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Assessment of canola agroecosystems health in Gorgan by geographic information system (GIS)

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Abstract

Background and Objectives: In recent years the development and intensification of agricultural activities and attempts to achieve more profitability, causes rapid deterioration in the structure and functional properties of agroecosystems and a lot of damage to ecosystems has arrived. Therefore, today's agroecosystem's health and management researches are increasingly considered. Considering the important role of Golestan province in production of oilseeds as canola and reducing the acreage of these crops in recent years, the investigation of field's condition is necessary. So, this study was aimed to assess canola-grown field's health in Gorgan township, Golestan province, by geographic information system (GIS).

Materials and methods: The studied region was agricultural lands of Gorgan township, Golestan province. The present study was conducted using 58 fields in spring 2015. During maturity stage the weed species were sampled and detected using a W method. Then the crop yield of each quadrat was taken and in parallel, management data were recorded by questionnaire. In the first step, geographic information system (GIS) was applied to produce distribution maps of weeds in the studied region. Specific formula of Shannon-Wiener index, Simpson's index of diversity and reverse Simpson index were used as weeds biodiversity assessment indices. After mapping and classifying of all layers, the three indices of biodiversity, crop yield and pesticide were interpolated in GIS. The fields with higher yield (>2 ton/ha), lower weed biodiversity indices and pesticides application than mean values of studied region, were considered as healthy fields.

Results: The biodiversity indices range of Shannon-Wiener, Simpson's and reverse Simpson were calculated as 0.9-2.2, 0.11-0.46 and 2.1-4.9, respectively. Our results revealed that just 3 percentages of surveyed fields were located in healthy condition. In this study, in 43 percent of surveyed farms, pesticides were higher than the average. And most of these farms were in east, north and west of studied area. The results of the yield map showed that 39 percent of farms have had above-average performance. Most of these farms were located within the east of studied area.

Discussion: In general, the standard amount of applied pesticides, the seeds with high quality, suitable cropping management and spraying equipment were the main reasons for the health of fields. But, present the strong seed bank in fields can be causes low ability for seed germination, undesirable preparations in farms and higher consumption of pesticide than average of were identified as mean reasons of unhealthy in many canola fields of Gorgan.

Keywords: Agroecosystem, Biodiversity, Pesticide, Yield.

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Evaluation of organic and chemical different nutrition systems on the yield, quantity and quality of essential oil of coriander (*Coriandrum sativum* L.)

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Abstract

Background and Purpose: Coriander is one the most important cultivated medicinal plants, because of high quality essential oil and its uses as food and herbal medicine. Sustainable agriculture with ecological principles can increase the efficiency of resource utilization and provide longer productivity for humans while creating a balance in the environment. Using organic fertilizers to replace or considerably reduce the use of chemical fertilizers leads to an increase in the quality and performance of the sustainable production of crops. This research is conducted in order to study the effects of organic and chemical different nutrition systems on yield and essential oil contents of coriander.

Materials and Methods: This field experiment was done based on a randomized complete block (RCBD) design with 8 treatments and 3 replications in the agricultural education and research center of the Ilam county during 2015. Treatments include control (without fertilizer application), 10 and 20 t ha⁻¹ of cow manure, 5 and 10 t ha⁻¹ of vermicomposting, 5 t ha⁻¹ of cow manure plus 2.5 t ha⁻¹ of vermicomposting, 5 t ha⁻¹ of cow manure plus 5 t ha⁻¹ of vermicomposting and chemical fertilizers (only 75 kg N ha⁻¹). Measured variables included seed yield, essential oil yield and percentage, and the essential oil components. In order to determine the amount of essential oil, the process of essence extraction is done through the Clevenger apparatus by distillation; and the essential oil components are determined by (GC/MS).

Results: The results indicated that the highest grain yield (3257.7 kg ha⁻¹), essential oil percentage (0.154%) essential oil yield (23.75 kg ha⁻¹), linalool content (62.61%), and geranyl acetate content in (21.9%) occur in 10 tons of cow manure, 5 tons of vermicomposting, and 10 tons of cow manure plus 5 tons of vermicomposting, respectively. Furthermore, the highest percentages of α -Pinene (11.45%) and γ -terpinene content (7.12%) were obtained related to 10 tons of vermicomposting.

Conclusion: The results showed that integrated nutrient management of Coriander as a medicinal plant has significant effects on quantitative and qualitative indicators. On the whole, the highest seed and essential oil yield are obtained using 10 tons of cow manure, and the highest essential oil yield compounds are obtained using vermicomposting. According to the results, organic different nutrition systems can replace the bulk of chemical urea fertilizer in cultivation of coriander as a medicinal plant. It's a step towards sustainable agriculture and environmental protection.

Keywords: *Essential oil, Geranyl acetate, Linalool, Organic manure, Urea*

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Evaluation of distribution and phytochemical diversity of roses species (*Rosa* spp.) in Northwest of Iran

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Abstract

Background and objectives: Rose (*Rosa* spp.) belongs to the Rosaceae family and is one of the most important genus of medicinal plants. Flowers and fruits of rose genus due to possess flavonoids, vitamins and antioxidant activity have many importance in food and medicinal industries. The geographic distribution of this species was in Europe, Turkey, Iran, Russia, Afghanistan, Pakistan and Iraq. Iran is one of the main biodiversity centers of this valuable medicinal plant. In order to begin domestication of roses, diversity of phytochemical and antioxidant flowers of 27 genotypes (6 species) genus rose were evaluated in the North West of Iran.

Materials and methods: Three provinces of the Northwest (West Azerbaijan, East Azerbaijan, Kurdistan), which are the origin of many roses species in Iran were chosen for sampling. After species identification, extraction of samples was conducted using ultrasonic device. Total phenolic content, total flavonoid content, total carotenoid and chlorophyll and Antioxidant capacity were determined by using Folin–Ciocalteu assays, aluminum chloride method, Lichtentaler method, FRAP and DPPH respectively. All the data obtained in a completely randomized design with three replications and were analyzed using SAS software and mean comparisons were done according to the LSD test.

Results: The analysis of results showed that genotypes had significant difference ($p \leq 0.01$) in phytochemical properties. Total phenolic content was in its highest value (104.02 mg GAE/g DW) in the flowers of G9 (*R. canina*), whereas the lowest level (19.78 mg GAE/g DW) was found in the flowers of G26 (*R. hemisphaerica*). Total flavonoid content was in its highest value (9.32 mg /g DW) in the flowers of G14 (*R. canina*), whereas the lowest level (1.89 mg /g DW) was found in the flowers of G26 (*R. hemisphaerica*). Also, the highest level of Chlorophyll a and b and total carotenoid (670.18 $\mu\text{g/g}$ DW) content were found in G20 (*R. canina*), G25 (*R. canina*) and G1 (*R. canina*) respectively. The highest level of antioxidant capacity in DPPH (*R. canina*) and FRAP (*R. canina*) assays were found in G19 (75.60 %) and G1 (242.63 $\mu\text{mol Fe}^{++}/\text{g}$ DW) respectively.

Conclusion: Results showed that the Northwest of Iran has a wide diversity of rose different species that can be considered in breeding programs. It can be considered that *R. canina* showed more distribution and better antioxidant activity than other species with highest content of phenolics. These results showed that phytochemical characteristics of different species of rose widely correlated with genotype and location type and are promising sources of natural antioxidants and bioactive compounds beneficial to be used in the food or the pharmaceutical industries.

Keywords: Antioxidant activity, Breeding, Medicinal plants, Rosa family

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Investigation genetic diversity of walnut (*Juglans regia* L.) genotypes using multivariate analysis in Lorestan province

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Abstract

Background and objectives: Persian walnut (*Juglans regia* L.) is one of the most important species of *Juglans* genus and Iran is one of the most important centers of genetic diversity of this species. Thus evaluation of genetic diversity of Persian walnut in Lorestan province is very important. So if the results displayed a sufficient genetic diversity of nut and tree, we can use it for walnut breeding programs in future. The aim of this study was investigation of genetic diversity of walnut genotypes in Lorestan province by multivariate analysis.

Materials and methods: In this study 43 Persian walnut genotypes of the five populations were selected. 41 morphologic traits evaluated between these populations that were including Alashtar, Doroud, Khorram-Abad, Boroujerd and Nourabad. Measuring of traits carry out on 10 to 20 samples from each tree, and 5 to 10 leaves, that selected accidentally, for 41 quantitative traits related to nuts and leaves such as protein and oil of nuts was done.

Results: One-sided variance analysis of the data's indicated a significant difference between regions for most traits. Means comparison with Duncan's test at 5% level showed that most traits were significantly different in various regions of Lorestan province. The study of variety coefficients of different traits showed that the husk weight had the most variation among the traits (35.51%). After that, husk humidity (29.45%) and green seed weight (28.39%) owned the major variation among the studied traits, respectively. In terms of high protein and oil, Alashtar (20.26 and 64.1%), Boroujerd (19.98 and 60.73%) and Doroud (19.14 and 59.11%) populations had the highest contents of protein and oil than other populations, respectively. In terms of nut yield, Boroujerd population had seed weight with hard skin of 12.13gr and highest kernel weight (4.98gr). On other hands, the highest percentage of kernel with hard skin was observed in Nourabad population and the highest percentage of kernel with green skin was in Doroud population. Cluster analysis of morphologic traits based on Ward method showed that differentiated genotype in 3 clusters in distance of -41.21 and populations, also in 3 clusters in distance of 67.71. In the first cluster, Alashtar, Nourabad and Beiranshahr populations, in the second cluster Doroud population and in the third cluster Boroujerd populations were placed. Based on the results of principal component analysis (PCA), 3 main components justified total of 93.30% of total variance. Dispersion of populations based on 2 main components were corresponded with cluster analysis of walnut populations based on morphologic traits in Lorestan province and populations were put in 3 different areas on diagram.

Conclusion: Results showed that genetic relationships among populations that were geographically near each other, caused these populations to be in same groups in cluster analysis. Green seed volume and thickness, length and width of seed with hard skin, had the highest effects on dispersion of populations in this study. Doroud and Nourabad populations with the highest percentage of kernel with green skin and kernel with hard skin are recommended for selection in terms of kernel yield and future walnut breeding program in

Lorestan province, respectively. Results showed that walnut populations in Lorestan province had a high diversity and the selection must be done through mentioned traits.

Keywords: Walnut (*Juglans regia* L.), Cluster Analysis, Principal Component Analysis (PCA)

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Comparison of damages on three olive cultivars (*Olea europaea* L.) at different mechanized harvesting methods

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Abstract

Background and objectives: Selection of the best olive harvesting method has a high effect on harvest efficiency and reduction of damage to olive fruits and trees. On the contrary, improper harvest method reduces the next year's fruit bearing. At harvest time of olives, extensive gardens, diversity of varieties in a garden, high cost and shortages of labour at harvest time, makes mechanical harvesting methods necessary. Thus an experiment in 2015 was performed in a garden at Ramian country to determine the best olive cultivar and harvest method for mechanized harvesting.

Materials and methods: At this experiment, harvesting efficiency and damage on three olive cultivars (Mari, Valanolia and Zard) by four types of harvesting methods (Knocking by a wooden rod, branch shaker machine, plastic comb shaker machine and portable branch shaker) were studied in a split plot experiment with three replications.

Results: Analysis of variance showed that the amount and percentage of lost leaf and damaged fruit to harvested fruit ration and damage index is significant according to variation cultivar and harvest method as well as interactional effects ($P \leq 0.01$). The results indicated that the most harvesting efficiency among cultivars were related to the Mari (81.80%) and among harvesting methods, the portable branch Shaker had the most harvesting efficiency (88.20%). At all harvesting methods, the least damage percentage was observed on the Valanolia cultivar and most damage was seen on Zard cultivar. The hand held pneumatic vibrating combs caused the most and least damaged fruits on Zard and Valanolia cultivars (45.32% and 7.03% respectively). Zard cultivar had shown the most damage index in harvesting by Knocking and a wooden rod (76.29%) and the Valanolia cultivar had the least damage index in harvest by plastic comb shaker machine (12.32%). Damage index of these cultivars were measured 54.12% and 23.03% correspondingly. Damage index of pneumatic vibrating combs on Zard cultivar had second rank (74.92%) and didn't showed a significant difference with Knocking by a wooden rod. Damage index of Valanolia and Mari cultivars in harvest by knocking a wooden rod was significantly higher than other harvest methods. At harvest of Valanolia cultivar by plastic comb shaker, the least damage index was observed and Valanolia cultivar had least damage index in harvest by all four methods in comparison to the other two cultivars. Also, Valanolia cultivar had the most leaf drop in harvesting by Knocking and a wooden rod (10.77%). Mari and Zard cultivars showed 8.21 and 7.58% of lost leaf percentage to harvested fruit ratio at this harvest method. The most leaf drop was observed at harvest by knocking a wooden rod. Harvest by the pneumatic branch shaker caused the least leaf drop and no significant difference in leaf drop had observed at harvest by this machine among cultivars.

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Conclusion: Because harvesting efficiency of portable branch shaker was more than the other methods, this method is more suitable for mechanized harvesting. Due to high damage level, knocking a wooden rod is not suitable and leads in reduction of oil quality and produced conserve.

Keywords: Olive cultivars, Mechanized olive harvesting, Damage index, Shaker.



Evaluation of gibberellic acid and humic acid on morpho-physiological indices and vase life of cut flower *Narcissus*

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Abstract

Background and objectives: *Narcissus* is one of the most important ornamental bulbous plant in the temperate regions which can be used as cut flower or flowering potted-plant. Moreover, this plant cultivated in high volume of landscape and gardens. One of the limiting factors in the post-harvest vase life and selling of narcissus is its short life and quick wilting of its petals. Fresh cut flowers of narcissus have a very short vase life of around 4 to 8 days. The production of cut flowers with suitable quality and long vase life is one of the favorite economical activities in cut flower industry. Previous studies tried to look for procedures to improve the quality and quantity of cut flowers and ornamental plant production, and amongst them, plant growth regulators have a special importance specifically in gibberellic acid effects. Humic acid is a natural organic polymer which can improve quality and durability of ornamental plants, directly due to hormone-like substances of gibberellic acid, auxin, and cytokinin and indirectly by increasing absorption and translocation of nutrients in the plant. The general purposes of the current study were to improve vase life of *Narcissus* and to determine the best concentration of gibberellic acid and humic acid.

Materials and methods: The current study was conducted on the basis of the factorial experiment with randomized complete design which consisted of with two experimental factors, 12 treatments, and replicated three times (each replication contains five pot). Experimental factors were gibberellic acid in four levels (0, 150, 300, 450 mg.L⁻¹) by dipping *Narcissus* bulb for 48 hours and humic acid in three levels (0, 250, 500 mg.L⁻¹) as a foliar spray application at the vegetative stage. Traits such as relative fresh weight, total soluble solids, water absorption rate, cell membrane stability index, height of floral stem, diameter of floral stem, calcium content and vase life of cut flowers were measured.

Results: Results from analysis of variance table showed that the effect of gibberellic acid on the height of floral stem, the total soluble solids and the cell membrane stability index was significant in comparison with control. Gibberellic acid and humic acid treatments independently had significant differences in the relative fresh weight and vase life of narcissus cut flowers. Also diameter of floral stem and calcium content were increased by humic acid treatment. Interaction between treatments of gibberellic acid 300 mg.L⁻¹ and humic acid 500 mg.L⁻¹ resulted in the highest length of leaf.

Conclusion: This research concludes that the best treatments for increase of vase life and improvement the studeid properties of narcissus were the 300 mg.L⁻¹ gibberellic acid and 500 mg.L⁻¹ humic acid concentrations.

Keywords: Calcium content of stem, Cell membrane stability index, Daffodil, Relative fresh weight, Total soluble solids, Water uptake.

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Exogenous sodium nitroprusside effect on the antioxidant enzymes activity and active substance yield in milk thistle under drought stress

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Abstract

Background and objectives: Milk thistle is a medicinal plant that is cultivated for the production of silymarin and oil. Silymarin composed of a different flavonolignans that have been used in treating liver disorders and other diseases. Although grain yield in the milk thistle decreases under drought stress, it may be influenced on secondary metabolites yield. This study was conducted to investigate the effects of sodium nitroprusside on the enzymes antioxidant activity and active substance yield in milk thistle in the water deficit conditions.

Materials and Methods: The experiment was conducted in split-split plot restriction in a randomized complete blocks design with three replications. Foliar spray with sodium nitroprusside (SNP) at three levels of 0, 100 and 200 $\mu\text{mol l}^{-1}$ was considered as the main factor, while drought stress at three levels of control, withholding of irrigation at stem elongation and withholding of irrigation at anthesis stage were regarded as secondary factors. Finally two genotypes of milk thistle (Hungarian and Sari) comprised the sub-sub factors. Measured traits were catalase, ascorbate peroxidase and peroxidase enzymes activity, RWC, cell membrane stability, silymarin yield and content and grain yield.

Results: Drought stress decreased leaf relative water content since stem elongation and cell membrane stability during both times of withholding irrigation. Moreover, exogenous sodium nitroprusside prevented a further reduction in RWC in stress conditions and improved cell membrane stability. Withholding irrigation enhanced catalase enzyme activity during stem elongation stage in both genotypes, while, drought stress in the Hungarian cultivar peroxidase and ascorbate peroxidase activity decreased and in Sari ecotype ascorbate peroxidase activity increased and had no effect on the peroxidase activity. Application of SNP in the Hungarian cultivar particularly at the time of stem elongation stress significantly increased enzymes antioxidant activity. However in Sari ecotype, only led to a significant increase of ascorbate peroxidase activity during anthesis stress while, it caused a significant decrease in catalase in the stage of stem elongation stress and did not have any effect on peroxidase activity. By increasing the intensity of stress, silymarin content increased, but had no influence on the silymarin yield. Application of up to 100 μM SNP had an increasing effect in silymarin content and improved silymarin yield in both withholding irrigation stages than plants which were solely under drought stress and did not receive SNP. Also drought stress significantly decreased grain yield while this decrease was compensated by exogenous application of 100 μM SNP in the stages of stem elongation and anthesis stress.

Conclusion: The results showed that SNP foliar application, particularly at the level of 100 μM increased activity of antioxidant enzymes and improved water use efficiency and stability of cell

membrane. Hence prevented grain yield drop in water deficit conditions and enhanced milk thistle's active substance yield and content.

Keywords: Milk thistle, Nitric oxide, Reactive oxygen species, Silymarin, Water stress

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Evaluation the effects of cycocel and salicylic acid on some physiological characteristic and essential oil under normal and drought conditions in medical plant Dragonhed (*Dracocephalum moldavica* L.)

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Abstract

Introduction: Drought is one of the most important environmental stresses which impact on morphological, physiological and biochemical process of plant and have major effects on agricultural productions. Application of plant growth regulators like salicylic acid as growth stimulator and cycocel as growth inhibitor effect on different growth process and influence on increases of drought tolerance. In order to study the effect of growth regulators, cycocel and salicylic acid on physiological changes and essential oil at dragonhead in water stress condition, this research was carry out in field of Zanjan University.

Material and method: A split plot experiment with two factors irrigation (normal and water stress) and growth regulators treatment (control, 600 and 1200 μm cycocel and 800 and 1600 μm salicylic acid) was conducted in based of completely randomized block design with four replications. Two irrigation regimes (normal and water stress) were main factors. In water stress, plants were irrigated before flowering stage and after that irrigation was stopped in drought stress treatment until end of experiment. Different levels of salicylic acid (800 and 1600 μm) and cycocel (600 and 1200 μm) and control were as sub factors which was applied once in two days before drought treatment.

Findings: Interaction of irrigation in growth regulators in year for treats transpiration, stomatal conduct, photosynthesis, mesophyll conduct and photosynthesis water use efficiency was significant, but treats of relative water content, essential oil percent, essential oil yield and substomatal CO_2 concentration was not significant. Mean compression of interaction of growth regulators in moisture for essential oil yield indicated that there is no significant differences between growth regulators treatment in water stress, but in normal condition it had significant effect, so that the highest essential oil yield at a rate 273.6 kg ha^{-1} , in normal conditions was obtained at salicylic 1600 μm acid, but under water stress conditions, cycocel 600 μm treatment with a rate of 2.217 kg ha^{-1} was highest essential oil yield than other treatments. The results showed that negative and significant correlation between essential oil percent with transpiration, stomatal conduct and photosynthesis rate and also exist a positive and significant correlation between essential oil percent with photosynthesis water use efficiency.

Conclusion: Results of this experiment showed that water stress reduced physiological traits include, chlorophyll content, photosynthetic rate, stomatal conductance and transpiration rate and also it significantly changed plant water status and decreased relative water content. Water stress decreased essential oil present and essential oil yield. So that even the use of growth regulators that used in this experiment were unable to compensate for this decrease. So it can be

concluded that in drought stress conditions due to decreased chlorophyll and greenness plant and also reduced leaf area in dragonhead, the essential oil is reduced.

Keywords: Essential oil yield, Mesophyll conductance, Photosynthesis, Stomatal conductance.

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Study of agronomical characteristics, flower yield and root inulin percentage of chicory (*Chicorium intybus* L.) under soil fertilizers and drought stress

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Abstract

Background and objectives: Chicory is valuable medicinal specie belongs to the *Asteraceae* family with blue or pink leaves. It is rich of flavonoid and inulin. Drought stress is one of the important yield limitation factors in the world. The present study with the aim of evaluating the agronomical traits and root inulin percentage of chicory under different bio-fertilizer treatments and drought stress was carried out.

Materials and methods: The experiment was conducted as a split plot based on randomized complete blocks design with three replications at the Agricultural Research Institute (Chahnimeh), University of Zabol, Iran during 2014-2015. The main plots were three irrigation levels (irrigation based on 50 (control), 70 and 90% of field capacity) and sub plots were four fertilizer rates (without fertilizer (control), inoculation of nitroxin, effective microorganism fertilizer (EM) and foliar application of nano potassium chelate). Traits such as plant height, number of branch per plant, number of flower per plant, flower yield, root and shoot fresh weight, leaf nitrogen percentage and inulin percentage, were evaluated. Drought stress was done using TDR. The data analysis was performed using SAS program and critical difference values at 5% level of probability were calculated for comparing the treatment means by Duncan's multiple range test.

Results: The results showed that the interaction of drought stress and soil fertilizers had a significant effect on all traits except plant height. With increasing in stress rate, plant height, number of branch per plant, number of flower per plant, flower yield, root fresh and dry weight, inulin percentage and leaf nitrogen percentage, decreased. The bio-fertilizers application improved all traits. The maximum plant height, number of branch per plant, number of flower per plant, flower yield, root fresh and dry weight were obtained from irrigation after 90% of field capacity along with EM application. The highest inulin percentage was obtained from irrigation after 90, 70 and 50% of field capacity along with EM application, respectively. With increasing in drought rates from control to 50% FC, leaf nitrogen percentage decreased so that the highest leaf nitrogen was obtained from irrigation after 90% FC along with nitroxin application and the lowest was belonged to severe drought stress without fertilizer.

Conclusion: According to the results, the highest fresh and dry weight and inulin percentage were observed in application of effective microorganism fertilizer (EM) along with irrigation after 90% FC. In general, the results revealed that bio-fertilizers could decline the pernicious effects of drought stress in chicory.

Keywords: Irrigation, Nano potassium chelate, Nitrogen percentage, Number of flower per plant, plant height

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Effect of GA₃ spraying on qualitative and quantitative characteristics of *Citrus reticulata* cultivar *Unshiu*

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Abstract

Background and objectives: Citrus is one of the most important fruit crops in the world because of the scale of its production and the health benefits derived from consumption of either fresh fruit or juice. New achievements in the use of compounds those which do not include the adverse effects on humans and the environment is an important matter of concern. The use of natural compounds such as gibberellins in commercial formulation could be used in the stages of fruit rapid growth, pre-harvest and post-harvest that result would be economical reactions. Therefore, this study was carried to aim evaluation effect of GA₃ on yield and fruit qualitative characteristics of *Citrus Reticulata* cultivar *Unshiu* and to attain to the best time for spraying.

Material and method: In order to evaluation effect of GA₃ on the fruit qualitative and quantitative characteristics of *Citrus Reticulata* cultivar mid-season *Unshiu*, this experiment was carried in a completely randomized block design (CRBD) with two factor in 5 levels and spraying time in 3 levels and 3 replications in during years 2016 and 2017. GA₃ levels including (0, 10, 30, 50 and 70 mg/l) and spraying time including (60, 45 and 30 days per-harvest). At the end of the experiment, the morphological, fruit qualitative and quantitative characteristics and Mediterranean flies' damage were evaluated.

Result and discussion: The results showed that with GA₃ spraying and increasing concentration it's, in all times studied, fruit weight, yield of per tree and yield of per hectare were increased significantly compare to the control. But the most rate of increase were observed in GA₃ treatment (70 mg/lit) that were sprayed in 60 days of per-harvest. Also, fruits down fall percentage in per-harvest, Mediterranean flies' damage percentage in total treatments were reduced significantly compare to the control. The results showed that GA₃ treatment in concentrations (30, 50 and 70 mg/lit) were delayed fruits reaching time significantly compare to the control.

Conclusion: In total, GA₃ treatment could have been increased fruits quantity and quality significantly to compare with the control. In between times studied, 60 days per-harvest was selected as the best time. However, with increasing concentration of GA₃ to 70 mg/lit, farmer gross income per product total sale and farmer gross income per yield increased ratio to control, were increased significantly to compare with the control. But the most of proportion total income to the per-unit cost and income obtained from yield increased ratio to per-unit cost concern using GA₃, were observed in GA₃ treatment to concentration 10 mg/lit that were sprayed in 60 days pre-harvest (2190.93 and 220.49 Rial), respectively.

Keywords: *Citrus Reticulata* cultivar *Unshiu*, GA₃, Increase of yield, Increase of gross income, Mediterranean fly

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