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## **Effect of organic manure on the morphophysiological characteristics of *Ziziphora clinopodioides* L.**

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### **Abstract**

**Background and objectives:** Nowadays, to have a sustainable agricultural system, the application of inputs that improve the aspects of ecological systems and reduce environmental hazards are necessary. *Lamiaceae* family plants have been used for centuries in many countries as a spice in foods, as well as to digest and as a drug against viral diseases. *Ziziphora clinopodioides* lam. is one of the herbs and aromatic plants that is used as herbal tea and tea to treat a sore throat, digestive disorders, carminative, antiseptic and wound healer and also used in the food and dairy industrial. This plant has relatively wide distribution in the mountainous regions of Iran, especially Khorasan, Azarbayjan, Hamadan, Kermansha provinces.

Therefore, in view of the importance of this medicinal plant, this experiment was conducted to evaluate the effect of organic fertilizers (manure and poultry) on some morphophysiological characteristics of *Ziziphora clinopodioides*.

**Materials and methods:** This experiment was conducted in designed as a randomized complete blocks with 3 replications in faculty of agriculture of higher education complex of Shrivan and laboratory experiments were carried out at Gorgan University of Agriculture Sciences and Natural Resources in 2013-2014. The treatments were included three levels of cow manure (5, 10 and 15 tons per hectare), three levels of poultry manure (2, 4 and 6 tons per hectare) and the control (no fertilizer) studied traits included height plant canopy diameter. Crown diameter, weight of fresh and dry matter yield and chlorophyll content.

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**Results:** The results indicated that the treatments had a significant effect on the studied traits at 10% probability. Application of organic fertilizers could increase the rate of some morphological traits including height, canopy diameter, crown diameter, weight of fresh and dry matter yield and total chlorophyll content of the plant. The cow manure treatment with 10 tons per hectare had the highest height (28.91 cm), the highest canopy diameter (31.90 cm) and crown diameter (10.15 cm) were observed in poultry manure treatment with 4 tons per hectare. The cow manure treatment with 10 tons per hectare had the highest weight of fresh yield (412.17 gr per m<sup>2</sup>) and weight of dry yield (148.88 gr per m<sup>2</sup>). The highest total chlorophyll content (64.12 mg per cm<sup>2</sup>) was observed by cow manure treatment with 15 tons per hectare. Also, the maximum amount of phenol, and antioxidants (0.472 and 59.703 respectively) were observed in control. The highest flavonoids content (0.273 mg/g) were obtained in cow manure treatment with 5 tons per hectare; poultry manure treatment with 2 tons per hectare and control

**Conclusion:** In general, the application of organic fertilizers had positive effects on measured morphological characteristics but negative effects on some biochemical characteristics such as phenols, flavonoids and antioxidants. So that by increasing the application of organic fertilizers, the amount of morphological parameters were increased and biochemical parameters decreased.

**Keywords:** Biochemical traits, Cow manure, Morphological characters, Poultry manure



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## Effect of planting date and plant density on yield, yield components and active components of bitter apple (*Citrullus colocynthis* L.)

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### Abstract

**Background and objectives:** Bitter apple (*Citrullus colocynthis* L.) is one of the most important plant in traditional medicine that grows at arid and semi-arid conditions, little information about agronomic requirement of bitter apple is available. Among different agricultural managements, sowing date and plant density are the main factors for achieving highest yield. This study was conducted for evaluating the effects of sowing date and plant density on yield and yield components of bitter apple.

**Materials and methods:** A field study was conducted as a split plot design based on a Randomized Complete Blocks design (RCB) with three replications at farm in Sabzevar township, Iran in 2013. The main plots consisted of sowing date (4 April, 5 May, 5 June) and the sub plots consisted of plant density (2, 4, 8 plant.m<sup>-2</sup>). At harvesting time, number of fruit per square meter, fruit dry matter, number of seed per fruit, 100 seeds weight, biological yield, fruit and seed yield, harvest index were measured as quantitative variables and colocynthin and cucurbitacin content were measured as qualitative variables.

**Results:** The result of analysis of variance showed that plant density and sowing date had significant effect on all studied traits but interactions between most of the studied traits were not significant. Delaying in sowing date significantly decreased number of fruit per square meter, biological yield, fruit and seed yield, harvest index, colocynthin and cucurbitacin content whereas seed weight and number of seed per fruit did not affect by sowing date. There was no significant difference

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between sowing date on June 4 and May 5 for number and dry matter of fruit, seed yield, harvest index, colocynthin and cucurbitacin content. Sowing date of June 5 had the highest fruit dry matter that had no significant difference with April 4. Increasing plant density was increased number fruit, biological yield, fruit and seed yield, colocynthin and cucurbitacin content. Plant density did not significantly effect on fruit dry matter, the number of seed per fruit, 100 seed weight and harvest index. There were no significant difference between 4 and 8 plant.m<sup>-2</sup> for fruit number per square meter, biological yield, fruit yield and seed yield, colocynthin and cucurbitacin content.

**Conclusion:** Overall, the result of this experiment showed that the highest seed yield and fruit yield were obtained on April 4 sowing date and 4 plant.m<sup>-2</sup>. In terms of quality of active components, the best sowing date and plant density were on May 5 and 8 plant.m<sup>-2</sup> for cucurbitacin and 2 plant.m<sup>-2</sup> for colocynthin.

**Keywords:** Bitter Apple, Plant density, Sowing date, Yield



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## ***Piriformospora indica* mutualistic effect on *Cynara scolymus* (L.) under water and saline stress**

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### **Abstract**

**Backgrounds and objectives:** Drought which is caused by the climate pattern change, can also lead to tough situations of salinity. Plants, however, may respond to the stressors by morphological and physiological changes within the related organs. Recently, a new discovered endophyte, *Piriformospora indica*, which is able to colonize onto the roots` cortex of many diverse plants can also be cultured in an axenic media, free from any specific host. This seems to be a sustainable solution for crop production in such climates. Thus, *P. indica* which can also exacerbate plants` tolerance during abiotic stress, was taken for further two separated saline and water deficiency experiments. In this survey, we tend to show whether artichokes` roots (*Cynara scolymus*) are the endophyte host. Next, what changes can be conveyed in either saline or water deficiency trials.

**Materials and Methods:** The experiment was conducted at Gorgan University of Agricultural Science and Natural Resources. Floating in spore suspension, rootlets were stained by Vierheilig method to ensure colonization in contaminated plants. Then, under different stress conditions, we quantified artichoke growth and yield. Water deficiency was induced at three levels according to regulation of water day interval; each 3, 6 and 12 days which were defined as control, mild and severe stress, respectively. Salinity, likewise, was induced by NaCl solutions in 0.7, 6 and 12 ds/m. This experiment was conducted as afactorial design based randomized completely design.

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**Results:** The results indicated that firstly artichoke accepted *P.indica* as a symbiotic agent, and secondly contaminated plants functioned far better rather than their controls in stress. As there was a considerable reduction in many yield components such as leaf length, RWC, root length and root volume in both saline and drought trials while plants went through more severity of 6 days to 12 days of water day interval or 6 ds/m to 12 ds/m; yet, these changes did not happen considerably for contaminated plants in the same period or salinity. Although the fungus performance was marginally considerable in saline stress, still there were significant morphological alterations; length in leaves and roots and the root volume were also changed ( $P<0.01$ ). Interestingly, the influence of the interaction of fungus and water shortage trial took over to show changes rather than the former experiment. For instance, plants dry weight, length and the volume measurements of the roots were all significant in the water deficiency trial.

**Conclusion:** In general, many essential changes would be occurred as plants challenge for adaptation. Mutualism might largely expand plants compatibility against stressors. Therefore, proportionally, *P.indica* was able to alleviate plants malfunctioning in both experiments.

**Keywords:** *Cynara scolymus*, Morphological changes, *Piriformospora indica*, Salinity, Water-shortage



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## **Effect of hormone type and basal media strength on germination and proliferation of Sanaz Rose (*Rosa chinensis* var. Elvis)**

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### **Abstract**

**Background and objectives:** Sanaz rose one of ornamental rose varieties that, nowadays widely used in landscaping and park places. Sanaz rose is one of several Rose species of our country is propagated by traditional methods to sell on the market. Because it's production by traditional methods very slow and time-consuming and usually associated with various problems such as limitation of stock plant, this study sought to determine the optimum conditions for micropropagation of Sanaz rose through tissue culture.

**Materials and methods:** Axillary and apical buds of the branches made from plants grown in pots were used as initial explants. Investigated media for the proliferation and regeneration included MS, MS/2 and MS/4. Hormone BAP at concentrations of 0, 1, 3 and 5 mg/l and IBA at concentrations of 0, 0.1, 0.3 and 0.5 mg/l. experiments were conducted as a completely randomized design with 3 replications and repeated 5 times.

**Results:** Results showed that MS media has the highest percentage of regeneration and full strength MS media with 3 mg/l BAP hormone has the largest regeneration percent. The results also indicated that the highest shooting coefficient obtained in 5 mg/l BAP concentration. The combination treatment of basal medium MS/4 with 5 mg/l BAP and medium MS/4 with 0.5 mg/l IBA and 5 mg/l BAP had the highest shoot induction. The results showed that the MS/4 containing 0.5 mg/l of IBA and 5 mg/l BAP has the shortest branch and MS medium without hormones had the longest shoots. Produced shoots were then transferred to different rooting media

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and were rooted successfully. Rooted plantlets are then transferred out of the lab and were adapted well to the ex vitro conditions.

**Conclusion:** According to the results of this research can see that MS basal media is a suitable media for Sanaz rose. Sanaz rose has suitable germination and proliferation in relatively high concentrations of cytokinins (BAP). With increasing in cytokinin concentrations of media, produced shoot number increased but shoot length decreased. The best shoot growth was observed in hormone free media.

**Keywords:** Cytokinin, Proliferation, Sanaz rose, Shoot length





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## **Effect of pre-treatment and seed size on yield and characteristics of two Onion (*Allium cepa* L.) cultivar**

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### **Abstract**

**Background and objectives:** The main objective of this work was to study the effect of priming and seed size on biological yield, growth and phenological characteristics of onion genotypes.

**Materials and methods:** In order to evaluate the effect of priming and seed size on biological yield, growth and phenological characteristics of onion genotypes a factorial field experiment based on a randomized complete block design with three replications was conducted in 2012 and 2013 cropping season at Agriculture and Natural Resources Research Center of East Azarbayjan, Iran. The experimental treatments included priming (at four levels: hydro priming, osmopriming (in %2 KNO<sub>3</sub>), priming with folamin amino acid (in 2%) and control (without priming), seed size (at three levels: small, medium and large) and cultivars (at two levels: Red Azarshahr and Zargun). Following characteristics such biological yield, number of leaves, leaf length, leaf area, leaf area index, bulbing ratio, leaf ratio, bolting percent, number of days to bulbing, physiological maturity and number of days to harvest were studied.

**Results:** Analysis of variance for the measured traits indicated that all characteristics significantly were affected by priming and seed size. Also Results showed that seed priming and seed size improved biological yield, growth and phenological characteristics. The highest biological yield, leaf area, leaf area index, bulbing ratio, were obtained from plant that primed with folamine 105.98 (T/ha),

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123.77cm<sup>2</sup>, 8.25 and 4.99, respectively and the lowest were achieved from control plants. Also mean comparison indicated that the higher values of biologic yield, leaf area, leaf area Index, bulbing ratio were obtained from large seed size 100.33 (T/ha), 119.38cm<sup>2</sup>, 7.96 and 4.98, respectively. Nevertheless, seed priming and seed size improved biological yield, growth and phonological characteristics onion cultivars were attributed to rapid seedling emergence and establishment, and consequently the optimum use of light, soil moisture and nutrients by the plants developed from the primed seeds and seed size.

**Conclusion:** According to the results and discussion mentioned above seed priming treatments improved biological yield, growth and phonological characteristics as compared to the unprimed. Among the treatments, seed priming with Falomin Amino Acid 2% was more effective than the potassium nitrite 2% and hydropriming. Large seed size significantly increased the biological yield, growth and phonological characteristics. Accordingly, the importance of seed priming and seed grading were obvious in this study, so seed priming with Falomin Amino Acid 2% and large seed size should be used for onion planting in order to insure high biological yield, to improve growth and phonological characteristics of onion.

**Keywords:** Bolting, Bulbing index, Folamine, Leaf area index



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## **Investigation of phenological growth stages of Hayward kiwifruit (*Actinidia deliciosa*) in the west of Guilan**

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### **Abstract**

**Background and objectives:** Kiwifruit as a new commercial crop in comparison with other crops that are grown in the similar climatic conditions has a high economic return. On the other hand, this fruit has better quality in Iran than that in other kiwifruit production countries. Management practices such as pruning, application of growth regulators, fertilizers, pesticides, mechanical natural and hand pollination, flower and fruit thinning, harvest time, etc. rely on the recognition of certain phenological stages. Therefore, the objective of this study was to describe the phenological growth stages of a Hayward kiwifruit cultivar growing under the west of Guilan using the BBCH code and to calculate the heat requirements that help predict the time to reach each phenological stage.

**Materials and methods:** This experiment was conducted in a randomized complete blocks design with 3 replications with 12 trees. Fruiting branches on each 4 tree (2 on each side) were marked for assessed. Principal and secondary phenological growth stages of development using the BBCH scale for 2 years in the west of Guilan (Astara) on mature vines were determined. Fruit growth curve, with measuring dimensions and equivalent water, TSS changes with hand refractometer and the effect of temperature changes on TSS and flowering and fruit development were studied. Heat requirements for phenological growth stages were calculated as GDD.

**Results:** Eight principal phenological growth stages on kiwifruit include: stage 0 (bud development), stage 1 (leaf development), stage 3 (shoot development), stage 5 (inflorescence emergence), stage 6 (flowering), stage 7 (fruit development), stage

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8 (maturity of the fruit) and stage 9 (Senescence, beginning of dormancy) that began with the beginning of bud swelling in the 17<sup>th</sup> of March and terminated on the 25<sup>th</sup> of December. The time of secondary phenological growth stages and some management practices related to each of these stages of BBCH scale also mentioned. Broken of branch buds increased from the base to the top of the shoots, so that all dormant buds were in the base. The percentage of bud break, and the number of fruitful shoots were affected by the year. The curve of fruit growth was double sigmoid and increased fruit soluble solids of fruit was about 3 months later. After dormancy breaking and from beginning of bud swelling, Hayward kiwifruit cultivar required  $429.275 \pm 10.67$  GDD to reach full bloom,  $1187.5 \pm 65.8$  GDD to reach 50% of final fruit size and  $2763.58 \pm 19.92$  GDD before the fruit could be harvested.

**Conclusion:** Determine of heat requirements is important for predict of the management time, so that the temperature difference between days in different years affected the development stages. The index can be used to predict developmental stages and thus to apply administrative tasks such as flowers thinning, fruit thinning, green pruning, winter pruning, fertigation, pest and disease control and also be used to expecting of physiological fruit maturity.

**Keywords:** BBCH scale, Hayward Kiwifruit, Phenology



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## Effects of different cow manure amount and plant density on yield and seed yield components, leaf and indigo yields of true indigo

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### Abstract

**Introduction:** True indigo (*Indigofera tinctoria* L.) is a forgotten crop and medicinal plant from Fabaceae family. The plant is annual, biennial and perennial, but it is cultivated as an annual plant (6). A material called Indigo is extracted from the leaves of true indigo which is extensively used in industries for dyeing objects. Indigo is blue in color. Indigo is formed when two indoxyl groups combine spontaneously in the presence of oxygen to form an indigo molecule (14). True indigo is used in constipation, liver diseases, heart palpitation and gout that is antiseptic and astringent. The leaves are useful for promoting growth of hair. Purposes of this study were study the effects of cow manure and plant density on quantitative and qualitative criteria of true indigo as a forgotten and medicinal plant under Mashhad climatic conditions.

**Materials and methods:** This experiment was conducted as factorial layout based on a randomized complete blocks design with three replications at the Agricultural Research Station, Ferdowsi University of Mashhad during two growing seasons of 2013-2014 and 2014-2015. Experimental treatments were five cow manure levels (10, 20, 30 and 40 t.ha<sup>-1</sup>) and four plant densities (10, 20, 30 and 40 plants.m<sup>-2</sup>). Studied traits were plant height, canopy diameter, yield components (such as number of branches per plant, number of pods per plant, number of seeds per plant and seed weight per plant), leaf yield, pod yield, stem yield, biological yield, indigo content and indigo yield of true indigo.

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**Results and discussion:** The results at the second year indicated that the effects of cow manure and plant density were significant ( $p \leq 0.01$ ) on plant height, canopy diameter, number of branches per plant, number of pods per plant, number of seeds per plant, seed weight per plant, leaf yield, stem yield, pod yield, biological yield and indigo yield of true indigo. The highest canopy diameter was observed in 30 ton cow manure per ha (88.3 cm) and the lowest was shown for control (16.6 cm). The maximum canopy diameter was related to 30 plants.m<sup>-2</sup> (56 cm). The highest leaf yield was obtained in 30 ton cow manure per ha (250.69 g.m<sup>-2</sup>). The maximum leaf yield was related to 30 plants.m<sup>-2</sup> (224.37 g.m<sup>-2</sup>). The highest indigo yield was achieved in 30 ton cow manure per ha (2.01 g.m<sup>-2</sup>) and by increasing plant density from 10 to 30 plants.m<sup>-2</sup>, indigo yield was enhanced up to 16%.

**Conclusion:** By increasing manure application from zero to 30 t.ha<sup>-1</sup> quantitative and qualitative yield of true indigo was enhanced. Also by enhancing plant density from 10 to 30 plants.m<sup>-2</sup> growth, yield components, leaf yield, stem yield, pod yield and yield indigo of true indigo were improved.

**Keywords:** Indigo yield, Medicinal plant, Neglected crop, True indigo



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## **Production of Delphinidin Anthocyanin in petals of gerbera flower by agroinfiltration of flower color gene constructs**

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### **Abstract**

**Background and objectives:** The study of flower color genes function in gerbera is hampered due to the low efficiency of transformation methods and the long time span needed for production of stably transformed transgenic plants. For some functional analysis, the transient expression of genes could be an efficient alternative.

**Materials and methods:** This study was conducted in two stages. In first stage, the agroinfiltration experiment with 3 flower color constructs (1-pBIH-35S-CcF3'5'H: with one gene, 2-pBIH-35S-Del2: with 3 genes and 3-pBIH-35S-Del8: with 5 genes) in 12 cultivars of gerbera was investigated. Agroinfiltration of gerbera petals were performed by *Agrobacterium tumefaciens* strain EHA 101 harboring binary vectors pBIH that contained one or more genes of flavonoid 3' 5'-hydroxylase (F3'5'H), dihydroflavonol 4-reductase (DFR), anthocyanidin synthase (ANS), flavanone 3 $\beta$ -hydroxylase (F3H), chalcone isomerase (CHI) and hygromycin phosphotransferase (*hpt*). After the establishment of induction and agroinfiltration media, agrobacterium suspension carrying gene constructs injected in the base of petals. Then, based on the results of the first experiment, this experiment was repeated for second time with 4 pink cultivars ('Aqua Melone', 'Bismarck', 'Esmara' and 'Rosalin') and mentioned constructs.

**Results:** Visual observations of injected petals showed that cultivars with pink color have shifted flower color from pink to blue and produced delphinidin. The results of HPLC analysis of 4 anthocyanins (delphinidin, cyaniding, pelargonidin

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and peonidin) in four cultivars of second experiment showed that the injected petals of 'Bismarck' cultivar with pBIH-35S-Del8 construct have the highest delphinidin production.

**Conclusion:** Therefore, 'Bismarck' cultivar of gerbera could be suggested as a promising candidate for sustainable transformation of genes involved in production of anthocyanins for change of flower color particularly production of delphinidin.

**Keywords:** Agroinfiltration, Flavonoid 3' 5'-hydroxylase gene, Delphinidin, gerbera





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## Effects of Indol-3-butyric acid and *Agrobacterium rhizogenes* on the rooting of hardwood cuttings of EM<sub>9</sub> and MM<sub>106</sub> apple rootstocks

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### Abstract

**Background and objectives:** Nowadays in the modern and industrial pomology, the rootstocks play an important role in the production, garden economy, trimming and the life of tree, harvest and garden management. In fact, rootstock forms half statue of the tree which is located inside the soil and not been replaceable and improved. In this respect, the choice of suitable rootstock for a cultivar and climatic and soil conditions of the region, as well as a selection of cultivars is important. Application and development of this vegetative rootstocks is necessary and depends on the availability of a simple and easy way to reproduce it.

**Materials and methods:** This study was conducted to evaluate the effects of different concentrations (0-1000-2000-3000 ppm) of Indole-3-butyric acid (IBA) and one strain of *Agrobacterium rhizogenese* (15834) alone or in combination with each other on the rooting capacity of hardwood cuttings of EM<sub>9</sub> and MM<sub>106</sub> apple clonal rootstocks in split factorial design with three replications at research greenhouse of Ferdowsi University of Mashhad. It was considered *Agrobacterium rhizogenese* as a main plot and different levels of Indole-3-butyric acid and rootstocks as a factorial on the sub-plots. The medium of this experiment was the mixture of perlite and disinfected sand in 1:1 ratio.

**Results:** The results indicated that different percentages of rooting were observed in cuttings treated by *Agrobacterium rhizogenese* alone and combination of Indole-3-butyric acid and *Agrobacterium rhizogenese* in both rootstocks while no rooting was observed with Indole-3-butyric acid alone. The highest rooting percentage (%)

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45.06) was obtained in EM<sub>9</sub> rootstock cuttings treated by *Agrobacterium rhizogenes* plus 3000 ppm IBA. The highest mean root length (4.45 cm) was obtained from *Agrobacterium rhizogenese* plus 3000 ppm Indole-3-butyric acid treatment. Maximum number of the main and secondary roots (3 and 6/5, respectively), were observed in the MM<sub>106</sub> rootstock treated by *Agrobacterium rhizogenese*. Callusing rate of cuttings were reduced with using of *Agrobacterium rhizogenese*, so the highest percentage of callus induction (% 86.42) was observed at control treatment of EM<sub>9</sub> rootstock.

**Conclusion:** A combination of *Agrobacterium rhizogenes* and 3000 ppm Indole-3-butyric acid treatment was found as the best treatment for rooting of MM<sub>106</sub> and EM<sub>9</sub> apple cutting in this experiment.

**Keyword:** *Agrobacterium*, Cutting



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## **Evaluation of drought tolerance in endemic ecotypes of cumin using tolerance indices**

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### **Abstract**

**Background and objectives:** Cumin seed yield reduction occurs in most regions of Iran due to the water stress. Therefore, based on literature review, major evaluations have been done using limited cumin ecotypes or mainly conducted under normal irrigated condition in the country. So, this study was designed to assess the most diverse cumin ecotypes currently cultivated in the major cumin cultivation areas of Iran in terms of seed yield, determination the effect of drought stress during flowering stage, identification of drought tolerant ecotypes to from segregating population using tolerance indices and indication of ecotypes response to drought stress and normal irrigation conditions.

**Materials and methods:** To determine the effect of water stress on yield of 49 cumin ecotypes adapted to Iran, a simple  $7 \times 7$  lattice design with two replications was conducted in research farm of college of Aburaihan, University of Tehran. Experiment was conducted during 2012-2013 season. Water stress initiated at 50% flowering stage when the soil humidity reached to 30% field capacity. Analysis of variance based on lattice design and evaluation of the relative performance compared to randomized complete block design were done. Further analysis was done based on randomized blocks design after correction of data. Calculation of 11 drought tolerance indices based on yield under drought and normal irrigated conditions, correlations among indices and seed yield and principle component analysis based on correlation coefficient matrix were followed.

**Results:** Lattice design relative performance compared to randomized complete block design was 153 and 148 percent in normal and stress conditions,

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respectively. Eleven different tolerance indices were estimated based on yield in both conditions. Correlation analysis, principal component analysis and biplot display showed indices MP, GMP, STI, Harm,  $K_1$ STI and  $K_2$ STI as suitable indicators showing high yield potential and stability. Cluster analysis based on indices grouped all ecotypes into three distinct groups. Tolerant ecotypes were placed in the same group. Ecotypes distribution in the biplot revealed genetic variation among genotypes regarding drought tolerance response.

**Conclusion:** Ecotype of Kerman (Baft), South Khorasan (Darmian) and Yazd (Sadooq) identified as most tolerant ecotypes while ecotypes from North Khorasan (Esfaraïen), Esfahan (Ardestan) and Khorasan-Razavi (Kashmar) identified as most sensitive ecotypes to drought stress in flowering stage. Then, usage of these accessions is recommended as parents to improve tolerant cumin cultivars in breeding programs.

**Keywords:** Cumin, Genetic variation, Low water, Yield