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The possibility of forage production of two kochia accessions by reducing water application under saline conditions

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Abstract

Background and objectives: In all arid and semi-arid area irrigation is necessary for crop production; salinization of soil is also unavoidable. Therefore, for sustainable crop production in such areas, growing crop species with higher threshold and lower yield reduction under saline and water shortage conditions is needed. Agriculture and animal husbandry are integrated in arid and semi-arid regions. Therefore, providing of forage for livestock in these areas is one of the main concerns of farmers. Kochia (*Kochia scoparia* L. syn *Bassia scoparia* L.) is an annual plant with high tolerance to salt and drought stress. It is capable to rapid established in saline soils, and is a ground cover plant that can introduced as an alternative fodder, in arid and semi-arid areas. Therefore, the aim of this study was to evaluate the drought tolerance of kochia in irrigation with saline water at different growth stages with emphasis on the forage characteristics.

Materials and methods: Experiment was conducted as split-plot based on randomized complete block design with three replications at the salinity research station of center of excellence for special crops of Ferdowsi University of Mashhad, Iran in 2008. In order to stimulation of drought stress at first and final growth stages drought stress was applied for four weeks. Three levels of drought stress (control, no irrigation in vegetative stage (recovery treatment) and no irrigation at reproductive stage for one month (stress treatments), and two kochia accessions (Birjand and Borujerd) were arranged as main and sub plots, respectively. Plants were irrigated with underground water with electrical conductivity (EC) of 5.2 dS m^{-1}. Forage harvesting was carried out after the third-stress treatment, in full flowering stage.

Results: The results showed that plant height in vegetative growth stage was more sensitive to water stress than the reproductive stage in kochia. In all irrigation treatments at different growth stages, Borujerd accession had higher plants height than Birjand accession and the highest plant height reduction in both accessions occurred in drought stress during vegetative growth stage. Branch number and forage yield in kochia were not affected by Irrigation treatments. Total dry matter percent of drought stress treatment at both reproductive stages were eight and nine percent higher in control and vegetative stage, respectively. Stems and leaves yield of Borujerd and Birjand accessions were not significantly affected by irrigation treatments. The highest and the lowest leaf to stem ratio were obtained in drought stress at vegetative and reproductive growth stage, respectively.

Conclusion: Four weeks irrigation cuts at vegetative and reproductive stages did not affect forage yield of kochia, and showed the high capability to recover the adverse effects of drought stress in vegetative growth stage. Generally, kochia has morphological features for introduce as a forage crop in saline and arid areas. In addition, the physiological mechanisms of drought and salt tolerance of kochia may introduce it as a candidate forage species for cultivation and to help feed the livestock in areas where salinity and drought stress is dominant.

Keyword: Drought stress, Dry matter percentage, Forage yield, Leaf yield, Stem yield

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Investigating the variation of essential oil content and composition of Moldavian balm in several areas of East and West Azerbaijan provinces

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Abstract

Background and objectives: Moldavian balm (*Dracocephalummoldavica* L.) is an annual medicinal plant that belongs to the Labiate family. The essential oil of Moldavian balm has wide usage in industries like pharmaceutical, dietary and many others (16, 20). Medicinal herbs are rich reservoirs of secondary metabolites and the active ingredients of many medications. Although these material basically created with genetic process but making them significantly affected by environmental factors. Due to the effect of environmental factors on the essential oil content and composition of medicinal plants and importance of Moldavian balm in food and cosmetics industry, this research was studied about the effect of environmental factors on essential oil content and composition of Moldavian balm.

Materials and methods: To determine the quantitative and qualitative characteristics of five Moldavian balm populations at five locations, an experiment was conducted as completely randomized design with three replications in 2013. In all regions, sampling were done in full flowering stage. In each region three samples were analyzed and these locations were Salmas, Urmia, Khoy, Maragheh and Tabriz. Cultivar of szk-1 was planted as a control treatment in the research field of Payam Noor University (PNU) in Marand. In each location, flowering branches of Moldavian balm were collected in full flowering stage. In this study oil contents and composition of essential oil were measured. After drying the aerial parts of plant in shade, their essential oils were obtained by hydro-distillation. In order to isolation and identification of oils GC and GC-MS were used.

Results: The results showed that effect of population was significant at 5% on essential oil content. The highest (6.10) and the lowest (4.0) essential oil were obtained in Salmas and Tabriz populations respectively. In total thirteen

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compositions were identified from collected populations from different regions and modern cultivar. Total compounds detected varied from 87.3 to 96 percent .The major components of the essential oil were Geraniol, Geranial, Nerol and Geranyl acetate. The highest and the lowest total amount of Neral +Geraniol+Geraniol were in Tabriz 57.3% and Maragheh 33.9 % population, respectively. Also, population of Maragheh (57.3%) and Tabriz (23.6%) produced the highest and the lowest amount of Geranyl acetate, respectively.

Conclusion: Salmas and Tabriz population produced the highest percentage and the essential oil composition respectively. In general, with selection of these two populations can produced cultivars with desirable agronomic traits.

Keywords: Medicinal plants, Secondary metabolites, Essential oil yield, Geranial

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The evaluation of quantitative and qualitative traits of barley and pea and Land Equivalent Ratio under different planting patterns and nitrogen levels

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Abstract

Background and objectives: Intercropping, the agricultural practice of cultivating two or more crops in the same space at the same time, is an old and commonly used cropping practice which aims to match efficiently crop demands to the available growth resources. Usually in intercropping treatments forage dry matter, percentage of dry matter, crude protein, neutral detergent fibre content and water-soluble carbohydrates compared with sole crop. The aim of this study was determining of quantity and quality of produced forage in sole and intercropping of barley and pea and also Land Equivalent Ratio.

Matherials and Methods: This experiment was arranged as factorial based on a Randomized Complete Block Design with three replications at research field, Gonbad Kavous University during growing season of 2012- 2013. Five intercropping levels were included sole crop of barley and pea, one row of barley + one row of pea, two rows of barley + two rows of pea and three rows of barley + three rows of pea and four levels of nitrogen were 0, 25, 50 and 75 kg ha^{-1}. Sowing date was 6 December 2011 and harvest date was 26 April 2012. The traits was forage dry yield, crude protein percentage, dry matter digestibility, water soluble carbohydrates, acid detergent fiber, ash and protein yield. For analysis variance of data SAS Ver.9.1.3 Software was used and treatments mean differences were separated by the least significant difference (LSD) test at the 0.05 probability level.

Results: The results showed that the effect of intercropping, nitrogen and interaction of intercropping × nitrogen on forage dry yield were significant (α= 1%). Effect of intercropping on percentage of crude protein, dry matter digestibility, water soluble carbohydrates, acid detergent fiber, ash and protein

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yield was significant (α= 1%). Crude protein percentage and ash content and so protein yield were affected by nitrogen application. Forage yield in sole crop of barley with consumption of 75 and 50 kg N ha^{-1} with 14.51 and 14.3 t ha^{-1} was the highest and in sole crop of pea without consumption of nitrogen with 3.76 t ha^{-1} was less than other treatments. Treatment of sole crop of pea had the highest amounts of crude protein, dry matter digestibility, water soluble carbohydrates and ash and the lowest of acid detergent fiber. Protein yield in sole crop of barley was higher than other treatments. Nitrogen increased percentage of crude protein, percentage of ash and protein yield. Land Equivalent Ratio in intercropping treatments was less than 1.

Conclusion: Forage dry matter in sole crop of barley with consumption of nitrogen was better than other treatments whereas sole crop of pea without nitrogen consumption produced the minimum yield. All quality traits except percentage of ash in sole crop of pea were higher than sole crop of barley and intercropping treatments. Land eqivalent ratio in all intercropping treatments was less than 1 so, intercropping was not superior to sole crops.

***Keywords*:** Ash, Forage Yield, Land Equivalent Ratio, Protein

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Evaluating natural saline water and nitrogen interactions on cumulative transpiration and water use efficiency in canola

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Abstract

Background and objectives: Currently, development of sustainable agriculture is constrained by freshwater scarcity. The use of low quality water such as saline and brackish waters should be considered as alternative water resources for agricultural productions. Based on global experiences, management of low quality water application is more appropriate choice than development of new fresh water resources. On the other hand, the availability of some nutritional elements such as nitrogen for plant production in saline soils is detrimental due to various reasons. The concentrations of some nutrients such as chloride are too high and toxic in these soils. Canola (*Brassica napus* L.) is one of the most important oilseed crops worldwide. Some environmental stresses can impose severe limitation for canola production in widely different climates. In recent years, much attention has been paid to develop oilseeds cultivation in Iran including canola. However, only little information on adaptability of this plant in various environmental conditions of Iran has been published. Consequently, it is quite important to investigate the limiting environmental constrains such as soil salinity in arid and semi-arid regions of the country. The objective of this study was to investigate the interactions of soil salinity and different levels of nitrogen application on transpiration and water use efficiency of canola seed production.

Materials and methods: A factorial experiment in a randomized complete block design with salinity and nitrogen factors were carried out on canola plant. The salinity treatments were consisted of non-saline water (0.3 dS m^{-1}) and four natural saline waters (a water which is not artificially made saline and directly taken from

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available natural saline water resources) of 3, 6, 9 and 12 dS m^{-1}. The nitrogen levels were consisted of zero (N1), 75 (N2), 150 (N3) and 300 (N4) mg N per kg soil applied as ammonium nitrate. The statistical analyses were performed using the MSTATC software and the means were compared by Least Significant Difference test (LSD) at 5% probability level.

Results: The results indicated that by increasing soil salinity, canola seed yield reduces but increases as result of nitrogen application in soil. Generally, by increasing nitrogen application, plant transpiration will increase due to the enlargement of plant transpiring area. Increase in transpiration by plant leaf would increase the nitrogen uptake by crops (nitrogen concentration × yield = N uptake). Application of N up to 75 mg per kg soil caused to increase the water use efficiency. Applying more nitrogen than 75 mg per kg soil reduced the water use efficiency. By increasing soil salinity to 6 dS m^{-1}, water use efficiency was first increased and reduced afterwards. Application of 150 and 300 mg N per kg soil when soil salinity was 12 dS m^{-1}, increased water use efficiency. This can be attributed to the sharp decrease of plant transpiring area. Application of nitrogen in lower salinity levels, however, decreased water use efficiency.

Conclusion: In general, using suitable amount of nitrogen under saline conditions not only would lead to increase canola yield and its oil content, but will improve its water use efficiency.

Keywords: Crop water requirement, Nitrogen, Osmotic stress, Yield

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Using the productivity effort, quantity and quality yield to identify sesame tolerant landraces to drought in symbiosis with mycorrhizal

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Abstract

Background and objectives: Drought is one of the most important factors limiting crop production and one of the main problems in many parts of the world. Sesame is one of the oilseed crops has important role in human health due to the high oil content (52-47%) and high quality (low in cholesterol and some anti-oxidants. The use of bio-fertilizers to reduce the use of chemical fertilizers and increasing yield, are an important issue in order to move towards sustainable agriculture. Arbuscular mycorrhizal fungi are one of the main components of bio-fertilizers and main part of plant roots flora in natural ecosystems. One of the mechanisms that enhance the stability of plants to drought stress is symbiotic relationship of mycorrhiza. There is still limited information about the sesame plant symbiosis with fungi in drought stress conditions. Therefore, this study was conducted to identify sesame tolerant landraces to drought stress using productivity effort, quantity and quality yield in presence or absence of different species of mycorrhizal in Urmia.

Materials and methods: This study was was conducted by factorial split plot arrangment with three replications in research field of Urmia agricultural high school that is located in the 12 km road Urmia - Mahabad. Longitude of site is 45˚ 2′, and latitude 37˚32′ and the average height of 1332 meters above sea level. The main factor was consisted different levels of irrigation, normal irrigation (irrigation after 70 mm evaporation of crop (ETc)), moderate drought stress (irrigation after 90 mm ETc) and severe drought stress (irrigation after 110 mm ETc), sub plots including two kinds of mycorrhizal fungi *Glomus mosseae*, *Glomus intraradices* and non-inoculated (control). Sub-sub plots consisted of eight landraces of sesame names Jiroft13, Zanjan Tarom landrace, Moghan landrace, several branches Naz, TC-25, TS-3, Darab 14 and Dashtestan 5. Studied traits in this research were grain

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yield, grain yield per plant, biological yield, total dry weight per plant, harvest index, productivity effort, oil yield and chlorophyll.

Results: According to the results, the effect of drought stress and mycorrhiza on all traits except harvest index and productivity effort was significant. Interaction of irrigation and genotypes on all traits except for productivity effort was significant. Interaction of mycorrhizal and genotypes only on biological yield and plant dry weight were significant. Landraces studied in different levels of drought stress and mycorrhiza had different reactions.

Conclusion: Mean comparison showed that with intensity of drought stress, all traits were significantly reduced. Severe drought stress reduced grain yield and biological yield about 63 and 52 percent, respectively. Use of two species of mycorrhizal fungi in comparison with control (lack of mycorrhiza) increased all traits. The landraces of sesame examined in this study, landraces Moghan and Zanjan Tarom for studied traits were superior to other landraces. According to the results, to improve grain yield of sesame landraces using mycorrhizal fungi especially species *G. mosseae* was recommended.

Keywords: Drought stress, Harvest index, Mycorrhizal, Productivity effort, Sesame

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Agro climatic suitability assessment of potato winter cropping system in Kerman province

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Abstract

Background and objectives: Winter cropping system of potato is a new cropping system in some area of Iran which its production at spring season is contemporary with planting time of main potato cropping systems overall this country, so extending of this cropping system is very important to fill the market gap of this commodity. This study was conducted in order to Agro climatic suitability assessment for winter cropping system of potato (*Solanum tuberosum*) using analytic hierarchy process (AHP) method and geographical information system (GIS) in Kerman province.

Materials and methods: Climatic database was made base on common historical period data (1989-2007) of maximum and minimum daily temperature, wind speed, precipitation, relative humidity and sunshine from all synoptic and climatology stations overall catchment area. Climatic indices which used to suitability assessment for winter cropping system of potato were determined based on ecological tolerance threshold and long term climatic database. Thermal and photoperiods requirements were calculated using physiological days index. Statistical analysis includes of regression modelling, correlation coefficient between climatic indices and elevation and other statistical indices was performed using SPSS software. Spatial analysis and geo statistical analysis was performed using related ArcGIS extensions. Weighting value of created spatial layers was determined using analytic hierarchy process. At the final step agroclimatic layers were overlaying to present suitability for winter cropping system of potato in Kerman province.

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Results: Results showed maximum length of growing period (110-140days) was in Kahnouj, Jiroft and Bam stations and its minimum was been in Baft and Shahre-Babak Stations. Evaluation of thermal stress showed occurrence probability of cold stress was less than 15-20% in some area of southern region and its probability was very high in elevated area of northern, western and central region of Kerman province. Based on results of this study the station of Kahnouj has the highest risk of heat stress (25%) for potato production at spring, heat stress probability of Jiroft and Bam stations were 20% and 7% and heat stress risk in other stations were very low. Physiological day's evaluation which used as the index for heat and photoperiod requirement showed lowest amount of this index was zero (station of Baft and Shahre-Babak) and highest amount of that was 130days (station of Kahnouj). Based on results of weighting with analytic hierarchy process (AHP), the indices weight of physiological days, frost stress probability, chilling stress probability, heat stress probability and slope were estimated 0.4206, 0.2028, 0.1947, 0.138, and 0.0439 which estimating consistency ratio was 0.035.

Conclusion: Result of agro climatic zoning using analytic hierarchy process showed that some of southern and eastern areas of Kerman province were climatically suitable for winter cultivation of potato but elevated area of western and central regions were not suitable. Eastern region of Kerman includes Dashte-Loot due to specific ecological condition have no ability for agricultural land use.

Keywords: Agro climatology, Potato, Pair-wise comparison, Physiological days, winter cultivation of potato

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Evaluation of seed yield variation, amino acids composition and proteins content of wheat grains by folic acid application

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Abstract

Background and purpose: Nowadays malnutrition due to low food diversity is a serious problem in developing countries like Iran. Due to important role of wheat in nutrition of these countries, researchers try to produce wheat grains with higher proteins, amino acids, iron and zinc content, providing essential body nutrients and as a result reduce malnutrition. Considering the role of folic acid in transfer of single carbon fragments and its effect on improvement of metabolic processes, in this research effect of external application of folic acid on the quality and yield of wheat grains were investigated.

Material and methods: Kohdasht wheat cultivar was planted in a farm experiment conducted at research farm of Maragheh University in early spring of 2013 using randomized complete block design with three treatments with density of 500 seeds per m^2 with 20 cm interval between rows. The three treatments were as follows: control (without application of folic acid), priming of seeds with 25 µM solution of folic acid accompanying leaf spraying in stem elongation stage. The third one was the same as second one except leaf spraying in heading stage. Folic acid spraying is carried out in the final hours of day by a pump sprayer. 100 mL of solution was sprayed per each square meter.

Finding: Results revealed that folic acid external application increase the yield of grain, protein, essential amino acids, iron content of grain significantly and finally cause to increase the chlorophyll content in flag leaf.

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Conclusions: In this research the effects of external application of folic acid have been studied on whole grain, but part of accumulated iron along with proteins during flour preparation process have been omitted. However, considering positive impact of external application of folic acid on quality of grains and on proteins, amino acids, iron content of them, this method could be considered as a short-term solution for both improving quality and quantity of food and reducing adverse effect of malnutrition.

Keywords: Essential amino acid, Iron, Phytic acid, Malnutrition

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Estimation of parameters for some dominant maize (*Zea mays* L.) cultivars of Iran for using in APSIM mechanistic model

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Abstract
Background and objectives: Investigating the impacts of agricultural management on crop productivity in specific environments is easily possible through crop simulation models. These computer-based tools, provide the ability of making some decisions regarding the use of agriculture resources and inputs. However, prior to use of these models, they need to be fully evaluated under different locations and years. Hence, this study has been performed to evaluate APSIM crop model and estimate the cultivar-specific parameters as inputs for the model.

Materials and methods: Different datasets were used in order to parameterize and evaluate APSIM-Maize model for three maize cultivars. So that, a four-year dataset (Shiraz) was used for the calibration of K.SC 260 cultivar from early maturing group. Also, for K.SC 704 (from late maturing group) and Maxima (from mid-maturing group) were applied from the two regions (Kerman and Khoramabad, each one at one year). These datasets are used to adjust parameters based on biomass, grain yield, number of days from emergence to flowering, number of days from flowering to physiological maturity and LAI for each cultivar. Model validation was conducted by a series of other datasets including published articles in journals and final reports of research projects.

Three statistical indicators including coefficient of determination (R^2) root mean squared error (RMSE) and index of agreement (*d* value) were computed from observed and simulated variables. The Origin Pro 9.1 software was used to statistical analysis and draw figures.

Results: The results of the model evaluation indicated that the model simulated flowering and physiological maturity stages of three cultivars with high accuracy in

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different years and different locations, so that the values of root mean square for flowering and maturity dates were as 1 and 1.35 %, respectively. Also, the simulation of LAI trend for two K.SC 704 and Maxima revealed that the APSIM-Maize model simulated LAI trend of these two cultivars with high accuracy. The values of root mean square for LAI trend of K.SC 704 in Kerman and Khoramabad were as 16.7 and 9.48 %, respectively. Also, for Maxima in Kerman and Khoramabad were as 16.75 and 10.65 %, respectively. Ultimately, APSIM-Maize model exactly simulated grain yield and biomass with high accuracy by accurate simulation of leaf area index and phenological stages.

Genetic parameters were different among the cultivars. The highest (650) and lowest (545) maximum number of kernel per ear belonged to cultivars K.SC 704 and K.SC 260, respectively. Also, the highest and lowest thermal time accumulations from flowering to maturity and those of seedling emergence to end of juvenile phase belonged to cultivars K.SC 704 and K.SC 260, respectively. Investigations show that the K.SC 260 is better rather than other cultivars just in terms of grain growth rate (9.6 mg $kernel^{-1}d^{-1}$). Finally, among the three cultivars, K.SC 704 has the highest biomass (21.81 t ha^{-1}).

Conclusion: The evaluation of APSIM-Maize model indicated that the model simulated phenological stages (flowering and physiological maturity) with high accuracy which proves that this model has suitable structure for simulation of phenological stages. Also, among the different cultivars, the number of kernel per ear, thermal time accumulation from flowering to maturity and thermal time accumulation from seedling emergence to end of juvenile phase, were greater in K.SC 704 rather than other cultivars.

Keywords: APSIM-Maize, Maxima, Potential conditions

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Effect of energy inputs on yield and economical analysis of cotton production in Khorasan Razavi province

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Abstract

Background and objectives: Khorasan Razavi province is one of the most important regions of cotton production in Iran. The sustainable production of cotton (*Gossypium hirsutum* L.) in Khorasan Razavi province of Iran requires the consideration of energy and economic analysis in the production system. Therefore, the aim of this study was to investigate the energy flow and economic analysis of cotton production in Khorasan Razavi province.

Materials and methods: Data were collected through questionnaires and also interviews with cotton producers during 2012-2013. Each farmer was asked to detail the activities in cotton production as inputs that recorded as seed used (kg), human labor (hr), machinery use (hr), diesel fuel (lit), chemical fertilizer (kg) biocides (kg), farmyard manure (kg) and electricity (kWh), and as the output yield (kg). The energy associated with each input was estimated by multiplying the activity data for each farm by a characterization factor. The Cobbe-Douglas model was then used to find the relationship between energy inputs and yield for the region using data compiled from all the farms. Marginal Physical Productivity (MPP) methodology was used to determine the sensitivity of energy inputs for cotton production in Khorasan Razavi province.

Results: The results revealed that the net energy and energy efficiency of cotton production in the region were 18683.78 $MJha^{-1}$ and 0.71, respectively. Electricity and chemical fertilizer inputs were 70.50 and 12.39 percent respectively, as the highest energy inputs consumed in the cotton production. The renewable energy and non-renewable energy of cotton production were calculated as 5896.64 and

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63299.11 $MJha^{-1}$, respectively. The Cobb-Douglas model results showed that the effects of inputs including seed, human labor, machinery and diesel fuel were positive on the yield while the effect of inputs including chemical fertilizers, biocide, and farmyard manure and electricity on cotton yield were negative. The results of the sensitivity analysis showed that increasing one MJ of energy inputs of seed, human labor, agricultural machinery and diesel fuel, the yield increased 0.09, 1.08, 0.73 and 0.17 kg, respectively and increasing one MJ of energy inputs of chemical fertilizers, biocides, farmyard manure, and electricity, the yield decreased 0.03, 0.09, 0.14 and 0.03 kg, respectively. The return to scale ratio was determined to be 0.88. It means that a 1% increase in the total energy inputs utilize would lead to 0.88% increase in the cotton yield. The net return and benefit-cost ratio were calculated as 9039451 Rial ha^{-1} and 1.21, respectively. Labor inputs were 42.9, as the highest variable costs consumed in the cotton production.

Conclusion: The energy use efficiency and benefit to cost ratio for cotton production were relatively low. The reason of relatively low energy use efficiency of cotton production was related to high consumption of water for irrigation and its electricity consumption.

Keywords: Benefit-cost ratio, Energy efficiency, Energy modeling, Labor

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Effects of water deficit on Leaf Relative Water Content, Chlorophyll Fluorescence indices and Seed Yield of four pinto bean genotypes

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Abstract

Background and objectives: Pinto bean is a susceptible plant to drought stress. However, there is genotype variation for the trait in this plant. The aim of this study was to investigate the effect of drought stress on leaf relative water content, chlorophyll fluorescence indices and grain yield of pinto bean genotypes (*Phaseolus vulgaris* L.) cultivated in Zanjan province.

Materials and methods: an experiment was conducted as spilt plot based on a completely randomized block design with four replications at Zanjan university research farm. Irrigation levels (control and drought stress) and genotypes (Local khomein, Sadri, Ks21193 and Ks21189) were set in the main and subplot, respectively. In this experiment leaf relative water content, minimum fluorescence, maximum fluorescence, variable fluorescence, quantum yield of photosystem II and grain yield were measured.

Results: Results showed that the drought stress effects for all traits, except for maximum fluorescence and the interaction of drought stress and cultivar for all traits, except for minimum fluorescence and maximum fluorescence were significant. In this experiment, it was also observed that on leaf relative water content, variable fluorescence, quantum yield of photosystem II and grain yield of genotypes were significantly lower under drought stress compared to the control.

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The results showed that water deficit caused quantum yield of photosystem II declined significantly due to increasing of minimum fluorescence and decreasing of maximum fluorescence. Results indicated that Ks21189 genotype showed maximum leaf relative water content (74.24%), variable fluorescence (2046) and quantum yield of photosystem II (0.70) under drought stress. Also, Ks21189 genotype exhibited the least reduction for leaf relative water content and quantum yield of photosystem II under drought stress in comparison to control. In addition, this genotype had maximum seed yield (741.6 Kg $ha^{-1)}$ under drought stress. These findings confirm the resistance of Ks21189 genotype to drought stress and stimulating this genotype to least reduction for quantum yield of photosystem II under water limitation conditions. Minimum leaf relative water content (51.8%), variable fluorescence (1245.5), quantum yield of photosystem II (0.63) and grain yield (503.1 Kg $ha^{-1)}$ was obtained in the plots which sadri genotype under drought condition was applied. Sadri genotype was identified as water deficit stress sensitive genotypes with the reduction of yield 80.18%.

Conclusion: Correlation analysis indicated significant and positive correlation between leaf relative water content, maximum fluorescence, variable fluorescence and quantum yield of photosystem II with grain yield. Thus, it seems that under drought stress, genotypes with stable quantum yield of photosystem II and leaf relative water content produce higher grain yield because of higher photosynthesis rate.

Keywords: Drought stress, Quantum yield of photosystem II, Variable fluorescence, Ks21189

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The effect of super absorbent on yield and yield components of chickpea under season terminal drought stress conditions

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Abstract

Water is the prime requirement for the existence of life. Due to the limited water resources, it is essential to save and economize the use of water resources. This can be achieved by applying proper water management including storage and maintaining soil water, improving soil water permeability and increasing water use efficiency. Due to the importance of chickpea plants as a source of protein and the other side, irreparable damage of terminal drought for chickpea, the achievement of strategies for drought tolerance could be very important and necessary. Super absorbent polymers of hydrocarbons can absorb and hold water, several times their weight and the polymer discharged at water deficit condition, gradually. The soil remains wet for a long time and again, don't need to irrigation. The effectiveness of super absorbent in sandy loam soil is higher than loam and clay soils. With increasing its consumption, biomass and water use efficiency increases. The objective of this study was to determine the right amount of super absorbent to achieve maximum chickpea yield and yield components under drought stress and also the most sensitive stages of chickpea growth to drought stress.

Materials and methods: In order to evaluate effect of super absorbent and terminal drought stress on yield and yield components of chickpea (Hashem cultivar), a field experiment was conducted as split plot on randomized complete block design with four replications during 2014 in Chaghatay. Treatments included drought stress: cutting irrigation at flowering stage, cutting irrigation at the beginning poding stage and control condition (non stress), as main plots and the use of super absorbent in three levels: 0, 50 and 100 Kg ha^{-1} as subplots.

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Results: Results indicated that yield, biological yield, pod number per plant, grain number per pod, grain weight and protein content were decreased with cutting of irrigation but plant height and harvest index were not significantly different. Super absorbent application moderate the effect of drought stress on yield and yield components of chickpeas. The maximum yield and yield component were obtained by application of 100 Kg ha^{-1} super absorbent but effect on protein content was not significant. Protein in cutting irrigation at flowering stage (115.23 kg ha^{-1}) was higher than the protein in cutting irrigation at pod stage (77.29 kg ha^{-1}).

Conclusion: To obtain optimum yield in drought stress condition, the best result was obtained with application of 100 kg ha^{-1} super absorbent.

Keywords: Biological yield, Drought stress, Economic yield and protein

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Comparison of salinity response in tolerant wheat cultivars with introduced cultivars for non-saline condition

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Abstract

Background and objectives: Salinity stress is a major constraint inhibiting yield of crops throughout the world. Salinity tolerance in crops responded to salinity stress by three main mechanisms including osmotic tolerance, ion exclusion and tissue tolerance.

Materials and methods: In order to study salinity response of introduced salinity tolerant wheat cultivars and comparison of them with introduced wheat cultivars for non-saline condition, this experiment arranged in three steps of germination, greenhouse (one year) and farm (two years) during 2012-2014. In farm experiment, treatment includes salinity tolerant cultivars of Akbari, Sistan, Arg, Ofogh and Roshan and introduced cultivars for non-saline condition namely Morvarid, KohDasht and Falat. This cultivars cultured in two stations of Salinity research farm (Agh-Ghala) and Gorgan station (as non-saline condition) in randomized complete block design with four replications. In greenhouse experiment, all of the cultivars planted in pots with sandy medium and Hoagland solution. Salinity treatments were control condition and 15 dS m^{-1}. Relative growth rate measured daily for seven days after salt exposure and then measured with two days interval for two weeks. The sodium content of leaves, the leaf area and total dry matter in all of the pots, measured three weeks after salt exposure. Additional pots for cultivars of Falat, KohDasht and Ofogh prepared and treated with salinities of 2, 7.5 and 15 dS m^{-1} in three replications. These pots continued until end of the season in order to determination of salinity threshold based on the grain yield. Also the germination of the cultivars measured at salinities of 0 until 30 dS m^{-1} with 5 unit intervals in three replications to calculate salinity threshold in germination stage.

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Results: Based on the results, salinity caused two phase growth reduction of osmotic and ionic, so that the osmotic effect influenced more than ionic effect. In the first week after salt exposure, the same dry matter reduction observed in cultivars, but reducing in leaf area starts immediately after salt exposure. The Sistan cultivar considered as osmotic tolerant and Falat as sensitive cultivar based on the reduction of relative growth rate in the first week after salt exposure. In the next two weeks of experiment more reduction occurred in growth rate in saline condition. This reduction attributed to accumulation of sodium ions and ionic effect phase of salinity stress. Based on the two linear model of response of crops to salinity, the cultivars of Falat, KohDasht and Ofogh had the threshold of 6.06, 5.27 and 4.00 dS m^{-1}, respectively. Based on the sigmoidal model these cultivars produced 50 percent relative yield in salinities of 11.86, 11.56 and 13.38 dS m^{-1}, respectively.

Conclusion: In general, results showed that, the salt tolerance cultivars produced higher yields only in native climate condition. When they cultured in different climatic condition with salinity stress, they can't produce higher yields and not shown salinity tolerance qualifications by effectiveness.

Keywords: Wheat cultivars, Osmotic effects, Ionic effects, Stress tolerance mechanism, Salinity tolerance threshold

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Effect of different planting dates on yield, yield components and growth characteristics of triticale (case study: Gorgan township)

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Abstract

Introduction and objectives: The nutritional value of each plant production is dependent to light and temperature in growing season, which is affected by planting date. Planting at the suitable time was provided the best environmental conditions at all growth stages and it causes to increase in crop yield. By understanding environmental factors, ecological requirements of crop and environment and cultivar interaction effects, planting date can be determine for each cultivar. The purpose of this study was to determine the appropriate planting date of triticale in the Gorgan township and investigation of planting dates effects on yield, yield components and growth characteristics of triticale.

Materials and methods: In this research, the effects of six planting dates (including 29 October, 12 November, 28 November, 12 December, 28 December and 11 January) were evaluated on grain yield, yield components and growth characteristics of triticale at the experimental field of Gorgan University of Agricultural Sciences and Natural Resources, during 2013-2014. The experiment was carried out based on a randomized complete block design with three replications. Measured traits were grain yield, biological yield, harvest index, SPAD index, number of days to full heading, Spike length, number of fertile tillers, total number of plants, 1000-grain weight, plant length, stem weights, number of grain per spike, percentage of filled and unfilled grain.

Results: The results showed that highest grain yield, filled grain percent and SPAD index were obtained in 29 October, 12 November and 28 November dates. Planting

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times was not significant effect on the yield components (exception of 1000 grain weight, harvest index and biological yield). The other results of this research showed that yield components of triticale were reduced with delay in planting date from 29 October to 11 January. Delay cropping reduced the total number of tillers, number of fertile tillers, plant length, spike length, number of grain per spike, 1000 grain weight, percentage of filled grain and biological yield equal to 35.86, 34.31, 21.86, 20, 21.75, 15.75, 16, 31.15 and 21.40 percent, respectively. Lower plant length and biological yield on 28 November planting date, lead to the highest harvest index (41.15%).

Conclusion: In general, It could be concluded that triticale planting in 29 October to 28 November dates in Gorgan, lead to the highest production of grain yield (7.84 -7.96 t ha^{-1}) and biological yield (19.06 - 19.80 t ha^{-1}).

Keywords: Biological yield, Harvest index, Juanillo – 92 cultivar, SPAD index