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The study of some native and exotic olive cultivars and genotypes in terms of morphological diversity, oil quality and fatty acid composition

S. Soltani[1], *E. Seifi[2], A. Ghasemnejad[2] and H. Fereidooni[3]
[1]M.Sc. Student, Dept., of Horticultural Sciences, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran, [2]Associate Prof., Dept., of Horticultural Sciences, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran, [3]Researcher, Seed and Plant Section, Center of Agricultural Sciences and Natural Resources of Golestan, Gorgan, Iran
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Abstract
Background and objectives: Iran is renowned as one of the olive origins in the world; therefore, characterizing and conserving the existing genotypes compared to exotic cultivars and organizing these genotypes are of critical importance. One of the most important factors in successful cultivation of olive trees is the identification and selection of suitable cultivars for each geographic region to produce oil with appropriate quantity and quality. This study was conducted to evaluate the genetic diversity of 12 native and exotic olive cultivars using morphological traits and to select the compatible cultivars for Gorgan region.

Materials and methods: The study was carried out using a completely randomized design with three replications, in which the quantitative and qualitative morphological characteristics were measured according to the procedure of International Olive Oil Council. The maturity index of fruit was measured according to a standard method suggested for olive. The oil was extracted using soxhlet method and the percentage of oil was recorded in both dry and fresh matters. For quality assessment of the oil, the oil also extracted using centrifugation method.

Results: The results suggested that there was a huge diversity among the selected cultivars and genotypes based on morphological characteristics. Cluster analysis could be utilized as a powerful tool to screen and classify the genotypes. The cluster analysis based on the morphological quantitative data, showed that the

*Corresponding author: esmaeilseifi@yahoo.com

cultivars were classified in three groups and each group contain the genetically similar genotypes which were different from the genotypes in other groups. There were also several subclusters suggesting considerable diversity within each group. There were some significant correlations among the measured characteristics. For instance there was a positive correlation between the fruit weight and the leaf length and width. The results showed that the cultivars had considerable variation in the oil percent in dry and fresh weight. In the next stage, the oil quality of four selected oil cultivars including Zard, Balady, Leccino and Arbequina were analyzed. The highest amount of chlorophyll (1.16 mg/kg) and carotenoid (0.718 mg/kg) were related to Leccino. The highest amount of peroxide value (11.33 meq O_2/Kg oil) was also in Leccino, while the lowest one (7.8 meq O_2/Kg oil) was observed in Zard. The highest amount of spectrophotometric index K232 was in Arbequina and no significant difference was observed among the cultivars. There were not any significant differences among the cultivars in acidity. Analysis of fatty acids indicated that Balady had the highest percent of oleic and linolenic acid (78.06% and 0.513%, respectively). The highest percent of palmitic acid was in Zard (19.1%) and the percent of linoleic and estearic acids were not significantly different.

Conclusion: According to the results, Balady cultivar showed higher oil quantity and quality compared to other three cultivars and is suitable for cultivating in the region.

Keywords: Clusters analysis, Cultivar Balady, Gas chromatography, Olive oil, Physicochemical traits

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Investigation the response of some photosynthetic attributes of Stevia (*Stevia rebaudiana* Bertoni) to different active coal concentrations with several solvents

V. Akbarpour[1], *H. Aruei[2], K. Mashaiekhi[3], M. Azizi Arani[2] and M.A. Bahmanyar[4]

[1]Graduated Ph.D. of Horticultural Sciences, Dept., of Horticultural Sciences, Faculty of Agriculture, International Campus of Ferdowsi University of Mashhad, [2]Assistant Prof., and Professor; Dept., of Horticultural Sciences, Faculty of Agriculture, Ferdowsi University of Mashhad, [3]Associate Prof., Dept., of Horticultural Sciences, Faculty of Plant Production, Gorgan Agricultural Sciences and Natural Resources University, [4]Professor, Dept., of Soil Sciences, Faculty of Agricultural Sciences, Sari Agricultural Sciences and Natural Resources University
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Abstract

Background and objectives: Active coal is applied in tissue culture media as the absorbant of phenolic compounds and toxic materials; but no research has been done regarding its direct application like spray on plants. Application of this material as the carbone source is based on researches done by sucrose; which had highly positive effect on plant growth and development. Thus; a hypothesis was brought that applied active coal could be absorbed by charged particles on the plant surface, a portion via cuticle and others via stomata, then entered into carbon fixation cycle. The aim of this study was to investigate the application of active coal in order to increase stevia plant required carbon during photosynthesis beside the other carbon dioxide sources. Since this plant possesses high supply of carbohydrate which prepares suitable system for such researches, it was selected for application of mentioned treatments.

Materials and methods: In order to investigate the effect of different concentrations of active coal on some photosynthetic attributes of Stevia, an experiment was carried out in a factorial based on randomized complete blocks design (RCBD) with four replications. Evaluated treatments consisted of different concentrations of active coal solution of 0, 0.2, 0.4 and 0.6 percent. Thus, the

*Corresponding author: aruei@um.ac.ir

mentioned material was diluted in solvents such as methanol 15%, borric acid 3 ppm, acetic acid 1 ppm and distilled water. Treatments were sprayed on plants with intervals of 10-day until plants start flowering stage. Chlorophyll fluorescence components such as min fluorescence under dark acclimated condition (Fo), max fluorescence under dark acclimated condition (Fm), variable florescence (Fv), min fluorescence under light acclimated condition (Fo'), max fluorescence under light acclimated condition (Fm'), electron transport rate (ETR), maximum photochemical quantum yield of photosystem (Fv/Fm), chlorophyll a, b and total chlorophyll were measured at beginning of flowering. Additionally, the leaf dry matter and stevioside content of the leaves were also measured.

Results: Results showed that application of active coal as a source of carbon is possible; and different concentrations of active coal in different solvents are significantly effective on all of the recorded parameters. Based on means comparison analysis, the most optimum amount of photosynthetic parameters were related to concentration 0.6% of active coal; while other concentrations placed in next orders. Also, the highest and the lowest optimum photosynthetic parameters were recorded in the solvents methanol (15%) (M), boric acid (3 ppm) (B), acetic acid (1 ppm) (A) and distilled water (control; C); respectively. Also, different solvents ($p<0.01$), different concentrations of active coal ($p<0.01$) and their interaction effect was significantly affected the leaf dry matter. Regarding the stevioside content of the leaf, methanol solvent (11.88) possessed the highest order and three other solvents consisting boric acid (10.67), acetic acid (9.42) and distilled water (8.28) had an assending trend.

Conclusion: Finally, it can be concluded that application of active coal with its appropriate solvent could decrease the obsolute plant requirement to carbon source existing in the environment or to be substituted. Results showed that application of mentioned treatments could increase the absorbed carbon by plant. Increase of absorbed carbon might be oxidized and intered the photosynthetic cycle in plant, and no increase of atmospheric carbon would be occurred.

Keywords: Acetic acid, Active coal, Boric acid, Chlorophyll fluorescence, Methanol, Stevioside

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Effect of soil moisture regimes under controlled conditions on growth and biomass of *mentha* species

***S. Nezami[1], S.H. Nemati[2], H. Aruee[2] and A. Bagheri[3]**
[1,2,3]Graduated Student of M.Sc., Assistant Prof., Professor, College of Agriculture, Ferdowsi University of Mashhad, Iran
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Abstract

Background and objectives: Water scarcity in arid and semiarid regions of the world can reduce growth and production of medicinal and aromatic plants, especially *Mentha* species. Mint species have shallow roots located in 30-60 centimeter of soil depth and inaccessibility to adequate moisture in this area of soil could reduce growth and yield of these plants. Studies showed that depletion of soil moisture to less than 100% of field capacity, significantly reduced fresh and dry weight of *mentha* speices. But excessive irrigation may decrease mints yield because of limitation of oxygen for plant roots, promoting root diseases, leaching of plant nutrients especially nitrogen and losing more leaves than normal.

Material and methods: In order to evaluate response of mint species to water deficit stress, an experiment was carried out using a completely factorial-randomized design with five replications at College of Agriculturae, Ferdowsi University of Mashhad, Iran. The evaluated factors included three mint species (peppermint '*Mentha×piperita'*, wildmint '*Mentha longifolia'*, spearmint '*Mentha spicata'*) that were exposed to four levels of irrigation treatments (control (100%), 80%, 60% and 40% of field capacity (FC)).

Results: In this study in 100% of FC spearmint' green area was 50% more than 80% of FC, while in wildmint and peppermint mentioned parameter in control treatment were 2.5 and 2 times more than 80% of FC, respectively. Reduction of soil moisture to 60% of FC decreased total dry matter of peppermint and wildmint to 85 and 96% respectively, while this reduction was 64% in spearmint. In spearmint, aboveground and underground dry matter in 60% of FC were 64 and 60% lower than control treatment, respectively, whereas these reduction in

*Corresponding author: nematish@yahoo.com

peppermint were 85 and 69% and in wildmint were 96 and 91 percent. However no difference observed between 100 and 80% of FC on aboveground to underground dry matter ratio in spearmint, but this parameter in control treatment of wildmint and peppermint were 50% more than 80% of FC.

Conclusion: Results showed that growth of all three species were significantly decreased when soil moisture reduced to lower than 100% of FC, but peppermint and wildmint were more sensitive than spearmint to depletion of soil water in 80 and 60 percent of FC during growing season.

Keywords: *Mentha piperita*, *Mentha spicata*, Soil moisture, Underground dry matter

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Effects of Abscisic acid, Paclobutrazol and Uniconazole hormones on the control of Egyptian broomrape (*Orobanche aegyptiaca*. Pers) and growth indexes of tomato (*Lycopersicon esculentum* Mill.)

***M. Zafarian[1] and A. Tadayyon[2]**
[1]Ph.D. Student of Weed Science, Faculty of Agriculture, Shahrekord University, Iran,
[2]Associate Prof., Dept., of Agronomy, Faculty of Agriculture, Shahrekord University, Iran
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Abstract

Background and objectives: Broomrape (*Orobanche spp*.) has no chlorophyll and is absolute parasites for dicotyledonous plants that cause pollution in warm and dry and semi-arid areas in temperate and Mediterranean countries, Eastern Europe and South America and the Middle East, including Iran. Parasitic weed especially broomrape because of the important factors of yield loss and increased production costs has special importance. In order to evaluate the effect of abscisic acid, paclobutrazol and Uniconazole hormones on the Egyptian broomrape (*Orobanche aegyptiaca*. Pers) control and tomato growth indices (*Lycopersicon esculentum* L.), an experiment was performed in research greenhouse of University of Shahrekord, Iran.

Materials and methods: This greenhouse experiment was conducted in a completely randomized design with four replications in 2014. Treatments consisted of abscisic acid in 4 levels (1, 3, 5 and 7 mM), Paclobutrazol in 2 levels (0.1 and 0.01 mM) and Uniconazole in 4 levels (1, 2, 3 and 4 mM) and two control treatments of weed free and weed infested treatments, respectively. Then, 65 days after transplanting, nodules number of broomrape on tomato roots, stems number and dry weight of broomrape and plant dry matter, plant height, leaf area, leaf area ratio, specific leaf area and specific weight of tomato were measured. Statistical analysis of data of tomatoes and broomrape (after testing normality Kolmogorov-Smirnov) was done by SAS v 9.2 and Fisher LSD at 5% probability was used for mean comparison.

*Corresponding author: zafarian.mojtaba@gmail.com

Results: Results showed that the treatments of Abscisic acid (5 and 7 mM), Paclobutrazol (0.1 and 0.01 mM) and Uniconazole (3 and 4 mM) decreased broomrape nodules on the tomato roots, number of stems and broomrape shoot dry weight, significantly. But in the case of tomatoes traits, Paclobutrazol treatment in both concentrations of 0.1 and 0.01 mM reduced shoot dry weight, plant height and leaf area of tomato and produced the lowest leaf area ratio and specific leaf area compared with the control treatment (without broomrape).

Conclusion: In general, it can be concluded that Abscisic acid (5 and 7 mM) and Uniconazole (3 and 4 mM) hormones had better results on broomrape controlling and had lower inhibition on tomato growth. Despite the favorable effect of Paclobutrazol on broomrape control it had inhibition effect on tomato growth and it would be better test it at lower concentration.

Keywords: Leaf area index (LAI), Leaf area ratio (LAR), Number of nodules, Shoot dry weight accumulation

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Effect of salinity stress on growth characteristics, chlorophyll fluorescence and concentrations of nutrients in fourteen pistachio cultivars

A. Momenpour[1], *M. Rasouli[2], A. Imani[3] and L. Dahaghin[4]
[1]Assistant Prof., National Salinity Research Center, Yazd, Iran, [2]Asistant Prof., Dept., of Horticulture, Faculty of Agriculture, University of Malayer, Malayer, Iran, [3]Associate Prof., Dept., of Horticulture Reasearch, Seed and Plant Improvement Institute, Karaj, Iran, [4]Graduate Student of M.Sc., Dept., of Plant Protection, Faculty of Agriculture, University of Tarbiat Modares, Tehran, Iran
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Abstract

Background and objectives: Pistachio (*Pistachio vera L.*) is the appropriate orchard tree in arid condition, its adapted to adverse climate condition, salinity and drought stress (16). Salinity is the the main constrain for agricultural production (23). Almost 12.5% of land areas in Iran are saline, which overwhelmingly contain sodium, while more than 800 million hectares of land area on the earth (6% of overall global land area) are affected by salinity (18). Therefore, salt tolerance cultivars and rootstocks is effective factors in sensitivity or tolerance to salinity of fruit trees including pistachio (11, 12, 22, 23). Therefore, the aim of the present study was to evaluate the effects of salt stress on growth charactristic and concentration of nutrition elements of pistachio cultivars and introducing most tolerant cultivar to it.

Material and method: In order to evaluate the tolerance of some pistachio cultivars to salinity an experiment was carried out with two factors including cultivar and salinity with factorial arrangement based on RCBD design in 2013. Fourteen cultivars (Ghazvini, Shah Pasand, Akbari, Khanjari, Jandaghi, Italiyayi, Fndoghi 48, Sabz Pesteh Tohg, Ahmad Aghayi, Rezaie Zood Res, Mousa Abadi, Ebarahimi, Kaleh Ghochi and Badami Zarand) in five levels of salinity including 0, 2.4, 4.8, 7.2 and 9.6 g/l of sodium chloride with electrical conductivity of 0.5, 4.9, 9.8, 14.74 and 19.8 dS/m. Morphological, physiological and chlorophyll

*Corresponding author: mousarasouli@gmail.com

fluorescence characteristic as well as nutrients such as K^+ and Na^+ in roots and leaves, was investigated in 14 pistachio cultivars then perform salinity stress.

Result and discussion: Results in all studied cultivars showed that increasing salinity decreased branch height, branch diameter, number of total leaves, percentage of green leaves, fresh and dry weight of leaves, shoots and root, relative humidity content, chlorophyll a, chlorophyll b and total chlorophyll. But, salinity increased the percentage of necrotic leaves, the percentage of downfall leave, root/shoot fresh and dry weight ratio, relative ionic percentage and cell membrane injury percentage. The results showed that salinity stress affected the young trees through increasing the amount of minimum fluorescence (F0) and decreasing the maximum fluorescence (Fm) and reducing variable fluorescence (Fv) as well as the ratio of variable fluorescence to maximum fluorescence from 0.83 in the control plants to 0.59 in Rezaie Zoodres cultivar and 0.61 in Mousa Abadi cultivar. The result showed that in the all evaluated cultivars, the highest rate of Na^+ in leaves and roots (2.09% and 3.04%), and the lowest rate of K^+ in leaves and roots (0.40% and 0.34%), was observed in 9.6 g/l salinity.

Conclusion: Overall, Ghazvini was found to be the most tolerant cultivar to salinity stress. This cultivar could well tolerate salinity of 7.2 g/l (14.75 dS/m). In contrast, Rezaie Zoodres and Mousa Abadi cultivars were most sensitive cultivars to salinity stress.

Keywords: Pistachio, Salinity stress, Growth indices, Chlorophyll fluorescence, Macronutrients, Micronutrients

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Effect of different training methods on qualitative and quantitative characteristics and concentration of nutrient elements of apple (*Malus domestica* L.) fruit

***E. Sepahvand[1], A.R. Talaie[2], M.A. Askari Sar Cheshmeh[3], M.R. Fatahi Moghadam[4] and M. Ghasem Nejad[5]**

[1]M.Sc., Prof., Dept., of Horticulture, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran, [2]Professor Dep., of Horticulture, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran, [3]Assistant Prof., Dep., of Horticulture, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran, [4]Associate Prof., Dep., of Horticulture, University College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran, [5]Associate Prof., Faculty of Agriculture, University of Guilan, Iran

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Abstract

Background and objectives: Apple is the most important horticultural crops that is allocated large share of world trade in agricultural products. Principles of sustainable fruit production systems are based on optimal use of natural resources (light, water, soil fertility) where the input (labour, energy, fuel, other material) and output (yield) are well balanced and the resources remain renewable. In such a system the minimizing of environmental polluting input (fuel and agrochemicals) is essential. Fruit orchards can be considered as artificial ecosystems converting the energy of photosynthetic active radiation (PAR) into edible, marketable fruits for human consumption. The core of this system is the bio-factory of leaves driven by the absorbed PAR. Several data support that the light interception is the basic factor for the modern orchard methods, albeit further factors as LAI, the spacing the trees, training and pruning methods, the species specific fruiting wood development, rootstocks also influence the orchard efficiency. Therefore, in this study, the effect of three different methods was investigated on qualitative and quantitative traits as well as fruit skin color and concentration of nutrition element of fruit two cultivar Gala and Delbarestival.

Material and method: In order to evaluate the types of training methods on qualitative and quantitative traits as well as fruit skin color and concentration of

*Corresponding author: esepahvand@ut.ac.ir

nutrition element an experiment was carried out with two factors including cultivar and training systems in 2013. Training methods including (V shape, HighTech and Cordon) and cultivars were Gala and Delbarestival.

Result and discussion: The results showed that types of training methods can affect on apple fruits quality and quantity and concentration of nutrition element. Fresh and dry weight of leaves (1.47 and 0.51 gr) and leaf area (4767.2 mm^2) in training methods of HighTech was higher than two other systems. The highest rate of fruit set was observed in training methods of HighTech (14.67%) and V shape (13.07%) whereas the highest rate yield and yield efficiency was observed in training methods of Cordon (13.42 kg/ha and 0.88 kg/cm^2) and High tech (11.23 kg/ha and 0.69 kg/cm^2), in respectively. Fruit tissue firmness and fruit skin a* value and concentration of phosphor, potassium, calcium in fruits of cultivar Gala in each three training methods were significantly higher than cultivar Delbarestival. The result indicated that rate of fruit set (13.6%5), rate of yield (14.49 kg/tree) and yield efficiency and (0.93 kg/cm^2), weight fruit (123.06 gr) and rate of EC (1.21) in cultivar Gala were significantly higher than rate of fruit set (10.86%), rate of yield and yield efficiency (7.13 kg/tree and 0.53 kg/cm^2), weight fruit (101.63 gr) and rate of EC (1.01) in cultivar of 'Delbarestival'.

Conclusion: Generally, results of investigations qualitative and quantitative traits as well as skin color of fruit and concentration of nutrition element showed that cultivar Gala in training methods HighTech and V shape and cultivar Delbarestival in training methods High-tech and Cordon produced fruits with more quality favorite than other system, in respectively.

Keywords: Apple, Training systems, Qualitative and Quantitative characteristics, Nutrition elements, Fruit skin color

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Effect of nitrogen fertilizer on tea yield and yield components in supplemental irrigation and rainfed conditions

***K. Majd Salimi**
Researcher of Tea Research Center, Horticultural Science Research Institute, Agicultural Research Education and Extension Organisation, Lahijan, Iran
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Abstract

Background and objectives: The number of shoots harvested and mean dry mass per shoot (dry matter) are yield components of tea which is influenced by various factors such as season and inputs like nitrogen fertilizer and water. It is reported that lack of nitrogen and water stress reduced the number of (population) shoots harvested, increasing dormant shoots, reducing the growth of shoots and the yield and quality of tea. The lowest rainfall and highest water stress occur for tea plants usually in the north of Iran in mid-June to early September. Appling 400 kg N ha^{-1} causes reduction of tea yield and quality. In this paper, for the first time, the effect of different levels of supplemental sprinkler irrigation and nitrogen fertilizer on yield and its components were investigated during three years.

Materials and methods: This experiment was conducted at Feshalam Tea research station in Fouman (Guilan). In this study, line-source irrigation technique and the strip plot experiment on randomized complete block design was used. Six levels of nitrogen, zero, 100, 200, 300, 400 and 500 kg ha^{-1} from urea as the main plots and five contiguous irrigation levels as sub-plots were arranged. Monitoring of volumetric moisture in soil treatments was conducted using TDR. In this experiment, yield and yield components of mature plant tea, such as the number of shoots harvested and dry matter content was determined at all treatment. Data regarding yield of made tea and components of yield for 2008 to 2010 years were recorded and analyzed statistically using MSTAT-C package.

Results: The maximum number of shoots harvested in the area with full irrigation treatments and the consumption of 300 to 400 kg N ha^{-1} within the years 2008 to 2010 was 179 and 181 per square meter harvested area respectively. Nitrogen application and water supply increased the number of active shoots harvested of

*Corresponding author: k_majdsalimi@yahoo.com

mature tea, hence increase the yield of green tea leaf. However, irrigation in comparison to nitrogen has a greater impact on increasing the number of shoots. Overall, the impact of irrigation on dry matter changes (22.25 to 26.37 percent) was more than nitrogen (22.7 to 25.6 percent). The results showed the effects of water stress and dry climate on reduction of shoots dry matter and dry matter with increasing nitrogen application. Interaction effects between nitrogen and irrigation showed that supplemental irrigation of mature tea plants may increase the positive slope of the yield changes, causing the greater use of nitrogen fertilizer in the range of zero to 300 Kg ha^{-1}.

Conclusion: The results showed that supplementary sprinkler irrigation and nitrogen fertilizer increased the number of harvested shoots in the months of water shortage during growing season. Full irrigation (3424 m^3) with less nitrogen uptake increased shoots dry matter. The highest yield (3928 kg ha^{-1} of made tea) was obtained with consumption of 200 to 300 kg N ha^{-1} under full irrigation condition and the lowest yield (788 kg ha^{-1}) without irrigation and fertilizer. Application of 100 to 200 kg N ha^{-1} produced the highest yield (1672 kg ha^{-1}) in rain fed conditions (with 228 mm rainfall during growing season).

Keywords**:** Nitrogen fertilizer, Sprinkler irrigation, Tea yield, Water stress

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Quantify the response of growth and chlorophyll fluorescence parameters of lemon balm (*Melissa officinalis* L.) medicinal plant to cadmium concentration in the soil

Y. Yaghoubian[1], S.A. Siadat[2], M.R. Moradi Telavat[3] and *H. Pirdashti[4]
[1]Ph.D. Graduated Student, Dept., of Agronomy and Plant Breeding, Ramin Agriculture and Natural Resources University of Khouzestan, Ahvaz, Iran, [2]Professor, Dept., of Agronomy and Plant Breeding, Ramin Agriculture and Natural Resources University of Khouzestan, Ahvaz, Iran, [3]Assistant Prof., Dept., of Agronomy and Plant Breeding, Ramin Agriculture and Natural Resources University of Khouzestan, Ahvaz, Iran, [4]Associate Prof., Dept., of Agronomy, Genetics and Agricultural Biotechnology Institute of Tabarestan, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
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Abstract

Background and objectives: Cadmium (Cd), being a widespread pollutant of soils and one of the most toxic heavy metals in the environment, adversely affects sustainable crop production and food safety. In plants, Cd causes damage to the photosynthetic apparatus and reduces carbohydrate assimilation, damage photosystems I and II, and thus reduces the maximum photochemical efficiency of PSII (Fv/Fm) and increases non-photochemical quenching. On the other hand, due to the increase of heavy metals in agricultural soils, lemon balm, like other medicinal plants, is exposed to heavy metals. Therefore, the aim of this study is to quantify and simulate the response of growth and chlorophyll fluorescence parameters of lemon balm (*Melissa officinalis* L.) medicinal plants to cadmium (Cd) concentrations in the soil.

Materials and Methods: This experiment was conducted at research greenhouse of Genetics and Agricultural Biotechnology Institute of Tabarestan at Sari Agricultural Sciences and Natural Resources University using completely randomized design (CRD) with three replicates in summer and autumn 2014. The treatment consisted of 12 Cd concentrations from 0 to 300 mg kg^{-1} of Cd in the soil (as $CdCl_2.5H_2O$) which was mixed with the experimental soil before planting. Lemon balm seeds were sown in pots containing different concentrations of cadmium. After eight weeks, SPAD value and chlorophyll fluorescence parameters

*Corresponding author: h.pirdashti@sanru.ac.ir

include the minimum (Fo), maximum (Fm) and variable (Fv) fluorescence intensity, maximum photochemical quantum yield of photosystem II (Fv/Fm), water-splitting complex yield on the donor side of the PSII (Fv/Fo), minimum (Fo′), maximum (Fm′) and steady state fluorescence (Ft) in light-adapted leaves were measured. Also, effective photochemical quantum yield of PSII [Y(II)], quantum yield of regulated energy dissipation [Y(NPQ)] and quantum yield of non-regulated energy dissipation [Y(NO)] and non-photochemical quenching (NPQ) were calculated. Finally the plants were harvested and morphological characteristics and fresh and dry weights of plant organs were measured.

Results: The results showed that response of vegetative and chlorophyll fluorescence parameters in lemon balm to Cd concentrations described by either linear (five parameters) or segmented (14 parameters) models. Vegetative traits, SPAD value and some chlorophyll fluorescence such as Fv/Fm, Fv/Fo and Y(II) decreased while Fo, Y(NPQ) and Y(NO) increased when Cd concentration increased in the soil. Lemon balm was more sensitive to lower concentration of Cd. The most studied parameters of lemon balm such as shoot fresh and dry weights, Fo, Fv/Fm and Fv/Fo reflect a sharp slope in lower Cd concentrations at the range of 0 to 75 mg kg^{-1} of Cd and then changed with a slight slope.

Conclusion: Generally, lemon balm plants are tolerant to 175 to 200 mg kg^{-1} of Cd in the soil, however, its dry matter accumulation was decreased up to 50% when Cd levels in the soil was nearly 30 mg kg^{-1}.

Keywords: Cd toxicity, Curve fitting, Medicinal plant, SPAD value, Quantum yield

Contacts