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Original Article:

The Effect of Maternal Corm Weight and Planting Depth on Flower Yield and Daughter Corm of Saffron (*Crocus sativus* L.) in Sari Plain

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Extended Abstract

Introduction: Saffron (C*rocus sativus* L.) is a perennial plant and geophyte, triploid and belongs to the family of Iridaceae .One of the most important factors that has a great effect on the final performance is the size of corm. Therefore, in order to obtain large corms, it is very important to create suitable environmental and management conditions. Determining the appropriate planting depth is also one of the ways to improve the performance of saffron per unit area. The purpose of this research is to investigate different sizes of saffron corms and planting depth on the yield of daughter corms of different sizes, flower and dry stigma of saffron in the conditions of Sari plain.

Materials and Methods: The present study was conducted to investigate the effect of different weights of mother corms and different planting depths on corm production and saffron yield in a factorial experiment based on a randomized complete block design and in three replications in the research farm of Sari Agricultural Sciences and Natural Resources University during the growing season 2019-2020. The experimental treatments included three corm sizes: weight group; small 4±2 g, medium 10±2 g and large 15±2 g and two planting depths of 10 and 15 cm. The studied traits included: the number and yield of daughter corms, the number of buds, the number and yield of flowers and the yield of dry saffron stigma. Data analysis and graphs were done using SAS 9.0, Excel 2016 and Sigma Plot 12.0 software, respectively, and comparison of average data with the help of LSD test at 5% probability level.

Results and Discussion: The trend of temperature changes as well as the investigation of the phenological events of saffron in the study area showed that at the beginning of the growing season and in the middle of autumn, the emergence of leaves is observed along with the emergence of reproductive organs (fig.1); This factor is probably related to the temperature fluctuations at the beginning of the plant's growing season (Table 1), and on the other hand,

due to the allocation of the stock of mother corms to the leaves, it ultimately reduces flowering and stigma yield. The results showed that the highest number of daughter tubers and the total yield of daughter corms with 485 corm/ m^2 and 2435.3 g/m^2, respectively, were related to the treatment of large mother corm; however, no significant difference was observed between these traits in two planting depths for large corm (Table 2). The lowest total yield of daughter corms related to the treatment of planting small mother corms at a depth of 10 cm was equal to 1488.7 corm/ m^{-2}. The average weight of daughter corms produced in this experiment (between 4.72 and 5.37 g) was about twice more than the amount produced in dry areas (Moallem Banhangi et al. 2019, Moein Rad et al., 2018. Razavian et al. 2019, Sharifi et al. 2021 & Esmi et al. 2019).

Conclusion: According to the results obtained in this experiment and also taking into account the texture of the field soil under test, the depth of 15 cm is more suitable than the depth of 10 cm for the production of corm with the desired size. But there is a possibility that in areas and lands with heavier soil, especially in the conditions of Mazandaran plain, which has abundant rainfall and poor drainage in some areas, shallower planting (10 cm deep) is better than deeper planting. It created more favorable conditions for root growth. Because the shallow planting depth, while creating drainage and better exit of excess water from the environment around the root and stem, provides a better growing environment for the growth of this plant. Therefore, according to the mentioned cases and the climatic features of the Sari plain, for better productivity of agricultural land in autumn and winter, saffron cultivation should be done annually and with priority to produce high-quality seeds and use these seeds in saffron-rich areas or conditions Aviation can be considered.

Conflict of Interest : Authors declared no conflict of interest.

Keywords: Annual cultivation, Flower and stigma weight, Lateral buds, Vegetative growth.

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Table 1. Soil analysis of farm in Sari city

pH	EC (dS/m)	O.M %	O.C %	N %	Available phosphorus (mg/kg)	Available potassium (mg/kg)	(Texture)		
							%Sand	%Silt	%Clay
							Sandy loam		
7.5	0.8	2.58	1.5	0.15	12.70	170.33	52	30	18

Table 2. Meteorological data of the experimental area during the one-year saffron growth period

Year	Month	Average temperature(° C)			Average of monthly relative humidity (%)	Total monthly rainfall (mm)
		Monthly min.	Monthly max.	Monthly average		
2019	September	20.6	29.4	25.0	74	45.0
	October	16.8	27.0	21.9	76	80.6
	November	11.3	19.8	15.5	78	228.4
	December	6.4	15.8	11.1	78	28.0
	January	5.5	15.3	10.4	76	44.9
	February	3.8	15.5	9.7	70	129.2
	March	7.3	16.5	11.5	78	103.4
2020	April	9.8	18.2	14.0	77	80.8
	May	14.8	25.0	19.9	76	33.4
	June	20.3	31.7	26.0	69	4.0
	July	22.9	32.6	27.7	69	16.6
	August	23.5	31.6	27.5	73	39.2
	September	20.8	30.8	25.8	70	32.8
	October	15.9	25.9	20.9	72	31.6
	November	12.3	22.2	17.3	76	44.0

Source: Meteorological Organization of Mazandaran Province

Table 3. Date of occurrence of some important morphological development events of saffron in Sari plain

Date of emergence	Date of onset of vegetative growth (leaf growth)	Flowering date	The end of flowering	The beginning of yellowing leaves	Full yellowing of leaves	Growth period length
24 OCT	Simultaneously with reproductive growth	13 NOV	6 DEC	22 MAR	14 APR	173

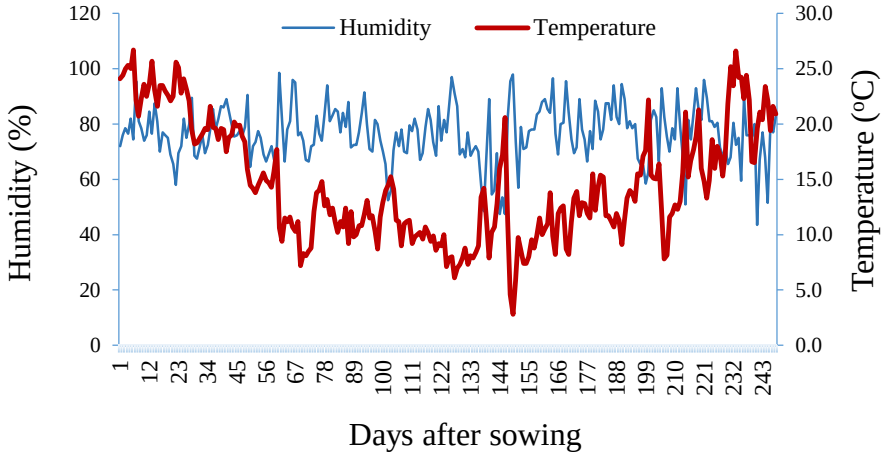

Fig 1. Trend of temperature and humidity during saffron growing season in Sari 2019-2020.

Table 4. Variance analysis (mean of squares) of the number of saffron daughter corms in different sizes

Source of variation	df	Daughter corms number < 4 g	Daughter corms number between 4 to 8 g	Daughter corms number between 8 to 15 g	Daughter corms number > 15 g	Total number of daughter corms
Replication	2	227.7 ns	10.5 ns	9.286 ns	0.02 ns	437.48 *
Corm size	2	15721 **	1495**	1805.7 **	254.3 **	48624.9 **
Planting depth	1	440.1 *	1618.8**	343.2 **	50.67 **	1265 **
Planting depth * Corm size	2	19.49ns	267.36*	1.58 ns	2.347 ns	307.5**
Error	10	57.26	54	15.85	3.82	32.96
CV (%)		3.6	6.5	8.8	7.9	1.5

**, * and ns are significant at the 0.01 and 0.05 probability levels and no significant, respectively.

Table 5. Variance analysis (mean of squares) related to yield of saffron daughter corms

Source of variation	df	Daughter corms yield < 4 g	Daughter corms yield between 4 to 8 g	Daughter corms yield between 8 to 15 g	Daughter corms yield > 15 g	Yield of daughter corms	Average weight of daughter corm
Replication	2	673.27 ns	92.69 ns	4.54 ns	3.99 ns	1235.5 ns	0.043 ns
Corm size	2	144551**	3297.1**	63910 **	73546 **	115577**	0.012 ns
Planting depth	1	7341 **	5208**	9311 **	12762 **	2664.5 ns	0.517 **
Planting depth* Corm size	2	2735.43*	701.7*	34.54 ns	558.22 ns	7832.6*	0.217 **
Error	10	438.2	160.5	93.14	969.01	1072	0.014
CV (%)		4.3	2.2	2.13	7.87	1.6	2.34

**, * and ns are significant at the 0.01 and 0.05 probability levels and no significant, respectively.

Table 6. Variance analysis (mean of squares) related to reproductive traits of saffron

Source of variation	df	Flower number	Average weight of each fresh flower	Flower fresh weight	Stigma dry weight
Replication	2	7.28 ns	0.0001 ns	1.089 ns	0.0001 ns
Corm size	2	1785 **	0.0003 **	219.1**	0.02 **
Planting depth	1	194.1 **	0.0003 *	28.7 **	0.005 **
Planting depth* Corm size	2	5.6 ns	0.0001 ns	1.51 ns	0.001 ns
Error	10	9.75	0.0003	1.16	0.00002
CV (%)		8	1.6	8.05	8.1

**, * and ns are significant at the 0.01 and 0.05 probability levels and no significant, respectively.

Table 7. Mean comparisons for the effect of mother corm size and planting depth on saffron corms number and yield

Treatments	Daughter corms number < 4 g (No.m^{-2})	Daughter corms number between 8 to 15 g (No.m^{-2})	Daughter corms number > 15 g (No.m^{-2})	Daughter corms yield between 8 to 15 g (g.m^{-2})	Daughter corms yield > 15 g (g.m^{-2})
Mother corm size (g)					
4±2	160.133 c	27.15 c	18.15 c	349.9 c	286.75 c
10±2	197 533 b	47.83 c	24.8 b	451 b	390.4 b
15±2	261.4 a	61.62 a	31.2 a	556.38 a	508 a
Planting depth (cm)					
10	201.4 b	41.17 a	23.05 b	429.71 b	368.4 b
15	211.3 a	49.9 a	26.41 a	475.2 a	421.7 a

Similar letters in each column indicate no significant difference based on LSD test in 0.05 probability level.

Table 8. Mean comparisons for the effect of mother corm weight and planting depth on some traits of saffron flowering

Treatments	Flower number ($No.m^{-2}$)	Average weight of each fresh flower (g)	Flower fresh weight ($g.m^{-2}$)	Stigma dry weight ($g.m^{-2}$)
Mother corm size (g)				
4±2	22.17 c	0.3300 c	7.31 c	0.15 c
10±2	39.02 b	0.3417 ab	13.32 b	0.21 b
15±2	56.67 a	0.3433 a	19.39 a	0.39 a
Planting depth (cm)				
10	36.0 b	0.3344 b	12.08 b	0.23 b
15	42.56 a	0.3422 a	14.6 a	0.31 a

Similar letters in each column indicate no significant difference based on LSD test in 0.05 probability level.

Table 9. Mean comparisons for the effect of corm weight × planting depth interaction on some criteria of saffron

Treatments		Number of daughter corms ($No.m^{-2}$)	Yield of daughter corms ($g.m^{-2}$)	Daughter corms number between 4 to 8 g	Daughter corms yield between 4 to 8 g ($g.m^{-2}$)	Daughter corms yield < 4 g ($g.m^{-2}$)	Average weight of daughter corm (g)
Corm size	Planting depth						
4±2 g	10	295.5 e	1488.7 d	90.73 c	514.3 d	369.9 d	5.37 a
	15	315.6 d	1586.1 c	91 c	518.1 d	381.9 d	4.72 d
10±2 g	10	362.9 c	1895.3 b	109.53 b	531.3 d	513 c	5.29 ab
	15	392 b	1918.1 b	123.4 a	570.6 c	532.7 c	4.84 de
15±2 g	10	483.9 a	2388.1 a	127.5 a	644.8 b	641.5 b	4.94 cd
	15	485 a	2435.3 a	133.17 a	677.3 a	731 a	5.02 bc

Similar letters in each column indicate no significant difference based on LSD test in 0.05 probability level.

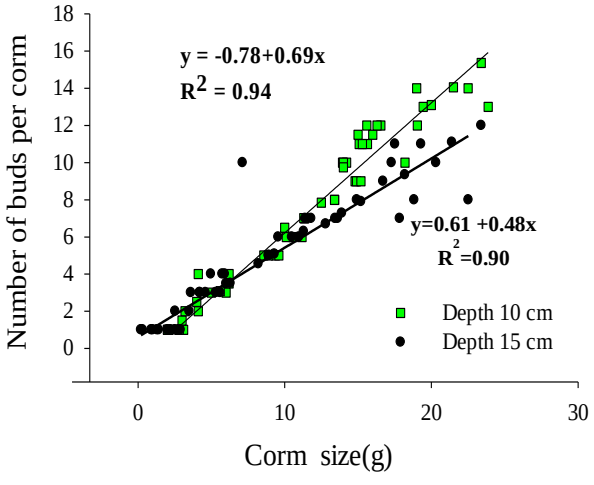

Fig 2. The relationship between the corm size and the number of buds per corm at different planting depths in the Sari plain region

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