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Evaluation of Irrigation Management of Saffron at Agroecosystem Scale in Dry Region of Iran

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Abstract: In order to study evaluation of irrigation management of saffron at agroecosystem, a study was conducted in 2001 and 2002. In this study four selected location were Birjand, Qaen, Gonabad and Torbat-Haydarieh, which are the main saffron producing areas in Iran. All information calculated based on actual data, collected from 160 saffron farms, aged between 1 and 5 years. Results showed there was very diverse date for first irrigation and therefore for first flowering in the area. Since irrigation application is the most important factor for flowering emergence in saffron, the timeliness of irrigation with regarded to labors intensification is important. There was a good correlation between irrigation interval and yield of saffron. Higher yield obtained with lower irrigation interval. Irrigation with 12 days, interval is the most frequent in Torbat-haydarieh and this could be reason for higher yield in this county, while in Gonabad a 12 day irrigation interval is not practices and in the other counties, the irrigation interval are more less the same. Mean yield for the farms with summer irrigation application was higher than other farms with no summer irrigation (4.9 and 3.35 kg ha⁻¹, respectively) and this whole area nearly 60% of yield was obtained from that farms in which summer irrigation was practice. In general reducing interval of irrigation and one summer irrigation at stage of flower differentiation increase yield of saffron.

Key words: Saffron, irrigation interval, summer irrigation

INTRODUCTION

Saffron has a long history in Iranian agriculture and its production is based on indigenous knowledge, particularly in central and southern Khorasan. Saffron is an expensive spice and it has been grown for a long time in many parts of the world including Spain, Italy, Greece and Iran. Today more than 95% of saffron in the world is Produced in Iran and most of this production is from central and southern khorasan. Saffron is an important cash crop for the small holding in the Khorasan province and more than 85000 farmers are involved in its production (Kafi *et al.*, 2002). Saffron is a family based crop and most of farming practices and particularly picking flowers are carried out by family members or community cooperation. Not only is this crop a cash crop for the farmers but also it has a strong tie with their social life.

Saffron is used locally and it has a traditional medicinal use (Koocheki, 2004). Recent opportunity in the use of saffron medicine as a cancer curing agent has brought more attention to this crop (Abdullaev, 2002) Saffron production does not requires much water but

timeliness of irrigation particularly the first irrigation is very important for flowering emergence and length of flowering period (Kafi *et al.*, 2002). There is limited information about effects of amount and intervals of irrigation on yield components of saffron. In this regard three aspects are of great importance: A- Effect of pre-flowering irrigation. B- Effect after harvest irrigation on yield of the following year. C- Effect of irrigation intervals on saffron yield. In an experiment different method and amounts of the first irrigation were investigated for their effects on saffron yield (Shir-Mohammadi, 2002). Results showed that mid October with the highest fresh flower and dry saffron yield was the best time for the first irrigation. Ghosheshi *et al.* (2006) in a 3 year experiment showed that saffron yield increased due to summer irrigation. The results of third year showed the highest yield was obtained in summer irrigation with 50% increase in flower yield compared with no summer irrigation. Based on these results summer irrigation imposed a significant effect on period of flowering but had not significant effect on date of first flowering. There are many factors contributing to yield of saffron. The most important factors are environmental conditions and farming

practices such as age of farm, corm size, method of planting, irrigation application, irrigation interval and recent practice of summer irrigation which is not usual practice for saffron. The purpose of present study was to qualitatively evaluate the irrigation application affecting crop yield by a comprehensive survey at farm level for two years.

MATERIALS AND METHODS

Saffron producing area of southern Khorasan in which 95% saffron is produced were investigated in four main counties namely Birjand, Qaen, Gonabad and Torbat-haydarieh in two growing season 2001 and 2002. One hundred sixty farms with a very divers criteria including the size (500 m² to 2 ha) age of saffron fields (1 to 5 year) farming practice (farmers skill) and farming background were chosen. A comprehensive survey was made during two years an associated with farming practices such as date of planting, time of first irrigation, time of first flowering, period of flowering, irrigation

interval, irrigation frequency (including summer irrigation, if any) and yield were collected by personal reference to the farmers and direct monitoring. These data were used for a quantitative analysis of relationships between variation of yield and factors contributing to these variations.

RESULTS AND DISCUSSION

Irrigation interval: There was a good correlation between irrigation intervals and yield of saffron (Fig. 1). By reducing irrigation interval, yield was increased for different age groups and also for the average of all age groups. Higher saffron yield obtained when irrigation was applied at 15 days intervals (Shir-Mohammadi, 2002).

Three different irrigation intervals that were used for different counties are shown in Fig. 2. It is observed that, irrigation with 18 days interval is most frequent and 12 days interval are most frequent in Torbat-haydarieh, which was found to be one of the reasons for higher yield in this county. There is not irrigation intervals with

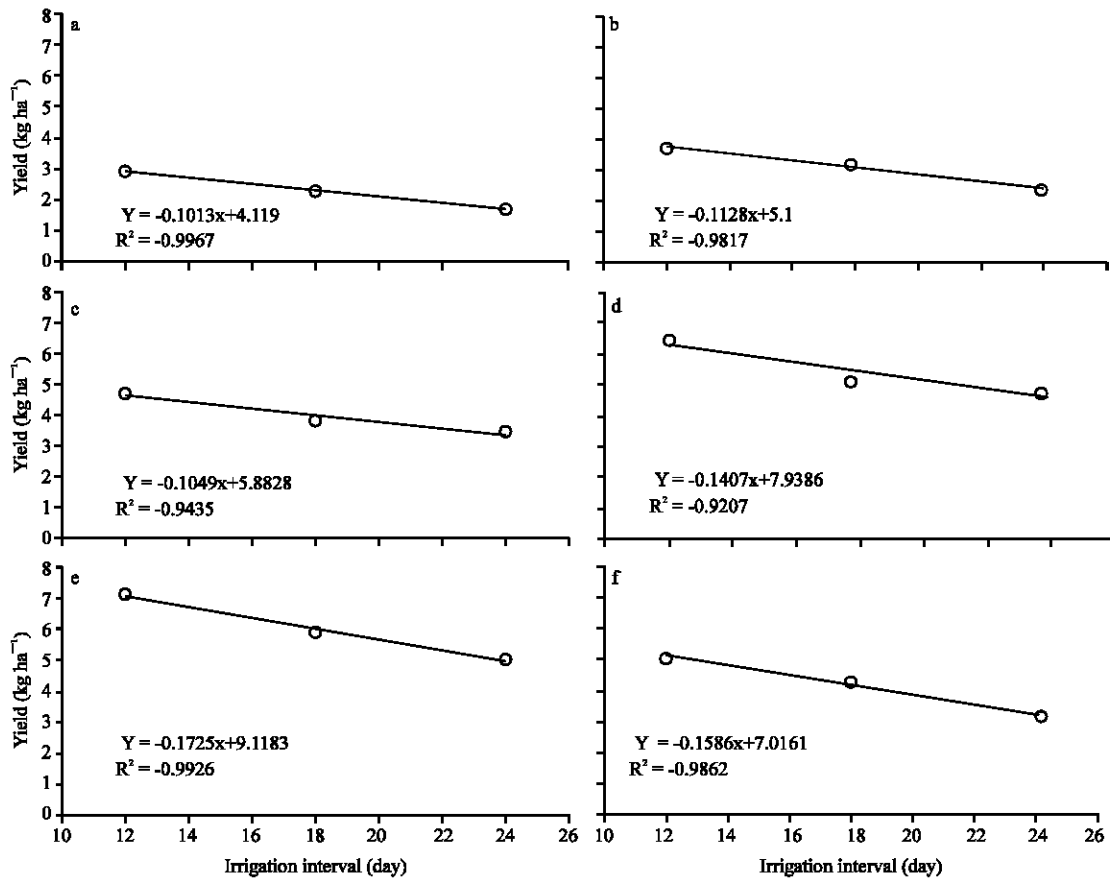


Fig. 1: Correlation between irrigation intervals and yield of saffron with different age farms (a-e), represent farms with 1, 2, 3, 4 and 5 years old, respectively and (f) shows the mean of different aged farms in whole surveyed area

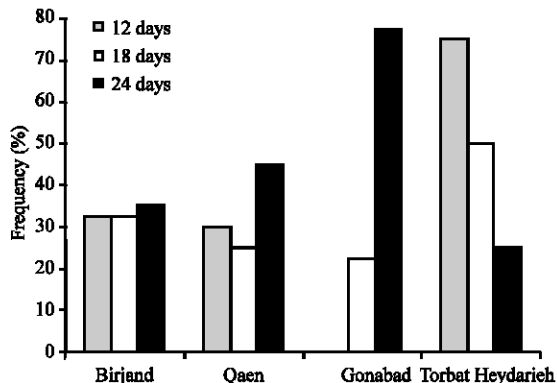


Fig. 2: Distribution of frequency of irrigation intervals in different areas

12 days in Gonabad and in other counties the irrigation interval are more less the same. Effect of irrigation intervals (15,30 and 60 days) on saffron yield were compared (Mosaferi, 2001). Results showed that all yield components of saffron were significantly higher in irrigation with 15 days intervals with up to 50% increase in number of flowers compared to no irrigation control.

Summer irrigation: Based on the physiological characteristics of saffron, (growth start in early autumn with decreasing temperature of the area), first irrigation at that time to stimulate emergence of flowers.

After flower emergence and harvesting which normally last 30 days vegetative growth starts and the leaves emerge. During winter days growth of leaves continue and by the end of May leaves are dried and goes to dormancy. Flower initiation start in early July (Farooq and Koul, 1983). Therefore, first irrigation is normally applied at the beginning of fall without any summer irrigation is applied. However in recent years one summer irrigation is practiced between end of July to middle of August. It is believed that application of one irrigation at time of early flowering helps this processes and results in higher rate of flowering (Farooq and Koul, 1983; Sadeghi, 1998).

Investigation shows that 45% of farms, in the area received one summer irrigation (Table 1) except in Gonabad. Mean yield for the farms with summer irrigation was higher than those with no summer irrigation (4.9 and 3.35 kg ha⁻¹, respectively) and as the whole, nearly 60% of yield was obtained from this farms in which summer irrigation was practiced. Summer irrigation is not a common practice. However, Sadeghi (1998) in a 2 year experiment showed that irrigation in July was harmful but irrigation in August led to an increase in saffron yield of both newly established and old saffron fields by

Table 1: Frequency (%) and yield of saffron farms (kg ha⁻¹) with and without summer irrigation

Areas	Farm yield characters	Summer irrigation is applied	No. Summer irrigation
Birjand	Number of farms	23.00	17.00
	Frequency	57.50	42.50
	Yield	3.89	3.17
	From total yield (%)	55.12	44.87
Qaen	No. of farms	15.00	25.00
	Frequency	37.50	62.50
	Yield	4.88	3.96
	From total yield (%)	55.50	44.50
Gonabad	No. of farms	0.00	40.00
	Frequency	0.00	100.00
	Yield	0.00	0.00
	From total yield (%)	0.00	0.00
Torbat	No. of farms	25.00	15.00
	Frequency	62.50	37.50
	Yield	5.83	4.32
	From total yield (%)	57.42	42.58
Total area	No. of farms	63.00	97.00
	Frequency	39.37	60.62
	Yield	4.90	3.35
	From total yield (%)	59.36	40.64

17 and 40%, respectively. Mosaferi (2001) also showed that irrigation in mid-June resulted in 17% reduction saffron yield but flower yield increased by 20% when summer irrigation was conducted in late-August. It has to be noted that summer irrigation will usually increase the risk of fungal disease.

CONCLUSION

In General farm practices related to irrigation interval, summer irrigation, age of farms and corm size are the main attributes of saffron yield. Increasing irrigation intervals, decreases yield however, a summer irrigation at flowers differentiation stage will led to yield increase. Traditionally saffron is irrigated four times during the growing season. However, to achieve high yields sufficient water is required from October until May. The highest saffron yield was obtained when irrigation with 12 days interval was applied under Khorasan climatic conditions. More experiments in different climates and with saffron fields at different ages are required to schedule the proper irrigation regimes and summer irrigation for saffron.

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