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ORIGINAL ARTICLE

The evaluation of time of corms lifting(Harvesting) and foliar nutriton on some morphological and chemical yield of saffron (*Crocus sativus* L.)

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Arsham Safipouriyan, Hosain Amir Shekari, Tayebe Rajabian, Hosain Fotokian; The evaluation of time of corms lifting(Harvesting) and foliar nutriton on some morphological and chemical yield of saffron (*Crocus sativus* L.)

ABSTRACT

For studying the effects of the time of corms lifting(Harvesting) and foliar nutriton on some morphological yield and chemical yield of the saffron (*Crocus sativus* L.) an split plat–experiment with complete randomized block design, was performed in three replication. The experiment was carried out in the Shahed university medical plant field and laboratory. The treatment of experience was existed in four levels consist of Dates of corm lifting(April 19th,may 5th ,may 20th,September 8th) as sub factor and four levels of foliar nutriton density(blank(pure water),5%,7%.9%) as a main factor consist of different. The results showed that in level of 9% of foliar nutriton the stigma has the most percent of humidity and in level of 7% of foliar nutriton we have seen the most crocin and picrocrocin content in stigmas .the most content of safranal and maximum stigma height was in level of 5% foliar nutrition, maximum dry corm weight was in the levels of 7% and 9% of foliar nutrition and in corm lifting time , September8th has the most effects in studied qualifications.

Key words: corm lifting, crocin, foliar nutriton, picrocrocin Saffron, safranal, yield.

Introduction

The flowers of saffron (*Crocus sativus* L.), a plant from the family Iridaceae, possess red-orange tripartite stigmas[12]. This triploid sterile monocot species is not known to grow in the wild, but has been cultivated for its stigma for a long time[12]. It is highly valued as a culinary spice for its flavouring and colouring properties, and is the subject of ongoing scientific research for its potential medicinal properties[12]. Interest in the impact of saffron carotenoids on human health is growing due to their high antioxidant capacity[1,11,13]. Saffron is one of the worldrs most expensive spices, [9]. Most percent of which this produced in IRAN[9]. It is sterile and dose not set viable seed, therefore the crop must be propagated by corm multiplication[8]. The saffron flowers in autumn shortly after planting, before, together with or after leaf appearance[8]. The remainder of its growing season consist of initiation, filling and maturation of the doghter corms at the beginning of summer[8]. Each corm only lasts as

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single season and is replace by 1 to 10 cormlet depending of the orginal mother corm[8]. One of the cultivation care proseures applied to increase productivity during saffron production are using big size mother corm and extanding harvest period[5]. For earn big size corm, foliar nutrition can effective [2]. Flower yield and yield of saffron is highly dependent on corm density and corm size[2]. The month of February-March is very important in saffron because the cormlets growth was complete[8]. In this stage the cormlets stem was very smalla and cormlets pending on there leafes for nutrition, until bigining sleep stage in end of spring[8]. Foliar nutrition in this time is effective on corm size and flowering of saffron determination[8,4].

The quality of saffron is dependent on its coloring power (crocin concentration), odour (safranal) and taste (picrocrocin)[8].

This study was carried out in order to determine. The evaluation of time of corms lifting and foliar nutriton on some morphological and chemical yield of saffron(*Crocus sativus* L.).

Materials and methods

Stigma collection

The experiments were conducted on *Crocus* stigmas grown under corm harvesting time and foliar nutrition during 2008, 2010. After preparation of farm Bunches of two or tree corms are planted 10-15 cm apart and the distance between the rows is about 25 cm. we did not use herbicides and saffron flowers in autumn. The flowers on each experimental plot were picked by hand at approximately the same time of day (from 6 to 7 am). Methods for removal of the stigma from flowers and drying conditions were kept identical. Stigmas were brought indoors where they were separated by hand shortly after collecting in the field, and were dried, in shade, for 8–10 days. Afterward, stigmas were weighed for yield determinations and analyzed for quality.

Experimental conditions

For studying the effects of the time of corms lifting and foliar nutriton on some morphological and chemical yield of the saffron (*Crocus sativus* L.) an split plat-experiment with complete randomized block design, was performed in three replication.

The experiment was carried out in the Shahed universiry medical plant field and laboratory.

The treatment of experience was existed in four levels consist of Dates of corm lifting(April 19th, may 5th, may 20th, September 8th) as sub factor and four levels of solution density (blank (pure water), 5%, 7%, 9%) as a main factor consist of different.

Three replicates were used. Sets of three corms are planted at a distance of 10 cm within rows. The planting depth is about 15 cm. Sowing density is about 3.5 tons of corms/ha. About 20–30 tons/ha of farm manure were applied during the ploughing. Afterward, manure is applied at a rate of 30 tons/ha after the crop establishment. Irrigation was initiated during the first week of September and applied every 15 days until the flowering period. Two to 3 more irrigations were added till the end of the saffron cycle depending on rainfall. Weeds are controlled by hand. Soil properties analyses were done at the experimental sites.

Sample preparation

Saffron stigma were placed in a Pyrex 100 mm × 50 mm glass dish and cut using a razor blade to "grind" the saffron as evenly as possible. Ground plant material was removed by using a spatula and paintbrush into pre-weighed 20 mL scintillation vials. Approximately 50–60 mg of each saffron sample was weighed in a 25 mL volumetric flask for extraction.

Determination of the main saffron characteristics using UV–vis spectrometric method

Saffron samples were analyzed according to the ISO 3632 trade standard[7]. This method allows the determination of the main characteristics of saffron related with picrocrocin, safranal and crocins content. Higher amount of these components means higher quality of saffron. According to ISO, picrocrocin, safranal and crocins are expressed as direct reading of the absorbance of 1% aqueous solution of dried saffron at 257, 330 and 440 respectively. 440 nm (maximum absorbance of crocrocin); $E_{1CM1\%}$ 330 nm: absorbance at about (maximum absorbance of safranal); t 257 nm (maximum absorbance of icrocrocin);

Where $E_{1CM1\%}$.=(D*10000) / (m*(100-H). the mass of the saffron sample, in grams; *H* is the moisture and volatile content of the sample, expressed as a mass fraction.

Moisture and volatile contents were identified by using powdered saffron stigmas. The sample were ground with a pestle and mortar and passed through a 0.5 mm mesh. After weighing, the powdered samples, they were introduced uncovered in an oven set at 103 °C for16 h. The moisture and volatile matter content are expressed as a percentage of the initial sample using the following relation: (initial mass – constant mass)/initial mass) × 100.

The reported values are the average values of three replicates. The material used for analysis is a Shimadzu (Tokyo, Japan) UV 310 PC, UV–visible–NIR Scanning spectrophotometer.

Statistical analysis

Data for all experiments were analyzed using a SAS (r) 9.1 (2007) (SAS Institute INC, Cary, NC, USA) statistical software package and Genstat Release 10.2, copyright 2007 (PC/Windows) (Law Agricultural Trust, Rothamsted Experimental Station). Statistical analysis was performed using one-way ANOVA followed by Duncan's Multiple Range Test (DMRT) for multiple comparisons. The *p*-values less than 0.05 were considered statistically significant.

Results and discussion

Moisture and Volatile Content of S Stigma

The statistical analysis show harvesting time of corm and foliar nutrition was affected on moisture and volatile content of stigma on(P≥0/05) (Table1). and in treatment of 9% of foliar nutrition maximum efficacy was registered (Table2) .September 8th in harvesting corm time was showed the most moisture and volatile content and it has linear correlation between moisture content of stigma and stigma hight (Table5).

$E_{1CM1\%}$ 440 nm: absorbance at about 440 nm (maximum absorbance of crocin)

Total statistical analysis show different in harvesting time , foliar nutrition and interaction effect on(P≥0/01) (Table1). The result showed that treatment of 7% in foliar nutrition was the most affected on crocin and testimonial treatment (pure water) was showed the least content. (Table2) and in harvesting time the September 8th we could seen most crocin (Table3) The table of Interaction showed to us that in April 19th and may 20th in all treatment of foliar nutriation were more affected than

The testimonial treatment,and in September 8th foliar nutrition treatment in content of 7% and9% show the most crocin. (Table4) and it has linear correlation between crocin and dry corm weigh, stigma hight, safrana (Table5).

$E_{1CM1\%}$ 257 nm: absorbance at about 257 nm (maximum absorbance of picrocrocin)

Total statistical analysis show different in harvesting time and corm,foliar nutrition and interaction effect on(P≥0/01) (Table1).

The result showed that treatment of7% in foliar nutrition was the most affected on picrocrocin (Table2) and in harvesting time the September 8th been the best treatment (Table3) the result of Interaction table showed to us that in April 20th and foliar tutrition in 5% and 9% we have the most picrocrocin . in may 5th all foliar nutrition treatment were more than testimonial treatment.in may 20th treatment of 7% of foliar nutrition show the most content of picrocrocin. And in September 8th in 7% and9% of foliar nutrition we could obtained best effect.(Table4) and it has linear correlation between picrocrocin, stigma hight,dry weght corm and safranal (Table5).

$E_{1CM1\%}$ 330 nm: absorbance at about 330 nm (maximum absorbance of safranal)

Total statistical analysis show different in harvesting time and corm,foliar nutrition and interaction effect on(P≥0/01) (Table1).

In foliar nutrition in 5% was the most affected on safranal content (Table2). and in harvesting time of corm September 8th was the best time(Table3). the result of Interaction table showed to us that in April 20th the treatment of 5% of foliar nutrition and in may 5th the7% of foliar nutrition in may 20th and September 8th the5%,7%,9% of foliar nutrition we have had the most content of safranal and it has linear correlation between safranal, stigma hight, dry corm wieght

Hight of stigma.

Total statistical analysis show different in harvesting time of corm,foliar nutrition and intraction effect on(P≥0/01) (Table1) in level of 5% of foliar nutrition the maximum of high in stigma of saffron was seen.(Tabla2).in harvesting time of corm in September 8th maximum of high was seen.(Table3). the result of interaction dose not show different but in time of may 5th the level of 9% of foliar nutrition and September 8th the level of 7% and 9% of foliar was affected on stigma hight.(Table4) and it has linear correlation between stigma hight and dry corm weigh.

Total statistical analysis show different in harvesting time of corm,foliar nutrition and interaction effect on(P≥0/01) (Table1).

The maximum weight of corm was seen in level of 7% and 9% of foliar nutrition and in September 8th in corm harvesting time.(Table2,3) and it has linear correlation between dry corm weight and stigma hight (Table5).

The result of Interaction show that April 19th and may 5th and may 20th the maxmum weigh was obtained in 9% of foliar nutrition and in September 8th all treatment of foliar nutrition were more than the blank level.

Soil properties analyses

30-60	0-30	Soil depth cm
Characteristics		
SANDY LOM	**SANDY LOM**	Soil texture
4.34	2.17	EC
7.6	7.8	pH
0.23	0.34	O.C%
0.026	0.037	N%
2.8	3.2	P.p.m
110	150	K. p.p.m

Table 1: Analysis of variance The evaluation of time of corms lifting(harvesting) and foliar nutriton on some morphological and chemical yield of saffron (*Crocus sativus* L.)

Source	df	Mean square					
		moisture of stigma(%)	$E_{1cm1\%}$ 440	$E_{1cm1\%}$ 257	$E_{1cm1\%}$ 330	Stigma height	dry corm Weight
Rep	2	0.07	2.1	0.22	0.66	0.019	0.176 ^{ns}
Foliar nutrition	2	0.318*	49.33**	167.37**	272.82**	0.194**	6.3**
Ra	6	0.061	1.49	1.65	1.29	0.061	0.049 ^{ns}
Harvesting corm time	3	0.32*	69.26**	276.36**	340.59**	0.708**	133.44**
Interaction	9	0.31 ^{ns}	8.38**	14.78**	23.06**	0.013 ^{ns}	1.76**
ERROR	24	0.09	1.28	0.65	0.89	0.55	0.213
c.v	-	3.47	0.44	1.02	3.03	5.65	10.21

n.s.: non-significant. *$P > 0.05$. ** $P > 0.01$.

Table 2: Evaluation of different foliar nutrition level on some morphological and chemical yield of saffron (*Crocus sativus* L.)

Treatment (Foliar nutrition)	Mean					
	moisture of stigma(%)	$E_{1cm1\%}$ 440	$E_{1cm1\%}$ 257	$E_{1cm1\%}$ 330	Stigma height(mm)	dry corm Weight (gr)
Control	8.15 ^{b}	250.8 ^{c}	73.5 ^{c}	2.1 ^{c}	2.4 ^{b}	^{b} 3.81
5 %	8.27 ^{b}	253.8 ^{b}	80.1 ^{b}	34.3 ^{a}	2.7 ^{a}	^{b} 4
7%	8.23 ^{b}	255.3 ^{a}	81.2 ^{b}	33.3 ^{ab}	2.7 ^{a}	^{a} 5
9%	8.53 ^{a}	254.8 ^{ab}	80.8 ^{ab}	32.8 ^{b}	2.7 ^{a}	^{a} 5.2

a Means in each column followed by the same letter are not significantly different ($P < 0.05$).

Table 3: Evaluation of different corms lifting(harvesting)time on some morphological and chemical yield of saffron (*Crocus sativus* L.)

Treatment (corm harvestig time)	Mean					
	moisture of stigma(%)	$E_{1cm1\%}$ 440	$E_{1cm1\%}$ 257	$E_{1cm1\%}$ 330	Stigma height(mm)	dry corm Weight (gr)
April 19th	8.1 ^{b}	252.1 ^{c}	75.5 ^{c}	^{d} 26.4	2.5 ^{b}	^{d} 1.58
may 5th	8.3 ^{ab}	252.3 ^{bc}	75.5 ^{c}	^{c} 28.2	2.5 ^{b}	^{c} 2.75
may 20th	8.2 ^{ab}	253.1 ^{b}	78.8 ^{b}	31.7 ^{b}	2.5 ^{b}	^{b} 4.61
September 8th	8.5 ^{a}	257.2 ^{a}	85.7 ^{a}	38.5 ^{a}	3.02 ^{a}	^{a} 9.16

a Means in each column followed by the same letter are not significantly different ($P < 0.05$).

Table 4: Analysis of Interaction The evaluation of time of corms lifting(harvesting) and foliar nutriton on some morphological and chemical yield of saffron (*Crocus sativus* L.)

Corm harvesting time	Foliar nutrition	moisture of stigma(%)	$E_{1cm1\%}$ 440	$E_{1cm1\%}$ 257	$E_{1cm1\%}$ 330	Stigma height	dry corm Weight
April 19th	0	7.96 a	69.13 c	19.46 c	2.33 a	2.33 a	1.33 b
	5	8.03 a	78.66 a	32.83 a	2.6 a	2.6 a	1.36 b
	7	8.1 a	75.86 b	27.73 b	2.53 a	2.53 a	1.7 ab
	9	8.3 a	78.7 a	32.83 b	2.6 a	2.6 a	1.93 a
may 5th	0	8.36 a	69.8 b	20.43 c	2.4 b	2.4 b	2.3 c
	5	8.4 a	76.7 a	29.76 b	2.56 ab	2.56 ab	2.66 cb
	7	8.06 a	77.4 a	31.66 a	2.56 ab	2.56 ab	2.83 ab
	9	8.46 a	78.4 a	31.03 ab	2.6 a	2.6 a	3.2 a
may 20th	0	8.23 b	71.23 c	20.86 b	2.4 a	2.4 a	2.93 c
	5	8.06 b	79.7 b	35.2 a	2.63 a	2.63 a	3.5 c
	7	8.1 b	83.7 a	a56/35	2.73 a	2.73 a	5.2 b
	9	8.7 a	79.73 b	35.3 a	2.53 a	2.53 a	6.76 a
September 8th	0	8.06 b	84.03 b	35.76 b	2.76 b	2.76 b	8.7 b
	5	8.6 a	84.66 b	39.4 a	3.03 ab	3.03 ab	8.5 b
	7	8.6 a	87.83 a	39.46 a	3.2 a	3.2 a	10.23 a
	9	8.6 a	86.53 a	39.43 a	3.1 a	3.1 a	9.23 ab

Table 5: Correlation evaluation of time of corms lifting(harvesting) and foliar nutriton on some morphological and chemical yield of saffron (*Crocus sativus* L.)

	moisture of stigma(%)	$E_{1cm1\%}$ 440	$E_{1cm1\%}$ 257	$E_{1cm1\%}$ 330	Stigma height	dry corm Weight
moisture of stigma(%)	1					
$E_{1cm1\%}$ 440	0.84 ^{ns}	1				
$E_{1cm1\%}$ 257	0. 82 ^{ns}	0.96**	1			
$E_{1cm\ 1\%}$ 330	0.88 ^{ns}	0.97*	0.98*	1		
Stigma height	0. 83 ^{ns}	0.99**	0.97*	0.96 ^{ns}	1	
dry corm Weight	0.89 ^{ns}	0.97*	0.98*	0.99**	0.96*	1

n.s.: non-significant. *P > 0.05. ** P > 0.01.

Conclusions

Use of manure have an important effect in saffron yield[3]. The maxmum yield in irridase was obtained when use of manure[6]. Behdani et al found a linear correlation between application yield and manure application and they also found that 67% of yield variations were attributed to fertilizers[4]. harvesting time effect and use of manure on corm size is effect on flowering. Our experiment show that foliar nutrition is effective on some yield of qualitve an quantative yield of saffron(*Crocus sativus* L.).for obtain more colur in saffron we can use 7% foliar nutrition and the taste of saffron is increase with increase of level of foliar treatment.the sffranal is on level 5% of foliar nutrition was the best.and increase of foliar nutrition have no effect on it. the best time for corm harvesting in this experiment were September 8th becuse the corms in that time on the best situation and subsequence in implant and maintenance of corms reduce the yield.the corm that was weghty and in big corm dimension has an important role on stigma production of saffron, [5,10].

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