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## Effect of *Arbuscular mycorrhiza* and *Bradyrhizobium japonicum* on Soybean Yield and Yield Components under Water Stress

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### Abstract

To evaluate the effects of biofertilizers on yield and yield components of a soybean cultivar (M9) under water stress condition, a study was carried out in a split plot randomized complete block design with three replications at research station of Bu Ali Sina University in 2012. The main plots included three levels of irrigation after 50, 100 and 150 mm evaporation from A pan and subplots included four biofertilizer treatments (*Bradyrhizobium japonicum*, *Arbuscular mycorrhiza*, both biofertilizers and no biofertilizer). Results showed a significant effect of water deficit on number of pods per area, grains per pod, plant height, biological yield, grain and oil yields, but seed weight, harvest index and oil percentage were not affected. In the absence of moisture stress, biofertilizers had no significant effects on the most traits, even mycorrhizae reduced the plant height. The highest reduction in soybean yield was observed in severe stress but the use of biofertilizers especially in both biofertilizer treatments, the negative effect of water stress minimized. So the number of pods per area, seed weight, plant height, biological yield, grain and oil yields increased by 33, 9.6, 15.4, 90, 93 and 170 percent, respectively, compared to severe water stress in the absence of biofertilizer treatments.

**Keywords:** Biofertilizer, Fungi, Oil, Water deficit.

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## Evaluation of Genetic Diversity of Lentil Germplasm using RAPD Molecular Marker

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### Abstract

Genetic diversity is the basis of success in improving the quality and quantity of crops. Recognizing of genetic diversity and genetic potential of each plant species in plant breeding is necessary. In this study, genetic diversity of 30 lentil samples from germplasm collection of the college of Agriculture and Natural Resources in Karaj were evaluated using RAPD molecular markers. RAPD products were scored for presence (1) or absence (0). 15 primers were used. 143 bands were scored from which 137 bands were polymorphic. The primer UBC611 revealed the highest polymorphic bands (16 bands) and the lowest polymorphic bands (5 bands) were primers (G, B, UBC502 and J). Cluster analysis was carried out according to WPGMA algorithm with the Dice similarity coefficient. The studied genotypes were classified into 4 main groups at the similarity coefficient of 0.56. The similarity varied from 0.44 to 0.89. The highest similarity (0.89) was found between Yunan and Shili16 genotypes, whereas, the lowest was between Shili2 and Shili17 (0.44). According to the results, it can be concluded that there is a high genetic diversity among genotypes of lentils and RAPD molecular markers is suitable option to assess genetic diversity among genotypes of lentil.

**Keywords:** Cluster analysis, Genetic diversity, Lentil, RAPD markers.

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## Effects of Humic Acid and Phosphorus Fertilizer on Seed and Flower Yield, Photosynthetic Pigments and Mineral Elements Concentration in Sour Tea (*Hisbiscus sabdariffa* L.).

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(Received: 8, December 2013 - Accepted: 14, April 2014 )

### Abstract

This experiment was conducted in a randomized complete block design with three replications in 2012 at the University of Zabol. Experimental treatments included phosphorus fertilizer at three levels including 0, 100 and 200 kg ha<sup>-1</sup> as the first factor and application of foliar humic acid at four levels of 0, 750, 1500, 2250 g/1000 L water as the second factor. Results showed that phosphorus treatment had significant effect on flower and seed yield, yield components including biological yield, number of branches, number of capsules per plant, seed weight per plant and 1000 grain seed weight. Phosphorus treatment of 100 kg ha<sup>-1</sup> increased these traits and the highest seed yield (0.61 ton ha<sup>-1</sup>) and flower yield (0.63 ton ha<sup>-1</sup>) were detected in this treatment. Phosphorus treatment significantly increased the photosynthetic pigments, soluble carbohydrates in leaves and seed phosphorus concentration. In this study, humic acid application caused an increase in the grain yield by improvement of yield components. The highest grain yield was detected at 1500 g/1000 L water. Except biological yield and leaf soluble carbohydrates, interaction between phosphorus fertilizer and humic acid had significant effect on all yield components. The highest number of branches per plant, number of capsules per plant and 1000 seed weight were detected in application of 1500 g/1000 L of humic acid in water and 100 kg ha<sup>-1</sup> of phosphorus treatment.

**Keywords:** Humic acid, Phosphorus, Quantitative traits, Sour tea. Yield.

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## Identification of QTLs and Evaluation of Simple Indices of Malting Quality and Quantity in Barely

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### Abstract

To investigate variation and detect genomic regions controlling quality and quantity of malt extract in barely, a study was conducted using a set of 72 double haploid barley lines as well as their parents (Stepito & Morex) at experimental stations of University of Mahabad and Agricultural Research Center of Mian'doab using RCBD with two replications during cropping season of 2011-12. Different characteristics including germination energy, total percentage of germination, seed dormancy, seed protein, seed malt extract, seed hull, hectoliter weight, seed plumpness, plant height, days to heading, spike length, seeds per spike, peduncle length, one thousand seeds weight, seed yield and harvest index were measured. QTL analysis was done using composite interval mapping (CIM) method for each trait by means of two environments; and multiple interval mapping (MIM) method was exploited for assessment of significant interactions between loci, additive  $\times$  additive epistasis and testing major effects of detected QTLs using a multiple regression model. For most of traits, transgressive segregation was observed in both positive and negative directions. For this study, a total of fifty-four QTLs with  $LOD \geq 2.5$  ( $LR \geq 11.5$ ) were identified. Explained genetic variance by these QTLs was varied by 37.15 to 77.24 and maximum LOD for the QTL controlling a thousand seed weight was obtained on chromosome 4H (QW4H) with a  $LOD = 6.36$ . The largest single QTLs allocated to the quantity and quality of barley grains malt were located on chromosomes 1H, 2H, 3H, 4H and 7H. Twelve additive  $\times$  additive epistatic effects between identified QTLs were significant. In the studied haploids and their parents great variation was observed in terms of quantity and quality characteristics of barley malt. This variation can be exploited for different breeding purposes.

**Keywords:** Barley (*Hordeum vulgare* L.), Malt extraction, QTL analysis.

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## Investigating the Effects of Lead Contamination and Foliar Application of Iron on Some Physiological Characteristics in Two Forage Corn (*Zea mays* L.) Hybrids in Calcareous Soil

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(Received: 24, December 2013 – Accepted: 9, June 2014)

### Abstract

To investigate the physiological traits of corn under lead contamination with iron spray, a factorial completely randomized design with three replications was conducted in the greenhouse. The treatments consisted of four levels of lead [zero, 100, 200 and 400 mg kg<sup>-1</sup> in soil, two hybrids of maize (SC260 and SC704) and four foliar applications of iron sulfate [0, 0.2, 0.4 and 6%]. Lead contamination reduced the root volume, shoot height, and shoot and root dry weight. The results showed the iron concentration of shoot increased in each level of lead by increasing foliar concentrations of iron. The highest membrane stability index (88.54%) was detected for hybrid 260 in non-contaminated soil treatment and foliar composition of iron in concentration of 2 per thousand, and the lowest value (42.69%) was detected for hybrid 704 treated with a combination of 400 mg/kg lead and 6 in thousands of foliar iron. The results showed that in terms of lead contamination, spray of iron in low concentrations (2 and 4 per thousand) had a positive effect on the studied parameters. According to the results of this research, between hybrids, 704 showed greater sensitivity to lead contamination.

**Keywords:** Corn, Leaf relative water content, Membrane stability index, Root volume.

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## **Determination of the Best Harvesting Time of Rapeseed Cultivars as Second Crop in Paddy Fields in the North of Iran**

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**(Received: Sep. 4, 2013 – Accepted: May 4, 2014)**

### **Abstract**

In order to study the effects of harvesting time on yield of rapeseed cultivars, this research was carried out at paddy fields of Rice Research Institute of Iran in Rasht and Amol during 2005-2006 and 2006-2007 cropping seasons. The experiment was conducted in a split plot based on a randomized complete block design with three replications. Four rapeseed cultivars including Hyola 308, Hyola 401, Hyola 420 and RGS003 and four harvesting times were arranged in main plots and subplots, respectively. For harvesting, the moisture content of seeds in the siliques of 1/3 base of main stem and four moisture content of equal or greater than 40%, 35%, 25% and 15% was used as an indication for harvesting the cultivars. The results showed that Hyola 401 and second harvesting time had maximum grain yield (with average of 2427 and 2367 Kg ha<sup>-1</sup>), oil yield (1066 and 1027 Kg ha<sup>-1</sup>), biological yield (7666 and 7624 Kg ha<sup>-1</sup>), harvest index (29.99 and 30.67%), number of seeds in the siliques (25.17 and 25.25) and number of silques in plant (152.7 and 144.9), respectively. Hyola 401 in the second harvesting time had maximum grain and oil yields and Hyola 308 in the fourth harvesting time showed minimum grain and oil yields. Based on the results, Hyola 401 and second harvesting time are superior compared to the other treatments due to the fast field discharge for rice planting and having maximum grain and oil yields.

### **Keywords:**

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## Investigation of Factors Affecting Seed Germination of London Rocket (*Sisymbrium irio*)

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(Received: 24, December 2012 – Accepted: 23, April 2013)

### Abstract

In order to investigate factors affecting seed germinating of London rocket (*Sisymbrium irio*), lab experiments were set up in 2011 at the Payamenoor University, Mashhad, Khorasan Razavi province. Effect of different concentrations of gibberellic acid (GA<sub>3</sub>) and cytokinin, wet and dry prechilling treatments, hydrogen peroxide duration, ethanol, salt and osmotic stress and burial depth on seed germination and seedling emergence were investigated. Increasing concentration of GA<sub>3</sub> from 50 ppm to 100 ppm enhanced germination of London rocket, but higher concentration of GA<sub>3</sub> had inhibition effect. Wet prechilling was more effective than dry prechilling in seed germinating of London rocket. Increasing concentration of cytokinin decreased seed germination. Seed germination of London rocket was reduced by increasing duration of soaking in hydrogen peroxide. Ethanol had inhibition effect on germination. Osmotic and salt stress decreased seed germination. Seed germination decreased with increase in burial depth. Results from this study could be used for integrated weed management programs.

**Keywords:** Gibberellic acid, Hydrogen peroxide, Salt and osmotic stress, Seedling emergence.

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## Effect of Sodium Nitroprusside on Growth, Yield and Yield Components of Bean (*Phaseolus vulgaris* L.) under Water Deficit Stress

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### Abstract

In order to investigate the effect of Sodium Nitroprusside (SNP) application on yield and yield components of kidney bean under water deficit stress, a field experiment was conducted in split-factorial based on a randomized complete block design with three replications in Hamedan in 2012. Water deficit stress at four levels including vegetative stress, reproductive stress vegetative+reproductive stress and without stress as main plot and cultivars (Akhtar and Derakhshan) and SNP foliar at three concentrations (0, 150 and 300  $\mu\text{M}$ ) as sub plot were used. Results showed that interaction between water deficit and foliar application had significant effect on characteristics such as subshrub number per plant, pod number per plant, seed number per pod, seed weight, seed yield and biological yield. Vegetative+reproductive stress reduced seed yield in Akhtar and Derakhshan cultivars about 34 and 35.5 percent, respectively. Reproductive stress reduced seed yield and its components more than vegetative stress about 6 and 6.5 percent in Akhtar and Derakhshan cultivars, respectively. SNP application (300  $\mu\text{M}$ ) enhanced seed yield in Akhtar and Derakhshan cultivars about 17 and 16 percent under reproductive stress, respectively. 300  $\mu\text{M}$  concentration of SNP had the most influence on amelioration of water stress effect on yield and yield components of both cultivars. So, SNP foliar application (300  $\mu\text{M}$ ) for bean under water deficit stress is recommended.

**Keywords:** Drought, Kidney bean, Seed yield, Sodium nitroprusside, Water deficit stress.

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## Dormancy Classification and Its Breaking Methods of Galbanum (*Ferula gummosa* BLOSS) Seed

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### Abstract

Galbanum (*Ferula gummosa* BLOSS) is a medicinal, commercial and industrial plant in Iran but its cultivation is restricted by seed dormancy. Therefore, a study was conducted to determine class and environmental requirements for breaking of seed dormancy. During imbibition study, both scarified and intact seeds exhibited similar pattern in water uptake and it seems there is not physical dormancy. Moreover, excised embryos from dormant seeds did not germinate in MS medium, therefore, there was not mechanical dormancy. Cold stratification (3°C) for 75 days reduced seed dormancy (germination percentage increased up to 94%). Increment in stratification temperature reduced dormancy, as cold stratified seeds for 75 days had 50 and 35% germination in 6 and 10°C, respectively. Stratification of seeds in alternative temperatures increased seed germination, but storing wet seeds in high temperatures for long time caused seed deterioration and decreased seed viability. Thus, the longest time in which seeds can be stored at high temperature (20 °C) is 30 days and seeds start to deteriorate after this time. The best condition for dormancy breaking was alternative temperatures (60/30 days, hot-cold) which resulted in 87% germination. It was shown that embryo grows during cold stratification. According to the results, galbanum seed dormancy is classified as deep complex morphophysiological dormancy.

**Keywords:** *Ferula gummosa* BLOSS, Dormancy breaking, Seed dormancy.

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## The Evaluation of Germination Parameters of *Scrophularia striata* under Water and Salinity Stress at Different Temperatures

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### Abstract

Germination stage is an important stage of plant growth stage that often is affected by environmental stress including water and salinity stress. In order to study germination characteristics of *Scrophularia striata* under water and salinity stress conditions at different temperatures an experiment was conducted. Temperatures regimes included 5, 10, 15, 20, 25, 30, and 45 °C. For each temperature, the treatment for salinity and water stress was seven potentials (zero, -2, -4, -6, -8, -10 and -12 bar) of NaCl and seven potentials (zero, -2, -4, -6, -8, -10 and -12 bar) of PEG. Results showed that increasing water and salinity stress decreased significantly germination rate, germination percentage, plumule and radicle length. The minimum decrease of germination characteristics under stress conditions was observed at 25°C. Results showed that optimum germination temperature for this plant is 28.69 °C.

**Keywords:** Germination, *Scrophularia striata*, Temperature, Drought and Salinity stress.

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## Effects of PGPR Bacteria and Seed Aging on Improving Common Bean (*Phaseolus vulgaris* L.) Yield and Yield Components

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### Abstract

To study the effects of different levels of seed aging and bacteria inoculation on yield of common bean under field conditions, an experiment was carried out as factorial arrangement in RCBD design with 3 replications at Research Farm of University of Tehran (Karaj-Iran) in 2012. Treatments consisted of four levels of seed aging (0 (control), 3, 6 and 9 days at 41°C and 90-100% relative humidity) and bacterial inoculations at four levels (Control (no bacteria), *Rhizobium oligominusarum*, *Pseudomonas putida* and co-inoculation by *Rhizobium oligominusarum* and *Pseudomonas putida*). Results showed that application of bacterial inoculants significantly increased grain yield and yield components of common bean compared to non-inoculated plants. However, the highest values of these traits were observed with co-inoculation by *Rhizobium oligominusarum* and *Pseudomonas putida*. Results showed that interaction between aging and bacteria inoculation was significant for 100 grain weight.

**Keywords:** 100 grain weight, Bacteria inoculation, Seed ageing, Yield components.

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## **The Effects of Iron Oxide Nanoparticles on Some Quantity, Quality and Physiological Characteristics in Four Wheat (*Triticum aestivum* L.) Cultivars under Khoram-Abad Climate Conditions**

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**(Received: 28, Nov. 2013 – Accepted: 10, June 2014)**

### **Abstract**

An experiment was conducted as a split plot based on a complete randomized block design with three replications in the fall of 2010 at the farm of Lorestan University, Khoram-Abad, Iran. Four winter wheat cultivars (Marvdasht, Azar, Shiraz and Line M-79-7) and the levels of iron oxide nanoparticles (ION) along with control treatment were considered as the main plot and subplot, respectively. Iron fertilizer spraying was done in two stages, beginning the stem elongation and beginning the flowering. The results showed significant differences between the cultivars in relation to many traits including, leaf area duration, net assimilation rate, growth rate, relative growth rate, grain and biological yield, harvest index, SDS sediment, grain protein, and iron. Marvdasht cultivar was superior to the others because of higher grain yield (6.4 t/ha under 250 ppm of ION), grain protein (15.39% under 500 ppm ION) and grain iron (202.4 ppm under 1000 ppm of ION). But in terms of sediment volume of SDS, Shiraz cultivar (74.33 mm under 750 ppm of ION) was higher than the others. Generally, foliar application of ION improved some physiological parameters and grain yield, harvest index, sediment SDS, grain protein and iron of all varieties and line M-79-7. Overall, 750 ppm of ION was the most effective for improvement of SDS and grain iron content, meanwhile, 500 ppm of ION was better for leaf area duration. The importance of the role of iron in plant physiology on one hand, and difficulties in calcareous soils in relation to providing enough iron requirement for the plant at other hand, show more necessity of using iron fertilizer especially as foliar application method. It can be concluded that the iron fertilizer can improve crop growth, yield and also nutritional value by increasing iron and protein.

**Keywords:** Iron, Physiological characteristics, Wheat, Yield.

## The High Molecular Weight Glutenin Subunit Compositions in *Triticum boeoticum* and *Aegilops tauschii* in Iran and Neighboring Countries

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### Abstract

The high molecular weight glutenin subunit (HMW-GS) compositions of 19 diploid wild wheats (*Triticum boeoticum*) and 36 (*Aegilops tauschii*), were evaluated by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE). All of *T.boeoticum* were characterized for their HMW-GS and showed 2\* in their *Glu-A1* locus. In the study of *A. tauschii* collected from Iran and 7 neighboring countries, high allelic diversity was observed. Six alleles were identified at *Glu-D1* loci in Iranian and 4 alleles were founded for *Glu-D1* locus in neighboring countries in *A.tauschii*. In addition, some rare subunits combinations such as 2+10, 2+11 and 11 were found in this study that were new subunits in compared with previous studies. Also, subunits 1/5+12 and 2+T<sub>2</sub> were the rare subunits that were detected in *A.tauschii* of neighboring countries.

**Keyword:** Bread making quality, Genetic diversity, *HMW-Glutenin*, SDS-PAGE.

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## **Analysis of Yield and Its Related Traits of Triticale Promising Lines under Various Sowing Dates**

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**(Received: 17, Sep. 2013 – Accepted: 19, Aug. 2014)**

### **Abstract**

In order to determine the optimum planting date, this research was carried-out in 2010-11 and 2011-12 cropping seasons, in a split-plot arrangement, using a complete randomized block design with three replications in Khuzestan Agriculture and Natural Resource Research Center. Main and sub plots were consisted of four planting dates (Oct.27 with 10 days interval) and four superior lines, respectively. Results showed that the effect of year was significant for days to heading and physiological maturity, biological yield, grain yield, grain number per spike and grain growth rate. The interaction effect of planting date by genotype was significant only for harvest index. The effect of planting date was significant for spike per unit area. Genotypes differences were significant for days to heading, harvest index, thousand grain weight, spike per unit area, grain number per spike and grain growth period. The highest grain yield with 6268 Kg/ha, was detected in the second planting date. Except grain filling rate, correlations of grain yield were positively significant with all other traits. Grain yield decreased in response to planting delay, mainly due to the reduction of grain filling period. According to the polynomial equation of grain yield trend, Nov.17 selected as the best planting point.

**Keywords:** Biological yield, Grain filling period, Harvest index,

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## **Evaluation of Remobilization Potential under Source Limited Condition in Iranian wheat Cultivars**

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### **Abstract**

Wheat stem reserves can be an important contributor to grain filling particularly under reduction of source strength through defoliation. The aim of this research was to study remobilization ability as important contribution on yield stability under drought conditions and to investigate their intrinsic compensatory mechanism in the wheat cultivars with different degrees of resource limitations under source limited conditions. To test this hypothesis, two separate field experiments were carried out at research field of university college of Agriculture and Natural Resources, University of Tehran (located in Karaj) during 2010-2011 growing seasons. First experiment was carried out in a split plot design based on RCBD that included 36 wheat cultivars and different levels of defoliation (non-defoliated control (ND), removal of all leaves (FD), removal of all leaves except the flag leaf (PD)), and the second experiment as a randomized complete block design that included 36 wheat cultivars and chlorophyll desiccation. The plants were defoliated and desiccated in 15 day after flowering growth stage. The result showed that removal of all leaves except the flag leaf (PD) and all leaves (FD) caused reduction of grain weight by 8% and 22%, respectively. Also the highest grain yield was detected in Fongh cultivar in PD and FD treatments. Generally, cultivars with higher accumulation were less affected by defoliation treatments. Wide ranges of remobilization were detected between cultivars and the highest remobilization was detected in Cross-Shahi cultivar. On average, contribution of stem reserves to grain yield was about 36%.

**Keywords:** Defoliation, Source, Stem reserves, Wheat cultivar.

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## فهرست

علوم گیاهان زراعی ایران

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