One of these injuries is increasing the generation of reactive oxygen that adversely affect the photosynthetic pigments, protein and thylakoid membrane lipids. Also, light affects on growth, development, plant productions including primary and secondary metabolites, so that leaf area, leaf area duration and plant biomass positively response to increasing light intensity while in low light intensity respiration rate is more than photosynthesis rate. Since light intensity can effect in plant resistance to environmental stress especially cold stress and stevia is sensitive to cold stress and it cannot tolerate temperature below 9 °C, therefore, the purpose of this study was to determine how vegetative and physiological traits and soluble sugar of the plant response to cold stress in different light intensities.

**Materials and Methods:** This study was done in a factorial arrangement based on a randomized complete blocks design with three replicates. Treatments were five levels of cold stress (0, 4, 8, 12 and 16 days) at 6±2 °C and three light intensity levels of normal light, 50 and 10% of normal light (240, 120 and 24 μm.m<sup>-2</sup>.s<sup>-1</sup>, respectively). The seedlings of stevia plant from in vitro were planted in the plastic pots after acclimation period (40 days). The seedlings were kept in favorite growth conditions at 20-24 °C and 15 h light photoperiod for 30 days. Then, the mentioned light and temperature treatments were applied. Then chlorophyll *a*, *b*, total chlorophyll, chlorophyll *a/b* ratio and carotenoid were measured. Also, plants were harvested and physiological traits and vegetative dry weights were measured. Finally, plant soluble sugar was measured by dry leaf sample.

**Results:** The results showed that root length, number of nodes, leaf area, leaf, root, shoot and total dry weights decreased as segmental model while stem dry weight decreased linearly when cold stress duration increased. Also, traits like leaf area, plant height, vegetative organs dry weight and soluble sugar content (from 10 to 48%) were decreased by reducing light intensity from 240 to 24 μm.m<sup>-2</sup>.s<sup>-1</sup>. Moreover, 16 days after cold stress in all light intensities, chlorophyll *a* (between 18 to 91%), *b* (between 16 to 76%), *a+b* (between 17 to 86%), *a/b* (between 1 to 60%) and carotenoid (between 16 to 91%) reduced as compared to the control in either segmental or linear models. The most reduction was recorded at low light intensity. Soluble sugar and total dry weight had the most correlation with leaf area and shoot dry weight, respectively.

**Conclusion:** The results demonstrated that physiological parameters are more sensitive to prolonged cold stress under lower light intensity.

**Keywords:** Chlorophyll, Cold stress, Light intensity, Soluble sugar, Stevia

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