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Assessment the quantitative traits of saffron in intercropping of saffron and chamomail.

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ABSTRACT: This study was conducted to assessment the quantitative traits of saffron in intercropping of saffron and chamomail (2011-2012 years) in a five years old saffron farm located in central regions of Iran with arid climate. Two method of german chamomile cultivation (pure cultivation and intercropping with saffron) as main plots and three chamomail sowing dates (early October simultaneous with first irrigation of saffron, early November simultaneous with final harvest of saffron flowers and second irrigation of saffron and early April simultaneous with increase in temperature and last weeding of saffron) as sub plots were studied in this research. According to results, intercropping of chamomail in saffron did not cause any reduction in saffron's yield but caused decrease in total corm weight in unit area and R/S index significantly. Chamomile yield were not differences in two method of cultivation. Also base on means comparison results, the highest chamomile yield was obtained in early October sowing in intercropping method.

***Keywords*:** Chamomile, Intercropping, Saffron, Sowing date, R/S index, corm.

INTRODUCTION

Many strategies like technology, genetics, chemical fertilizers, and pesticides have been used to increase the yield of agricultural and horticultural crops, but these strategies have been useful only in regional scales and for part of our need. Thus, our main goal must be providing sufficient food while we protect natural environment.

One way to this goal is “mixed culturing” or “inter cropping” because it has been seen that mixed culture has higher yield than monoculture (Mazaheri, 1994). Mixed culture is simultaneous planting of two or more plants in one farm and includes many benefits which increase in yield is the most important one. Maximum yield of mixed culture will be obtained when the mixed plants are completely different in using natural resources. Plants with different morphological properties can use environmental factors better and then yield will be increased per area unit (Mazaheri, 1994). Saffron has a short life cycle which is mostly in autumn and winter seasons and farm is not really used all year, so, mixed culture of it with other crops can be economical (Farhoudi and Esmaeilzadeh, 2003). Chamomile is one of the most important Pharmaceutical plants known by human and is frequently used in Europe, Middle east, North America , Australia , and Africa . It is mainly used for its blue essence and is really important considering its increasing use in pharmaceutical sanitary industries, perfume industries and preparing food spices (Omidbeigi, 1994). By selecting appropriate autumnal sowing date in cold winter regions, chamomile will not face to soil freezing can until multi leaves stage. Sowing is possible in early spring and also in summer in early July. On the other words, sowing date is not effective in growth quality of chamomile.(Ebaadi et al., 2010) reported that among three sowing dates (November 5th, March 5th,and April 3rd) in Mashhad the highest yield of Geman chamomile (783.3 kg/ha) was produced in March 5th. Results of (Omidbeigi, 1994) studies showed that dried flower yield of spring chamomile was less than autumnal one but flowers essence amount and chamomile percentage was more. (Haajseyyedhaadi et al., 2002) reported that yield was affected by sowing date and was decreased by later sowing. In their study March 24th, April 3rd, and April 13th dates produced 390, 354 and 305 kg/ha dried flowers, respectively. (Bettery and Vomel, 1992) reported that late sowing of chamomile decreased flowers dry weight and flower yield due to high temperatures.(Bagheri et al., 2006) obtained the highest chamomile yield in March 5th

sowing date of Isfahan.Considering that there is not any scientific report about mixed culture of saffron and chamomile and also about the effect of chamomile's sowing date on yields of these plants, this study was conducted to examine the effect of intercropping of saffron and chamomail on quantitative traits of saffron.

MATERIALS AND METHODS

The experiment was conducted in the Research Site of Islamic Azad University (Khorasgan Branch). This site is located in the East of Isfahan ($32^{o}40'N$, 51^{o} 48' E) with 1555m altitude. The region climate is dry, very warm with dry summers (Bwhs), according to Kouppen classification. The long time annual means of rainfall and temperature are 120mm and 16˚C, respectively.

To determine soil properties, some soil samples were collected from 0-40cm depth and analyzed. Results are reported in table 1.

Table 1. Some of physicochemical properties of site soil

Soil depth (cm)	EC (ds/m)	Acidity	Organic Carbon	Absorbable Phosphorus (ppm)	Absorbable Potassium (ppm)	Total Nitrogen (%)	Texture
0-40	3.5	7.7	0.9	16.5	300	0.07	Silty Loam

The experimental design was a split plot in a randomized complete blocks design with three replications. Two planting methods (mixed culture and pure chamomile) were main plots and three sowing dates of chamomile [early October (simultaneous with first saffron irrigation), early November (after saffron flower harvesting) and early March (last weeding time of saffron)] were sub plots. Variance analysis of saffron's yield was done as simple randomized complete blocks design. Every experimental plot had five saffron rows (five meter length, 30 cm inter-row distance and 10 cm distance between plants on rows). Saffron plants were five years old. Chamomile seeds were sown between saffron rows with 1 cm depth and 10 cm distance. Meanwhile, in chamomile control plots seeds were sown like mixed culture plots and chamomile were not sown in pure saffron plots.

RESULTS AND DISCUSSION

Meteorological data for the experimental site during the experimental periods shows in figure 1.

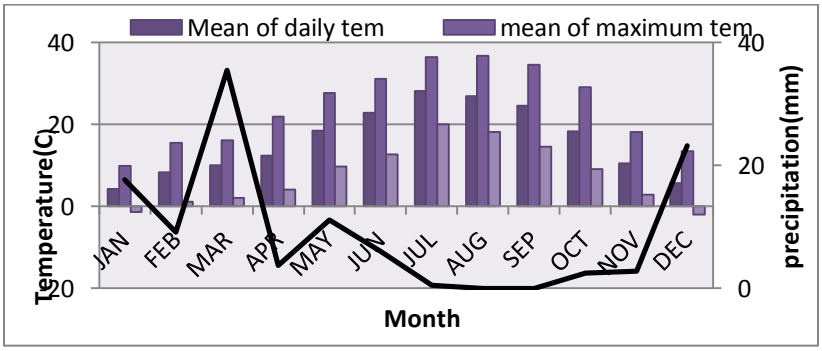

Figure 1. Mean of some meterological data of experimental site in 2011

Saffron:

Corm weight per unit area

Effect of culture of chamomail in saffron plot on saffron corm total weight per unit area was significant (Table 2). Means comparison results (Table 3) showed that saffron corm Total weight per unit area of mixed culture with a range from 851.3 g/m2 to 502.3 g/m2 was lower than its trait in saffron pure cultivation (1203.2 g/m2). Also corm total weight per unit area in Saffron + Chamomile in Apri tretment with 502.32 g/m2 was significantly lower than saffron pure(Table 3). Base on our results there were no significant different between weight of saffron corms with range of lower than 2 and higher than 3 centimeter in mixed saffron and weight of same corn in pure saffron but corms with range of 2-3 centimeter in Saffron + Chamomile in Apri treatment with 179.70 g/m2 was significantly lower than same trait in pure saffron with 638.30g/m2. Of course sith there wasn't significant and strong correlation between this trait and saffron yield(r=0.30ns), this bad effect of chamomail isn't important(Table 8). These results

showed that chamomile existence didn't cause any loss in growth of saffron plants and accumulation of dry matter in their corms. Also, existence of chamomile roots beside saffron corms and extra irrigations until physiological maturity of chamomile didn't cause negative effect on corms and their summer dormancy. General results of conducted studies on mixed culture of saffron and other plants (Banitaba et al., 2008 and Koucheki et al., 2009) showed that whatever agronomical and ecological requirements of companion plant to be similar to saffron, bad effects of it will be less.

Table 2. Results of analyze variance for saffron corm wieght

S.V	df	MS				
		Total corm wieght	Corm weigth ($<1^{cm}$)	Corm weigth $1\text{-}2^{cm}$	Corm weigth $>2-3^{cm}$	Corm weigth $>3^{cm}$
Block	2	3650.33*	1761.00	13784.12*	61894.23*	15608.23
Cropping Method	3	2514.55*	668.21	1858.14	103518.25**	32859.22
Error	6	599.41	2384.23	2156.90	9550.54	30565.45
Total	11	--	--	--	--	--
CV %	---	28.59	34.25	23.34	23.10	27.90

* and **: Significant at the 5% and 1% probability levels, respectively

Table 3. Means comparison of effects treatments on saffron corm wiegh

Treatments	Total corm weight g/ m^2	Corm weigth ($<1^{cm}$) g/ m^2	Corm weigth $1\text{-}2^{cm}$ g/ m^2	Corm weigth $>2-3^{cm}$ g/ m^2	Corm weigth $>3^{cm}$ g/m^2
Pure Saffron	1203.20a	156.70a	207.70a	638.30a	200.00a
Saffron + Chamomile in Oct.	851.30ab	153.3a	189.00a	423.00b	257.30a
Saffron + Chamomile in Nov.	847.30ab	135.00a	228.70a	459.30ab	295.30a
Saffron + Chamomile in Apri	502.32b	125.3a	170.70a	179.70c	192.00a

Means in each column, followed by similar letter(s) are not significantly different at the 5% probability level- Using Dancan test

Biological yield

Effect of cropping method on biological yield of saffron was not significant(Table 4). Means comparison results (Table5) showed that saffron biological yield of mixed culture with a range from 94.52 kg/ha to 184.30 kg/ha was not significantly different from its biological yield in pure cultivation (127.3kg/ha). These results showed that chamomile existence didn't cause any loss in growth of saffron plants and accumulation of dry matter in their corms and shoots. General results of conducted studies on mixed culture of saffron and other plants (Banitaba et al., 2008 and Koucheki et al., 2009) showed same our results.

Table 4. Results of analyze variance for saffron corm

S.V	df	MS		
		Biological yield	Shoot/Root Ratio	Stigma yield
Block	2	10334.32*	259.65	8.99*
Cropping Method	3	4198.44	1363.21*	1.49
Error	6	1208.77	320.57	1.15
Total	11	--	--	--
CV %		25.44	29.47	29.39

* and **: Significant at the 5% and 1% probability levels, respectively

Table 5. Means comparison of effects treatments on saffron traits

Treatments	Biological yield Kg/ha	Root/Shoot Ratio	Stigma yield Kg/ha
Pure Saffron	127.30ab	97.03a	3.99a
Saffron + Chamomile in Oct.	141.00ab	75.90ab	3.48a
Saffron + Chamomile in Nov.	184.30a	53.37b	4.41a
Saffron + Chamomile in Apri	94.52b	52.07b	3.78a

Means in each column, followed by similar letter(s) are not significantly different at the 5% probability level- Using Dancan test

Root/Shoot Ratio

Root/Shoot ratio index as a important index in saffron changed by cropping method (Table 4). Base on means comparison results (Table5) R/S ratio of mixed culture with a range from 52.07 to 75.90 was significantly different from its trait in pure cultivation (97.03). These results showed that chamomile existence caused balance of root and shoot growth in saffron to be change.

Dry stigma yield

Effect of cropping method on dry stigma yield wasn't significant (Table 4). Means comparison results (Table5) showed that saffron yield of mixed culture with a range from 4.18 kg/ha to 4.78 kg/ha was not significantly different from its yield in pure cultivation (4.99 kg/ha). These results showed that chamomile existence didn't cause any loss in growth of saffron plants and accumulation of dry matter in their corms. Also, existence of chamomile roots beside saffron corms and extra irrigations until physiological maturity of chamomile didn't cause negative effect on corms and their summer dormancy. General results of conducted studies on mixed culture of saffron and other plants (Banitaba et al., 2008 and Koucheki et al., 2009) showed that whatever agronomical and ecological requirements of companion plant to be similar to saffron, bad effects of it will be less. It seems that the reason of no negative effect of chamomile in all three sowing dates has been appropriate accordance of agricultural ecological requirements of two plants, so that until late March which saffron highly needed to light, water and soil nutrients, chamomile plants were in rosette form and there was no competition. Also, from late March which chamomile plants started to grow rapidly, saffron plants had a finishing slow growth and there was not any considerable competition. This lack of competition was more obvious in early April sowing which major growth of chamomile was started from April. On the other hand, chamomile plants needed to irrigation until maturity which was from early June to early July depend on sowing date, but it seems that this extra irrigations didn't cause any considerable damage to saffron yield. The irrigation interference was more obvious in early April sowing but was less in early October sowing which chamomile was harvested almost in late May.

Chamomile

Dried flower yield

According to means comparison results, early October chamomile sowing produced the highest yield (1602 kg/ha) which was significantly higher than yields of early November and early April (1167.23 and 893.30 kg/ha, respectively). Meanwhile, the difference between two last dates was significant also. Chamomile yield of pure chamomile (1138.89 kg/ha) and mixed culture (1302.22 kg/ha) were located in the same statistical group (Table 7). Results of means comparing of three sowing dates of chamomile showed that early October cultivation produced yield two times more than early April. Considering good adaption of chamomile to cool weathers (Salamon, 1994), October cultivated seeds were germinated in autumn and were established before soil freezing. In late March, seedlings started to grow and before high temperatures plants were ready to harvest. This is the reason of its higher yield in proportion to two other cultivations which had less and later vegetative growth and part of their reproductive phase faced to high temperatures of June.(Bettery and Voel, 1992) reported that late cultivated chamomile produced less dried flower weight and flower yield due to increase in temperature. (Baagheri et al., 2006) obtained the highest chamomile yield in Isfahan in early April sowing.

Results of (Omidbeigi, 1994) studies, showed that dried flower yield of spring chamomile was less than autumnal one but flowers essence amount and chamomile percentage was more.(Haajseyyedhaadi et al., 2002) reported that yield was affected by sowing date and was decreased by later sowing. In that study March 24th, April 3rd, and April 13th dates produced 390, 354 and 305 kg/ha dried flowers, respectively.

Table 7. Means comparison of simple effects treatments on chamomile traits.

Treatments	Flower dry yield (kg/ha)
Cropping method	
Pure cropping	1138.89 a
Intercropping	1302.22 a
Sowing date	
Early Oct.	1602.00 a
Early Nov.	1167.23 b
Early Apr.	893.30 c

Means in each column, followed by similar letter(s) are not significantly different at the 5% probability level- Using Dancan test

Table 8. Correlation coefficient of saffron traits

Traits	1	2	3	4	5	6	7	8
1-R/S	1.00							
2- Stigma yield	-0.25	1.00						
3- biological yield	-0.11	0.61	1.00					
4-Total corm weight	0.68	0.24	0.65	1.00				
5- Corm weight <1^{cm}	0.91**	-0.28	0.18	0.84*	1.00			
6- Corm weight 1-2	0.11	0.81*	0.89*	0.73	0.26	1.00		
7- Corm weight>2-3	0.79*	0.30	0.49	0.95**	0.82*	0.69	1.00	
8- Corn weight>3	-0.55	0.29	0.81*	0.19	-0.18	0.48	-0.08	1.00

* and **: Significant at the 5% and 1% probability levels, respectively

CONCULSION

The technique discussed in this paper provides an interactive approach in which the decision maker can search for an acceptable solution of the multi-objective optimization problem. The proposed method to solve multiobjective linear programming problem is better than many existing methods as the concept of bound is used in the iteration.

If we substitute some values to a_i , α_i in multi-objective linear programming problem (3.1), it reduces into single objective LPP. This discussion also holds in the case as given by by (Kanniappan and Thangavel, 1998). The same problem for integer solution was studied by (Bhargava and Sharma, 2003).

REFERENCES

Ait-aubahou A, El-otmani M. 1999. Saffrom Cultivation in Morocco. Amesterdum: Harwood Academic Publishing, 154p.

Azizi M. 2006. Study of Four Improved Cultivars of Matricaria chamomilla L. in climatic condition of Iran, Iranian J of Medic and Aromatic Plants 22 (4): 120-129.

Baagheri M, Golparvar A R, Shiraniraad A H, Zaynali H, Jaafarpour M. 2006. The effect of sowing date and various nitrogen fertilizers on qualitative quantitative properties of German chamomile in Isfahan. J of Agri Res 4(1): 150-158.

Banitaba A. 2008. Mixed culture of cumin and saffron in Isfahan-Iran. Report of Res project. Islamic Azad University. Golpayegan Branch.

Bettery G, Vomel A. 1992. Influence of temperature on yield and active priciples of Chamomilla recutita under controlled conditions. Acta Horticulturae, 306: 82-87.

Ebaadi M, Azizi M, Omidbeigi R, Hasanzaadeh Khayyat M. 2010. The effect of sowing date and harvest time on flower yield, essence percentage, and components of Marticaria Recutita L Cultivar presov. J of pharmaceutical aromatic plants of Iran 26 (2): 213-226.

Farhoudi R, Rahnama A, Esmaeilzaadeh H. 2003. Saffron in a mixed culture. Third National Conference of saffron, Mashhad, Ferdowsi University.

Haajseyyehaadi S M, Khodabandeh N, Yasa N, Darzi M T. 2002. The effect of sowing date and density on flower yield and effective matter of chamomile, J of Agri Sci of Iran 4(3): 208-216.

Kaafi M. 2002. Saffron (Production, Technology and Processing). Zaban-o-Adab press. 276 PP.

Koocheki A, Najeebnia S, Lalehgaani B. 2009. Evaluation of saffron yield in mixed culture with cereals, grains and pharmaceutical plants. J of Iran Agri Res. 7(1) :163-172.

Mazaaheri D.1994. Mixed culture. Tehran University press. 262 pp.

Omidbeigi R. 2002. Pharmaceutical plants cultivation. Raazi Magazine 5: 24-39.

Salamon I. 1994. Growing condition and essential oil of chamomile, Chamomilla recutita L. (Rauschert). J of Herb Spices & Medic plants 22: 31-37.