



Najaf, new Saffron homeland

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Abstract

Since its foundation, the International Energy and Environment Foundation (IEEF) interested in improving the situation of the environment in Iraq, where it has several projects and activities in this regard. Among these pilot projects, comes agriculture and indigenization of saffron plant project in Najaf, Iraq. Saffron is a spice derived from the flower of *Crocus Sativus*, commonly known as the saffron crocus. *Crocus* is a genus in the family Iridaceae. This project is implemented in two stages: The first stage: Pioneering Agriculture: where is planting limited area and under inspection for the purpose of follow-up agricultural conditions and took the basic data for the stages of plant growth. The second stage: Production Agriculture: where is planting large areas and productive quantities. This project is an important achievement, which is the first of its kind in Iraq in general and in the holy city of Najaf, in particular, where large tracts of land will be invested to cultivate this important and useful plant, and in addition to its commercial benefits, it will contribute stabilize the topsoil and preservation of erosion and improve the climate in the adjacent areas.

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1. Introduction

Crocus sativus, commonly known as saffron crocus, is a species of flowering plant of the *Crocus* genus in the Iridaceae family. It is best known for the spice saffron, which is produced from parts of the plant's flowers. The cormous autumn-flowering perennial plant species is unknown in the wild. Human cultivation and use of saffron spans more than 3,500 years [1, 2] and spans cultures, continents, and civilizations. Saffron, a spice derived from the dried stigmas of the saffron crocus (*Crocus sativus*), has through history remained among the world's most costly substances.

With its bitter taste, hay-like fragrance, and slight metallic notes, the apocarotenoid-rich saffron has been used as a seasoning, fragrance, dye, and medicine. *Crocus sativus*, unknown as a wild plant, is considered to be a mutant that has derived from *C. cartwrightianus*. The cultivated clone was probably selected for its triploid vigour and extra long stigmas and has been maintained in cultivation for over 3000 years. The saffron crocus (*Crocus sativus* L.) is sterile and does not set viable seed. Therefore, the crop must be propagated by corm multiplication. The saffron crocus flowers in autumn shortly after planting, before, together with or after leaf appearance. The remainder of its growing season consists of initiation, filling up, and maturation of the daughter corms at the beginning of summer. Each corm only lasts a single season and is replaced by 1 to 10 cormlets, depending on the original size of the mother corm [3].

Corms are globular and depressed, up to 4.5 cm in diameter and covered with a tunic of parallel fibres. Corms are dormant during the summer and produce 5 to 11 erect, narrow, grass-like green leaves, up to

40 cm long, that emerge in autumn. Flowers are fragrant, up to 8 cm long, and usually pale lilac or mauve with darker coloured veins. The outstanding feature of the flower is its style, which divides into three brilliant red stigmas 25-30 mm long [3].

Saffron is native to the moderate environment, characterised by cool to cold winters, with autumn-winter spring rainfall, and warm dry summers with very little rainfall. It can withstand substantial frosts (-10°C), and can tolerate occasional snow in the winter [3].

Flower yield is highly dependent on corm density and corm size. Traditionally, saffron is grown on raised beds to allow good drainage and easy access for picking. Corms are planted out during their dormant period in summer. The best yields for flower and corm production are obtained by leaving a space of 2-3 cm between each corm in the furrow, with a planting depth of 8-10 cm. Optimal corm quantity per hectare is 13-15 tons, which is about 600-700 thousand corms with an average weight of 20-22 g each (45-48 corms/kg) [3].

Recommended planting depths for corms vary from 7.5-10 cm to 15-22 cm. Planting depth affects corm production; more buds sprout from shallow planted corms than from deep planted ones, resulting in more daughter corms. Corm size has a significant effect on the production of daughter corms and on the production of flowers and the yield of saffron. The larger the mother corm, the more daughter corms will be produced in the annual cycle, which increases the potential for higher yields in subsequent years. New saffron corms also grow above the old ones each season, so they creep towards the soil surface by 1-2 cm each year. Therefore, the crop needs to be lifted and replanted periodically. This occurs about every 4 years in Spain, but fields may last up to 12 years or more under non-irrigated conditions in Kashmir. Replanting is normally done when yields begin to fall due to overcrowding or damage to corms that are too close to the soil surface [3].

In traditional saffron culture, large amounts of farm yard manure were applied to the saffron fields before planting, and typically 20-30 tons per hectare are incorporated during cultivation. This material supplies nutrients, but its other major role is to improve soil moisture holding capacity and structure under nonirrigated conditions. Under traditional growing systems no further fertiliser was applied after corm planting. However, recent data suggest that at least some annual fertiliser applications are beneficial and a base dressing of 80 kg P/ha and 30 kg K/ha followed by a split application of 20 kg N/ha in autumn and again immediately after flowering is recommended [3].

Saffron flowers in the autumn, about 40 days after planting, and continues for 30-40 days, depending on the weather. The flowering period of each plant may last up to 15 days. Rain 10-15 days before flower picking results in excellent flowering and high production, whereas under drought conditions, small flowers with small stigmas can be expected. A cold period or a late planting can retard flowering [3].

Flowers are usually picked daily in the morning after the dew has evaporated but before flowers wither. The flower is cut at the base of the flower stem with a slight twisting movement or by cutting with the finger nail. Care is taken not to damage the leaves [3].

Following the separation of the stigmas from the flowers, it is essential to dry the flower heads immediately. Brightness of colour is aided by quick high temperature drying. Slow drying gives a poor quality product. A final dry matter close to 10% moisture is adequate for long-term storage [3].

The quality of saffron is dependent on its colouring power (crocin concentration), odour (safranal) and taste (picrocrocin). The best quality saffron has a high safranal content. Saffron is dry, glossy and greasy to the touch when freshly dried, turning dull and brittle with age. It is easily bleached if not stored in the dark, and also stores better under conditions of low temperature and low relative humidity. An International Standard for saffron is available (ISO3632-1:1993). Saffron in filaments is classified into four categories based on the content of floral waste and extraneous matter, with category 1 (extra) having a maximum of 0.5% floral waste and 0.1% extraneous matter. Category 1 has the highest bitterness (as expressed in the absorbance test for picrocrocin), and the highest colouring test (as expressed in the absorbance test for crocin). Safranal levels, also based on an absorbance test, have a range for all grade categories.

2. Description of the study area

Najaf is one of the sacred cities of Iraq. The Najaf area is located 30 km south of the ancient city of Babylon and 400 km north of the ancient Biblical city of Ur. It is located on the edge of western plateau of Iraq, at southwest of Baghdad the capital city of Iraq, with 160 km far from the capital. It is raised upon sea level with almost 70 meters, and is situated on the longitude of 19 degree and 44 minutes, as well as on the latitude of 31 degree and 59 minutes [4].

3. Indigenization of saffron plant project

This project is implemented in two stages: The first stage: Pioneering Agriculture: where is planting limited area and under inspection for the purpose of follow-up agricultural conditions and took the basic data for the stages of plant growth. The second stage: Production Agriculture: where is planting large areas and productive quantities. Ten stations have been elected in ten districts in Najaf city as shown in Figure1. The weather data for the city has been recorded during the year 2014 as shown in Figures 2-8.

4. Results

The cluster that have been planted in the experimental stations, shown in Figure 9. After four weeks, about 85% of planted clusters have been grown up, where the vegetative growth complete. Figure 10 shows the vegetative part of the saffron, grass like leaves. Within the four to six weeks, growing of the vegetative part of the plants, few of flowers have been witnessed in some of stations. Figure 11 shows the saffron crocus flowers. Within 2-4 days of flower growth, the red threads of the flower were harvested (picked) and dried then stored, as shown in Figure 12.

5. Recommendations

- 1- The preliminary results obtained from the first stage of the project, were very encouraging, therefore the second stage it is believed to be an encouraging and productive.
- 2- The availability of suitable climate with accepted range of minimum/maximum temperature degree and humidity in addition to suitable soil type, make the investment of large tracts of land in saffron planting, feasible.
- 3- In order to protect the saffron fields from the effects of extreme weather conditions, it would be appropriate that the saffron fields are under tall trees such as palm and citrus trees, as well as the corms should be cultivation about 15-20 cm deep in the soil.

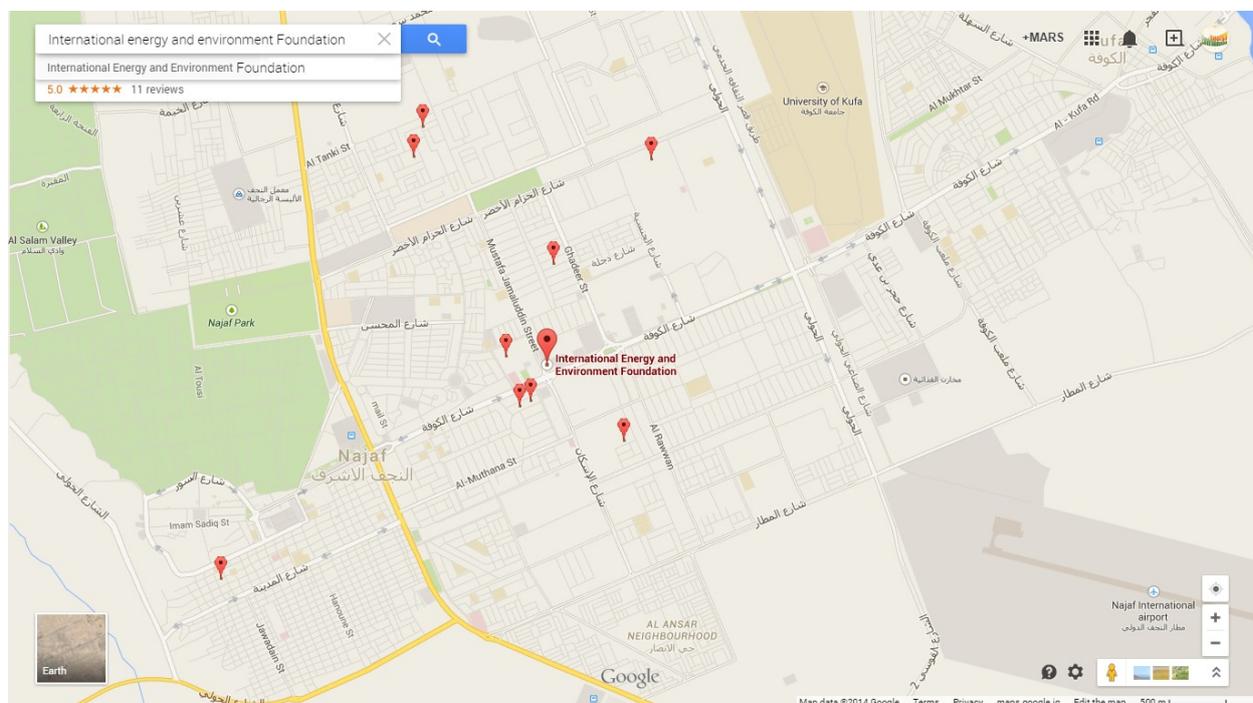


Figure 1. Satellite image of Najaf city explain the locations of the planting areas of Saffron [Google earth, 2014].

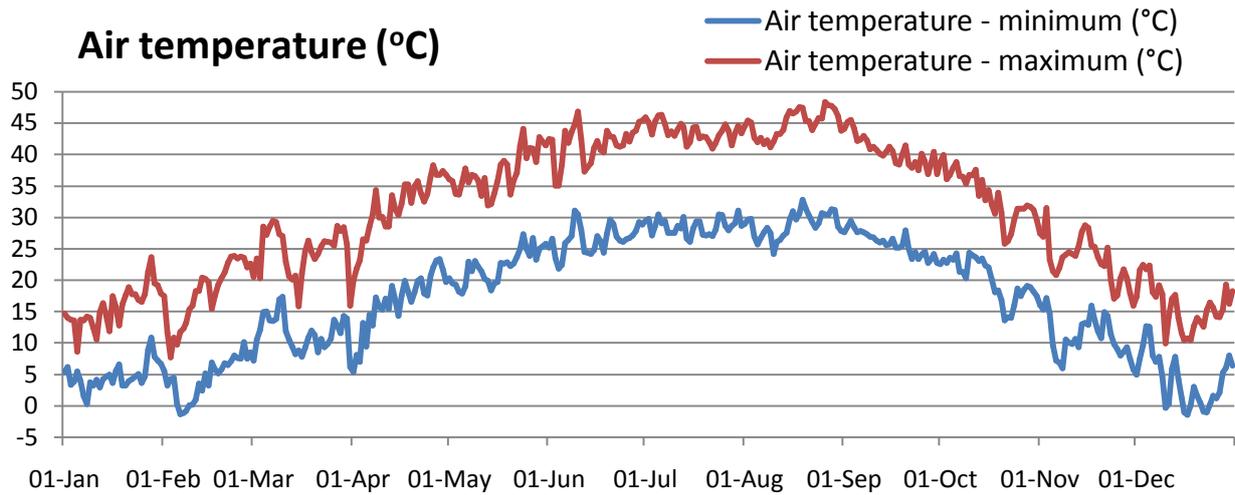


Figure 2. Maximum and minimum air temperature in Najaf city during 2014.

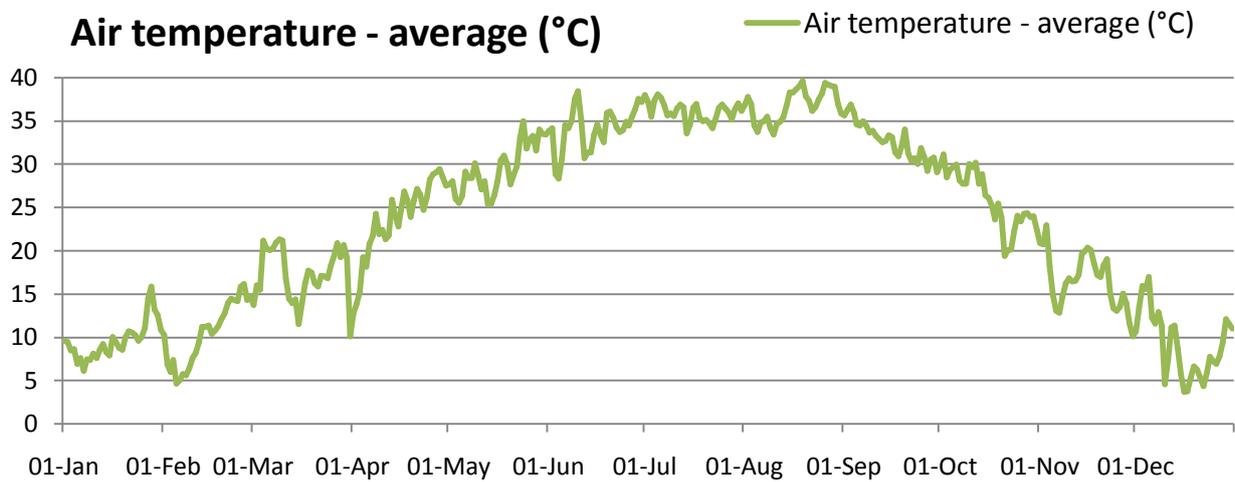


Figure 3. Average air temperature in Najaf city during 2014.

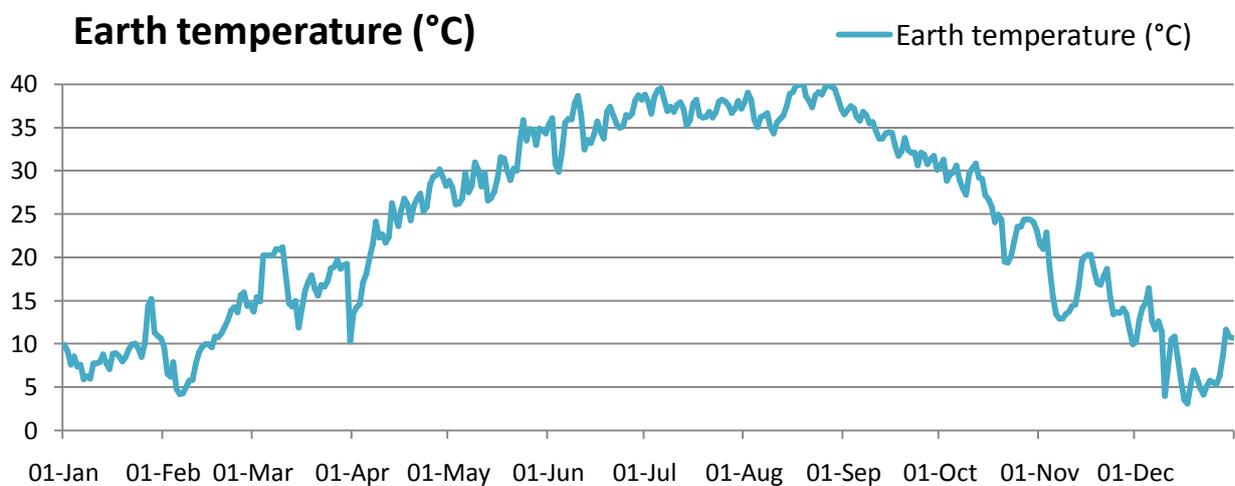


Figure 4. Earth temperature in Najaf city during 2014.

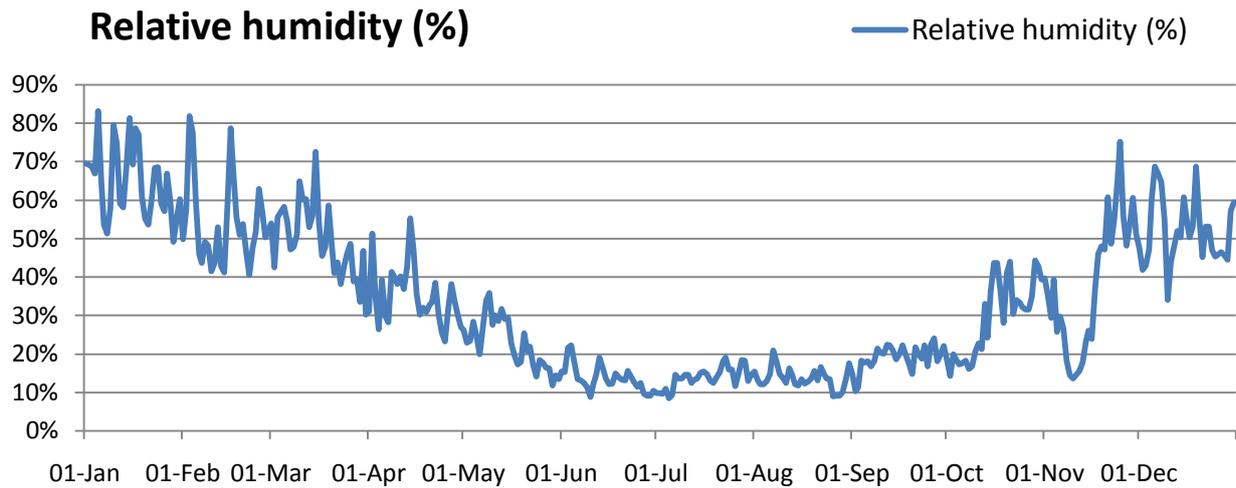


Figure 5. Relative humidity in Najaf city during 2014.

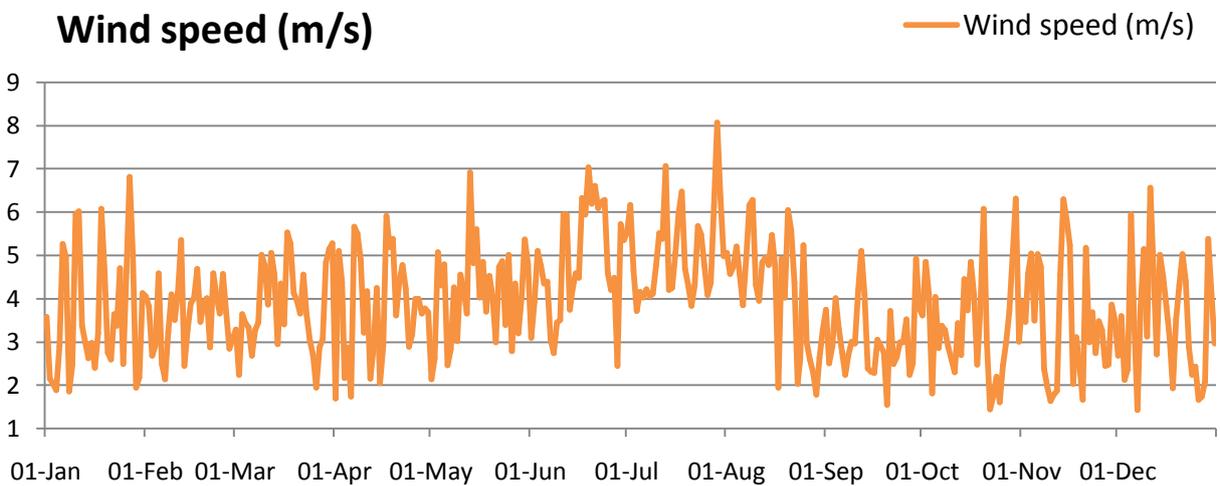


Figure 6. Wind speed in Najaf city during 2014.

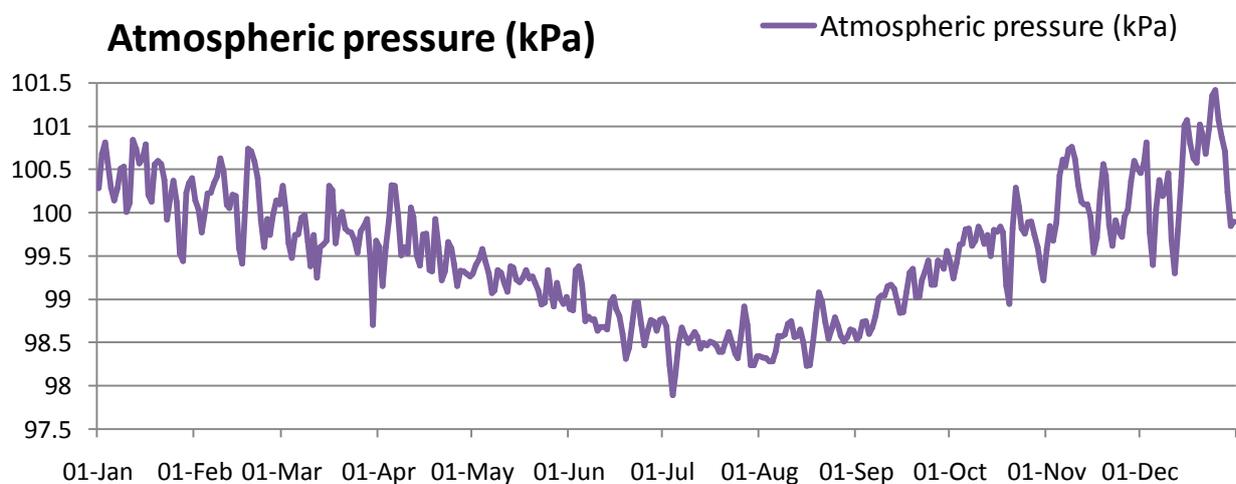


Figure 7. Atmospheric pressure in Najaf city during 2014.

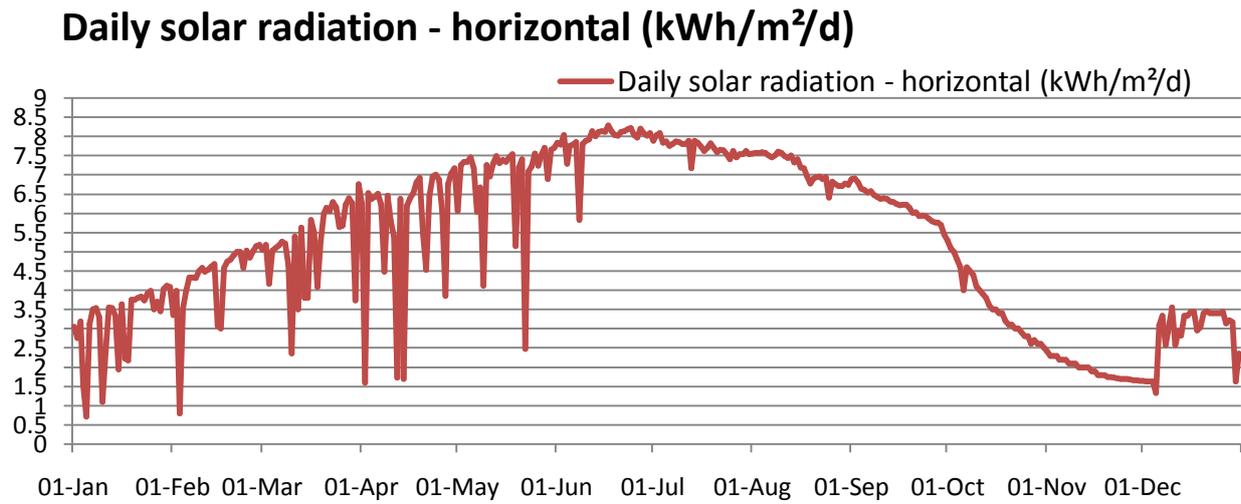


Figure 8. Daily solar radiation in Najaf city during 2014.



Figure 9. A cluster of new daughter corms.



Figure 10. The 'grass like' leaves of the saffron crocus during the autumn to spring vegetative stage.



Figure 11. continued.



Figure 11. Saffron crocus flowers in autumn either before, together with (as above), or after leaf production.



Figure 12. Saffron red threads.

6. Conclusion

In conclusion, this project is an important achievement, which is the first of its kind in Iraq in general and in the holy city of Najaf, in particular, where large tracts of land will be invested to cultivate this important and useful plant, and in addition to its commercial and medical benefits, there is an environmental benefits where it will contribute stabilize the topsoil and preservation of erosion and improve the climate in the adjacent areas.

Acknowledgements

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