



## Crops Improvement

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### Stomatal behavior of two rose cultivar under different light intensities

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#### Abstract

Light as an important environmental factor, influences many aspects of plant growth and development. Leaves are different in some characters including stomatal behavior under shade or light conditions. In this study, the effects of different levels of light intensity on stomatal behavior of two rose cultivars, 'Gulmira' and 'Red One' were evaluated under controlled conditions. To obtain different light intensities, green polyethylene nets were used. Treatments were light intensities of 1200 (Control), 640, 520 and 240  $\mu\text{mol}/\text{m}^2/\text{s}$ . Based on the results, the highest stomatal length and width were found in 640  $\mu\text{mol}/\text{m}^2/\text{s}$  in both cultivars. Regarding stomatal density, there were no significant differences among different levels of light intensities, although cultivar effect was significant. Therefore, stomatal density was higher in 'Gulmira' than 'Red One'. Also, stomatal conductance was significant only between cultivars, and there was no significant difference among light treatments. However there was an increasing trend of stomatal conductance with increasing light intensities.

**Keywords:** shading, stomatal conductance, stomatal density, stomatal length, stomatal width.



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### Determination of economic damage threshold of wild mustard (*Sinapis arvensis* L.) in competition with four wheat cultivars at Gorgan

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#### Abstract

For determination of economic damage threshold of four wheat (*Triticum aestivum* L.) cultivars in different densities of wild mustard (*Sinapis arvensis* L.), experiments were conducted at Agricultural Research Station Gorgan during 2010-2012. The experimental design consisted of four randomized complete blocks in a factorial arrangement. The treatments comprised of factorial combination of wild mustard densities and wheat cultivars. Five different densities of wild mustard (zero, four, eight, 16 and 32 plants.m<sup>-2</sup>) and four wheat cultivars ('Arta', 'Tajan', 'Mogan' and 'Morvarid') were considered in all the replications. Cousens hyperbolic equation was used to describe the yield reduction due to wild mustard competition. The maximum yield reduction was associated with high densities of wild mustard and among the cultivars, 'Arta' and 'Morvarid' had the maximum and minimum yield reductions, respectively. Calculated competitive indexes indicated that 'Morvarid' cultivar in competition with wild mustard had a high capacity to prevent yield loss (high tolerance) and on the other hand, dry weight and seed amount of weed was also greatly reduced. Using extended Cousens hyperbolic model and Odonovan formula, economic damage threshold for wheat in two years determined in densities of 4.11, 3.68, 2.33 and 2.11 plant/m<sup>2</sup> for 'Morvarid', 'Moghan', 'Tajan' and 'Arta' cultivars in climatic conditions of Gorgan.

**Keywords:** competition, economic threshold, wheat, wild mustard, yield loss functions.



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### Effect of cadmium on concentration of copper, iron, manganese and zinc in shoot of different cultivars of wheat

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Received: 19 May 2014

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#### Abstract

The aim of this research was to evaluate the average concentrations of micronutrients including: Copper (Cu), Iron (Fe), Manganese (Mn) and Zinc (Zn) in the shoots of different cultivars of wheat in stem elongation stage in a soil contaminated with cadmium (Cd). The treatments consisted of three levels of Cd (0 (as control, Cd<sub>0</sub>), 40 (Cd<sub>40</sub>) and 80 (Cd<sub>80</sub>) mg Cd/kg soil) and fourteen different cultivars of wheat ('Bahar', 'Alvand', 'Niknezhad', 'Pishtaz', 'Azadi', 'Shahriyar', 'Pishgam', 'Marvdasht', 'Parsi', 'Sivand', 'Shiraz', 'Omid', 'Roshan' and 'Navid'), respectively. The results showed the effect of Cd on concentrations of micronutrients were highly significant. Cu concentration was decreased in shoot of all studied cultivars, as levels of Cd were increased. Except two cultivars ('Pishgam' and 'Omid') which showed an increase in Fe concentration in Cd<sub>40</sub> comparing with control, Fe concentration was decreased in other cultivars. Most and least Cd concentration in Cd<sub>40</sub> was recorded by Niknezhad (7 mg/kg DW) and Parsi (2 mg/kg DW), respectively. Also, most and least Cd concentration in Cd<sub>80</sub> was observed in 'Pishgam' (20 mg/kg DW) and 'Navid' (6 mg/kg DW). Generally, 'Niknezhad' and 'Pishgam' had the highest reliability of cadmium uptake. Also the lowest reliability of cadmium uptake was observed about 'Parsi' and 'Navid'.

**Keywords:** food safety, heavy metals, micronutrients, toxicity.



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### Investigation of energy balance in castor bean cultivation in Varamin county for biodiesel production

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#### Abstract

Castor bean (*Ricinus communis* L.) with a capability to withstand harsh conditions, low nutritional needs, 50 percent of oil content and high- quality, is one of the best crop used to produce biodiesel. The first step toward introduction and widespread cultivation of this crop is to investigate the energy balance for its cultivation. To do so, energy input (include renewable and nonrenewable) and output were calculated through an examination of all inputs during two consecutive years of cultivation (2012-2014) in Varamin county in Tehran province. Energy indicators were also assessed. Result showed Indirect, non-renewable sources of energy with 59.68 and 80.86 percent of 11245.64 MJ energy consumption, comprise the major part of the consumable energy in castor bean cultivation. Moreover, among inputs fertilizers and pesticides with the share of 55.26 percent of the total consumable energy considered as the highest energy inputs. Fuels with the share of 21.28 percent formed placed at the second rank of consumable energy. Energy use efficiency in seed production was calculated to be 3.81, which is a considerable amount when compared with other crops used to produce biodiesel. Therefore, in order to expand the cost efficient and mechanized system of castor production, breeding of the current local ecotypes is recommended.

**Keywords:** bioethanol, biofuels, energy, input, net gain, output.



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### Effect of glycine betaine on chilling tolerance of cucumber seedlings

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Received: 03 March 2013

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#### Abstract

Glycine betaine (GB) is one of the osmotic plant-protecting members that accumulate in response to abiotic stresses. An experiment was, therefore, conducted to test whether GB application at various concentrations (0, 10, 20 and 30 mM) through seed soaking or foliar spray methods would protect cucumber seedlings, subjected to chilling stress. At two true leave stages, after GB treatment, the seedlings were exposed to chilling six h/day at 3°C for 6 days. Results showed that GB pre-treatment improved growth parameters of seedlings subjected to chilling stress and provided significant protection against chilling stress compared to non-GB-treated seedlings. GB prevented chilling injuries with increasing chlorophyll, proline content and antioxidant activities and decreasing electrolyte leakage, malondialdehyde and hydrogen peroxide content. The highest cold tolerance was obtained with 20 and 30 mM GB application and seed soaking method provided better protection compared to foliar spray method.

**Keywords:** antioxidant activity, electrolyte leakage, *Hydrogen peroxide*, *Malondialdehyde*, proline content.



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### Evaluation of insect's fauna diversity and agronomical yield, in intercropping coriander (*Coriandrum sativum* L.) and faba bean (*Vicia faba* L.)

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Received: 25 January 2014

Accepted: 3 June 2014

#### Abstract

In order to evaluate the density, population and insect fauna diversity and agronomical yield in intercropping faba bean (*Vicia faba* L.) and coriander (*Coriandrum sativum* L.), a field experiment was conducted based on a randomized complete block design with three replications at the farm located in Nagadeh, West Azerbaijan province, Iran during growing season in 2012-2013. Treatments included 75 percent faba bean + 25 percent coriander, 50 percent faba bean + 50 percent coriander, 25 percent faba bean + 75 percent coriander and their monoculture. Results showed that the maximum population of pest obtained under monoculture, while the maximum population of biological predators was observed under 50 percent faba bean + 50 percent coriander, respectively. The highest seed yield and biological yield of faba bean were obtained in monoculture and the lowest grain yield and biological yield were achieved in 75 percent faba bean + 25 percent coriander, respectively. The results showed that the maximum seed yield and biological yield of coriander were obtained at monoculture, and the minimum seed yield and biological yield of coriander were achieved in 75 percent faba bean + 25 percent coriander, respectively. There was no significant difference between treatments in the essential oil percentage but the highest essential oil yield was higher than other treatments. The highest (1.58) and the lowest LER (1.40) values was obtained from 75 percent faba bean + 25 percent coriander and 50 percent faba bean + 50 percent coriander, respectively.

**Keywords:** biological predators, essential oil, land equivalent ratio, pest, shannon-wiener index.



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### Effect of preharvest application salicylic acid on physicochemical characteristics of apricot (*Prunus armeniaca* L.) fruits cv. 'Shamlou' during storage

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Received: 2 February 2014

Accepted: 22 July 2014

#### Abstract

To determine the effects of pre-harvest salicylic acid (SA) treatments on postharvest life and quality of apricot fruits, four different concentrations (one, 1.5, three and 4.5 mM) were applied six days before harvesting of apricot fruits cv. 'Shamlou'. Fruits harvested at commercial maturity stage and stored at 2°C with 90 percent RH on the same day for a period of three weeks. The fruit was evaluated for weight loss, flesh firmness, total soluble solid (TSS) contents, titratable acidity (TA), ascorbic acid contents, total phenolic contents and total flavonoids in treated and nontreated fruits. Results showed that salicylic acid treatments significantly exhibited weight loss and flesh firmness compared with control. At the end of storage, the highest ascorbic acid content and total phenolic content was observed in 4.5 mM SA treated fruits. The highest flesh firmness, titratable acidity and flavonoids were observed at three mM SA treated fruits and at the end stage of storage. The lowest weight loss, TSS and pH were recorded at 3mM SA treated fruits.

**Keywords:** flesh firmness, postharvest life, total flavonoids, total phenolic, weight loss.



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### Effects of fertilizer treatments on yield quantity and quality of coriander

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Received: 6 May 2014

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#### Abstract

To investigate the effects of mycorrhizal fungi, phosphatic biofertilizer and manure application on yield and quantitative and qualitative criteria of coriander an experiment was conducted at Khoramabad during growing season of 2013. The experiment design was applied as factorial layout based on a randomized complete block design with 18 treatments and three replications. The factors were mycorrhizal inoculation in two levels (non-inoculation and inoculation), phosphate biofertilizer in three levels (zero, 35 and 70 kg/ha) and manure in three levels (10, 20 and 30 ton/ha). Result indicated that mycorrhizal inoculation and phosphate biofertilizer had significant (one percent) effects on plant height, inflorescence number per plant, 1000 seed weight, seed yield, biomass yield, essential oil and essential oil yield of coriander. Mean comparison showed that the highest effects among factors were obtained by mycorrhizal inoculation on all parameters. The highest seed yield (1780.67 kg/ha), biomass yield (3831.7 kg/ha) and essential oils (0.4 percent) were obtained of inoculation with mycorrhiza, consumption of 70 kg/ha phosphate biofertilizer and 20 ton/ha manure and they were 80, 51 and 135 percent more efficient than chemical control, respectively. Positive and synergistic interactions were obtained between mycorrhizal inoculation  $\times$  phosphate biofertilizer on seed yield.

**Keywords:** biofertilizer, coriander, essence, manure, mycorrhiza.





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### Effects of zinc application and biofertilizers on nodulation, yield and some growth characteristics of soybean

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Received: 15 March 2013

Accepted: 3 September 2014

#### Abstract

To study the effects of nano-zinc oxide and seed inoculation with brady rhizobium and plant growth promoting rhizobacteria on yield and some agronomic traits of soybean, a factorial experiment based on randomized complete block design with three replications was conducted in 2013 at the research farm of the Islamic Azad University, Ardabil Branch. Treatments were foliar application of nano-zinc oxide at four levels (zero, 0.3, 0.6 and 0.9 gr/litr) and seed inoculation with *brady* rhizobium and plant growth promoting rhizobacteria at five levels (without inoculation as control, seed inoculation with *brady Rhizobium japonicum*, seed inoculation with *brady* rhizobium *R. japonicum* + *Azospirillum lipoferum* strain OF, seed inoculation with *brady Rhizobium japonicum* + *Pseudomonas putida* strain 41, seed inoculation with *brady Rhizobium japonicum* + *Azospirillum lipoferum* + *Pseudomonas putida*. The results showed that maximum of plant height, grain 100 weights, the number of nodules per plant and grain yield, total dry matter (530 gr/m<sup>2</sup>), crop growth rate (9.48 gr/m<sup>2</sup>.day) and relative growth rate (0.1 gr/gr.day) were obtained at foliar application of 0.9 gr/litr nano-zinc oxide + seed inoculation with rhizobium + *Azospirillum* + *Pseudomonas* and the least of these indices were obtained at without foliar application of nano-zinc oxide + seed inoculation. It seems that using 0.9 gr/lit of nano-zinc oxide × seed inoculation with rhizobium and PGPR could increase the grain yield and some agronomic traits of soybean and can be recommended to the growers.

**Keywords:** nano-zinc oxide, PGPR, rhizobium, seed inoculation, soybean.



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### Effect of some Amino acids on increasing of the microtuberization potato (cv. Agria)

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Received: 01 March 2014

Accepted: 13 June 2014

#### Abstract

Due to the importance of production and propagation of virus-free potato plants, some of the factors involved in the propagation of potato (plantlet production and virus-free *in vitro* microtuberization) has been studied. In most reports, adding a mixture of amino acids play an important role in plant tissue culture and development of the explants in many cases increase. This experiment was conducted in a completely randomized design with three replications to investigate the effects of glutamine, arginine, asparagine, cysteine and their combinations on microtuberization of potatoes. Lateral buds from *in vitro* shoots were cultured on MS medium under sterile conditions. Cultures were kept in constant darkness and temperatures of  $17\pm 2^{\circ}\text{C}$  in a germinator. During the first month of culture microtuberization rate and after two months other microtuberization traits such as microtubers weight was measured. Analysis of variance showed that all traits except microtuber without rest were significantly affected by four amino acids. In this study, arginine in combination with asparagine had a positive role in improving the most important characteristics such as weight and microtuberization rate.

**Keywords:** arginine, asparagine, dormancy, microtuberization rate, weight of microtuber.



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### The role of planting date, foliar application of benomyl fungicide and potassium silicate in increasing seed quality of soybean cv. Williams

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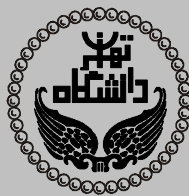
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#### Abstract

This study was conducted to investigate the effects of planting date, foliar application of benomyl fungicide and potassium silicate in improving the quality of soybean (cv. Williams) seed in Gorgan during 2011 and 2012. In the first year (2011), the experimental treatments were including planting dates (April 20, May 13, June 3, June 29 and July 22) and foliar application of benomyl fungicide (used at R<sub>3</sub> + R<sub>6</sub> or unused) and in the second year (2012) were including planting dates (May 1 and July 7), foliar application of benomyl fungicide, silicon (Si) and silicon + benomyl. Water-soluble potassium silicate as silicon supply, in three stages (V<sub>6</sub>, R<sub>1</sub> and R<sub>4</sub>), at the concentration of 40 grams per liter was sprayed on the leaves. The results showed that an increase in air temperature during seed filling period (R<sub>5</sub>-R<sub>7</sub>) in the early planting dates is the most important factor in reducing seed quality. Also, a significant negative correlation was observed between seed infection by *Phomopsis* sp. and *Nigrospora* sp. and seed germination and vigor. Delayed planting by reducing the temperature during seed filling period and seed infection by this pathogenic fungi, increased seed quality. Foliar application of benomyl fungicide and potassium silicate by reducing seed infection by pathogenic fungi, improved the quality of soybean seeds. Thus, the delay in planting of precocious cv. Williams, foliar application of potassium silicate and benomyl fungicide in reproductive stages can be advised as the strategies to enhance the seed quality of this cultivar to the farmers and seed producers in Gorgan.

**Keywords:** fungicide, *Phomopsis* sp., potassium silicate, seed quality, temperature.



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### Evaluation the effect of nano-iron fertilizer in compare to iron chelate fertilizer on qualitative and quantitative yield of saffron (*Crocus sativus* L.)

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Received: 10 May 2014

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#### Abstract

To evaluate the effect of nano-iron chelate and also to make a comparison with effect of EDDHA iron chelate on saffron, an experiment was conducted as factorial based on a randomized complete block design with six treatments and three replications in Shahed University, Tehran in 2011 and 2012. Treatments included iron fertilizer (Nano chelate and common chelate) in three levels (zero, 450 and 900 g/ha iron). The results showed that all traits except carotenoid, chlorophyll a concentration and leaf width affected by type and amount of iron fertilizer or their interaction. Saffron yield increased by both iron sources (about 50 percent). Application of 10 kg/ha of nano-iron chelate fertilizer, increased dry stigma yield, fresh flower weight, flower number, leaf number, main corm diameter and total corm weight of saffron compared to control though they were in some cases two times compared to control. Totally, results indicated more effectiveness of nano-iron at five kg/ha nano iron chelate fertilizer and 10 kg/ha common iron chelate fertilizer had the same effects on most of the traits. It seems that soil Fe deficiency and nano chelate efficacy in slow releasing may lead to saffron yield increment.

**Keywords:** corm, crocin, picrocrocine, saffron, stigma yield



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### Effect of nano titanium oxide, nano zinc and multiwall carbon nano tube on yield and yield components of green gram (*Vigna radiata*)

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Received: 05 May 2014

Accepted: 11 December 2014

#### Abstract

Effect of nano titanium oxide, nano zinc and multiwall carbon nano tube on yield and yield components of green gram was carried out in Kohkiluyeh-Boyerahmad province, Iran with 30 degrees 45'N and 50 degrees 44' in 2013 growing seasons. The experiment was arranged as factorial in a completely randomized block design with three replications, treatments including: four concentrations (zero, 50, 100 and 200 mg/l) of above nano particles, were spraying on green gram plants at 4-2 leaf, 8-6 leaf stages and pod stage. The results showed all of nano particle treatments had significant effect on some yield components of green gram plants. Concentrations of multiple carbon nano tube at 50, 100 and 200 mg/l had significant effect on number of pod/plant, seed thousand weight and biological yield, also nano titanium oxide at 50 mg/l had positive effect on grain yield. The harvest index, the number of grain/pod and seed protein percent was higher under 50 and 200 mg/l of nano zinc treatments. In conclusion, the spraying of 50 mg/l of above nano particles had the highest effect on yield and its components of green gram.

**Keywords:** green gram, nano particles, protein percent, yield.



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### Evaluation of relay intercropping of sunflower (*Helianthus annuus* L.) and faba bean (*Vicia faba* L.) on their yield and land use efficiency

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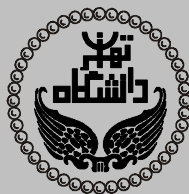
Received: 16 March 2014

Accepted: 17 June 2014

#### Abstract

To evaluate the yield components, yield and land equivalent ratio affected by relay intercropping of sunflower (*Helianthus annuus* L.) with faba bean (*Vicia faba* L.), a field experiment was arranged based on a randomized complete block design with three replications at the Agricultural Research Station Payamenoor University of Nagadeh, Iran during growing reason of 2012-2013. The treatments included row intercropping (one row of sunflower + one row of faba bean), strip intercropping (two rows of faba bean + four rows of sunflower, four rows of faba bean + two rows of sunflower, three rows of faba bean + three rows of sunflower) and monoculture faba bean and sunflower. The results indicated that the relay intercropping patterns had significant effect on studied traits of sunflower and faba bean (except number of seed per pod of faba bean). The highest seed yield of sunflower (4140 kg/ha) and faba bean (2567.33 kg/ha) were obtained from row intercropping and the lowest seed yield of sunflower (3136.67 kg/ha) and faba bean (1957 kg/ha) were obtained in their monoculture. The oil percentage of all intercropping treatments was higher than monoculture. The maximum land equivalent ratio (1.85) and actual yield loss (1.74) were calculated in row intercropping and the highest intercropping advantage (1.25) was achieved in four rows of faba bean + two rows of sunflower. The results showed that the use of relay intercropping results in better utilization of environmental resources and increased crop production compared to monoculture of the same species.

**Keywords:** actual yield loss, intercropping advantage, land equivalent ratio, oil percentage, seed yield.



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### Effect of salinity stress on growth characteristics and concentrations of nutrition elements in almond 'Shahrood 12', 'Touno' cultivars and '1-16' genotype budded on GF<sub>677</sub> rootstock

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Received: 5 April 2014

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#### Abstract

The types of scion-rootstock compound and level of salinity affect on growth characteristics and concentration of nutrition elements of almond leaves and roots. In order to evaluate the effect of salinity stress on vegetative traits and concentration of nutrition elements of leaves and roots almond genotypes, a experiment was carried out with two factors; cultivar in four levels including 'Shahrood 12', 'Touno', '1-16' budded on GF<sub>677</sub> rootstock and GF<sub>677</sub> and water salinity in five levels including zero, 1.2, 2.4, 3.6 and 4.8 g/l of sodium chloride salt (with the electrical conductivity of 0.5, 2.5, 4.9, 7.3 and 9.8 ds/m, respectively). The result showed that with increasing salinity concentration, branch height, branch diameter, and number of produced leaves and percentage of green leaves have been reduced but percentage of necrotic leaves and percentage of downfall leave were increased. The result showed that in the total genotypes studied, the highest rate of Na<sup>+</sup> (2.12%), Cl<sup>-</sup> (4.94%), ratio Na<sup>+</sup>/K<sup>+</sup> (2.03%), ratio Na<sup>+</sup>/Ca<sup>++</sup> (1.92%), ratio Na<sup>+</sup>/Mg<sup>++</sup> (6.81%), ratio Na<sup>+</sup>/P (14.07%), and the lowest rate of Ca<sup>++</sup> (1.06%), Mg<sup>++</sup> (0.33%), P (0.146%), Zn<sup>++</sup> (32.7 ppm), Cu<sup>++</sup> (9.33 ppm), in leaves was observed in treatment 9.8 ds/m of NaCl. The result showed that type of scion was affected in obstruction of Na<sup>+</sup> absorption by the roots and their transported to leaves. In the total level of salinity studied, 'Shahrood 12' was the lowest rate of Na<sup>+</sup>, Cl<sup>-</sup>, ratio Na<sup>+</sup>/K<sup>+</sup>, ratio Na<sup>+</sup>/Ca<sup>++</sup>, ratio Na<sup>+</sup>/Mg<sup>++</sup>, ratio Na<sup>+</sup>/P and the highest ratio Cl<sup>-</sup>/Na<sup>+</sup>. Also, this cultivar can tolerate high level of salinity (7.3 ds/m), by increasing content of K<sup>+</sup> (1.65%), Cu<sup>++</sup> (9.62 ppm), Fe<sup>++</sup> (22.30 ppm), Zn<sup>++</sup> (50.45 ppm) more than other genotypes studied in this research, to deal with the devastating effects of Na<sup>+</sup>. Overall, 'Shahrood 12' was recognized as the most tolerant cultivar to salinity stress.

**Keywords:** almond, GF<sub>677</sub>, macronutrients, micronutrients, salinity stress, 'Shahrood 12'.



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### Determination of temperature-related parameters and response ranges of Almlookhiyeh (*Corchorus olitorius* L.) seeds and seedlings using nonlinear regression

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#### Abstract

Almlookhiyeh (*Corchorus olitorius* L.) was known in the world as a valuable medicinal plant that was produced for the first time in Iran in 2011. This study was aimed to quantify germination response of Almlookhiyeh to temperature. For this purpose, seeds were exposed to different constant temperatures (10, 15, 20, 25, 30, 35, 40, 45 and 50°C) in Seed Research Lab, Gorgan University of Agricultural Sciences and Natural Resources in 2011. Results showed that the effect of temperature on the maximum germination percentage (MGP), germination rate ( $R_{50}$ ), germination uniformity (GU), and time to 10, 50 and 90 percent germination as ( $D_{10}$ ), ( $D_{50}$ ) and ( $D_{90}$ ), the percentage of normal seedlings (NS%) and seedling length (LS) was highly significant. Assessment of three nonlinear regression models including segmented, dent-like and beta models based on 10, 50 and 90 percent germination revealed that beta model was superior to other models. Based on the superior model (Beta), base, optimum and ceiling temperatures were estimated as 10.18, 37.31 and 50°C, respectively. Biological hours also were calculated as 13.56 hours. Using beta model to regress seedling length against temperature and normal seedling percentage versus temperature showed that seedling emergence, the maximum seedling length and the highest normal seedling percentage were occurred at 11 to 44, 35.34 and 31°C, respectively.

**Keywords:** almlookhiyeh, beta model, biological time, cardinal temperatures, normal seedling.





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### Using nonlinear regression models to quantify germination response of annual savory (*Satureja hortensis* L.) to temperature and water potential

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#### Abstract

This study was conducted to quantify germination response of annual savory (*Satureja hortensis* L.) to temperature and water potential. For this purpose, seeds were exposed to different temperature (12, 15, 20, 25, 30, 35, 37 and 40°C) and water potential (zero, -0.1, -0.3, -0.5 and -0.7 MPa) treatments in Seed Research Lab., Gorgan University of Agricultural Sciences and Natural Resources in 2013. Results indicated that temperature and water potential and interacted effects had significant effect on maximum germination percentage, germination rate (reciprocal time to 50 percent germination), and time to 10, 50 and 90 percent germination. Along with water potential decrement, both germination percentage and rate decreased. With temperature increasing to optimum temperature, both germination percentage and rate increased, while it decreased from optimum temperature onward. Assessment of three nonlinear regression models including segmented, dent-like and beta models revealed that the last one was selected as the superior model. Based on the superior model (Beta), base, optimum and ceiling temperatures were estimated as 7.56, 23.98 and 40°C, respectively. Biological hours for control treatment (zero potential water) were calculated as 91.17 hours. Cardinal temperatures were not affected by water potential, but biological hours for germination was delayed as 17.64 hours per each unit water potential increment.

**Keywords:** beta model, biological time, cardinal temperatures, dent-like model, segmented model.



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### Effect of putrescine and spermine spraying on increasing vase life of alstroemeria (cv. 'Sukari')

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#### Abstract

In order to study the effect of pre and postharvest polyamines spraying on increasing vase life of alstroemeria (*Alstroemeria aurantica* cv. Sukari), an experimental was conducted on completely randomized factorial design with two types polyamines (putrescine, spermine) in four levels (zero, five, 10, 15 and 20 mg/l). Results showed that, 20 mg/l of putrescine and spermine treatments increased vase life to 19 and 20 days, and 10 mg/l increased vase life to 14 and 18 days, respectively. Putrescine and spermine treatments had a significant effect on leaf chlorophyll index in three stages of sampling. In the first stage of sampling, 20 mg/l putrescine concentration and 10 and 20 mg/l spermine concentration had a significant effect on fresh and dry weight. Concentrations of putrescine and spermine (10 and 20 mg/l) significantly increased catalase enzyme activity in the first and second stage of sampling and spermine effect was more than putrescine. Treatment of 20 mg/l spermine significantly increased superoxide dismutase enzyme activity and increased its activity until third stage of sampling. Putrescine and spermine significantly decreased chlorophyllase, pectinase and phenoloxidase and best treatment was 20 mg/l spermine. Treatments of putrescine and spermine (10 and 20 mg/l) had significant effect on increasing membrane resistance in the first and second stage of sampling. According to results it can be said that, spermin 20 and putrescine 10 mg/l had most effect on increasing vase life and decreasing senescence of alstroemeria flowers. Spermin was more effective than putrescine in increasing vase life of alstroemeria flowers.

**Keywords:** catalase, chlorophyllase, pectinase, phenoloxidase, superoxide dismutase.



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### Evaluation relationships between seed number, used water in evapotranspiration and leaf relative water content with canola seed weight

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#### Abstract

To study the effects of used water in evapotranspiration, seed number per unit area and leaf relative water content on seed weight of canola (*Brassica napus* L.), an experiment was conducted as a randomized complete block design, arranged in a split-plot under two conditions, i.e. supplemental irrigation and rainfed in 2005-7. Two cultivars of canola ('Hyola401' and 'RGS003') as subplots were grown at five sowing dates as main plots, spaced 30 days apart. There was a linear relationship between seed weight and used water in evapotranspiration. Irrigation increased seed weight and seed yield significantly. The mean 1000- seed weight under irrigation and rainfed conditions was 3.2 and 2.7g in 2005-6, and 4.2 and 3.7g in 2006-7. There was a strong linear relationship between seed weight and leaf relative water content, explaining 92 and 84 percent of the variation for 'Hyola401' and 'RGS003', respectively. For an each percent increase in leaf relative water content, 1000-seed weight of 'Hyola401' and 'RGS003' increased 0.191 and 0.146g, respectively. The strong relationships of seed weight with used water in evapotranspiration and leaf relative water content, over different environmental conditions and cultivars, showed these variables to be generally applicable in canola seed weight determination.

**Keywords:** canola, cultivar, Golestan, rainfall, supplemental irrigation.



## Crops Improvement

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### Evaluating yield and phenological and morphological characteristics of chickpea genotypes in autumn cultivation under complementary irrigation regime and winter sowing in Mashhad

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#### Abstract

In order to evaluate yield and yield components properties of cold-tolerant chickpea under winter sowing and complementary irrigation conditions, two experiments in the context of partial balanced block design with 81 chickpea genotypes and three replications were carried out. Complementary irrigation was performed during growing season including irrigation immediately after sowing, 20 days after the first irrigation and at early phase of flowering. After winter cold, survival percentage of the chickpea genotypes was calculated and total precipitation rate from sowing to harvesting was 267 mm. Moreover, properties of grain yield components (survival percentage, pod number per plant, the number of grains per pod and weight of 1000 grains), grain yield, biological yield and harvest indices of the genotypes were measured and recorded. Based on the results, the difference between the genotypes was significant for all the measured properties. Under complementary irrigation, 40 percent of the genotypes showed winter survival rate higher than 76 percent and grain yield in 52 percent of the genotypes was higher than 100gr/m<sup>2</sup>. Under winter sowing condition, grain yield in 32 percent of the samples was higher than 40gr/m<sup>2</sup>. Finally, under winter sowing and complementary irrigation regime, the genotypes 'MCC333', 'MCC186', 'MCC803' and 'MCC743' possessing yield over 600 kg/ha were determined as the superior genotypes.

**Keywords:** chickpea, cold tolerance, complementary irrigation, survival percentage, winter sowing.