

Investigation of the effects of gelling agent, carbohydrate source and culture container on micro propagation of three potato cultivars

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Abstract

Background and objectives: Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world. Potato micropropagation can be affected by some factors including the type of culture container, carbohydrate source and gelling agent. In this study, the effects these factors were investigated on the micropropagation of three potato cultivars (Agria, Marfona and Savalan) using MS medium.

Materials and methods: In this study, the effects of above-mentioned factors were investigated on the micropropagation of three potato cultivars (Agria, Marfona and Savalan) using MS medium. The effects of two type gelling agents (Agar Agar (7 g l⁻¹) and phytigel (3.5 g l⁻¹)), three carbohydrate sources (grade sucrose, table sugar, brown sugar (30 g l⁻¹)) and different culture containers (test tube, small glass bottle (110 × 60 mm), large glass bottle (150 × 95 mm) and polypropylene container (90 × 90 × 110 mm)) were investigated in the separated experiments. Each experiment was performed according to a factorial experiment based on completely randomized design (CRD) with 10 replications. After 30 days, different traits including shoot length per plantlet, mean of root length per plantlet, number of roots per plantlet, leaf size per plantlet, number of nodes per plantlet and mean of minituber weight per plantlet were measured. The regenerated plants were acclimated and cultured in the field conditions for minituber production.

Results: The results indicated that the medium containing agar-agar as gelling agent had the highest shoot length per plantlet (5.16 cm) and mean of root length per plantlet (6.06 cm). The highest number of roots per plantlet (4.7) has been obtained by cultivars Marfona and Savalan. Cultivar Marfona also produced the maximum number of nodes per plantlet (9.2). Investigation of the carbohydrate source showed that the brown sugar has improved the most studied traits and the highest shoot length per plantlet (7.07 cm) and mean of root length per plantlet (6.61) have been obtained by the use of brown sugar. Also, the use of polypropylene container (Vitro vent plant tissue container) improved the different studied characters including shoot length per plantlet (17.96 cm) and mean of root length per plantlet (11.73 cm).

Conclusion: In general, the use of agar-agar, brown sugar and polypropylene container can enhance the micropropagation rate and decrease the production input costs. Polypropylene container has the unique capacity of continuous gas-exchange between the inner volume of the container and the outside environment. There is a continuous supply of fresh air in the container and no accumulation of volatile compounds.

Keywords: Culture medium, Micropropagation, Phytigel, Culture container

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Effect of Brassinosteroid application on safflower cultivars tolerance to water stress in Ardabil

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Abstract

Background and objectives: Safflower is cultivated for a long time in the past. This plant is tolerant to drought and salinity stress. Water limitation restricts the crop production in many parts of the world, especially in arid and semi-arid regions. The aim of this study was selection proper varieties of safflower in drought conditions of the cold regions and was increasing safflower tolerance to these conditions. Since the safflower is one of the important oil seeds crop, so this plant was selected for this study.

Materials and methods: In order to investigate the effect of water deficit stress on some physiological traits of safflower, an experiment carried out in Agricultural Research Station of University of Mohaghegh Ardabili in 2014, as a split plot factorial based on randomized complete block design with three replications. The main factor was three irrigation schedules as irrigation after 80, 120 and 150 mm evaporation of the class A pan, and subplots, consisted of three safflower cultivars (Goldasht, Spiny Sina and Faraman) and two levels of Brassinosteroid (control and 10^{-7} M).

Results: Based on results interaction effect of cultivars and irrigation schedules was significant on chlorophyll a, b and total chlorophyll, F_o and F_m , relative water content and proline, soluble sugars and leaf protein. At severe stress (irrigation after 160 mm evaporation), Faraman cultivar had the highest soluble sugars, relative water content, chlorophyll a and total chlorophyll. Spiny Sina cultivar had the highest chlorophyll water saturation deficit and Goldasht had the highest content of proline and f_o . In the severe stress (160 mm evaporation) f_m of Goldasht and Faraman was placed in one statistical group and both had more f_m than spiny Sina and in leaf soluble protein, spiny Sina and Faraman with equal statistical group were superior to Goldasht. Simple effects of drought stress, cultivar and brassinosteroid were significant in all studied traits. The main effects of water deficit showed that increasing water stress leads to elevated levels of proline, soluble sugars and the f_o and f_m . In contrast, the chlorophyll a, b, total chlorophyll content, relative water content, F_v/F_m , and soluble protein reduced. Applying Brassinosteroid, resulted to significant increase of chlorophyll a, b, total chlorophyll content, relative water content, f_v/m , proline and soluble protein, while it caused to reduce the amount of soluble sugar and F_o and F_m .

Conclusion: It is concluded that in cold regions like Ardabil Faraman cultivar had better growth in dry conditions than Goldasht, and the spiny Sina is not suitable for the cultivation in the Ardebil region. Also, Brassinosteroid improved water content and caused more growth under the water deficit stress.

Conclusion: It is concluded that in cold regions like Ardabil Faraman cultivar will have better growth in dry conditions than Goldasht and the spiny Sina is not suitable for the cultivation in the Ardebil region. Also, Brassinosteroid improved water content and caused more growth under the water deficit stress.

Keywords: Proline, Fluorescence, Chlorophyll content

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Process of seed research in Iran: from past to now

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Abstract

Background and objectives: It seems that there is no good long-term plan to resolve existing problems of seed production and technology fields in Iran. Most of studies about seed technology are based on researchers' opinion, ease of implementation or following published articles in credible journals without considering the real needs of the country. Since there is not enough comprehensive information about the previous works in the field of seed, awareness of the past research trends can help researchers and the seed industry planners to know whether they are in right direction of seed industry or attention to unnecessary topics has prevented them from reaching this important. So the aim of this study is to summarize and organize past conducted studies in the field of seed technology. It is important to determine what areas of seed science have been overlooked to make recommendation.

Materials and methods: This study was conducted in Gorgan University of Agricultural Sciences and Natural Resources in 2014. All the published articles by Iranian journals and three seed science and technology congresses were collected from 1987 to 2012. The articles were grouped based on their subjects and topics (seed germination and emergence, germination under stress conditions, seed vigor, seed dormancy, seed improvement, seed production and certification, seed storage, seed-borne diseases and pests, seed biotechnology, seed biochemistry, gene bank, seed bank, seed mechanization and other subjects) for crop plants, orchard plants, weeds, medicinal plants, and etc. The number and percentage of articles in each group were determined.

Results: According to the published articles in seed science and technology conferences, most of the articles were related to seed germination and seed control and certification (for first, second and third congresses were 45, 38 and 54 percent of total articles published, respectively). Mainly, more articles related to agricultural plants, especially cereals and oil industrial groups crops (for first, second and third congresses were 78, 77 and 81 percent of the articles for crops, respectively). Among the articles that published in national journals, the highest growth rate was on the subject of improving seed quality (0.79 numbers of articles per years). The growth rates of articles publishing for the other topics were varied from 0.06 (mechanization) to 0.43 (germination) number of articles per years. In related to crops, cereal crops had the highest proportion plant and pulse had the lowest. Based on comparison of papers published in Iran and international journals, it was found that in Iran considering to seed dormancy and generally weeds is less than international journals.

Conclusion: Due to the high losses of grains during storage, high amount of weeds damage, machines inability to crop production and storage in Iran, attention to these issues are necessary.

Keywords: Scientific seed journals, Seed enhancement, Seed science and technology conferences, Seed storage, Weed

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The effect of waterlogging on yield and yield components of chickpea under dry farming

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Abstract

Background and objectives: About 10 percent of arable land in the world and almost one million hectares of land under cultivation in Iran has problem of waterlogging. When the soil water is increases as far that prevent the flow of oxygen in soil, waterlogging is happen. Plants have different mechanisms in the waterlogging conditions. The amount of damage depends to the crop, variety, waterlogging duration, plant growth stages, water temperature, and etc. So, this study was conducted in order to investigate the effect of different periods of waterlogging on various growth stages of chickpea in dry land conditions.

Materials and methods: This study was conducted in Gorgan University of Agricultural Sciences and Natural Resources in 2014. All the published articles by Iranian journals and three seed science and technology congresses were collected from 1987 to 2012. The articles were grouped based on their subjects and topics (seed germination and emergence, germination under stress conditions, seed vigor, seed dormancy, seed improvement, seed production and certification, seed storage, seed-borne diseases and pests, seed biotechnology, seed biochemistry, gene bank, seed bank, seed mechanization and other subjects) for crop plants, orchard plants, weeds, medicinal plants, and etc. The number and percentage of articles in each group were determined.

Results: The results showed that grain yield with increasing waterlogging durations in establishment, vegetative and flowering increased, but it decreased at the poding stage. The highest grain yield loss was observed at waterlogging during poding stage. With increasing duration of waterlogging number of grain per plant increased significantly (22.2%), but one hundred grain weight response was diverse. Waterlogging effect on the number of grain in the final growth stages was 40% lower in comparison to flowering stage. The lowest of grain protein content (16.04%) observed at 12 days waterlogging during poding stage. Leaf area index, leaf dry weight and total dry weight increased with waterlogging treatment at establishments, vegetative and flowering stages, but at the poding stage decreased in all waterlogging periods.

Conclusion: The waterlogging conditions at different growth stages of chickpea in dry conditions (except for poding stage) was not only did not reduce the yield and yield components, but also after the removal of waterlogging, cause recovery and increase growth again after treatment and each plant produces new flowers and pods compensated the damage caused by waterlogging conditions. Furthermore, in this study, the most of damage to chickpea had non waterlogging (dry conditions) and 12 days waterlogged treatments.

Keywords: Chickpea, Different growth stage, Dry farming, Waterlogging, Grain yield and yield components

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Evaluation the effect of different irrigation intervals on some agronomic characteristics of domestic and foreign corn hybrids in the north of Khuzestan region

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Abstract

Background and objectives: one of the aspects of managing the maize, like any other crops, is determine the plant cultivar and irrigation interval for using the cultivar potential. One of the most important problems in corn cultivation in the northern region of Khuzestan is low information of farmers about grain yield and some agronomic characteristics of domestic and foreign corn hybrids in this region and this factor lead to difficulties in the decision of farmers to select suitable hybrids for cultivation. Also water consumption is high in corn, thus this study was carried out to evaluate the reaction of domestic and foreign corn hybrids available in response to different irrigation intervals.

Materials and Methods: This experiment was carried out on the basis of split-plot design in completely randomized block design with three replicates in 2015. Irrigation treatments in three levels includes 7, 14 and 21 day's interval) as main-plot that applied in flowering(tassel emergence) and available hybrids in region in nine levels includes Moghan704, Jovin704, Mobin 616, Karoon 701, NS770, Simon, BC582, BC678 and AS71 as sub-plot were carried out. The characteristics measured were yield and grain yield components (number of kernel rows, number of kernels per row, 1000-kernel weight), plant height, number of leaves per plant, plant diameter, length and width of ear leaf, ear length.

Results: Results showed that the effect of irrigation treatments, hybrid and irrigation×hybrid interactions on grain yield, 1000-kernel weight, ear length and number of kernels per row was significant. The effect of hybrid and irrigation×hybrid interaction on number of kernel rows was significant. Mean comparison of irrigation×hybrid interactions on grain yield showed that the highest amount of grain yield was observed in Moghan704 in 7 day (1.18 kg/m²) and 14 day (1.14 kg/m²) intervals, Jovin 704(1.23 kg/m²) in 7 day intervals, Simon in 7day (1.15 kg/m²) and 14 day (1.2 kg/m²) and NS770 in 7 (1.2 kg/m²) and 14(1.27 kg/m²) day interval and the lowest amount of grain yield was observed in Mobin 616 in 21 day interval(0.54 kg/m²) and Karoon 701 in 21 day intervals (0.62 kg/m²). Mobin616 hybrid had the highest number of kernel rows in 7 day intervals (14.9) and Simon had the lowest amount in 21 day interval (12.4). NS770 had the highest number of kernels per row in 14 day intervals (43.9) and Mobin616 had the lowest amount in 21 day interval (28.06). BC582 hybrid had the highest ear length in 14 (21.9) and 21 day intervals (22.06) and Mobin616 had the lowest amount in 21 day interval (15.5). Simon had the highest plant height (260.16 cm). Mobin hybrid had the highest leaf number (15.6). Simon hybrid had the highest leaf length (89.3 cm). In terms of leaf width, BC678 had the highest amount (9 cm).

Conclusions: 7-14 days irrigation interval can be applied after corn tasseling and achieved grain yield similar to 7 days. But irrigation interval more than 14 days is not recommended because cause a significant decrease in the grain yield. Grain yield of Moghan 704, Jovine 704, Simon and AS71 was the highest in the north of Khozestan as a second crop.

Keywords: Corn, Domestic and foreign hybrid, Grain yield, Irrigation interval

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Mutation breeding by gama irradiation for improvement of assimilate remobilization and production in wheat

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Abstract

Background and objectives: Drought stress is one of the most important limiting factor of wheat seed yield in arid and semi-arid regions, the remobilization of assimilates gain more value for filling the grains. The mutant genetic materials are invaluable tools to understand the physiology of remobilization and to help the introducing new drought tolerant cultivars. The aim of this study was to determine the reasons of variation in bread wheat genotypes in the process of remobilization and its relationship with grain yield in drought stress conditions and the role of mutation breeding in bread wheat breeding programs under drought stress.

Materials and Methods: This experiment was carried out on the basis of split-plot arrangement in completely randomized block design with three replicates in 2015. Irrigation treatments in three levels includes 7, 14 and 21 day's interval) as main-plot that applied in flowering (tassel emergence) and available hybrids in region in nine levels includes Moghan704, Jovin704, Mobin 616, Karoon 701, NS770, Simon, BC582, BC678 and AS71 as sub-plot were carried out. The characteristics measured were yield and grain yield components (number of kernel rows, number of kernels per row, 1000-kernel weight), plant height, number of leaves per plant, plant diameter, length and width of ear leaf, ear length.

Results: Based on the results the capacity of genotypes to storage assimilates before terminal stress and high capability of the sink are main factors to determine the amounts of stem remobilization. Considering the senescence possibly induced by drought stress on the mutant lines (as a stimulating factor for remobilization), yield and maximum specific weight, remobilization and remobilization efficiency of the lines were in better situation than the wild type (cv. Tabasi). Also the using the full-length potential of stem had a key role in the mobilization of stem reserves. For better response to stress conditions, mutant line T-65-7-1 has utilized from potential of all parts of the stem (peduncle, penultimate and lower Internodes) for remobilization of assimilates.

Conclusion: Based on the results It could said that the reasons of variation in bread wheat genotypes in the process of remobilization are the difference in receiving signals of senescence phenomenon under drought stress, capability of the sink, the rate of the reserves assimilated before anthesis and the use of reserves capacity over stem (different stem internodes).

Keywords: Mutation, Drought Stress, Senescence, Yield, Bread Wheat

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Effect of drought stress on water status, stability of cell membranes and yield in several cultivars of Foxtail Millet

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Abstract

Background and objectives: Water scarcity is one of the most important limiting factors for crop production that affected on growth by changing physiological conditions. Millet is an important plant to investigate the mechanisms of stress tolerance in plants which are relatively resistant to drought. The assimilation and dry matter production is high in this plant under dry conditions and its reason is the mechanism of condensed carbon dioxide. Chavez (2003) stated that the first plant response to stress is stomatal closure and the impact of drought on photosynthesis can be evaluated based on stomatal conductance (4,25). Relative water content is as well as an indicator of plant water status in stress conditions (22). Resistant varieties show high relative water content (27). Low electrolyte leakage indicates membrane integrity (22). electrolyte Leak and membrane lipid peroxidation are indexes of drought resistance (3).

Materials and methods: This study was carried out in Research greenhouses of Birjand University in 2014. A factorial arrangement of treatments based on randomized complete block design (Due to the lack of uniformity of light) with four replications was used. The studied factors were drought stress with three levels including 100, 75 and 50 percent of plant water requirement (non-stress, moderate and severe stress respectively) and millet cultivar with three levels (including Bastan, promising lines KFM5 and KFM20). Relative water content, stomatal conductance, electrolyte leakage was measured in 30 and 45 day after stress and yield in maturity.

Results: The results showed that relative water content (RWC) and stomatal conductance decreased as intensity and duration of drought stress increased in all three varieties. Membrane lipid peroxidation, permeability of membranes and electrolyte leakage increased and membrane stability decreased as intensity and duration of drought increased in all three cultivars. Drought stress reduced number of grains per panicle, seed weight and seed yield compared to control. The highest and lowest seed yield was observed in control and severe stress respectively in all three cultivars. All three variety or cultivar had similar status in stomatal conductance and leaf relative water content in 30 day after stress. Although among the varieties, Bastan had the highest stomatal conductance and was less affected under moderate and severe stress (50 and 33 percent respectively compared to control) in 45 day after stress but Bastan had an appropriate relative water content (0.43 and 0.41 respectively) and had not significantly different with other lines. The malondialdehyde content (MDA) was low in Bastan compared to other cultivars and the membrane lipid peroxidation was less affected by increasing drought stress indicating that the variety was more potential to protect membrane integrity. Bastan indicated greater performance than the other lines, this performance was more drastically decrease compared to KFM20 line under stress treatments.

Conclusion: Bastan is better than the other lines and is advisable to drought stress conditions. Relative water content and stomatal conductance are mechanisms of adaptation and resistance to drought stress and Malondialdehyde is an index of the amount of damage to the cell membrane that used in order to identify the susceptible and resistant variety to drought stress.

Keyword: Yield components, Malondialdehyde, Relative water content, Electrolyte leakage

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Effects of different nitrogen levels and transplanting date on growth characteristics, yield and essential oil of peppermint in row intercropping with Lentil

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Abstract

Background: Peppermint (*Mentha piperita* L.) is one the valuable medicinal plant due to its efficacy in treatment of many diseases and other industries, so increment of quantity and quality of its essence through agricultural techniques has special importance. Excessive use of chemical fertilizers, especially nitrogen, in addition to environmental pollution, infers quality risks for medicinal uses. Intercropping reduce chemical input and increase resources productivity. Intercropping with legumes could be a technique to reduce chemical inputs, especially nitrogen. In addition, it may increase desire of farmers to cultivation of this plant and lead to higher performance, while biodiversity and productivity also increase. So the study was conducted to investigate effects of different levels of nitrogen and transplanting date on some growth traits, yield and essential oil of peppermint in different ratios of intercropping with lentils.

Materials and Methods: This experiment was done as factorial based on randomized complete block design with three replications on the research farm of Shahrekord University during 2015. Different ratios of intercropped or sole cropping (66% mint: 33% lentils, 50% mint: 50% lentils, 33% mint: 66% lentils, and sole cropping of peppermint and lentils), three nitrogen levels (100%, 75% and 50% of peppermint request) in two transplanting date for peppermint (29 April and 25 May) were evaluated as first to third factor. Growth characteristics of mint like plant height, leaf production rate, dry matter yield and grain yield of lentil were measured along with essential oil rate and yield of pepper mint.

Result: Effect of intercropping ratios, nitrogen and transplanting date was significant on growth characteristics, yield and essential oil of peppermint. Higher peppermints observed in sole cropping, at 29 April and 100% nitrogen requirement, more number of leaves per plant observed in this planting date and nitrogen level in sole cropping. But by reducing of nitrogen fertilizer to 75% and 50%, the highest number of leaves were obtained in intercropping treatments especially 66% mint: 33% lentils at 29 April transplanting date. Intercropping increased dry matter yield, the essential oil rate and yield compare to sole cropping. Conversely, delay cropping and lower nitrogen fertilizer application decreased these parameters. Intercropping could partly compensate for the lack of nitrogen and planting date. In 29 April, dry matter yield of 66% mint: 33% lentils at all levels of nitrogen fertilizer was higher than sole cropping. The highest yield of grain (2614 kg per hectare) also was obtained in its sole cropping, this means that lentil was not dominated in this intercropping system. Total land equivalent ratio for 75% N fertilizer was more than one in all intercropping ratios, tough in first transplanting date plots with 50% mint:50% lentil and for second transplanting date 66% mint: 33% lentil with 1.17 and 1.1 had higher LER.

Conclusion: Since late transplanting (25 may) decreased growth parameters of peppermint, transplanting on 29 April is recommended. But in nitrogen deficiency condition, intercropping with lentil could improve plant nitrogen supply. In order to achieve sustainable agriculture, intercropping of these plants recommended.

Keywords: Essential Yield, Intercropping Ratio, Nitrogen Fertilizer, Dry Matter, Equivalent Yield

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Study the Effect of Different Nitrogen Resources on Quality and Quantity of Tobacco in Two Locations

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Abstract

Background: Nitrate (NO_3^-) and ammonium ion (NH_4^+) in the soil differ for their effects on yield quantity and quality of tobacco. Climatic and edaphic factors and agronomic management can undermine their differences. With increasing leaf yield, chlorine and nicotine content of the leaves and on the contrary, by reducing potassium content, nitrogen, has the opposite effect on the quantity and quality of tobacco leaves. Tobacco farmers do not consume urea fertilizer in the country and they believe that the use of urea result to the late tobacco and tobacco leaf color is inappropriate technology. This experiment was conducted for evaluation different nitrogen resources (Urea and nitrate ammonium) and application pattern on western tobacco.

Material and method: Two field experiments were conducted based on randomized complete block design with factorial arrangement in Oromieh and Tirtash in 2014. First factor was nitrogen fertilizer from urea (ammonium) and nitrate ammonium fertilizers and second factor was application pattern with basal, 2/3 basal and 1/3 after initiation of rapid growth (AIRG, about three days after transplanting), 1/2 basal and 1/2 AIRG, 1/3 basal and 2/3 AIRG) with three replications.

Finding: The results indicated that the leaf yield was higher in Tirtash than Oromieh. In terms of leaf yield, the best application pattern for urea and nitrate ammonium was 2/3 basal and 1/3 AIRG, and 1/3 basal and 2/3 AIRG, respectively. Regarding potassium content of cured leaf, urea was better than nitrate ammonium in Tirtash but in Oromieh, it was adverse. Nicotine content was only affected by application pattern; the 1/2 basal and 1/2 AIRG was the best for nicotine content. Ammonium nitrate caused lower accumulation of chloride in leaf than urea.

Conclusion: Although urea and nitrate ammonium did not differ for leaf yield but urea and nitrate ammonium application increase leaf potassium content. The results reduce the ambiguities use of urea fertilizer in the tobacco field. With complementary evaluation, urea could be recommended because of relative abundance of urea relative to ammonium nitrate fertilizer and domestic production of urea fertilizer, then tobacco farmers' problem in the preparation of ammonium nitrate fertilizer in different region eliminated.

Keywords: Ammonium nitrate, Quality, Quantity, Tobacco, Urea

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Response of yield and physiological characteristics of Purple Coneflower (*Echinacea purpurea* (L.) Moench) to nitrogen sources at different levels of irrigation

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Abstract

Background and objectives: Purple coneflower (*Echinacea purpurea* L.) is a perennial and herbaceous medicinal plant belonged to Asteraceae. All plant organs, have medicinal properties, but roots, leaves and flowers use to provide pill and syrup in large-scale. *Echinacea* is widely used in treating urinary tract diseases, respiratory disorders and viral infections. Nitrogen has an important function in physiological responses of medicinal plants to drought. Application of nitrogen biological fertilizers to achieve proper and sustainable quality and also reducing chemical fertilizers is critical. This field experiment was conducted to study the response of yield and physiological characteristics of Purple coneflower to chemical and biological sources of nitrogen under different irrigation regimes.

Materials and methods: The experiment was conducted in a research field in Lordegan County, Caharmahal and Bakhtiari province as a split plot arrangement based on a randomized complete block design with three replications during 2013–2014 and 2014–2015 cropping seasons. Irrigation treatments were scheduled based on the soil available water depletion percentage (SAWD) (25% SAWD, 50% SAWD and 75% SAWD) which were allocated as main-plot, and five levels of nitrogen source including 80 Kg N ha⁻¹, 40 Kg N ha⁻¹, 40 Kg N ha⁻¹ + 5 L ha⁻¹ Nitroxin, 5 L ha⁻¹ Nitroxin and non-nitrogen (control) as sub-plot factor. The measured characteristics included of chlorophyll a, chlorophyll b, total chlorophyll, leaf proline, soluble sugars, fluorescence parameters and biological yield.

Results: Results showed that different levels of irrigation and nitrogen effect on all traits (except the effect of nitrogen for total chlorophyll) were significant. Interaction of year×irrigation×nitrogen source for yield and all physiological characteristics except for soluble sugars was significant. During the two years of experiment application of nitrogen sources increased chlorophyll content in irrigation after 25% and 50 % SAWD. The minimum and maximum fluorescence yield, achieved from interaction between 80 kg nitrogen at 25% and 75 % SAWD in the second year, respectively. Maximum biological yield in first year (5105.2 Kg ha⁻¹) and second year (12178/8 Kg ha⁻¹) obtained from 80 kg nitrogen and 5 L ha⁻¹ nitroxin+ 40 Kg nitrogen at 50% SAWD in both years. In general, Purple coneflower in response to drought stress increased soluble carbohydrate and proline content of leaves and nitrogen level affected soluble carbohydrate and proline content of leaves.

Conclusion: Irrigation after 50% SAWD could be suggested to obtain maximum biological yield of *Echinacea purpurea*. Application of Nitroxin as a biofertilizer and 40 Kg N ha⁻¹ could be a proper alternative than the consumption of 80 Kg N ha⁻¹.

Keywords: Chlorophyll, Fluorescence, Nitroxin, Soluble sugars

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Investigation of factors affecting the fuel consumption of soybean production in the Golestan province

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Abstract

Background and objectives: On a global scale, agricultural processes consume about 5 percent of fossil fuels (6). Farming activities including tillage, Fertilizer Distribution, spraying, irrigation and harvesting of crops as a direct consumer of fossil fuels (16). In recent years due to the rising cost of fossil fuels and the existence of distribution rationing, Farmers interested in more efficient use of fossil fuels and the use of equipment and new machinery in order to reduce the consumption of it. Seventy four percent of soybean production belongs to Golestan province in Iran. Therefore study the factors affecting fuel consumption and its consumption in Golestan province could have a significant role in reducing consumption.

Materials and methods: This study was performed in Golestan province in north of Iran. Data were collected from 140 fields. Notes were done in the townships of Gorgan, Aliabad, Khanbebein, Ramian, Azadshahr, Galikesh, Minoodasht, Kalaleh, Bandar-e-Gaz and Kordkouy. Soybean production operations were divided to various groups including land preparation, planting, fertilization, plant protection, irrigation and harvesting. Information related to fuel consumption was done through the evaluation in the land of soybean producers. Farmers used different tractors to perform various operations in the production of soybean. Also to make comparisons easier fuel consumption in a different city, the townships were divided into 6 groups, and comparisons were done in 6 groups.

Results: Based on the results soybean cultivation in the summer had lower fuel consumption. The soybean cultivation after the potato crop also showed that the lowest fuel consumption. One reason was the loss of traditional tillage and reducing the number of disking times compared to other crops. The use of tractors with more power by reducing the consuming of time in agricultural operations such as land preparation and also reduction in number of it had an important role in fuel consumption. Also, Kordkouy and Bandar-e-Gaz cities were used fossil fuel 39 percent less than Gorgan, Galikesh and Minoodasht cities. Grain yield had significant and positive relationship with fuel consumption for harvesting and all of the operations. Also, grain yield had the significant and negative relationship with the fuel consumption for crop protection against pests and diseases. Also, by increasing the land area under the soybean cultivation, fuel consumption decreased in land preparation and crop protection but in harvesting and total operations increased.

Conclusion: By using the equipment that the with existence of crop residue such as faba bean and without the requirement to perform primary tillage and also less secondary tillage can be saved the fuel consumption for spring soybean production. Fuel consumption for plant protection in summer soybean production was higher than spring soybean production. The use of tractors with a power of more than 100 horsepower and equipment with a further working width, number of units and duration of the use of the machines is reduced and can make reduction in fuel consumption. Also, using the combined equipment such as combinat for performing the land preparation and planting can be reduced 60 percent the fuel consumption for the land preparation. The use of electricity instead of fuel utilization for soybean irrigation caused a significant reduction in fossil fuel consumption up to 70 percent. Timely spraying for soybean pests could save up to 15 percent in fuel consumption. The use of non-waste and low-consumption engines and commensurate with deep and semi-deep wells and timely adjustment and service had the very effective role in reducing fuel consumption for irrigation. Also, land integration and leveling had the effective role in reducing fuel consumption for land preparation, spraying and harvesting.

Keywords: Cultural operations, Fossil fuel, Golestan province, Soybean, The power of tractors

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