Effect of Corm Weight on Saffron Production in Saudi Arabia

Mahmoud Sharaf-Eldin[1,2], José-Antonio Fernandez[3], Abdulrahman Al-Khedhairi[1] and Elsayed Ahmed Elsayed[*4,5]

[1] Salman bin Abdulaziz University (SAU), College of Science and Humanities, P.O. Box 83, 11942 Alkharj, Saudi Arabia
[2] National Research Centre (NRC), Department of Medicinal and Aromatic Plants Research, 33 Elbehooth St., 12622 Cairo, Egypt
[3] University of Castilla-La Mancha, School of Agronomy (ETSIA) & Group of Biotechnology (IDR), Campus Universitario s/n, 02071 Albacete, Spain
[4] King Saud University, College of Science, Zoology Department, P.O. Box 2455, 11451 Riyadh, Saudi Arabia
[5] National Research Centre, Department of Natural & Microbial Products, 33 Elbehooth St., 12622 Cairo, Egypt
[*]eaelsayed@ksu.edu.sa

Abstract: Saudi Arabia is one of the highest consuming countries for saffron spice. In year 2009; the price for one kg of saffron spice in the local market reached 18,000 SR (˜US$ 5,000). We report, for the first time, the cultivation of saffron in the Kingdom of Saudi Arabia (KSA), in particular at Alkharj Governorate. The effect of corm weight on saffron production was investigated under Alkharj governorate cultivation conditions. Corms of *Crocus sativus* L. (Iridaceae) of Spanish origin (accession #: BCU001584 from Minaya, Albacete, Spain) were provided by Professor J.A. Fernández (Albacete, Spain). Three different corm weights (fresh weight) as CW1: >10g, CW2: ≥5g - ≤10g and CW3: <5g were studied. The higher weight of saffron corms increased the number of leaves per corm. The maximum mean values of leaf length were obtained as a result of lesser weight of saffron corms weighing <5g. The highest number of sprouts was observed with the use of saffron corms weighing >10g. None of the three corm weights produced saffron flowers, which might be due to the late planting in December, while the flowering period is mainly in November. Daughter corms have been produced by the three different corm weights. The higher weight of saffron mother corms increased the number of daughter corms, up to three daughter corms per mother corm were produced by the end of May.
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1. Introduction

Saffron (*Crocus sativus*) is the most expensive spice in the world belonging to the Iridaceae family. Saffron plant is a perennial, herbaceous and stemless crop. Its purple flowers appearing as the first organ in autumn are bisexual and have six colored tepals. Traditionally, saffron was used since ancient time as a spice and food additive due to its colorant (crocin), flavour (picrocrocin), and aroma (safranal) and it is also used in the cosmetic preparation and colouring industries (Schmidt et al., 2007). Moreover, it has many medicinal properties, and nowadays, there has been a growing interest in its anti-carcinogenic compounds (Nair et al., 1991; Abdullaev et al., 2002). Saffron has been used in the traditional medicine for centuries (Fernández, 2004). Recently, saffron attracted the scientists to discover this herb's value for its cytotoxic, anti-carcinogenic and anti-tumour properties (Abdullaev 2002; Abdullaev and Espinosa-Aguirre 2004; Fernández 2004; Magesh et al., 2006; Chryssanthi et al., 2009; Dalezis et al., 2009).

The flowers include three stigmas with three anthers. The dried stigma is the edible part of saffron plant (saffron spice). Its leaves which usually appear after flowers are narrow and protracted (length reaching 30-40 cm). The corms are compact and round. The outer layer of uncovered corms has 7-8 horizontal circles, which are the nodes of underground stem. Depending on corm weight, each corm includes 1-4 apical bud(s) which are the origins of flower and leaves. Between horizontal lines of corms, there are many small brown spots, which are the origins of daughter corms. Saffron propagation is done by these daughter corms which originated from the main corm (so called mother corm). The size of the corm varies between 1-20 g/corm. Flowering occurs in a limited period which takes about 2-3 weeks and the contribution of each corm to produce flowers, depending on corm size, varies between 1-4 flowers/corm. Accordingly, the corms should have a threshold age to be capable to produce flowers and to increase the total number of flowers.

Different research groups have studied the effect of corm weight and size on the production of flowers in many ornamental plants such as narcissus, lily and tulip. Kaushal et al. (2002) reported that both the production of daughter corms and the yield of

flowers were dependent on the size of the mother corms planted.

In spite of the wide range of properties of this plant, no agronomical studies have yet been conducted in Saudi Arabia to explore the horticultural practices that may affect the yield and the active constituents. Therefore, in this study, the effect of corm weight on saffron production in Saudi Arabia was investigated.

2. Material and Methods

To study the effect of corm weight on saffron production in KSA, the experiment was conducted during 2009 to 2010 and 2010 to 2011, at the premises of the College of Science and Humanities, Salman bin Abdulaziz University, Alkharj (24° 15′ N, 47° 30′ E), Saudi Arabia. Corms of *Crocus sativus* L. (Iridaceae) of Spanish origin (accession #: BCU001584 from Minaya, Albacete, Spain) were provided by Professor J.-A. Fernández (Biotechnology IDR, University of Castilla-La Mancha, Albacete, Spain). For this purpose, the corms were sown at Dec. 2009 and 2010. All needed agricultural practices were applied to provide unstressed conditions. To study the effects of corm weight on saffron production, a wide range of corm weights (fresh weight) were sown as follows: CW1: >10g, CW2: ≥5g - ≤10g and CW3: <5g. To provide weight ranges the corms were screened precisely and weighted using a two digits balance (Figure 1).

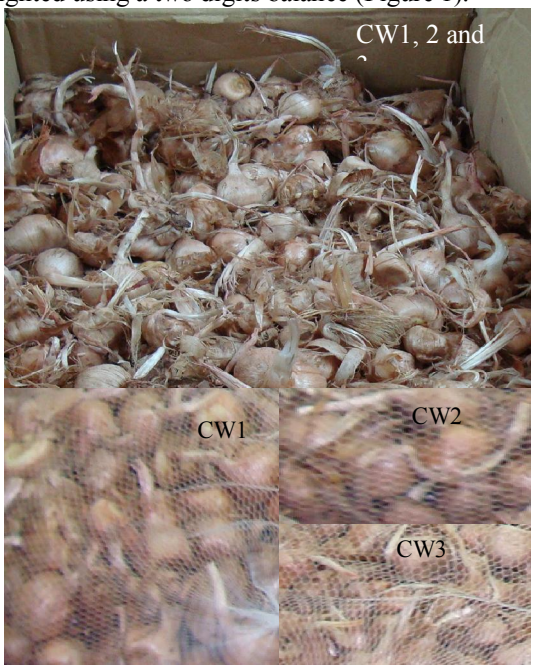

Figure 1. Weight of the mother corms as follows; CW1: >10g, CW2: ≥5g - ≤10g and CW3: <5g.

In addition to the number of daughter corms, the number of leaves as well as the number of sprouts of the corms was recorded three months post sowing during the two successive seasons. Finally the relationships of corm weight with flower number were studied. The experimental design was planned in the complete randomized block design. The combined data were statistically analyzed according to the procedure of Snedecor and Cochran (1980), where the means of the studied treatments were compared using L.S.D. test at 0.05 significance level.

3. Results and Discussion

There is virtually no unified information on the best saffron mother corm weight which is suitable for the production of the optimal number of daughter corms. For saffron, the data in Table 1 shows that, the highest number of daughter corms production was observed in mother corms weighing above 10g. This was followed by the corms weighing from ≥5g to ≤10g. The lowest number of daughter corms produced per mother corm was recorded when the corms weighing <5g were planted. Additionally, the same trends were observed from the plants sown in the second season. However, slight differences in the values have been observed, as shown in Table 1. The saffron mother corm weight rates had significant effects on all growth parameters considered (Table 1). The growth increased with increasing the initial mother corm weight, but did not increase the leaf length. The longest leaf length value was obtained by the mother corms weighing <5g. The second longest leaf resulted from the mother corms weighing from ≥5 to ≤10g. On the other hand, the shortest leaf length was obtained by the mother corms weighing >10g (Figure 2). Again, the same trends were observed for the results concerning corms sown in the second season, but with slight differences in their corresponding values as shown in Table 1.

The number of sprouts per corm resulting from mother corms weighing <5g was significantly lower than those in the case of other mother corms. The heavier the mother corms, the more the number of sprouts produced per corm. The same trends were observed in the second season, but with slight differences in the values as shown in Table 1. Additionally, significant increase in the number of leaves has been observed for mother corms weighing >10g (Table 1). However, mother corms with less than 5g showed a substantial decrease the in number of leaves. Midst number of leaves per mother corm was observed in corms weighing ≥5 to ≤10g.

Table 1. Effect of corm weight on saffron growth and daughter corms production.

Mother corm weight (g)	No. of leaves/corm	Leaf length (cm)	No. of sprouts/corm	No. of daughter corms
Year 2009				
>10	10.3[a]	16.4[c]	2.0[a]	2.1[a]
≥5 - ≤10	7.6[b]	20.1[b]	1.3[b]	1.4[b]
<5	4.6[c]	23.2[a]	1.0[c]	1.1[c]
LSD 5%	0.75	2.4	1.1	1.1
Year 2010				
>10	11.5[a]	17.3[c]	2.3[a]	2.4[a]
≥5 - ≤10	8.8[b]	21.0[b]	1.6[b]	1.7[b]
<5	5.8[c]	24.1[a]	1.3[c]	1.4[c]
LSD 5%	1.77	3.3	1.4	1.4

Values followed by the same letter within a column are not significantly different (P = 0.05)

This study reveals that, the initial corm weight has a crucial effect on the production of daughter corms. The data in Table 1 shows that none of the three corm weights produced saffron flowers, which may be attributed to the late plantation in December, while the flowering period is mainly in November. Accordingly, we can conclude that in order to reduce the sowing costs, it is better to select the corms with the proper weight. Kaushal et al. (2002) and Marzi (1996) showed that the yield of flowers was dependent on the size of the mother corms. Other researchers evaluated saffron flowering based on corm diameter. Therefore, to link the results of the present work with the findings by Munshi et al. (2003), the correlation between corm diameter and corm weight should be investigated.

Figure 2. Different growth stages of saffron plant grown at Alkharj governorate.

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Corresponding Author:
Dr. Elsayed Ahmed Elsayed
Department of Zoology
College of Science, King Saud University
Saudi Arabia
E-Mail: eaelsayed@ksu.edu.sa

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