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University of Torbat-e-Heydarieh

IMPS

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Khorasan province in Iran with a diverse climatic conditions has accommodated a wide range of plant communities particularly herbs, spices and medicinal plants. Among these Saffron (*Crocus sativus* L.), has been the most cultivated plant for thousands of years. These crop deliver unique interests and applications. The novel use of Saffron in recent years in cancer cure have been promenaded and stimulated more investigation on this crop. Almost 94% of the total world's Saffron production (298 t) and 95% of the total Iran's Saffron production (280 t) originates from Khorasan province. Saffron is unique for the area where water scarcity is the most limiting factor in crop productions for the farmer. Saffron is almost cultivated and harvested and also to some extent processed by family workers and community cooperation bases. These crop is not only the most important source of income for farmers but also historically strong socio-cultural activities have been formed within the local community. Cultivation area and its surrounding environment conditions and production volume of Saffron, has made Khorasan province a unique location in the world. The sustainable management of these traditionally cultivated and used plants not only helps to conserve nationally and globally important biodiversity but also provides critical resources to sustain livelihoods.

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University of Torbat-e-Heydarieh

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Journal Info

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The research papers of different fields of Saffron science, e.g. Plant production, basic science, medical properties, biotechnology, genetic and plant breeding, processing, food industry, phytochemical properties, economic, marketing and other related subjects to Saffron are published in this journal for dissemination of the scientific knowledge and research. Journal of Saffron Agronomy and Technology is basically dedicated to promoting scholarly exchanges among professors, researchers, and students of different universities, and research institutes, focusing in particular on the exploration of cutting edge knowledge on Saffron science and technology.

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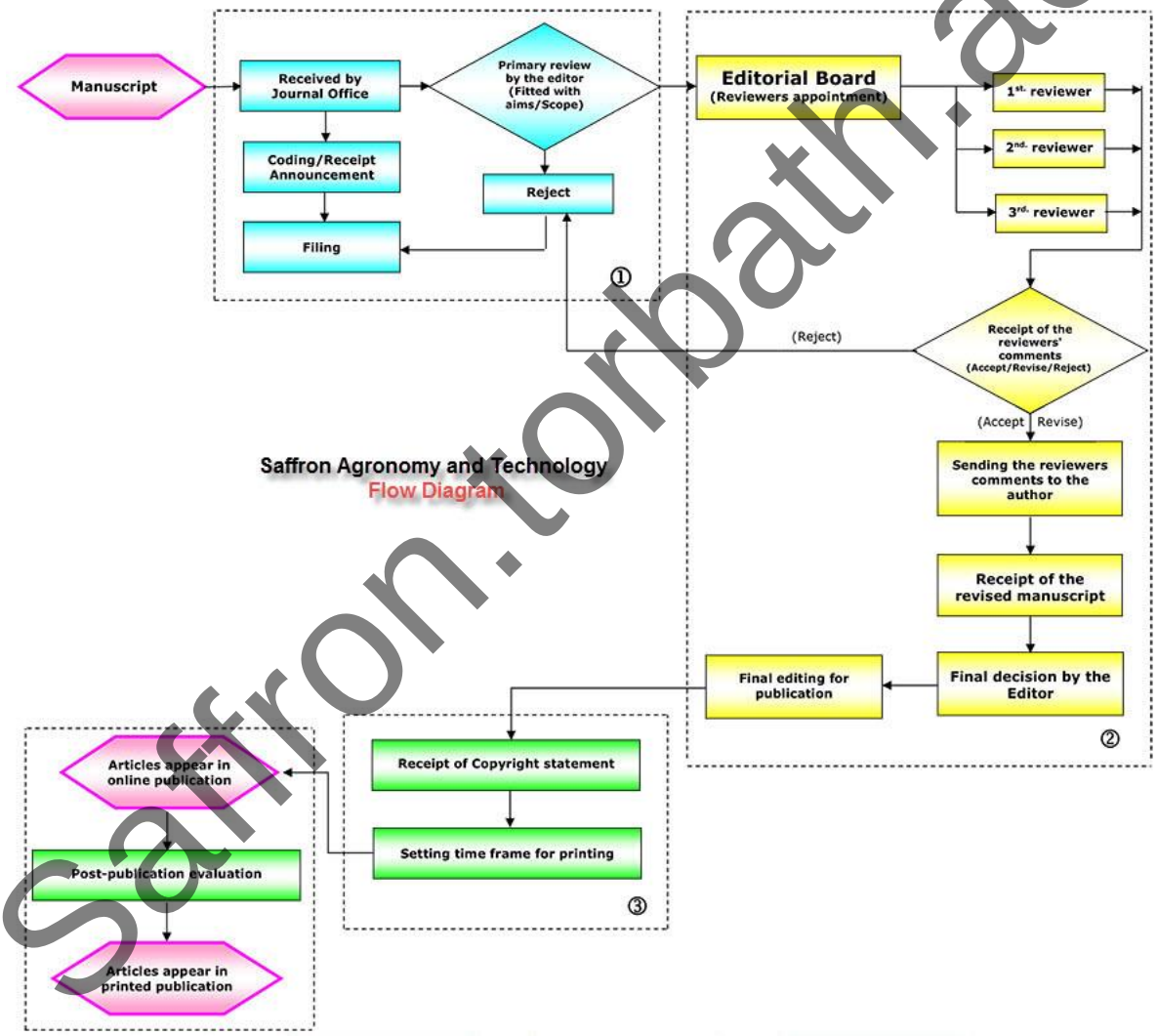

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Torbat Heydarieh

Torbat Heydarieh is a city in the Khorasan Razavi Province, northeast of Iran. Torbat Heydarieh city is 1005 km. far from Tehran and is located in a mountainous region on the skirt of mountain having different weathers in different areas. The name Torbat in Persian means Burial place, thus the name of the city means Burial Place of Heydar named after Qotboddin whose tomb lies in the heart of the city.

Torbat Heydarieh is the most important center in saffron cultivation and production in Khorasan Razavi Province and Iran. It has the first rank in the world for producing Saffron (Wikipedia).

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Saffron Institute

Saffron research institute of Torbat Heydarieh University is one of the first specialized institute of Saffron in Iran and the world. This institute was established with aims to educate and promote fundamental researches related to Saffron, in 2007.

Saffron

Saffron has strong ties with the economic, social, environmental and political aspects of agriculture in the country with particular impact on the local communities of the growing area. The role of Iranian farmers in domestication and cultural development of Saffron has been clearly demonstrated in the international literature. However, the past scientific achievement of the Iranian scientists on the agronomic attributes of Saffron seems to be insufficient with regards to the importance of this crop and the expectation of international scientific bodies. Basically in the 60s the pioneer researchers from Khorasan founded the conventional research on basic agronomic aspects and in the later stages with establishment of organization such as Organization for Scientific and Industrial Research (Khorasan branch) and expansion of graduate studies in the universities, research activities was progressed

These activities gained a momentum in the last two decades particularly in recent years due to establishment of different public and private organizations associated with Saffron such as National Saffron Council, permanent secretariat for Saffron festival, organizing various seminars and conferences, establishment of research group for Saffron in a University, establishment of Saffron focal point for science and industry, establishment of Saffron institute and publication of two specialized scientific Journal on Saffron.

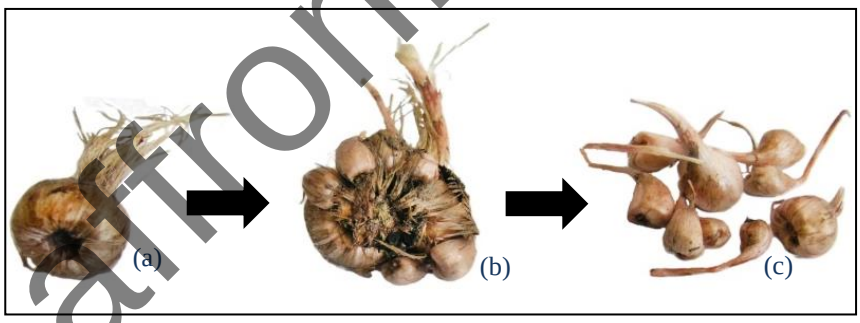
Contents

Introduction

Iran has a long history of saffron production and has a lot of established saffron populations which are being cultivated since ancient times. Saffron in the Islamic Republic of Iran is planted as a perennial crop, and its cultivated area has increased greatly from 4100 ha in 1981 to 61775 ha in 2012. Producing more than 90% of the global production of saffron, Iran is certainly the most important saffron producing country in the world. Khorasan Razavi province, with 61775 ha of saffron fields, is the greatest saffron cultivation area in Iran. In this province, saffron production creates a very key income for numerous rural families and is an important source of employment. One of the most important saffron production and cultivation regions in this province is Torbat Heydarieh covering about 45.5% (28100 ha) of the cultivated area in Khorasan Razavi province in 2012.

In Iran, cultivation of saffron is important from different aspects including high water productivity, employment, and non-oil exports. Currently, this product provides a major part of the income of rural families in the Razavi and Southern Khorasan provinces. In terms of employment, it creates around 270 person day work per a growing season.

Currently, the global production of saffron is 330 ton per year where Iran with a production of 310 ton annually has the first rank in the world and has claimed over 94% of the global production of this product. Production of saffron in five countries including Spain, Greece, Morocco, India, and China, standing in the next ranks after Iran, is a trivial amount in total where their production does not exceed even 20 ton.



Production Stages of replacement corms (Koocheki et al., 2014).

(a) Mother corm in planting time, (b) Mother corm in end of the first growing season, (c) Nine replacement corms of saffron.

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Research on production of Saffron in Iran: Past trend and future prospects

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A B S T R A C T

Saffron has strong ties with the economic, social, environmental and political aspects of agriculture in the country with particular impact on the local communities of the growing area. The role of Iranian farmers in domestication and cultural development of saffron has been clearly demonstrated in the international literature. However, the past scientific achievement of the Iranian scientists on the agronomic attributes of saffron seems to be insufficient with regards to the importance of this crop and the expectation of international scientific bodies. In this review an attempt has been made to look at the past agronomic research status and find a trend for the present and a prospect for the future. On this bases although the history of conventional research in Iran on saffron goes back to seven decades ago a dormant period of almost 40 years up to the 1960s is evidenced. Basically in the 60s the pioneer researchers from Khorasan founded the conventional research on basic agronomic aspects and in the later stages with establishment of organization such as Organization for Scientific and Industrial Research (Khorasan branch) and expansion of graduate studies in the universities, research activities was progressed. These activities gained a momentum in the last two decades particularly in recent years due to establishment of different public and private organizations associated with saffron such as National Saffron Council, permanent secretariat for saffron festival, organizing various seminars and conferences, establishment of research group for saffron in a University, establishment of saffron focal point for science and industry, establishment of saffron institute and publication of two specialized scientific Journal on saffron. Based on these achievements it is hoped to enhance the conventional research topics and shift them towards a holistic and comprehensive approaches for novel research on the subjects such as production under controlled environment, evaluation of yield gaps, growth and development modeling, crop physiology and ecology and impacts of climate change on saffron expansion area etc. This could be fulfilled by transferring the findings to the fields and presenting the results to the world scientific societies by publishing in international Journals.

Keywords: Agronomic; Iran; Research; Saffron

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Iranian Medicinal Plants Society

Effects of maternal corm weight and different levels of cow manure on corm and flower yield of Saffron (*Crocus sativus* L.)

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A B S T R A C T

In order to investigate the effects of different maternal corm weight and different levels of cow manure on saffron (*Crocus sativus* L.) production, an experiment was conducted at the Agricultural Research Station, Ferdowsi University of Mashhad during 2011- 2012 and 2012- 2013 growing seasons. For this purpose a factorial experiment was used based on complete randomized block design with three replications and 16 treatments. The experimental treatments were done at 4 levels of maternal corm weight (1.1- 3, 3.1- 5, 5.1- 7 and 7.1- 9 g) and 4 levels of cow manure (0, 20, 40 and 60 t.ha-1). Variance analysis results for studied characteristics of saffron corm showed that maternal corm weight, cow manure and maternal corm weight × cow manure had significant effects on these characteristics. Among the experimental treatments, maternal corm with 7.1- 9 g weight and the use rate of 60 t.ha-1 of cow manure treatment had both the highest total corm number (510 corm.m-2) and corm yield (1044 g.m-2). It seems that the corms with higher weight in the first year produce larger number of replacement corm than the corms with lower weight. The saffron flower yield characteristics showed that flower yield in the first year increased by increasing the maternal corm weight. The results of variance analysis of the number of flowers and fresh and dry yield of flower and stigma of saffron in the second year showed that the maternal corm weight, cow manure and maternal corm weight × cow manure had significant effects on them. These characteristics increased by increasing the maternal corm weight and levels of cow manure. It seems that producing replacement corm with high weight in the first year, requires large amount of maternal corm and high levels of cow manure usage.

Keywords: Corm size; Manure; Replacement corm; Stigma yield

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The effects of different levels of applied wheat straw in different dates on Saffron (*Crocus sativus* L.) daughter corms and flower initiation criteria in the second year

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A B S T R A C T

In order to investigate the effects of different maternal corm weight and different levels of cow manure on saffron (*Crocus sativus* L.) production, an experiment was conducted at the Agricultural Research Station, Ferdowsi University of Mashhad during 2011- 2012 and 2012- 2013 growing seasons. For this purpose a factorial experiment was used based on complete randomized block design with three replications and 16 treatments. The experimental treatments were done at 4 levels of maternal corm weight (1.1- 3, 3.1- 5, 5.1- 7 and 7.1- 9 g) and 4 levels of cow manure (0, 20, 40 and 60 t.ha-1). Variance analysis results for studied characteristics of saffron corm showed that maternal corm weight, cow manure and maternal corm weight × cow manure had significant effects on these characteristics. Among the experimental treatments, maternal corm with 7.1- 9 g weight and the use rate of 60 t.ha-1 of cow manure treatment had both the highest total corm number (510 corm.m-2) and corm yield (1044 g.m-2). It seems that the corms with higher weight in the first year produce larger number of replacement corm than the corms with lower weight. The saffron flower yield characteristics showed that flower yield in the first year increased by increasing the maternal corm weight. The results of variance analysis of the number of flowers and fresh and dry yield of flower and stigma of saffron in the second year showed that the maternal corm weight, cow manure and maternal corm weight × cow manure had significant effects on them. These characteristics increased by increasing the maternal corm weight and levels of cow manure. It seems that producing replacement corm with high weight in the first year, requires large amount of maternal corm and high levels of cow manure usage.

Keywords: Corm size; Manure; Replacement corm; Stigma yield

Article 2, Volume 1, Issue 2, Winter 2014, Page 14-28

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Effect of plant density and corm weight on yield and yield components of Saffron (*Crocus sativus* L.) under soil, hydroponic and plastic tunnel cultivation

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A B S T R A C T

Saffron is the most precious spice crop in the world which nowadays has nutritional, medical and industrial importance. Its average yield is 4.83 kg/ha in Iran. The research was conducted to investigate the effect of corm weight and its density on yield and yield components of saffron under soil, hydroponic and plastic tunnel conditions. The effect of three different weights of corm (6-8, 8-10 and more than 10 g) and also three different densities of corm (50, 100 and 150 corms per m^2) was investigated in factorial experiment based on CRD with three replications. The traits which were investigated included: number of flower, fresh weight of flower, fresh and dry weight of stigma and style, and economic yield. The results showed that the main effects of bed types. Weight and corm density were significant in all traits. Interactions of bed type and corm weight were significant at 5% except for flower dry weight, and dry weight of stigma + style that were not significant .As well, interactions of bed type and corm density, corm weight and density and all interactions of bed type ,corm weight and density were not significant in all traits. The heavier corms (more than 10 g) provided the highest yield. By decreasing corm weight, all traits were reduced significantly. Also the results showed that least yield(stigma dry weight) obtained from hydroponic cultivation with 50/ m^2 yielded 4.14 kg/ha and increase in yield (dry weight of stigma) was obtained under soil cultivation and in the density of 150 corms/m^2 economical yield was equivalent to 7.36 kg/ha in the first year.

Keywords: Saffron; Cultivation systems; Dry stigma yield; Number of corms per m^2

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Effect of buds removing and corm size on growth characteristics and yield of Saffron (*Crocus sativus* L)

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A B S T R A C T

The objectives of this research were investigated the effects of removal of lateral and main buds in different corm size on vegetative traits and yield of saffron. The research was conducted as factorial based on a randomized complete block design with three replications at the Research field of Faculty of Agriculture, Tarbiat Modares University in Tehran-Iran, during growing season of 2012-2013. The first factor was corm size with two levels of corm weight (2-4 and 6-8 g) and the second factor was buds removal with nine levels included without bud removal, remove all lateral buds, remove all buds except main buds and one lateral bud, remove all buds except main buds and two lateral buds, remove all buds except main buds and three lateral buds, remove all buds except one lateral bud, remove all buds except two lateral buds, remove all buds except three lateral buds, remove all buds except four lateral buds. In this research, vegetative traits in the first year and reproductive traits in the second year were investigated. The results showed that by removing main bud from corm leaf length and root length were decreased. Also, there was most root length by removing all lateral buds. Overall, the results showed that bud removal could be produce large corm but main bud should not eliminated. The most appropriate the number of buds that could be remaining is 4 large buds on saffron corm.

Keywords: Corm; Lateral Budsbuds; Main Budbud; Remove Budsbuds; Saffron

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A survey on technical efficiency, marketing and market structure of Saffron crop, Iran

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A B S T R A C T

The current study attempted to determine technical efficiency as well as study the marketing and market structure of Saffarn crop in Iran. To access the research goals 140 farms, 25 retailers and 14 wholesalers randomly selected. The necessary data collected through interview and filling questionarie. Apart from this, some agricultural Expert from selected cities of Razavi province have been chosen to interview. To determine the market time-series data for the period of 1995-12 was used. To determine technical efficiency DEA method, to calculate marketing margins Digbi method and to find market structure concentration ratio and Herfindal index were used. The results indicated that, the average technical efficiency was 63.49 and minimum and maximum technical efficiency respectively 19.04 and 100, retailer margin mean of Saffron was more than wholesale margin mean and average marketing cost coefficient of Saffron was about 14.78. It means that, marketing factors share in final price is 14.78. Address to the results the Saffaran's market structure is oligopoly.

Keywords: Concentration ratios; Herfindahl Index; Marketing cost coefficient; technical efficiency

Article 1, Volume 2, Issue 1, Spring 2014, Page 3-16

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The effects of mother corm size, organic fertilizers and micronutrient foliar application on corm yield and phosphorus uptake of Saffron (*Crocus sativus* L.)

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A B S T R A C T

Saffron flowering can be mainly affected by mother corm size and phosphorus content of corm. In order to investigate the effects of mother corms size, organic fertilizers and foliar application on corm yield and phosphorus uptake of saffron (*Crocus sativus* L.) under control conditions, an experiment was conducted in the growing years of 2012-2013 at Faculty of Agriculture, Ferdowsi University of Mashhad, Iran, by using a complete randomized design with 24 treatments and three replications. The mother corms size (0.1-4 g (small), 4.1 – 8 g (medium) and 8-12 g (large), organic fertilizers (cow manure 25 t. ha^{-1}, vermicompost 10 t. ha^{-1},compost 10 t. ha^{-1} and control) and micro nutrient (Fe-EDTA and Zn-EDTA) in two levels (foliar application and no application) were the first, second and third experimental factors, respectively. Based on the results, the highest number and yield of replacement corms were observed by using the large (8.1-12g) mother corms. The effect of cow manure on replacement corm yield was significantly more than other organic fertilizers. The effect of foliar application on replacement corms yield were also significant. In addition, the highest concentration and content of phosphorus replacement corms was observed by using the large (8.1- 12g) mother corms. The content of phosphorus in replacement corms was significantly decreased by reducing the size of the mother corms.
Keywords: Micro nutrients; Replacement Corms; Vermicompost

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Effects of soil and foliar applications of nutrients on corm growth and flower yield of Saffron (*Crocus sativus* L.) in six-year-old farm

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ABSTRACT

Saffron (*Crocus sativus* L.) is one of the most important crops and medicinal plants in Iran. Appropriate application of nutrients has special important role on replacement corm growth and flower yield of saffron. In order to investigate the effects of different levels of soil and foliar nutrients applications by using mixture fertilizer on replacement corm production and flower yield of saffron, an experiment was conducted by using a factorial layout based on complete randomized block design with three replications at the Agricultural Research Station, Ferdowsi University of Mashhad during 2011- 2012 growing season. The experimental treatments were all combinations of four levels of soil nutrition (0, 50, 100 and 150 kg.ha^{-1}) and three levels of foliar spray (0, 5 and 10 per 1000). Results of variance analysis showed that the soil application of treatments had positive significant effects on weight of replacement corms and number and weight of flower and stigma yield of saffron but these treatments had no significant effects on total corm number. The number and yield of replacement corms and flowers were not affected by simple effect of foliar spray and soil and foliar applications interactions. The results of this research showed that the using 150 kg.ha^{-1} of nutrients soil application in early March had more positive and significant effect on yield of fresh and dry flower (120 and 963 kg.ha^{-1}, respectively), yield of fresh and dry stigma (45.5 and 7.90 kg.ha^{-1}, respectively) and weight of replacement corms (1646 g.m^{-2}) than other treatments but foliar application of nutrients in this time had no significant effects on flower and corm yield of saffron.

Keywords: Fertilization; Replacement corm; Spraying; Stigma of saffron

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Effects of weed management strategies on weed density and biomass and Saffron (*Crocus sativus*) yield

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A B S T R A C T

In order to study and compare chemical and non-chemical methods of weed management in saffron (*Crocus sativus*) fields, two field experiments were carried out in a randomized completely block design with three replications at Research Field Station of Gonabad during 2009 to 2011. Treatments included cover crops of barely, Mushroom bed mulch, herbicides of haloxyfop R methyl ester (EC10%), iodosulfuron methyl sodium+mesosulfuron. methyl + mefenpyr. diethy (WG6%) l, hand weeding (DF75%) and control. For determining the ability of treatments for weed control, dry matter of weed, leaf dry weight of saffron, stigma and saffron flower yields were determined. Results showed that dominant weed species were mouse barely (*Hordeum murinum*), wild barley (*Hordeum spontaneum*) Hoary cress (*Cardaria draba*), and yarrow (*Achillea millefolium*). Herbicides of iodosulfuron methyl sodium + mesosulfuron methyl + mefen pyr. Diethy (WG6%) destroyed grasses and broadleaf, but it destroyed saffron plant too. Haloxyfop. R methyl ester damaged grasses but decreased stigma yield and leaf of saffron. Applied mulch was not be able to control the weeds, however, it increased saffron stigma yield. Cover crops of barley significantly decreased weed dry matter weights. Barley caused least weeds dry matter weight similar to hand weeding. In conclusion, the treatments of cover crops showed the best performances in weed control and saffron yield comparing to other studied weed management methods.

Keywords: Barely; Cover crop; Hand weeding; herbicide; Mulch; Saffron stigma

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Effect of nano-silver on root and bud growth of Saffron in flooding stress condition

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A B S T R A C T

Saffron (*Crocus sativus* L.) is cultivated as spices, medicinal and aromatic plant species. At autumn season, heavy rainfall can cause flooding stress and inhibits growth of saffron. Thus this research was conducted to study the effect of silver ion (as an ethylene inhibitor) on growth of saffron under flooding conditions. The corms of saffron were soaked with one concentration of nano silver (0, 40, 80 or 120 ppm) and then planting under flooding stress and non-flooding stress conditions. Results showed that number of roots, root length, root fresh and dry weight, leaves fresh and dry weight were reduced by 10 day flooding stress. Soaking saffron corms with 40 or 80 ppm concentration of nano silver rewarded the effect of flooding stress on the root number, by increasing it. Furthermore, 40 ppm of nano silver increased root length in stress. Nano silver 80 ppm in flooding stress, increased leaves dry weight.

Keywords: Corm; Flooding stress; Nano silver; Root dry weight; Root length; Saffron

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The study of some physiological responses of three Iranian Saffron (*Crocus sativus* L.) landraces to salinity stress

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A B S T R A C T

In order to study some physiological responses of saffron under saline conditions, three landraces of saffron which were collected from Gonabad, Ferdows and Torbat-e-Heydarieh were compared under 0, 3, 6, 9 and 12 dS/m electrical conductivity of saline water during two years under a rain shield in pots in a randomized complete block design with three replications at the Research Center of Yazd which three levels of the landraces and five salinity levels were distributed as factorial. After uniform emerging of the buds, NaCl solutions with the above mentioned levels of salinity were used gradually for pots irrigation with 30% leaching fraction in order to control soil water salinity in desired levels. The results showed that with increasing salinity, relative water content 6.26%, dry weight 19.80%, the total number of leaves 17.042%, the dry weight of corm 49.42%, the concentration of sugars in the leaves and corms 43.36 and 23.72% were reduced and corms and leaves ion leakage 34 and 27%, sodium concentration70%, sodium to potassium ratio 66.66% and proline in leaves 2.88 times were increased that in most cases these fluctuations were observed in 3dS/m of irrigation water.

Keywords: Biochemical characters; Corm; Growth characteristics; Salinity soil

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Evaluation of effects of date, depth and corm sowing distance on corms growth and stigma yield of Saffron (*Crocus sativus* L.) in Langarood, Guilan province

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A B S T R A C T

In order to study the best time, depth, and corm sowing distance of saffron cultivation in Guilan Province, a factorial experiment was carried out based on a randomized complete block design with three replications in Langeroud, Guilan Province, during growing season of 2011-2012. Studies factors included sowing date (A) (a_1: 18th July, a_2: 18th August, and a_3: 18th September), sowing depth (B) (b_1:5 and b_2: 10 cm), and distance between corms (C) (c_1:5 and c_2: 10 cm). Yield of dry stigma, wet weight of petal, dry weight of leaf, length of stigmas, total length, number of flowers and number of days from sowing to flowering of saffron were recorded. The results showed that sowing date had significant (at a significance level of 1%) impacts on the weight of style and stigma, wet weight of flower, number of flower, and number of days from sowing to flowering of saffron. Sowing depth had no significant effect on the weight of style and stigma of saffron. On the other hand, the interaction between sowing date and sowing depth was significant on dry weight of leaf, weight of style and stigma, and number of flower per square meter of saffron. The interaction between sowing depth and corm distance was significant on dry weight of leaf. The highest yield of style and stigma and number of flowers of saffron were recorded at sowing date of 18th September based on 5 cm corm distance, while the lowest yield was for sowing date of 15th July and 10 cm corm distance. Density of 5 × 25 m^2 produced the maximum yield of style weight, stigma weight, and dry weight of leaf. The highest leaf dry weight was observed in interaction of sowing depth and corm distance (sowing depth of 5 cm and corm distance of 5 cm) and interaction of sowing date and corm distance (sowing in July and corm distance of 5 cm). On the other hand, the lowest dry weight of leaf was produced in interaction of sowing depth and corm distance (sowing depth of 5 cm and corm distance of 10 cm) and interaction of sowing date and corm distance (sowing in July and corm distance of5 cm).

Keywords: Corms; Density planting; Stigma and style

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The effect of root-zone temperature on antioxidant activities in Saffron corm

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A B S T R A C T

This research was conducted in a completely randomized design with three replications, to evaluate the effect of root-zone temperature on antioxidant activity in saffron corm in 2013. In this experiment, effect of two root-zone temperatures (23±1˚C and 33±1˚C) in growth chamber on the activity of antioxidant enzymes: peroxidase, polyphenol oxidase, superoxide dismutase, catalase and auxin oxidase in the apical of saffron corms during corm dormancy stage (July) and at beginning corm growing stage (October) were studied. The results showed that at both root-zone temperatures the activity of all enzymes were least in July. Moreover at the 33˚C root-zone temperature no differences in enzyme activities were observed between the months of July to October. In addition measured soluble sugars in buds and corms of saffron showed the highest rate of glucose, mannose, and arabinose at a temperature of 23˚ C, respectively. Thus, treatment of 23˚ C as the best temperature for storage and maintenance of saffron corms was introduced.

Keywords: antioxidant; catalase; peroxidase; Polyphenol oxidase; Super oxidase dismutase; Auxin oxidase; Saffron

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Effect of some chemical fertilizer and biofertilizer on quantitative and qualitative characteristics of Saffron

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A B S T R A C T

In this research, effects of chemical and biological fertilizers on qualitative and quantitative traits of saffron, were evaluated in a field experiment as randomized complete block design with three replications at Saffron Research Farm of Shahed University during growing season of 2012-2013. Experimental factors were chemical nitrogen fertilizer (0, 25 and 50 $kg.ha^{-1}$) and plant growth promoting rhizobacteria including *Pseudomonas* and *Bacillus* as biofertilizer (inoculation and uninoculation). The results indicated that complete application of chemical fertilizer with biofertilizer enhanced yield of saffron, up to 217%, compared to control. The highest yield obtained in application of biofertilizer and 50 $kg.ha^{-1}$ chemical fertilizer. It is worth noting that control (no inoculation) resulted in highest percentage of ingredients of stigma. Application of 50 $kg.ha^{-1}$ of fertilizer was caused severe loss of quality traits in stigma, as safranal and crocin contents decreased by 5.13% and 10.9%, respectively. Integrated application of 25 $kg.ha^{-1}$ nitrogen fertilizer and bio-fertilizer increased the picrocrocin up to 11.9% compared to control. Application of 50 $kg.ha^{-1}$ nitrogen fertilizer along with biofertilizer was the efficient treatment in increment of stigma yield and qualitative characteristics of saffron leaves. The concentration of phosphorus, zinc and copper increased up to 83.05, 69.36 and 86.6%, respectively compared to control. Totally, *Pseudomonas* and *Bacillus* inoculation increased most of the qualitative and quantitative traits of saffron through nutrients uptake.

Keywords: Crocin; Inoculation; Integrated fertilizer management; Plant Growth Promoting Rhizobacteria; Safranal; Stigma

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Saffron Response to the Rate of Two Kinds of Potassium Fertilizers

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A B S T R A C T

In order to investigate the response of saffron to rate and time of application and two kinds of potassium (K) fertilizers, a factorial experiment was conducted with three factors, including the amount of potassium (0, 20.75, 41.5, 65.25, 83 and 103.75 kg $K.ha^{-1}$); time of application (annual application of K, and application of cumulative potassium needed for 4 years in the first year; these plots received 415, 332, 249, 166, 83, 0 Kg $K.ha^{-1}$,respectively in the first year and at other three years not received any K fertilizer); and sources of potassium (K_2SO_4 and KCl) with three replications in a randomized complete block design in Gonabad agriculture and natural resource research station for 4 years. Results of the first year were not analyzed, because these results not related to fertilizer treatments.Results showed that effect of potassium rate on saffron dry stigma was significant ($P<0.05$) and the highest dry stigma yield was obtained from application of 20.75 Kg $K.ha^{-1}$.Application time of K fertilizer had a significant effect on saffron dry stigma yield and application of fertilizer each year increased saffron dry stigma yield significantly ($P<0.05$) in compared to application of all fertilizer at the first year. Effects of sources of K on dry stigma yield of saffron was significant ($P<0.05$) and application of K in the form of K_2SO_4 increased dry stigma yield in compared to muriate of KCl treatment.
Keywords: Dry stigma; K2SO4; nutrition; Yield

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The effects of mother corm size and type of fertilizer on nitrogen use efficiency in Saffron

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A B S T R A C T

Mother corm size and nutrient management are the most important factors in relation to nitrogen uptake of saffron (*Crocus sativus* L.). In order to investigate the effects of mother corms size and type of fertilizer on uptake and use efficiency of nitrogen in Saffron, a field experiment was conducted as factorial layout based on a randomized complete block design with three replications at Faculty of Agriculture, Ferdowsi University of Mashhad, Iran, during the years 2013 and 2014. The mother corm size (4 g and lower (small), 4.1–8 g (medium), 8.1-12 g (relatively large) and over 12 g (large)) and fertilizer sources (cow manure 25 t ha-1, chemical fertilizer (N+P) and control) were the first and second experimental factors, respectively. In both years, the larger mother corms (8.1-12 g and more) significantly resulted in greater nitrogen content (g m-2) of replacement corms and whole plant of saffron. In addition, uptake and use efficiency of nitrogen were significantly increased with increasing mother corms size. In the first and the second years, nitrogen use efficiency in manure treatment was significantly higher than that of chemical fertilizer (by 21 and 61%, respectively).
Keywords: Replacement corm; Chemical fertilizer; Organic fertilizer; Nitrogen uptake efficiency

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Effect of Summer Irrigation and Conservation Tillage on Flower Yield and Qualitative Characteristics of Saffron (*Crocus sativus* L.)

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A B S T R A C T

In order to investigate the effects of summer irrigation and conservation tillage on flower characteristics and corms behavior of Saffron (*Crocus sativus* L.), a field experiment was conducted during 2009- 2010, at Faculty of Agriculture, University of Torbat-e-Heydarieh, Iran. A factorial trial based on complete randomized block design with four replications was used. The experimental treatments were all combination of summer irrigations (July, August, July + August and no irrigation) and conservation tillage (application and non- application). Based on analysis of variance, in the first and second years, summer irrigation had significant effects on number and flower yield of saffron. In the first year, the highest number of flower, flower and stigma yield of saffron significantly observed by irrigation on July + August (25 flowers per m^2, 12.1 and 0.16 $g.m^{-2}$, respectively,). In the second year, irrigation in August had highest significant effects on mentioned characteristics of saffron (127.4 flowers per m^2, 61.4 and 0.87 $g.m^{-2}$, respectively). In the first year, flower and stigma yields of saffron significantly increased by conservation tillage (by 11.3 and 11.7%), as compared to control (no conservation tillage). In addition, summer irrigation and conservation tillage significantly increased picrocrocin content.

Keywords: Corm; Picrocrocin; Safranal; Tillage

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Effects of planting date and corm size on flower yield and physiological traits of Saffron (*Crocus sativus* L.) under Varamin plain climatic conditions

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A B S T R A C T

In order to evaluate the effect of different planting dates and the corm size on yield and some physiological characteristics of saffron, an experiment was conducted as factorial in a randomized complete block design with three replications at the Research Farm of College of Abouraihan, University of Tehran, is located in Varamin dry plain during growing season 2013-2014. Four planting dates, 10 June, 7 and 27 September and 12 October and two corm sizes 5-9 g and 10-14 g were considered as treatments. Evaluated physiological traits include such as proline and protein content in leaves and yield traits, include number of flowers and dry weight of stigma were measured and were examined in a square meter and starting date of flowering were recorded. The results of this research showed that cultivation of large saffron corms (10-14 g) on planting date of 10 June, had Maximum yield, by production 62.7 number of flower and 0.299 gram dry weight of stigma in a square meter. Leaf proline concentration of small saffron corms (5-9 g) on planting date of 12 October and leaf protein concentration of small saffron corms (5-9 g) on planting date of 10 June, were higher than the other planting dates. Increasing proline concentration increased plant resistance under drought and cold in corms planting on 12 October, particularly small corms. In general, these results indicate that flower yield in first year is more influenced by corm size and planting of large corms (10-14 g) on 10 June will have a suitable production.

Keywords: Dry weight of stigma; protein; Proline; Start of flowering.

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Evaluation of the effects of soil texture on yield and growth of Saffron (*Crocus sativus* L.)

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A B S T R A C T

This experiment was conducted to study the effect of soil texture on flower and corm yield of saffron. This experiment was carried out based on Randomized Complete Block Design with four treatments and four replications in box at Faculty of Agriculture, Ferdowsi University of Mashhad, Iran, in 2011. Treatments included of: 1- 100% field soil + cow manure, 2- 70% field soil + 30% sand, 3- 70% field soil + 30% sand + cow manure and 4- 70% sand + 30% field soil + cow manure. Results showed that the effect of soil texture was significant on all flower and corm properties. The highest flower and stigma fresh weight per box (1.59 and 0.10 g, respectively) and petal dry weight (0.12 g) were observed in 70% sand + 30% field soil + cow manure. The highest corm number in 2-3 cm diameter per box was obtained in 70% field soil + 30% sand + cow manure (3.75 numbers). Treatment of 70% sand + 30% field soil + cow manure produced the highest corm number in 3-6 g (1.75 numbers) and 6-9 g (1.25 numbers) per box, but the lowest values of most studied indices were obtained in 100% field soil + cow manure. Generally, our results indicated that light soil texture has more advantages than heavy soil texture in saffron cultivation. Therefore, soil modification through lighter soil application can improve saffron flower and corm yield.

Keywords: Clay soil; Saffron; Stigma dry weight; Substrate; Yield

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Allelopathic effects of leaf and corm water extract of Saffron (*Crocus sativus* L.) on germination and seedling growth of flixweed (*Descurainia sophia* L.) and downy Brome (*Bromus tectorum* L.)

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A B S T R A C T

This study was conducted in two factorial experiment based on completely randomized design with three replications at research laboratory of faculty of agriculture in University of Birjand in 2013. Factors included saffron organs at 2 levels (leaves and corms) and water extract concentrations at 5 levels (0, 0.5, 1, 1.5 and 2 percent).The allelopathic effects of saffron leaves and corms on seed germination and seedling growth characteristics of flixweed (*Descurainia sophia* L.) and downy brome (*Bromus tectorum* L.) were studied in two separate experiments. Results indicated lowest seed germination percentage of downy brome and flixweed were observed at concentration of 2% of corm extract (by 65% and 66% reduce compared to control, respectively). The rate of germination of downy brome decreased (by 71% compared to control) with concentration of 2% of leaf extract but the rate of germination on flixweed was not significantly affected by extract concentrations. Different concentrations of leaf and corm extracts significantly decreased length and weight of plumule and radicals of two weeds. A logistic model provided a successful estimation of relationship between leaf water extract and germination percentage of two weeds. Based on orthogonal comparison tests, the allelopathic inhibition effects of saffron leaves and corms were more on downy brome and flixweed, respectively.

Keywords: Allelopathy; Length of radical; Percent of germination; Weight of seedling

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Effects of first irrigation date and organic fertilizer treatments on Saffron (*Crocus sativus* L.) yield under Khaf climatic conditions

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A B S T R A C T

In order to investigate the effects of first irrigation date and organic fertilizers on growth and yield characteristics of saffron, an experiment was conducted as a split-plot based on a randomized complete-block design with three replications, in Khaf city during growing season 2013-2014. Date of first irrigation treatment in three levels (15 September, 30 October and 15 November) was allocated as main plots and fertilizer treatment in five levels (control, humic acid at 5 and 40 liters per hectare, cow manure at 5 and 40 t.ha-1) was set as subplots. Analysis of variance showed that the date of first irrigation had a significant effect on all studied traits except for total fresh weight of corm and the average weight of corm of saffron. Effects of different organic fertilizer treatments on all studied traits were significant, except for corm number with 8 g (8.00) weight were obtained in first irrigation on 6th November. The first irrigation at 7th October was superior to the other irrigation treatments for corm number with

Keywords: Animal manure; Corm number; Corm weight; humic acid; Number of flower

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Effect of Different Heavy Metals on Physiological Traits of Saffron (*Crocus sativus* L.)

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A B S T R A C T

Increasing the concentration of different heavy metals, such as lead, copper, nickel and other heavy metals in air, soil and water can pose negative effects on the entire ecosystem and cause harmful health consequences for all forms of life. The major sources of pollution in many parts of world are overburdens of mine, industrial effluents, fertilizers and pesticides. In order to study the effects of different heavy metals on some of the physiological attributes of saffron such as photosynthetic pigments, Prolin and carbohydrates of leaf and the amount of crocin in the saffron stigmas, an experiment was conducted based on completely randomized design (CRD) with four replications and seven treatments. The experimental treatments were control and six different heavy metals (i.e. nickel nitrate, silver nitrate, zinc nitrate, copper carbonate, lead nitrate and manganese sulfate). Before sowing the corms, all of the heavy metals were added to the soil based on the concentration of 500 $mg.kg^{-1}$ soil. The effects of experimental treatments on chlorophyll a, chlorophyll b, total chlorophyll and chlorophyll a/b were significant, but there was no significant effect on leaf carotenoids. Proline and soluble carbohydrates were significantly affected by the treatments. However, the effects of these treatments on reducing carbohydrates were not significant. Heavy metals also had significant effects on crocin content of the saffron stigmas. By using all of the heavy metals except for nickel nitrate, the amount of crocin increased.
Keywords: Carbohydrates; Environmental stress; Proline; Secondary metabolites

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Determination of Effective Agronomical Traits on Saffron Ecotypes Stigma Yield in Zanjan Conditions

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A B S T R A C T

In order to investigate the effective traits on yield of saffron ecotypes, a study was carried out as a split plot in time based on randomized complete block design with three replications in the research farm of Zanjan University during the growing seasons of 2013-2015. Eighteen saffron ecotypes were studied in this experiment. The traits of number of flowers, fresh weight of flowers, fresh weight of stigma, dry weight of flowers, dry weight of stigma, stigma length and dry stigma yield of saffron were measured. The results indicated that there were significant differences among all studied traits of ecotypes except for stigma length. The correlation matrix revealed that the number of flower and dry weight of stigma had a positive and highly significant correlation with dry stigma yield (r= 0.99 and 0.70, respectively). Analysis of stepwise regression and path analysis showed that the traits of number of flowers, dry weight of stigma and dry weight of flowers were the most effective traits on dry stigma yield. Therefore, these traits can be used to achieve a higher stigma yield.

Keywords: Number of flower; Path Analysis; Stigma weight; Stigma yield

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Optimizing Corm Size and Density in Saffron (*Crocus sativus* L.) Cultivation by Central Composite Design

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A B S T R A C T

In order to determine the optimal use of corm size and density, an experiment was conducted by central composite design at the Research Station, the Ferdowsi University of Mashhad, Iran, during two growing seasons of 2008-2009 and 2009-2010. The treatments were designed based on low and high levels of corm size (3 and 7 g) and density (50 and 150 corm.m-2). Central point in each treatment was repeated 5 times and a total of 13 experimental treatments were designed. Economic yield, corm diameter, number of daughter corms, number of mother corms, number of flowers and fresh weight of flowers were measured as dependent variables, and the response surface of these variables to experimental factors was estimated by the polynomial regression model. The results indicated a positive effect of corm size and density on economic yield, corm diameter, dry weight of tunic, number of daughter corms, number of mother corms, number of flowers and fresh weight of flowers. The optimum level of corm size and density were 7 g and 250 plant.m-2, respectively.

Keywords: Corm diameter; Economic yield; Fresh weight of flower; optimization

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The Effect of Different Levels of Salinity Stress on Some Physiological Characteristics of Saffron (*Crocus Sativus* L.)

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A B S T R A C T

Salinity is a common stress in many parts of the world especially in Iran that decreases the yield and quality of many crops. In order to investigate the effects of different levels of salinity stress on some physiological indices of saffron, an experiment was conducted in the Malayer University in 2012. The experiment was arranged based on a completely randomized design (CRD) with four replications and six levels of salinity (i.e. 0, 2, 4, 6, 8 and 10 dS m^{-1}). The results showed that the effect of salinity on chlorophyll a and chlorophyll b content was not significant. However, increasing the salinity stress up to 6 dS m^{-1} resulted in an increase of these photosynthetic pigments. The effect of salinity stress on leaf carotenoides and xantophyll content were significant and higher salinity stress resulted in an increase of these pigments. Moreover, the effect of salinity on leaf proline was not significant, but the amount of leaf glucose content increased by increasing salinity stress, significantly. The effects of experimental treatments on leaf dry weight, leaf length and relative water content were significant and negative, but there was no significant effect on leaf number. By increasing the concentration of salt, the mean weight of replacement corms decreased significantly whereas the corms number increased up to 4 dS.m^{-1} and then decreased significantly.

Keywords: Electrical conductivity; glucose; photosynthetic pigments; Proline

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Evaluation of the Extinction Coefficient, Radiation Absorption and Use Efficiency of Saffron (*Crocus Sativus* L.)

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A B S T R A C T

Leaf area index, light extinction coefficient and radiation use efficiency are important eco-physiological characteristics for realization of crops growth, development and radiation absorption. In order to determine the leaf area index (LAI), light extinction coefficient (K) and radiation use efficiency (RUE) of saffron during the first and second growing seasons, four experiments were started in 2011 and ended in 2014, at the Research Farm of the Agriculture Faculty, the Ferdowsi University of Mashhad, Iran. Saffron corms with weights between 13 to15 g and density of 50 plant.m^2 were cultivated in 2011 and 2012. In all experimental years during the growing season, crop sampling was taken for required measurements including the leaf area index and shoot dry weight of saffron once every 14 days. The results showed that by increasing the age of saffron from 1 year to two years, the maximum LAI of saffron increased from 0.33 to 1.81, and light extinction coefficient decreased from 1.20 to 0.54. The increasing trend of LAI was coincident with fraction of absorbed radiation for all four years of the experiment. In the first and the second growing seasons, the amount of fraction of absorbed radiation gradually increased with increasing LAI and at 1083 and 1034 GDD reached its maximum value, respectively. In saffron farms when the plant was one year old and two years old, the mean value of RUE was 0.68 and 1.73 g.MJ^{-1} PAR, respectively. These results indicate that by increasing the saffron age and LAI, the value of K decreases and consequently radiation absorption and use efficiency will increase.

Keywords: Dry matter; Leaf area index; Radiation; Saffron age

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Evaluation of the Effect of Maternal Corm and Planting Methods on Flower and Replacement Corms Yield of Two Ecotypes of Saffron (*Crocus Sativus* L.) in Tabriz

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A B S T R A C T

In order to evaluate and access the best conditions to cultivate saffron in Tabriz, an experiment was conducted at the Agricultural Research Station of the University of Tabriz (Khalatpooshan), in a factorial experiment based on randomized complete block design and three replications. The treatments included two ecotypes of saffron in 4 levels of mother corm weight (3.1- 5, 5.1- 7, 7.1- 9 and more than 9 g) and two planting methods (row and mass). The results showed that corm weight and planting method had significant effects on the number and weight of replacement corms. But there was no significant effect on the different ecotypes. Among the experimental treatments, corms with 7.1- 9 g weight lead to the highest total corm number (342.65 corm.m-2) and corm yield (892.9 g.m-2) and the yield of flowers and stigma of saffron. It seems that for production of larger replacement corms and increased flowering yield, we need to culture large maternal corms. In addition, we observed the best economical yield that is determined by amount of stigma, in row planting method. The results showed that row planting method leads to a higher amount and yield of replacement corm production in comparison to mass planting method. As a result, producing corms with high weight followed by increasing of flower yield requires the use of large maternal corms for cultivation and row planting method.

***Keywords**:* Replacement corm; Row planting method; Mass planting method; Stigma yield

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The Study of Saffron (*Crocus Sativus* L.) Replacement Corms Growth in Response to Planting Date, Irrigation Management and Companion Crops

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A B S T R A C T

Selection of suitable mother corms is an important factor for achieving optimum yield in saffron. In order to investigate the effect of some agronomic factors on the growth of replacement corms of saffron, an experiment was done at the Faculty of Agriculture, the Ferdowsi University of Mashhad, Iran during 2009-2011. The experimental treatments consisted of planting on the following dates (22 May, 22 July and 22 September, 2009), irrigation management (Irrigation and no irrigation after each planting date and repeating them in the second year in late spring, summer and early autumn irrigations) and companion crops [Persian clover (*Trifolium resupinatum*), Bitter vetch *(Vicia ervilia)* (*Lathyrus sativus*) and control), that were arranged in a split-split plot experiment based on a randomized complete block design with 3 replications. Sampling of replacement corms was done after the second growth cycle of saffron in May, 2011. The results showed that with delay in corm planting from May to September, the number of replacement corms and percentage of corms with contractile root increased by 25 and 33%, respectively. However, the amounts of total weight of replacement corms per clone, mean number of flowering buds per corm, mean number of total buds per corm, mean weight and mean diameter of replacement corms planted in July were 21, 70, 40, 32 and 37% higher than those planted in September, respectively. Irrigation increased the amount of contractile roots and number of replacement corms per clone (12%), but decreased the amount of mean number of flowering buds (19%), mean number of total buds (11%) and mean weight (19%) and diameter (8%) of replacement corms. Moreover, application of companion crops had a partially positive impact on the indices of growth of replacement corms of saffron such as follows: the total weight of replacement of corms per clone (8%), corms to scales weight ratio (14%), number of flowering buds (10%) and mean weight of replacement corm (10%). Overall, mother corm planting during real dormancy, no irrigation after planting and during summer as well as application of associated crops have a positive effect on the mean weight of replacement corms as the main important factor in saffron flowering.

Keywords: Flowering bud; Bitter vetch; Persian clover; Real dormancy; Summer Irrigation

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Effect of planting density on flower and corm yield of Spanish & Iranian Saffron (*Crocus sativus* L.)

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A B S T R A C T

In order to investigate the effect of planting density and maternal corm weight on some characteristics of daughter corms and agronomic characteristics of saffron (*Crocus sativus* L.) a field experiment was conducted at the Agricultural and Natural Resources Research Center of Mashhad. This experiment was carried out as a factorial split plot in time based on complete block design with three replications and 12 treatments during the years 2010-2014. The experimental factors were 3 levels of density (40, 80 and160 corm in m^2) and 4 levels of mother corm weight (≤3, 3-6, 6-9 and 9-12 g per corm) as a main plot and time as a sub plot. The results showed that density, maternal corm weight and year had significant effects on daughter corm's weight, but the effect of interaction density × corm weight and density × weight × year were not significant for the most characteristics. The mean comparison of interaction effect of density × weight for number of daughter corm showed that maternal corm weight (9-12 g) × planting density (160 m^2) had the highest number for daughter corms (771 m^2). Maternal corms with higher initial weight produced the highest number of corms in different corm classes. In addition, the results showed that maternal corm with lower initial weight produced heavy daughter corms compared to other maternal corm weight classes. Flower weight and stigma dry weight of saffron (m^2) were increased by increasing planting density and maternal corm weight flower number. The highest dry stigma (0.65 $g.m^{-2}$) yield was produced by maternal corm (9-12 g per corm) weight class.

Keywords: Replacement Corms; Corm density; Saffron yield; Flower weight

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The Effects of Different Amounts of Density and Mother Corm Weight on Corm and Flower Yield of Saffron (*Crocus Sativus* L.) Under Mashhad's Climate

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A B S T R A C T

In order to investigate the effect of planting density and maternal corm weight on some characteristics of daughter corms and agronomic characteristics of saffron (*Crocus sativus* L.) a field experiment was conducted at the Agricultural and Natural Resources Research Center of Mashhad. This experiment was carried out as a factorial split plot in time based on complete block design with three replications and 12 treatments during the years 2010-2014. The experimental factors were 3 levels of density (40, 80 and160 corm in m^2) and 4 levels of mother corm weight (≤3, 3-6, 6-9 and 9-12 g per corm) as a main plot and time as a sub plot. The results showed that density, maternal corm weight and year had significant effects on daughter corm's weight, but the effect of interaction density × corm weight and density × weight × year were not significant for the most characteristics. The mean comparison of interaction effect of density × weight for number of daughter corm showed that maternal corm weight (9-12 g) × planting density (160 m^2) had the highest number for daughter corms (771 m^2). Maternal corms with higher initial weight produced the highest number of corms in different corm classes. In addition, the results showed that maternal corm with lower initial weight produced heavy daughter corms compared to other maternal corm weight classes. Flower weight and stigma dry weight of saffron (m^2) were increased by increasing planting density and maternal corm weight flower number. The highest dry stigma (0.65 $g.m^{-2}$) yield was produced by maternal corm (9-12 g per corm) weight class.

Keywords: Corm weight; Corm number; Daughter corm; Dry stigma weight; Flower weight

Introduction

The red stigmas constitute the most important economic portion of saffron flower. This part of the flower contains carbohydrates, minerals, vitamins, and some kind of pigments including carotene and flavones. Although saffron is mainly used as a coloring, flavoring, and fragrance condiment for a variety of foods, existence of special chemical compounds in it have made it a suitable candidate to be used in pharmaceuticals as well. The saffron color, bitter taste, and scent are due to crocin, picrocrocin ($HC_{626}O_7$), and safranal ($C_{10}H_{14}O$), respectively.

Among the major ingredients of saffron, crocetin, which is responsible for its coloring property, is a special carotenoid with multi-unsaturated conjugate olefin acid structure. The compound exhibits favorable effects in the prevention or treatment of a variety of diseases such as dyslipidemia, atherosclerosis, myocardial ischemia, hemorrhagic shock, cancer and arthritis. Crocetin also showed obvious inhibitory effects on atherogenic factor-induced disorders in vascular endothelial cells, smooth muscle cells and monocyte-derived macrophages.

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The effects of different levels of applied wheat straw in different dates on Saffron (*Crocus sativus* L.) daughter corms and flower initiation criteria in the second year

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A B S T R A C T

In order to investigate the effects of different levels of applied wheat straw as mulch in different dates on flower characteristics and corms behavior of Saffron (*Crocus sativus* L.) in the second year, a field experiment was conducted as factorial layout based on a randomized complete block design with three replications at Faculty of Agriculture, Ferdowsi University of Mashhad, Iran in years of 2010-2011 and 2011-2012. The experimental treatments were all combination of different levels of wheat straw as mulch (0, 2, 4, 6 and 8 t. ha^{-1}) based on surface applied method in three different dates (June, August and October). The results showed that the applied wheat straw as mulch in different dates had significant effects on flower characteristics of saffron (flower number, fresh and dried flower and stigma+ style yields). Based on these results, applied wheat straw as mulch in October had highest effects on increasing flower number, fresh and dried flower yields (by 46, 61 and 65%, respectively). In addition, applied wheat straw as mulch had significant effects on number and yield of replacement corms. The applied straw as mulch in October increased yield of replacement corms with 12 g or higher weight and total corm yield of saffron by 104 and 103 %, respectively, as compared to control treatment.

Keywords: Flowering; Saffron corms; Wheat mulch

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Aflatoxin determination in Saffron by high-performance liquid chromatography and immunoaffinity column clean-up

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A B S T R A C T

In this paper, method based on high performance liquid chromatography with fluorescence detection has been suggested to measure aflatoxin in saffron. This method required a simple extraction of aflatoxin using MeOH/H_2O (80:20, v/v) and a purification by immunoaffinity column cleanup. Aflatoxin measurement was performed at an emission wavelength of 445 nm and an excitation wavelength of 365 nm. Detection limits for AFB_1, AFB_2, AFG_1 and AFG_2 were 0.293, 0.08, 0.55, and 0.30 ng g^{-1}, respectively. The percentage of Relative standard deviations for measuring aflatoxin is in the range of 1.33-5.10 % and the percentage of recovery is in the range of 94-67. Regarding The overall results of high-performance liquid chromatography applied in this experiment, we can realize that this method can be used for detection and measurement of different kinds of aflatoxins in saffron.

Keywords: Aspergilus Flavous; Florescence detector; Mycotoxin

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Effects of Saffron (*Crocus sativus* L.) aqueous extract in the conversion of larvae to pupa and pupa to mature of fruit flies (Drosophila melanogaster M.)

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A B S T R A C T

Saffron (*Crocus sativus*L.), a native plant from Iran and especially of Khorasan region, has a specific place for people's diet. According to several studies about effects of saffron and because there are no specific studies on the effects of saffron aqueos extract on the development of *Drosophila melanogaster* as an animal model, this subject evaluated in conversion of larvae to pupa and pupa to mature of fruit flies. 5 pairs of 3-day-old wild *D. melanogaster* were transferred to every culture plate containing different concentrations of saffron aqueos extract in order to intercross and oviposition and were brought out after 8 hrs. The percent of larvae to pupa transitionand pupa to mature conversion, were evaluated in all concentrations. The obtained data were evaluated statistically using SAS software and the mean of data were compared using Tukey test with minimum significance level of pD*. elanogaster* depends on dose proportionately. It means that saffron has some effects on the percentage of conversion of larvae to pupa, pupa to mature in low volumes and increased consuming concentrations of saffron may have inverse effects on that.
Keywords*:* development; Model; nutrition

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Classification and prediction of three and multi stigma in Saffron by statistical, unsupervised machine learning tools.

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A B S T R A C T

Saffron is a triploid, sterile plant, used as a spice and medicinalplant in all countries. Stigma is the most important part of saffron. So far no reliable molecular methods were provided to identify and prediction of the three/multi branches species. In this study, using different bioinformatics algorithms, new tools for prediction based on Sequence-Related Amplified Polymorphismmolecular markers is presented. Five alleles M1311400, M151200, M12100 and M10850 selected as the most important classifier by Attribute Weighting models which has the potential to cluster and recognize the three from multi branches stigma. K-Means and K-Medoids unsupervised clustering algorithms were fully able to cluster each genotype to the right classes. Our results showed that for the first time, data mining techniques can be effectively used to genetic differentiation between three and multi stigma with above 90 percent the accuracy andprecision. These methods can use in gene mapping and selection by biomarker.

Keywords: Classifier; Machine learning; Molecular marker; Sequence-related amplified polymorphism

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Identification of some Saffron corm rot fungi and their control

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A B S T R A C T

In order to isolation and identification of causal agents of corm rot and their control, the sampling was done from corms in farms of Bushroueye, southern Khorasan province. After culturing of sections of infected corms, the fungi, *Penicillium digitatum*, *Aspergillus niger*, and *Rhizopus stolonifer* were isolated and identified. For their control test, four concentrations of *Pseudomonas fluorescens* CHAO, *Trichoderma harzianum* Bi, and four concentrations of fungicides, cupper oxichlorore and benomil,were used with four replications. The control effect of antagonists and fungicides were determined by measurement of diameter of pathogens colony on medium. The results showed that the maximum of control of antagonistic fungus were obtained in concentrations of 1×107 and 1×108, and in the case of antagonistic bacterium wereshown in concentrations of 1×109 and 1×1010. The fungicides had maximum control in concentrations of 3×10-3 and 4×10-3. In general, among of the treatments, *T. harzianum*was most effective to reducing the growth of pathogenic fungi.

Keywords: Biocontrol, Antagonist, Saffron, Southern Khorasan

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Evaluation of antioxidant activity of aqueous and alcoholic extracts (methanol, ethanol) Saffron petals

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A B S T R A C T

The medicinal plants are important sources of antioxidants. Natural antioxidants increase the antioxidant capacity of the plasma and reduce the risk of certain diseases such as cancer, heart diseases and stroke. Synthetic antioxidants commonly used in processed foods have side effects and are toxic. Therefore, there is a need for more effective, less toxic and cost effective antioxidants derived from medicinal plants. Saffron petal is a rich plant source of polyphenolic compounds. Hence, this research was conducted for studying the antioxidant properties and phenolic compositions of saffron petal. In this study, saffron petal extraction was prepared by ethanol, methanol (30, 70 and 90%) and water. The phenolic compositions were determined using Folin-ciocalteau method. In next step, antioxidant activity evaluated using generates free radical of DPPH. The results showed that the type and contents of solvent significantly affect the phenolic values and antioxidant activity.Also there was a significant relation between phenolic compound content and radical scavenging activity. Moreover, the antioxidant activity and phenolic compound concentration were increased by increasing solvent concentration. Finally, it was concluded that the ethanol extract could be considered as a effective solvent for the maximum extraction of phenolic compounds and antioxidant activity.

Keywords: DPPH; Folin-ciocalteaul; Phenolic composition

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Effect of corm planting density, organic and chemical fertilizers on formation and phosphorus uptake of Saffron (*Crocus sativus* L.) replacement corms during phonological stages

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A B S T R A C T

Saffron (*Crocus sativus* L.) propagates by replacement corms producing from the mother corm after flowering during each season. In order to investigate the effect of corm planting density, organic and chemical fertilizers on formation and phosphorus uptake of saffron replacement corms during phonological stages, a field experiment was conducted as factorial layout based on randomized complete block design with three replications, at Faculty of Agriculture, Ferdowsi University of Mashhad, Iran, during 2013 and 2014 growing seasons. The experimental treatments were all combination of different levels of planting density (25, 50, 75 and 100 corms per m^2) and fertilizer sources (manure 25 t. ha^{-1}, chemical fertilizer (N 150 kg ha^{-1} + P 75 kg ha^{-1}) and control). Due to different sampling dates of replacement corms during phonological stages (21 November, 21 December, 20 January, 20 April and 21 May, respectively), the experimental data were analyzed as factorial - split in time based on a randomized complete block design. Based on results, the highest number of replacement corms lower than 4 g (5.8 corms per plant) were observed in fifth sampling stage and then decreased. In all levels of planting density (25 to 100 corms per m^2), the effects of manure on increasing the number, weight and phosphorus content of replacement corms in range of 4.1 to 8 and 8.1 to 12 g per plant were significantly higher than chemical fertilizer. In fifth sampling stage, by applying the manure, the weight and phosphorus content of replacement corms in range of 8.1 to 12 g per plant were significantly increased (approximately twice), as compared to chemical fertilizer. It seems the decrease in saffron yield as result to decreasing the corm planting density can be slightly offset by increasing the percentage of larger corms formation per plant.

Keywords: Manure; Phonological stages; Phosphorus content in corm

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Effect of Stevia (*Stevia rebaudiana*) as a Substitute for Sugar on Physicochemical, Rheological and Sensory Properties of Dietary Saffron Syrup

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A B S T R A C T

In recent years production and usage of functional food and drinks is one of the public and scientist's interest. Since carbohydrates have been recognizedas the major calorie source in many food baskets, most attention has been focused on substitution of sucrose with non-caloric sweeteners. Although both natural and synthetic sweeteners have been used in the formulation of food stuffs, deep concern is raised regarding safety aspects of synthetic ones. Stevia is a natural suitable sweetener that is currently being used as a substitute for sugar in many dietary and functional foods and drinks. In the present study the effect of using stevia sugar as a replacement for sucrose in the preparation of saffron beverages was investigated. Accordingly, saffron syrup was prepared with 5 treatments in which100%, 75%, 50%, 25% and 0% of stevia sugar replaced sucrose. Then, the physicochemical, rheological and sensory properties of saffron functional syrup were investigated. The results indicated that by increasing stevia brix level, density and viscosity increased but the syrups' pH decreases. The best treatment was the sample containing 25% steviaand 75% sucrose that compared to other samples regarding sensory characteristics had a higher acceptance by consumer and regarding physicochemical and rheological characteristics more similar to the control sample.

Keywords: Stevia; Saffron Syrup; Artificial Color; FunctionalDrink

Introduction

Saffron (*Crocus sativus* L.) is a sterile autumn-flowering species, which propagates vegetatively by means of a tuberous bulb, known as a corm. Genetic improvement and propagation of high quality plant material could improve saffron industrialization and stop the process of genetic erosion. A high quality and improved plant is supposed to produce more flowers per plant, flowers with a higher number of stigmas, increasing stigma sizes or stigmas with an increased amount of dye and aroma.

Callus **Micro corm** **Regenerated of callus**

Different reaction of various explants to tissue culture in different hormonal media (Sajjadi F ard and Pazhouhandeh).

Gene network of high represented genes of mature Saffron stigma. Black circles: gene codes applied in service. Gray circles: complementary genes added from service (Aliakbari et al., 2013).

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Bioinformatic analysis of Saffron (*Crocus sativus* L.) stigma EST sequences to determining functional genome orientation and gene network

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A B S T R A C T

Functional genomics methods such as Expressed Sequenced Tag (EST) analysis have provided possibilities for identification, expression analysis and study of transcripts involved in metabolic and regulatory networks. In order to identify of genome orientation and to determine gene networks involved in the evolution of saffron stigma, 6202 EST sequences from mature saffron stigma were analyzed. After initial trimming, sequences clustering and assembling resulted in 910 unigenes (604 Contigs and 304 Singleton). BLAST X revealed that 570 unigene had significant hit among the Arabidopsis protein database, whereas the remaining unigenes displayed no significant match with the any hit. Classifying and gene enrichment analysis of unigenes, put them into 31 distinct functional groups, where 12 groups of them were statistically significant at α=0.01. Gene network of high represented Contigs (which had greater than 20 transcripts), showed that there is a complex gene interaction in mature saffron stigmas. Results revealed that jasmonic acid signalling pathway and its transcription factors such as MYB21 and Zinc fingers play a key role in regulating of stigma primary and secondary metabolism, especially in metabolism of carotenoids (as the most important saffron metabolites). The genes identified in this study could be good candidates for manipulating the evolution and metabolism of saffron stigma.

Keywords: Functional genomics, Secondary metabolite, Carotenoid

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Molecular detection of some plant and non-plant frauds in commercial Saffron using ITS marker network

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A B S T R A C T

Saffron (*Crocus sativus* L.) is the most valuable food additive in the world which little production and high price of it caused some adulterations such as plant and chemical material similar to saffron. There are several methods for detecting these fraudulent based on morphological and chemical tests but they are not effective in some cases. In this research a novel molecular method based on ITS-2 marker is introduced. A common forward primer based on 5.8s rDNA for all plant frauds such as safflower, corn stigmas, pomegranate, turmeric and capsicum slices was designed then specific reverse primers based on ITS-2 for any frauds have been designed for polymerase chain reaction. Related ITS-2 bands were amplified in any adulterations in saffron. Specific primer for camel and cow meet fibers was designed based on cytochrome b gene and could amplified the related bands. Multiplex PCR with all of these primers could amplify all of the bands related to any adulterations. Furthermore, using 20% polyacrylamide gel lead to good segregation of bands. This method can be used successfully for detection of low percentage (1%) of fraudulent in saffron. So this marker can be used efficiently for detection of these frauds in commercial saffron.

Keywords: Fraud Saffron; ITS marker; polymerase Chain Reaction

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Study on Effect of Type of Explant and Hormone on Callus Induction and Regeneration in Saffron (*Crocus sativus* L.)

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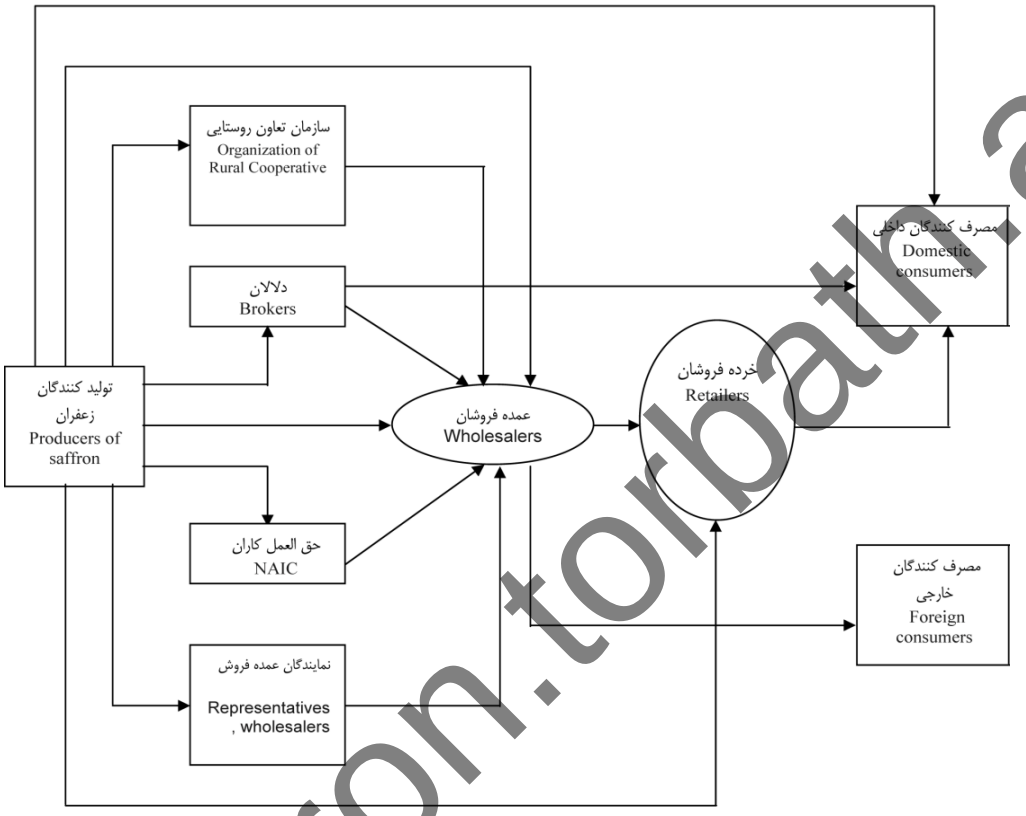
A B S T R A C T

Saffron (*Crocus sativus* L.) is one of the medicinal plants that contain active components and medicinal materials. Tissue culture of saffron can improve the quality and quantity of the saffron product, increase its export and the farmers' income. In this study, 36 different types of hormone combinations in the dark and 9 different treatments of hormone combinations in cold (4°C), using different saffron explants (bulb, leaf, scales around leaf and distal parts of the leaf) were studied in tissue culture. To investigate the growth of corms, the callus formation and the regeneration rate, three replications for each treatment were used and the length of shoot (cm), the callus formation percentage and the regeneration percentage were measured and statistical analysis was performed. Among the types of explants, only explants from bulbs produced the callus on MS medium containing 2 mg.l-1 BAP and 1 mg.l-1 IBA in both the dark and cold conditions. The highest percentage of regeneration was obtained in MS medium with hormonal composition of 0.3 mg.l-1 TDZ, 1 mg.l-1 BAP, 2 mg.l-1 IBA and 0.01 mg.l-1 GA3 in the cold conditions.

Keywords: Hormones; in vitro; Micropropagation; Saffron

Introduction

Saffron has a specific economic value for farmers in Khorasan Province in terms of revenue and job generation. This commodity ranks second in export of agricultural product for the country. Economic value of Saffron could be observed during the flower picking period where almost all business in the area including transport are highly involved.



Marketing routes Saffron Khorasan Razavi (Shaban et al., 2015).

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Operational plan of Iran Saffron's branding

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A B S T R A C T

Despite the extensive production and export of saffron in Iran, we have no strong and credible brand of Iranian saffron in global market. In other words, the absence of strong brands in the global market has made almost no name of Iran in these markets. Thus, it is useful to aware of the importance of branding for export crops such as saffron and exploring the solutions of leading brands using in the global market. The present study with regard to theoretical foundations, comparative studies and by using the opinions of saffron industry experts via in-depth interview and questionnaire, have addressed the challenges facing the industry, and Using SWOT matrix for formulating branding strategies and operational plans. The results of the study show that branding in the industry is so weak and has a lot of weaknesses and threats. Therefore, to develop branding in the industry, four main strategy categories were presented. By using these strategies we can guarantee the improvement in the industry.

Keywords: branding; Packaging; Geographical Index; Export; strategy

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Application of data envelopment analysis to evaluate the efficiency of Saffron growers (Case study: Qaen county)

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A B S T R A C T

Agricultural sector to meet the requests such as a higher yield, less pollution and fulfill consumer demands due to increasing scarcity of resources is under pressure. According to the importance of efficiency in productivity growth, this index can play an important rule, especially in developing countries, for the development of agricultural systems in order to meet these requests. The aim of this study was to evaluate the technical, economic and allocative efficiency of producers of saffron for Qaen region using data envelopment analysis. Information and data is collected through completion 50 questionnaires in year 2011-2012. Results show that average technical efficiency, allocative and economic in condition of constant return to scale are 0.86, 0.92, and 0.88 and in condition of variable return scale are 0.89, 0.92, and 0.80, respectively. Also, according to the results obtained, educating and advising farmers to the proper use of available resources, and promotion, and the use of appropriate technologies such as improved efficiency is recommended.

Keywords: Allocate efficiency; Economic Efficiency; Qaen city; technical efficiency

Article 5, Volume 2, Issue 1, Spring 2014, Page 59-74

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Evaluation of comparative advantage on production and export of Saffron

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ABSTRACT

With due attention to facilities, and different potentials and sources in agriculture of Torbat Heydarieh city, this region is suitable for cultivation and production of saffron. In this study comparative advantage of saffron production in Torbat Heydarieh investigated using DRC index and policy analysis matrix (PAM) during 2012-13. Also in this study evaluated comparative advantage of saffron export using RCA and RSCA index. The Results showed that saffron production in Torbat Heydarieh has a comparative advantage. According to the NPC price index is higher than market price and so producers benefited from subsidies and market support. According to the EPC standard, government interventions has a positive effect on production of this crop, so was supported from input and production markets this crop. In result, NSP index was positive in all sectors. Results of these two indexes showed that Iran, Spain and Greece had preferences on export relative advantage in the world during 2004-2012. While value added of Iran saffron export is not considerable, therefore, for improving this condition, joining Iran to the WTO in order to reduce tariffs on exports, paying more attention in marketing and supplying necessary facilities such as foreign exchange support in the country was suggested.

Keywords: Policy analysis matrix; Revealed comparative advantage; Revealed Symmetric Comparative Advantage; Torbat Heydarieh

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Organic Saffron position in the future household consumption basket and effective structures (Case study)

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A B S T R A C T

Considering the importance of planning at the production level, it is necessary to identify the consumer's future behavior towards organic products. Thus, using seemingly unrelated regression and data of 2012 for 200 households in mashhad, in the present study we have tried to determine the future share of these products in the household's basket and also survey the effective factors on this share in organic saffron. The results showed that households in mashhad tend to allocate an average of 34 percent of their future consumption basket for organic saffron. The regression results illustrated that while children below 10 years old in the households, willingness to pay the price differential compared with non-organic products and organic labeling positively affected the willingness to pay for organic products, environmental concerns variables created by non-organic products had a negative effect on their willingness. Considering the research results, helping to raise people's awareness about food through different educational and advertising approaches, providing a mechanism to label organic products and assessing the strengths and weaknesses of producing and distributing the organic products are provided as suggestions.

Keywords: Seemingly Unrelated Regression; organic agriculture; Mashhad

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Comparison of chemical inputs consumption in Saffron and wheat fields in Qaenat region

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A B S T R A C T

Commercialization of agricultural operations and use of pesticides and chemical fertilizers in agricultural production has been created serious environmental impacts. Due to this issue and in order to assess the amount of chemical fertilizer and pesticide inputs in saffron and wheat production systems, a study was conducted in Qaenat region (South Khorasan province), 50 wheat fields and 48 saffron fields were investigated during 2011-12. The results showed that average nitrogen fertilizer consumption was 222.38 and 57.83 kg.ha-1 in wheat and saffron production systems, respectively, which from sstatistically point of view the difference was significant. In addition, unlike wheat, the use of pesticides very low in saffron cultivation and in many saffron farms it was zero. Therefore, the results can be considered saffron is an healthier product and have greater potential to organic product. Also, the amounts of nitrogen, phosphorus and potassium fertilizers which were using in wheat in the study area were significantly different with recommended values. While in saffron production there was no significant difference between the values of consumed and recommended. Therefore, it seems, performing soil testing in each region and providing appropriate fertilizer formulas and required promotional-educational services in this regard, and raising public awareness is a good strategy for reducing the use of chemical inputs.

Keywords: Agricultural inputs; Sustainable Agriculture; Sustainability indicators

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Analysis the price transmission on Saffron market case study: Razavi, North and South Khorasan Provinces

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ABSTRACT

Asymmetric price transmission is instances of market imperfection which can affect consumers' welfare. Because of this matter, analyzing price transmission in agricultural market is an important issue. Saffron is a strategic agricultural commodity in Iran, which mostly produces in Razavi, North and South Khorasan provinces. In this study saffron's price behavior in these provinces has been investigated. First Johanson Co-integration and Engel-Granger test have been used to investigate long-run relation between monthly saffron's prices from 2006- 2011. Then, threshold Co-integration test has been used to examine whether price transmission is symmetric or asymmetric. Plus, Threshold Vector Error Correction model has been used to analysis short-run adjustment in saffron market in these provinces. Main results showed that saffron price transmission in Razavi, north and south khorasan is symmetric. The results show that the market price support policies can be helpful in the three provinces of saffron.

Keywords: Price transmission; Saffron; The error correction model; Threshold Co-integration

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Examination of integration and central market hypothesis for Saffron market in Khorasan Razavi, northern khorasan and southern khorasan

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A B S T R A C T

Saffron is one of the important agricultural product and North Khorasan, Razavi and South is considered as the major producers in Iran. In this study Central Market Hypothesis or price leadership has been examined. For this purpose Johanson Co-integration test for monthly price data since 2006 to 2011 for these provinces has been used. Main results indicated that South Khorasan is a price leader between these provinces. In addition, saffron market is unit in South Khorasan and Khorasan Razavi and the law of one price is indefeasible. Moreover, North Khorasan has a separate market and in long run saffron market in this province is not an impressible market. The adoption of a policy on each of the three provinces, affects the other two the product market provinces.

Keywords: Central Market; Continuity Market; Saffron; Co-integration

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Experimental study of the impact of foreign exchange rate fluctuations on Iran's Saffron export demand: A dynamic pooled mean group (PMG) approach

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A B S T R A C T

This study estimate the effect of exchange rate fluctuations on saffron export demand. To this end, the pooled mean group (PMG) approach is used in order to implement the model of auto regressive distributed lag model (ARDL) and vector error correction model (VECM) in the context of panel data. The results showed that, relative price of exports has a negative and significant effect on Iran's saffron export demand. In the short- and long-term, the estimated price elasticity suggests that Iranian saffron export demand is price inelastic. The results indicate that real income effect of importing countries on the export of Iranian saffron is positive. In the short-term, income importing countries has no significantly effect on Iranian saffron export demand, while the long-term effect is significant at the 0.01 level. In both short- and long-term, the results indicate that exchange rate has a significant, positive effect on Iran's saffron export demand. The exchange rate elasticity of export demand for Iran's saffron is elastic in both short- and long-term. Therefore, the devaluation of the Rial, Iran's currency, led to a significant increase in the export of Iranian saffron. Also, the results showed in the short-term, the unpredictability of exchange rate fluctuations lead to increase the degree of risk aversion of exporters of Iranian saffron and so they prefer to deal with this issue by reducing their export. However, in the long-term, the income effect dominates the substitution effect, and exchange rate fluctuations has a positive effect on the export of Iranian saffron by creating profit opportunities.

Keywords: International Trade; Exchange Rate Policies; Uncertainty

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Determining and ranking export goal markets of Iran's packaged Saffron

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A B S T R A C T

Considering the position of saffron in Iran's non-petroleum export basket, establishing proper export strategy through concentrating marketing activities in markets with high priority is inevitable. This study ranks export goal markets of different Iran's packaged saffron using annual data of 2010-2012. To this end, three approaches of numerical taxonomy, TOPSIS and weighted riddling were applied. Results revealed that priorities for exporting different saffron powder in 10 to 30 g packages include Spain, UAE and Italy, for saffron in less than 10 g packages these priorities include Saudi Arabia and Spain, for saffron in 10 to 30 g packages (tariff code 09102013) these priorities include UAE, Spain and Saudi Arabia. Numerical taxonomy approach showed that for different saffron powder in 10 to 30 g packages Saudi Arabia and Spain, saffron in less than 10 g packages Saudi Arabia and Spain, and for saffron in 10 to 30 g packages (tariff code 09102013) United Arab of Emirates, Spain and China are heterogeneous markets. Results of TOPSIS approach showed that for exporting different saffron powder in 10 to 30 g packages and saffron in less than 10 g packages Spain is the first priority and for saffron in 10 to 30 g packages (tariff code 09102013) United Arab of Emirates is the first priority. In weighted riddling approach according to the experts' viewpoints the weight of import demand index considered as 50% and the other indices weights equal 8.3%. Results of this approach revealed that for exporting different saffron powder in 10 to 30 g packages and saffron in less than 10 g packages Spain was the first priority. Also, for exporting saffron in 10 to 30 g packages (tariff code 09102013) United Arab of Emirates was the first priority. Based on these results, for ranking markets in order to export different packaged saffron, using weighted riddling and TOPSIS methods results and for ranking homogenous markets (considering used indices) applying numerical taxonomy results were advised.

Keywords: Numerical Taxonomy; TOPSIS; Weighted riddling; packaged saffron

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Investigating the Causes of Expansion of Saffron Cultivation in Temperate Mountain Areas of Golestan Province (Case Study: Vamenan Village)

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A B S T R A C T

One of the Iran's agricultural problems is the decrease in native products. The objective of this research is to study the reasons for cultivating saffron in the temperate mountainous regions of the Golestan province. Accordingly, the type of research is both applied and developmental and its methodology is descriptive-analytical. The field of research includes the farms of Vamenan village in the Azadshahr County. Its statistical society is 110 farmers who are experienced in saffron cultivation. Data was collected from the Census carried out through questionnaires, and was analyzed and interpreted by SPSS. The results have shown that, in comparison to other local products, saffron is more climatically resistant, in so far as 82.1% of farmers, in their prioritizations to cultivate agricultural products, have named saffron as the first one. This rate is usually low among other products. From the income indicator perspective, saffron cultivation income is more than the income from cultivation of other local products. To compare, saffron income is (92,372 thousand Rials), while for potatoes it is (5983 thousand Rials) and for cereals it is (9617.2 thousand Riyals). In addition, there is a meaningful relationship of 99% between people's interest to grow saffron and its economic conditions on the one hand and physiological features on the other hand. Lack of the necessary infrastructure and markets in the region, lack of drying machines, and shortage of labor are stated as the greatest obstacles to the development of saffron in the area. Therefore, obstacles in the development of saffron in the region are essential.

Keywords: economic conditions; Geographical factors; Culture barriers

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Study of the Effective Factors on the Commerce of Iranian Saffron

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A B S T R A C T

Considering the role of the foreign commerce in economic development of the country and the emphasis of economy planners to develop non-oil exports, and also to get released from the single-product economy, it is necessary to pay more attention to one product economy. Among the export products with substantial privilege, saffron is considered as an important product in the economy. This is because of its special position in the occupation of farmers in the agriculture sector and having a considerable exchange income for the country. The importance of saffron as a valuable export product in the country's economy and also in world economy becomes more obvious now. To keep Iran's position as the greatest producer and exporter of saffron in world markets and increase the export of this valuable product, a study of the problems of export and its effective factors could be an important step in this case. Therefore, this research studied the effective factors on saffron commerce in Iran during the period of 2001-2013. In this study, the gravity model and the method of economy measuring panel is used. The result showed that the gross internal production and the population of importing countries and exchange rate with coefficients: 1.55, 0.015, and 0.54 have positive and considerable effect on Iranian saffron.

Keywords: Gravity model; None-Oil Exports; Panel method; Saffron

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Efficiency of Saffron Farmers in Shahyk Region of Ghaen City, Iran (Application of Data Envelopment Analysis Using the Efficient and Inefficient Frontiers)

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A B S T R A C T

Addressing the special conditions of saffron growing areas, and planning the optimum use of its production factors need specific attention and determination of the efficiency of saffron farms seems to be necessary. Thus, the current study attempts to measure the efficiency of saffron fields by using bounded data envelopment analysis to give an overall assessment of the performance of the farms. The necessary data was collected by interviewing and filling 36 questionnaires by the saffron farmers of the city of Ghaen, Iran and the data were analyzed by GAMS software. The results showed that average optimistic output and input oriented efficiency is 1.259 and 0.849, respectively. Also, 13.8% of the farms are located on the inefficiency frontiers. 47 percent of the farms are surrounded by efficient and inefficient frontier that reflects the overuse of inputs and potential to produce more and reduce the use of inputs. According to the results, it may be suggested that the efficient farms should be considered as a pattern and we should present training of need assessment in inefficient farms in order to enhance farmers' efficiency with appropriate and scientific planning.

Keywords: Bounded data envelopment analysis model; Optimistic efficiency; Pessimistic efficiency; Saffron

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Comparison of Indicators of Technical and Economic Water Use Efficiency in Saffron and Wheat Production Systems in the Qaenat Region

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A B S T R A C T

The main objective of this research was to determine indicators of technical and economic water use efficiency in the cultivation of saffron and wheat in the Qaenat region located in the South Khorasan province in Iran), where 50 wheat farms and 48 saffron farms were investigated during 2011 and 2012. For this purpose, the necessary information about farmer's age and education, crop yield, the area under wheat and saffron cultivation, type of irrigation source, water flow rate and the number and duration of irrigation were collected by using a questionnaire. The results showed that the calculated indicator of water use efficiency was 0.84 and 0.34 kg.m-3 for wheat total biomass and grain and 0.36 and 0.002 kg.m-3 for saffron total biomass and stigma, respectively. Economic water use efficiency was estimated to be 23706.43 and 1836.89 Rials per cubic meter of water use in saffron and wheat production systems, respectively. There was a significant difference between the different ages of saffron farms for economic water use efficiency and the maximum value of this indicator was related to five-year old farms. Education of the farmers and the area under cultivation were identified as factors influencing the studied measures for wheat. Also, the results showed that there is a significant negative correlation between economic water use efficiency and soil salinity.

Keywords: Irrigation, Water used, Water Use Efficiency, Yield

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Effects of Cow Manure and Foliar Spraying on Agronomic Criteria and Yield of Saffron (*Crocus Sativus* L.) in a Six Year Old Farm

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ABSTRACT

Saffron (*Crocus sativus* L.) is the most expensive spice and 95% of its global production is in Iran. In order to study the effects of cow manure and foliar spraying on criteria of daughter corms and flower yield in six year-old saffron, an experiment was conducted based on a randomized complete block design with three replications at the Agricultural Research Station, Ferdowsi University of Mashhad during two growing seasons of 2013-2014 and 2014-2015. Treatments were Yaramilla complex (A), Humestar (B), True fertilizer (C), Delfard (D), manure fertilizer as composted cow manure (E), A+E, B+E, C+E, D+E and control. Twenty t.ha-1 of cow manure were applied at the end of fall on the soil surface. Foliar nutrient treatments were sprayed at three times during vegetative stage of saffron (7 mg.kg-1). The results showed that the effects of cow manure and foliar spraying were significant on dry weight of tunic, dry weight of leaf, dry weight of corm, leaf length, leaf appearance rate, flower emergence rate, flower number, fresh weight of flower and dry weight of stigma for saffron ($p \leq 0.01$). The highest leaf appearance rate and flower emergence rate were observed in C+E with 7.34 leaves per day and 11.7 flowers per day, respectively. The maximum fresh weight of flower and stigma dry weight were obtained in C+E with 69.77 and 0.66 g.m-2, respectively. These lowest amounts were obtained in control with 27.30 and 0.26 g.m-2, respectively. The application of cow manure resulted in enhanced growth and yield of corm and flower. Also, foliar spraying improved flowering rate, flower yield and stigma yield of saffron due to increasing in production assimilates and their translocation to corm and below ground organs.

Keywords: Foliar spraying; Organic manure; Flower emergence rate; Stigma weight

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Modeling the Factors Affecting the Promotion of the Share of R&T Units in Iran Export Agriculture Product's Added Value: Case Study of Saffron and Barberry

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A B S T R A C T

In this study we investigate the importance of agricultural sector research and technology organizations (RTO) in the national economic system. The main objective of the paper is to identify and rank the factors affecting the promotion of these RTOs share in saffron's added value. Through the literature review we extracted all the relevant factors that have been mentioned by different researchers. Then, we classified these factors into six components: applied research, technology acquisition, commercialization, market development, industry's internal factors and national macro factors. We used a Likert scale questionnaire to gather the data about the importance of each factor based on research and technology experts' points of view. To analyze the data we utilized confirmatory factor analysis and structural equation modeling (SEM) methods using SPSS and smart PLS software packages. The results show that the most important factor affecting the share of agricultural RTOs in a products added value is the promotion of industrial firms to invest in the field of agricultural research and development. Finally, according to the obtained results, some suggestions for improving research and technology have been provided.

Keywords: Agriculture; Innovation System; RTO; Value Added

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Identification and Prioritization of Marketing Mix Elements Affecting the Export of Saffron from the Perspective of Experts

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A B S T R A C T

The importance of saffron in the growth of non-oil exports makes it necessary to explain proper marketing systems based on expert priorities. The aim of this study is to identify and prioritize marketing mix elements influencing the increase in export of this product. In this regard, based on McCarthy's 4P model, different criteria for export marketing of this product were determined and prioritized using Analytical Hierarchy Process and interviews with 63 experts in the export of saffron. Based on the findings, product criteria with important sub criteria such as brands, the standard sign and packaging weighting 0.485, have the highest priority in saffron marketing. Promotion criteria (weight 0.281) are the next important in determining the marketing mix. Among the indicators of this criterion, advertisements (0.408), overseas sales (0.23) and specialized exhibitions (0.138) were the determining factors in maintaining Iran`s share of this market. Finally, the criteria of price (weight 0.183) and distribution (0.068) have third and fourth priority in saffron marketing mix. Accordingly, identifying distribution channels in target markets, funding the establishment of an international distribution network for Iranian brands, supporting mechanized production process of saffron, and encouraging and requiring manufacturers to food-grade and health license are required and recommended.

Keywords: Analytical Hierarchy Process; Saffron; marketing; 4P Model

Article 4, Volume 4, Issue 1, Spring 2016, Page 41-50

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Assessment of Saffron Farmers' Knowledge on the Issues Associated with Irrigation (Case Study: Southern Khorasan)

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A B S T R A C T

In spite of lots of work performed by saffron farmers in the Southern Khorasan province, a desirable yield has not been obtained which is partly attributed to the lack of scientific knowledge. This investigation is aimed to assess the indigenous knowledge of saffron farmers on the issues related to irrigation, and also to examine their strengths and weaknesses for taking effective steps to increase crop productivity. A questionnaire (researcher made) including 11 questions about the issues related to irrigation and 14 questions on general information and extensional items were randomly distributed to 235 subjects in the population of farmers of the Southern Khorasan province. The dependent variable was the score of the subjects for the correct answers. Statistical comparison between the levels of each of the independent variables (with significant effect) was undertaken by Tukey-Kramer test using the SAS software. The findings revealed that the groups of subjects participating in the extension courses who were either natives in the South Khorasan province, or had insuring their products answered a greater number of questions correctly with a significant level of 1%. However, the subjects living in the villages had more correct answers at a significance level of 5%. Overall, the results suggest that short-term and long-term programming are needed for the region's farmers to gain appropriate scientific knowledge about saffron planting.

Keywords: Cash crop; Irrigation; yield; Knowledge level; Observational research

Article 5, Volume 4, Issue 1, Spring 2016, Page 51-62

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Estimating Profit Efficiency of Saffron Cultivation in the Torbat Heydarieh County

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A B S T R A C T

In this study, profit efficiency and its influence factors were analyzed using stochastic frontier production approach and simultaneously estimating the behavioral profit model of saffron farms. For this purpose, information from 81 farmers that were interviewed randomly in 2014 was used. The results showed that the average profit efficiency of saffron farms was 61.4 percent and 51.3 percent of saffron farms have lower profit efficiency than 50 percent. Based on the results of the frontier profit function, pesticide costs have a negative effect on the profit of saffron farms and the cost of water, machine, labor cost, years of experience, farm size and participation in promoting class are positive and have a significant effect on profit efficiency. Based on the results of this study providing the necessary conditions along with easier and cheaper access to modern equipment and also encouraging farmers to use optimal allocation and reduce costs is an effective step to improve the profitability of saffron farms.

Keywords : Profitability; Behavioural profit; Stochastic frontier approach

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Investigating Financial Impacts of Cultivating Saffron on Rural Families with an Emphasis on Sustainable Agriculture (Case Study: Balavelayat Rural District, City of Bakharz)

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ABSTRACT

This study has been carried out with the goal of investigating the social and financial impacts of saffron on rural families. In this research, descriptive analysis has been implemented through field and library studies. The statistical population used were all the families of 13 villages in Balavelayat rural district in the city of Bakharz (=2908N) where 272 families were chosen randomly among the families there. To gather data, a questionnaire was designed and distributed in villages based on the number of the families there. The reliability of the questionnaire has been tested by professors in geography, rural planning and agricultural education. The reliability coefficient of the questionnaire has been estimated using SPSS software and its amount was found to be 0.81. The results of the research show that the environmental conditions of the region for cultivating saffron are suitable because the level of significance of each three variable was 0.000 which was less than 0.50. These variables include: "lack of water in the region and the fact that saffron needs low water", "proper soil conditions for saffron cultivation" and "suitable season for harvesting". Also the results of T-Test show that the level of significance for indices like human, saffron cultivation training and experience and local knowledge equals 0.000. Then the positive social-financial impacts of saffron cultivation on rural families have been proved, in such a way that saffron income in comparison with other agricultural products has a 0.000 level of significance and a high mean of 3 (3.38).

Keywords: Social Impacts; Financial Impacts; Sustainable Agriculture; Saffron; Bakharz City

Introduction

Saffron has been known since Antiquity as a remedy for all pains, without claiming to be a universal medicine, it is however a natural solution for many health problems in our times. Traditional knowledge can be used as a source for development of new medicines. A variety of properties of saffron including diuretic, analgesic, anti-inflammatory, hepatoprotective, appetite suppressant, hypnotic, antidepressant, and bronchodilator effects may forms some of these medical fields of study.

A summary of cardiovascular effects of saffron (Razavi et al., 2015).

Article 1, Volume 1, Issue 2, Winter 2014, Page 3-13

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Cardiovascular effects of Saffron and its active constituents: A review article

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ABSTRACT

(*Crocus sativus* L.) Commonly known as saffron, is a perennial stem less herb of the iridaceae family, widely cultivated in Iran and other countries. It is used as a flavoring and coloring agent for many thousands of years. In traditional medicine, saffron has been used for various purposes including abortion, as a fever reducer, an analgesic, expectorant, antispasmodic, aphrodisiac, sedative, digestive and a carminative. Various pharmacological studies have been described that saffron and its constituents exhibit different beneficial properties, including antioxidant, anticancer, anticonvulsant, antiischemic, antigenotoxic, antidote, antiapoptotic, antitussive, antidepressive, sedative and hypnotic, hypolipidemic, antinociceptive and antiinflammatory effects. Research projects have also revealed that saffron also exhibits protective effects against cardiovascular diseases including cardiac ischemia, arrhythmia, hypertension and atherosclerosis. In this review article, the effects of saffron and its active constituents on cardiovascular system were introduced.

***Keywords**: Crocus sativus* L; cardiovascular; Crocin; Crocetin; Saffron; Safranal

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Effects of Saffron supplementation on the cardio-respiratory endurance in the healthy inactive girls

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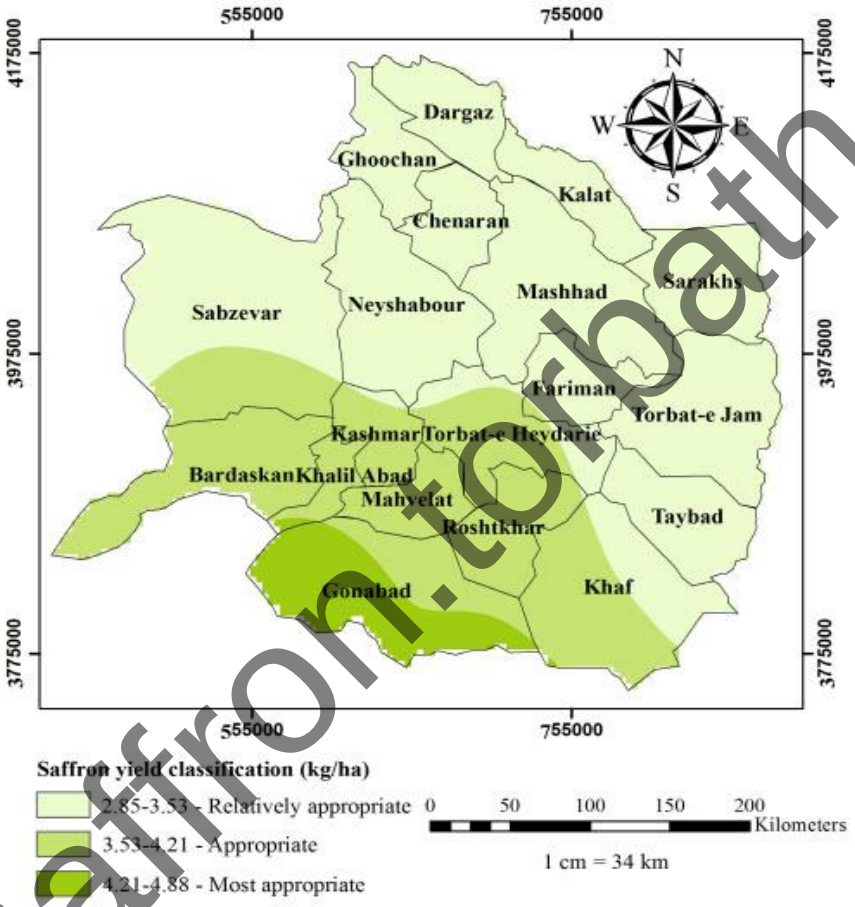
ABSTRACT

We aimed to investigate the effect of saffron supplementation on the cardio-respiratory endurance factors in the healthy non-active girls. After filling a health and fitness questionnaire and perform 1-mile run test, 14 non-active female students were selected among the eligible students in the University of Mohaghegh Ardabili (Age: 20.7±1.38 years; BMI: 21.1±1.8 kg/m2) and they performed Bruce test on a computerized treadmill connected to a respiratory gas analyzer in three stages with one week interval. In this study, test has been done on subjects in stage one after placebo consumption. In the second stage, similarly test done after one week consumption of dry saffron stigma (300 mg/day) and the results were measured. Analysis of Covariance and Bonferroni pair-wise comparison were used for the data analysis. Results showed that the consumption of 300 mg saffron for one week caused a significant enhancement in VO2, VO2max, and time to exhaustion and significant reduction in the resting blood pressure and resting heart rate as well as significant increase in fat oxidation and a significant reduction in carbohydrate consumption during the Bruce test ($p<0.05$). It seems saffron consumption has ergogenic effect on the cardio-respiratory performance in non-active female students.

Keywords: blood pressure; Gasometry; Saffron supplementation; Sport performance; VO2max

Introduction

Climate is one of the most important and effective factors in Saffron cultivation. Corm sprouting, flower initiation and time of flowering are the critical stages that are influenced by environmental fluctuations in terms of temperature and availability of water. Any change in the critical limit of climate conditions influences the growth of the saffron plant and finally the production of economic product. This make it necessery to study on the effects of climate change on saffron.



The actual zonation based on average of saffron yield during 20 years (Tosan et al., 2015).

Article 5, Volume 1, Issue 1, Autumn 2013, Page 71-95

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Possibility study of areas with potential cultivation of Saffron in Kashmar plain using GIS

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A B S T R A C T

Saffron as the most expensive agriculture and medicinal product of world, is a plant in Consider to aridity resistant has interesting role in social and economical status of arid and semi arid of southern and Razavi Khorasan provinces. The aim of this paper, is determining the suitable area in Saffron cultivation with regards to effective factors. The climatic elements data were obtain from Khorasan Razavi Meteorological Organization for 1989-2012 periods. The topographic data including; relief, slope, aspect and TIN layers extracts from 1: 50000 topographic maps of the region. The land use and vegetation land cover maps were prepared using 1: 50000 maps of National soil and water Research Institute. The spatial analysis facilities of GIS were used for numerical calculation and drawing the requiring maps. A spatial geo database from region was established then spatial and description data entered on this database. Using by AHP software each layer weighted by its importance. Finally, by overlaying analysis in ArcGIS, cultivated area were classified by its capabilities .The results showed that Central and Southern Kashmar plain are the best capabilities for Saffron cultivation that in present statues, these lands specified to dry farming, irrigated farming, semi condense and condense rangelands.

Keywords: Climatologic and Environmental factors; Geographic Information System (GIS); Kashmar; Saffron; Zoning

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Effect of climatic factors affecting Saffron using analytic hierarchy process(AHP); (Case Study Roshtkhar Region, Iran)

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A B S T R A C T

The present paper aimed to determine the criteria for understanding climate and ranking factors influencing saffron and assess its impact on Roshtkhoar city of Khorasan Razavi province. The city of Roshtkhar has potential for increasing saffron cultivation; therefore, the main hypothesis during the research was, which climatic factors had the most influence on the cultivation of saffron in the city Roshtkhar. The research methodology was based on a period of ten years cross-sectional data collected from meteorological stations in the studied area. In this study, with taking into account of climatic factors affecting the cultivation of saffron, Analytical Hierarchy Process (AHP) method was used to prioritize rural and regional municipalities Roshtkhar cultivated land. Research process included data collection, analysis, statistical analysis, data entry software Expert choice, clustering and selection criteria, and integrating information. The results showed that, among environmental factors, precipitation index (0.281) and temperature coefficient (0.137) had the greatest impact in saffron cultivation. Water resources and evaporation of water had the lowest score in the survey accounted. In the municipalities of the city, Hossein-Abad districts had favorable conditions for growing saffron.

Keywords: Saffron; Climatic factor& element; Multi-criteria decision making; Ranking; Expert choice

Article 4, Volume 2, Issue 4, Winter 2015, Page 277-288

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Analysis of Effects and Factors Influencing on Increasing the Cropping Pattern of Saffron in the City of Nishapur; Case study: Ishaq Abad district

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A B S T R A C T

Selected appropriate cropping patterns, especially high-value crops such as saffron, shows that the pattern of cultivation of these crops can facilitate the achievement of the objectives of rural development programs. In recent years, saffron cultivation considerably has been increased in parts of the city of Nishapur like Isaac Abad district which altered the pattern of crop cultivation from onion to saffron cultivation. The purpose of this study was to identify factors that influence the development pattern of saffron, and the economic and social consequences of the mentioned districts. This study was conducted based on library information and field collected data. A random sampling method was used. The sample size was calculated using Cochran equation, the number of calculated samples were 220 Isaac Abad district saffron grower. Data was analyzed by Pierson Correlation methods. The results showed that geographical factor and attractions in the consumer market were the most important factors in the spread pattern of saffron cultivation in the region. In order to maintain the local potential is also planning to expand the crop pattern deserves more attention to geographical factors.
Keywords: Effects of economic and social; Geographic factors; Market attractions

Article 1, Volume 3, Issue 1, Spring 2015, Page 1-12

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Evaluation of yield and identifying potential regions for Saffron (*Crocus sativus* L.) cultivation in Khorasan Razavi province according to temperature parameters

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A B S T R A C T

Saffron is cultivated in most part of Iran, because of low water requirement and well adaptation to diverse environmental condition. In recent years, for many reasons such as low water requirement, saffron cultivation areas has been increased especially in Khorasan Razavi province. Temperature is one of the most important factors in saffron flowering phenomena. The aim of this research was to evaluate the response of saffron to temperature in Khorasan Razavi province counties (Torbat-e-Heydarieh, Gonabad, Nishabour, Sabzevar and Ghoochan). Climatic data (monthly minimum, average, maximum temperatures and diurnal temperature range) and saffron yield data were collected for past 20 years period. The stepwise regression methods were used to remove extra parameters and only keep the most important ones. By using these equations and ArcGIS software zoning, Spline method was find the best for saffron crop zoning. The results of linear regression in Gonabad showed that minimum, maximum and average temperature and also diurnal temperature range in March and April months had the greatest impact on saffron yield. For each of the four indices (the minimum, maximum and average temperature and also diurnal temperature range) the best area for saffron cultivation was the southern part of the province (particularly Gonabad); so by increasing distance from this area to north areas (such as Kashmar, Torbat-e-Heydarieh, Sabzevar, Nishabour, Mashhad and finally Ghoochan) saffron yield reduced by 30 to 50 percent. Therefore, the northern areas of the province had relatively low saffron yield. According to result of this research, saffron yield in Khorasan Razavi province was significantly influenced by temperature parameters. Flowering which basically is the most important stage of plant growth, is directly setting up with temperature.

Keywords: Climate; Regression; Saffron yield; temperature; Zoning

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The estimation of phenological thresholds of Saffron cultivation in Isfahan province based on the daily temperature statistics

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A B S T R A C T

In this research, the statistics of daily temperature of meteorology stations for estimating the probable occurrence of the first and last frost temperature, the phonological thresholds of saffron and its flowering and irrigation dates were explored. Furthermore, by applying different methods, the probabilities of the attained dates in different probability levels were fit in Smada software. The estimated probability level of 95 percent, as the optimum date, was donated for the entire Isfahan province in ArcGIS9/3 software environment using the interpolation method of Cokriging. The time of occurrence of minimum temperatures is under the influence of the geographical and height condition of each region and the first fall season frost occurs in high regions of the eastern half of Isfahan province at the beginning of November and in the low-lying eastern regions in the late December. The occurrence of daily temperature is changeable from the first half of October and the second half of November. From the west to the east of Isfahan, the time of occurrence of this threshold has a delay of about one month. The optimum flowering date of saffron, based on climatic conditions, is from the first half of October to the late of November. By considering the flowering date and daily temperature requirement of saffron, the irrigation date prior to flowering continues from the second half of September in the western parts and the beginning of November in the eastern regions. From the perspective of thermal condition, the western, central, northern and eastern parts of Isfahan province are more suited to the cultivation and development of saffron product. The amount of water requirement in the study area based on evapotranspiration and crop coefficients of saffron occurred in the mid-season, late season and Initial.

Keywords: Climate condition; Growth degree days; Minimum Temperature; Saffron; Water requirement

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The effects of meteorological factors (rainfall, temperature, relative humidity, freezing days and sunny hours) on yield of Saffron (*Crocus sativus* L.) in Kashmar and Ghaenat Towns

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ABSTRACT

In this study parameters of daily and monthly rainfall, minimum, average and maximum temperatures, relative humidity, number of sunny hours and number of freezing days in the towns of Kashmar and Ghaen were analyzed for a statistical period of 20 agricultural years (1992-2011). Several traditional methods of climate classification were used to compare climate conditions of Ghaen and Kashmar towns by climate determining software. Then effective meteorological indicators on saffron cultivation were selected. Results of climate classification by traditional methods showed that these towns are located in the same climate class. Although the climate was similar, but studies showed that saffron quality in color, odor and taste in Ghaen was higher than Kashmar. The Maximum temperature and relative humidity were the same in both towns. Relative humidity in both towns was the same, especially in October and November which coincided with the beginning of saffron flowering time. Minimum temperature and sunny hours made climate conditions of Ghaen at more favorable for saffron because of mountainous nature. Sunny hours in Ghaen during flowering season was more than Kashmar. Finally, a slight difference in three climate parameters, i.e. rainfall during summer, temperature and sunny hours cannot be the only reason for lower quality of saffron in Kashmar in comparison to Ghaen and saffron quality in Kashmar could be highly raised by other factors such as better planning and management.

Keywords: Agricultural Climate; Quality; Saffron

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Evaluation of Adaptability of Different Cultivated Ecotypes of Saffron Under Maragheh Climatic Conditions

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A B S T R A C T

In order to evaluate the adaptability of saffron ecotypes under Maragheh climatic conditions, an experiment was conducted based on a Randomized Complete Block design (RCBD) with three replications during the growing seasons of 2013 and 2014. The ecotypes used were Bardaskan, Abrud, Sabzevar, Bonab1, Torbat-e-Heydarieh, Bonab2, Marand1, Marand2, Kashmar, Taybad, Esfiukh and Mahvelat. The following traits were evaluated: fresh weight of stigma, dry weight of stigma, length of stigma, emergence percentage, emergence rate, flowering percentage, flowering rate, dry and fresh weight of flowers and dry yield of stigma in the area. The results showed that the ecotypes established very well in the first year of the experiment, but frosty days of the winter severely damaged Abrud, Taybad and Esfiukh ecotypes. There were significant differences among the ecotypes for the traits: the number of flowers, emergence, flowering percent and fresh weight of saffron. Also, a significant difference was recorded among the studied ecotypes for flowering and emergence rate. The highest emergence percentage was observed in Marand 2, while Sabzevar had the highest rate of flowering and flowering percentage. Despite the low yields for Marand1 and Sabzevar in the first year of the experiment, these ecotypes with 1.5 and 1.4 kg per hectare produced the high stigma yields, respectively in the second year. In conclusion, the results showed that the ecotypes of Marand are suitable for cultivate in the Maragheh climate conditions and the use of exotic corms is not recommended.

***Keywords**: Adaptability*, *Corm*, *Flowering percentage*, *Stigma yield*

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Predicting Yield and Water Use Efficiency in Saffron Using Models of Artificial Neural Network Based on Climate Factors and Water

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A B S T R A C T

The predicted models for crops yield are developing rapidly by the creation of new statistical techniques and neural networks. For this purpose, a research was carried out in the Torbat-e-Heydarieh region for predicting yield and water use efficiency of saffron by using an artificial neural network model. The model was calibrated and validated by using crop yield and climate parameters data during 2009-2010. The models were evaluated by using indices of correlation coefficient (R2), root mean squares error normalized (RMSEn), and mean squares error (MSE). The results showed that the suggested neural network (model No. 9) with having 2 hidden layers, 8 neurons, and R2= 0.97 (for saffron yield); and 1 hidden layer, 7 neurons, and R2= 0.90 (for water use efficiency) had a high accommodation with these two factors. Also, according to the indices RMSEn and MSE, model No. 9 simulated the yield and WUE of saffron with a high accuracy, such that RMSEn and MSE for yield in this model obtained were 2.78% and 0.0041, respectively; and for WUE they were calculated to be 5.41% and 0.0073, respectively. Also, the results of sensitivity analysis indicated that irrigation is the most important parameter for predicting yield and WUE, and after that is precipitation and solar radiation. Generally, use of the suggested neural network in this research can improve saffron cultivation in the Torbat-e-Heydarieh region.

Keywords: Model; Simulation; Stigma; Torbat-e-Heydarieh

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Climate and Agriculture Tourism in the City of Ghaen

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A B S T R A C T

Climate is an important factor in the development of industrial tourism. The group travels to heal with climate. Elevation, moderate temperature and suitability of landscape are factors that are required to consider as conditions for tourism. There are some benefit such as center of cultivating barberry and saffron, a moderate climate and being located in transportation axis of east of Iran in the city of Ghaen that make it have a in high potential to absorb tourists. A review of climate convenience with bioclimatic indices such as W-strain and W_Sens shows that the first month of the spring and autumn in Ghaen, the climate is suitable for travelling, especially for the beautiful landscapes of barberry and saffron. Therefore, combining the moderate climatic and the beautiful landscapes of barberry and saffron can provide good conditions for agriculture tourism. Saffron tourism master span is the accurate and reasonable title in areas where the crop is grown, and studied. It is also a tourist profile. In this study, using the ecological indicators of climate such as severe weather, heat stress, cooling power of wind during the 22 years in Ghaen station. Bioklima software was used to investigate the climate comfort. This city provides such a situation that in the first months of spring and autumn, weather conditions are fit for tourists and for recreation and travel. Especially, the early autumn harvest of saffron in the city plus the beautiful scenery can attract travelers. So, combining the two factors of moderate climate and harvest of Saffron work hand in hand to attract tourism. Therefore, these two factors combined (a moderate climate and harvesting saffron) create beautiful scenes and can provide conditions for the development of agricultural tourism.

Keywords: Agricultural tourism; Bioclimatic indices; Climatic comfort

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Determining Suitable Places for Saffron Planting Using Fuzzy Hierarchical Analysis Process in the City of Torbat Heydarieh

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A B S T R A C T

The city of Torbat Heydarieh located in the central Khorasan is the largest producer of saffron in the world. According to the influence of various environmental factors on the growth and yield of saffron, the process of assessing land ratio for its cultivation requires the use of various detailed spatial and descriptive pieces of information. In this study, first the conditions of cultivating saffron have been studied in detail and suitable regions for planting saffron have been identified using maps of elevation, slope, soil characteristics, water and some climatic factors influencing the cultivation of saffron including effective threshold temperature, rainfall and sunshine hours. For this purpose, Fuzzy Analytical Hierarchy Process (FAHP) method was applied and modeling and spatial analysis were carried out using Arc GIS software environment based on the lands of the city of Torbat Heydarieh which were evaluated for their suitability for cultivation of saffron. It is worth noting that the final map showed that 43 percent of the central parts of Torbat Heydarieh have the highest potential for saffron cultivation. To evaluate the results and ensure the accuracy of the final map data, plant functions and crop qualities were compared with obtained data from final maps and the accuracy of the results was confirmed that shows the effectiveness of Fuzzy Analytical Hierarchy Process (FAHP) method in assessing the potential of lands for saffron cultivation.

Keywords: Earth facts; FAHP; GIS; Zoning

V

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VO2max; Volume 2, Issue 3, 2014

W

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