



Study of the effect of sowing dates on morphological and agronomical characters of two safflower cultivars in double cropping in Sanandaj region

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Abstract

In order to study the possibility of double cropping of safflower after harvest of winter cereals in sanandaj region an experiment was conducted at the Experimental farm of Agriculture College of Sanandaj Azad University during 2003-2004 and 2004-2005 growing season. Experiment design was factorial 3×2 as complete block base with three replications. The treatments included: Sowing dates (21, 27 June and 4 July), cultivars (IL111 and mahali Isfahan). Results of simple variance analysis in first year showed that all characters investigated with exception of 1000 seed weight was affected significantly by treatment. In the second year of study all characters investigated was affected significantly by treatment. Results of variance analysis in two year were showed that all characters investigated were affected significantly by treatment in the 5% and 1% levels. In this study, the highest seed yield in two years was achieved as rate 1626.6 kg/ha in 21 June and Isfahan cultivar. In this study also maximum amount of biological yield, flower yield and oil yield was achieved in 21 June and Isfahan cultivar as arrangement equal to: 8753.4, 193.5 and 550.3 kg/ha. The other characters included: maximum height plant was obtained in the same treatment equal to: 64 cm. the most number of axillary's stem, number of fertile head and oil seed percent also showed in the 21 June and Isfahan cultivar as arrangement equal to: 5.93, 8.4 and 36.07%. The most number of seed in head and harvest index also showed in the 27 June and Isfahan cultivar as equal: 34.97, 23.69.

Keywords: Safflower - sowing dates - double cropping - agronomical characters.

Introduction

Double cropping is defined as planting of two crops in a piece of land in the one year. In the most area of Iran double cropping of corn, sunflower, Safflower, soybean, sorghum, cotton and potato are customary after harvesting of winter cereal. The benefits of double cropping included as: optimum usage of land, water, agricultural machine, increasing of income farmers, and obtain ecological benefit as: increasing biodiversity, maintaining the sustainability of agricultural production systems, breaking of pest and disease cycle, infiltration of soil, increasing of soil organic matter and decreasing weeds competition.

Safflower is a suitable oilseed crop in the arid and semiarid region and well grown in the sunny and high temperature condition that occurred after harvest of winter cereal in the Iran. In addition to, it able to meets its water requirements by drawing moisture from deep in the subsoil. It also could improve the overall N use efficiencies of cropping systems and minimize nitrate leaching to groundwater (3). Early ripening (decreasing rosette stage period in the warm weather), possibility of less weed competition, resistance to drought and salinity conditions, are the other characters of safflower.



Abel (1976) reported that due to the shortened period of growing season in double cropping, early-maturing are more likely to be better than medium and late-maturing cultivars (1). Yield decreases of double cropping can be minimized as select suitable cultivar and sowing date. The yield of double cropping will be able to at the most by selecting suitable cultivar and sowing dates (4). For double cropping to be successful, both crops must have different time to grow without frost affecting them and they must produce acceptable yield. Therefore, in order to obtain safflower with high yield and quality, it is essential to determine the suitable sowing dates and cultivars in double cropping.

Materials and methods

The experiment was conducted at the Experimental farm of Agriculture College of Sanandaj Azad University in the northwestern of Iran (35° 10' 41" N, 46° 59' 16" E, 1302 H) during 2003-2004 and 2004-2005 growing season. Experiment design was factorial 3×2 as complete block base with three replications. The treatment included: Sowing dates (21: first day of summer in Iran, 28 June and 4 July), cultivars (IL111: early-mature and mahali- Isfahan: late-mature). Grain crop was a fore crop for safflower in both two years of study. Current practices were used for soil preparation. Only in second year of study, experiment was conducted in a farm about 500 m above farm of first year, in order to prevent of soil born disease because safflower is very sensitive to them. The soil type was a clay loam with a pH of 7.5 and 0.66 % organic matter. N, P, K fertilizing was applied according to soil testing in both year. Plot sizes were 5 m long and consisted of 6 rows, 0.5m apart. Seed were hand-planted with high density to achieve finally of 400000 plants per hectare. Irrigation method was as furrowing and crop was kept from of weeds by hand hoeing when necessary. Pest controlled as spraying with diazinon in the beginning of head forming. Crop harvesting carried out 103-127 day after sowing in the beginning of October to beginning of November.

The following parameters were investigated: seed yield, biomass, flower yield, stem height, axillary's height stem, and number of fertile head in plant, numbers of unfertile head in plant, number of seed in head, 1000seed weight, harvest index, oil seed content and oil yield. Data were statistically analyzed using SAS software and to compare treatments means Duncan method were used.

Results and discussion

1- Seed yield

As seen in table 1 the seed yield affected significantly by treatments. In general the second year data were higher than first year; this may have been due to more fertility of soil in the second year. According of table 2 the highest seed yield was obtained from 21 June sowing date and mahali Isfahan cultivar. Based on two year data, seed yield was decreased as sowing date delayed from 21 June to 4 July equal to: 201.61- 466.68 kg/ha. Allesì et al (1981) reported that delayed sowing shortened the growing season and ripening of seeds does not well (3). Juknevičius and Pekarskas (2002) in two year study found that the highest seed yield was obtained in the first sowing date as: 2000 kg/ha. Also they observed that 9-18 day delaying in sowing, decreased seed yield by: 510-850 kg/ha (4). The same results were found by Kizil (2002), Özel (2003), Ozbay (1994), Samancı, and Özkaynak (2003), Wachsmann et al (2004).

In this study Isfahan cultivar produced 538.4 kg/ha more seed yield than IL111. This may be attributed to late-mature cultivar of Isfahan so that it has more time to continue growing. Isfahan is an endemic cultivar also, and it is very appropriate to different condition of Iran. On the other hand Akmal et al (2005) with study on 10 genotypes and 1 endemic cultivar were found the lowest yield in the endemic cultivars as: 313kg/ha (2).



Table1-biennial results of some agronomical characters of safflower cultivars in double cropping1.

Source	df	seed yield	biomass	flower yield	no of fertile head	no of seed in head	1000 seed weight	oil seed content	oil yield
Year	1	432394.42**	4983469.86**	9832.7**	12.72**	794.39**	573.52**	611.65**	81123.38**
Block (year)	4	6637.21 ^{ns}	377629.95 ^{ns}	272.75 ^{ns}	0.16 ^{ns}	14.41 ^{ns}	6.04 ^{ns}	4.2 ^{ns}	635.73 ^{ns}
S : (sowing dates)	2	657397.83**	24952558.91**	19900.21**	23.87**	5.78 ^{ns}	22.2 ^{ns}	25.44*	72608.81**
Year × S	2	5509.27 ^{ns}	2219971.51**	518.9*	4.22**	6.92 ^{ns}	25.52 ^{ns}	8.49 ^{ns}	1562.79 ^{ns}
C : (cultivar)	1	2608763.36**	50004179.39**	22861.44**	47.15**	1852.29**	114.24**	1182.09**	61160.8**
Year × C	1	86396.8 ^{ns}	977217.92 ^{ns}	79.09 ^{ns}	10.24**	0.31 ^{ns}	75.71*	312.4**	3034.35 ^{ns}
S × C	2	11406.08*	810290.64*	640.7*	4.26**	9.6*	3.62*	6.52*	9525.65*
Year × S × C	2	113371.8 ^{ns}	8750606.67**	2233.21**	18.2**	40.49 ^{ns}	2.18 ^{ns}	16.95 ^{ns}	12632.8**
Error	20								
CV		17.05	8.54	9.37	10.93	15.14	14.4	10.02	17.77

1-data are means of square, ns: non significant, *, ** significant at 5% and 1% level arrangement.

2- Biomass

The highest biomass was found in 21 June sowing date and Isfahan cultivar. Biomass was decreased by delay in sowing by 1449.9-2884 kg/ha. Wachsmann et al (2004) studied 4 hybrid cultivars and 3 open-pollinated cultivars in Australia and found that the highest biomass was obtained from hybrid cultivars (10).

3- Flower yield

This variable was affected significantly by treatments also. The highest flower yield was achieved in 21 June sowing and Isfahan cultivar. Also the lowest yield obtained from 4 July and IL111 cultivar. Since flower of safflower have different usage in dyeing industry, food and medicine in Iran, flower yield were recorded. Ozel et al (2004) studied the effects of 4 sowing dates on flower yield of safflower in the Turkey, and they reported significant difference between sowing dates (7). Of course there are few reports about flower yield in safflower.

4- Numbers of fertile head in plant

The highest number of heads per plant was obtained in 21 June sowing and Isfahan cultivar. Based on study of researchers, numbers of head per plant is the most yield component in safflower plant, so it has huge effect on yield. Numbers of head per plant in Isfahan was significantly greater than in IL111 cultivar. Uher (1999) was studied the effect of sowing dates on different cultivars of safflower and suggested that later sowing decreased numbers of head in plant (9). The same results were found by Wachsmann et al (2004), Juknevičius and Pekarskas (2002), Akmal et al (1993).



Table2: mean of two year data from double cropping of safflower cultivars in different sowing dates.

<i>factor</i>	<i>seed yield (kg/ha) (kg/ha)</i>	<i>biomass (kg/ha)</i>	<i>flower yield (kg/ha)</i>	<i>no of fertile head</i>	<i>no of seed in head</i>	<i>1000 seed weight</i>	<i>oil seed content (g)</i>	<i>oil yield (%)</i>
Sowing dates:								
21June	1351.02 ^a 396.94 ^a	7372.2 ^a	160.06 ^a	6.56 ^a	25.64 ^a	26.55 ^a	29.52 ^{ab}	
28June	1149.41 ^b 340.98 ^b	5922.3 ^b	114.61 ^b	4.6 ^b	26.98 ^a	25.99 ^a	29.74 ^a	
4July	884.34 ^c 243.25 ^c	4482.2 ^c	78.81 ^c	3.95 ^c	26.62 ^a	23.96 ^a	27.12 ^b	
Cultivar:								
IL111								
Mohali-Isfahn	859.06 ^b 196.71 ^b	4749 ^b	92.63 ^b	3.92 ^b	19.24 ^b	27.28 ^a	23.06 ^b	
Sowing dates × Cultivar:								
21June × IL111	1397.45 ^a 457.4 ^a	7106.1 ^a	143.03 ^a	6.21 ^a	33.59 ^a	23.72 ^b	34.52 ^a	
21June × Mohali-Isfahn								
28June × IL111	1075.4 ^{bc} 243.54 ^d	5990.88 ^b	126.58 ^b	4.91 ^b	18.32 ^b	27.71 ^a	22.98 ^c	
28June × Mohali-Isfahn	1626.63 ^a 550.33 ^a	8753.43 ^a	193.55 ^a	8.4 ^a	32.96 ^a	25.38 ^{ab}	36.07 ^a	
4 July × IL111	853.1 ^{cd} 202.28 ^{de}	5036.68 ^{bc}	94.93 ^c	4.05 ^c	19 ^b	27.96 ^a	24.21 ^c	
4 July × Mohali-Isfahn	1445.72 ^a 479.67 ^b	6807.92 ^b	134.29 ^b	5.15 ^b	34.97 ^a	24.03 ^{ab}	35.27 ^{ab}	
	648.68 ^d 144.31 ^e	3219.37 ^c	56.38 ^d	2.81 ^d	20.4 ^b	26.18 ^{ab}	22 ^c	
	1120 ^b 342.18 ^c	5756.94 ^b	101.24 ^c	5.1 ^b	32.83 ^a	21.75 ^b	32.23 ^b	
Total mean	1128.25 327.05	5927.54	117.83	5.07	26.41	25.5	28.79	

5- Numbers of seeds in head

The results showed that numbers of seed in head was not affected significantly by sowing dates. The numbers of seeds in head was less in the 21 June sowing, because the numbers of head in plant was the most in 21 June sowing and since between the number of head in plant and number of seed in head is negative correlation, it was concluded that decreasing number of seed in head is dialectic. In addition to this variable is a genetically character and less affected by environmental condition. In this study numbers of seed in head was more about two times in Isfahan than IL111.



6- 1000-seed weight

Based on two year results sowing dates not affected significantly seed weight. However the highest seed weight was achieved in 21 June and it decreased by late sowing. Since the lowest seed in head was obtained in 21 June, the weight of seed remaining was increased in 21 June due to less competition of seed in head and longer seed filling period probably. Juknevičius and Pekarskas (2002) reported that seed weight and seed viability of safflower decreased by late sowing. In this study because the numbers of head in plant affected significantly but not about seed in head and 1000 seed weight, it was concluded that numbers of head in plant is the most component yield in safflower. As seen in table 2 the 1000 seed weight of IL111 was more than Isfahan, because IL111 have bigger and more seed weight genetically. In this study amount of seed weight decreases by late sowing was more in Isfahan than IL111. The same result was found by Abel (1976) who Also reported that amount of loss in yield and 1000 seed weight was more in late-maturing cultivar in comparison with early -maturing. Wachsmann et al (2004) reported the same results.

7- Oil seed content

According to table 2, the highest oil was obtained in 21 June sowing and Isfahan cultivar. Oil seed content was decreased when sowing dates delayed. Although it has proven that is negative correlation between seed yield and oil seed content, but it was observed that as delay in sowing date, both seed yield and oil content decreased. It may for short period of growing season in summer and also short time for synthesis of oil. Juknevičius and Pekarskas (2002) showed that the highest oil and crude protein and lowest seed fiber of safflower was found in the first sowing date, namely: 1May. In this study Isfahan produced more oil seed than IL 111 also that is related to genetically potential of Isfahan cultivar. Akmal (1993) studied 10 genotypes and 1 endemic cultivar of safflower in Pakistan and reported the highest oil in endemic cultivar.

8- Oil yield

Since oil yield equals to: seed yield × oil content, hence oil yield affected significantly by treatments also. The same results were found by Kizil (2002), Özel (2003), Ozbay (1994), Samancı, and Özkaynak (2003). In this study the highest oil yield was achieved in 21 June sowing and Isfahan cultivar. In general results of this study showed that double cropping of safflower followed winter cereal was successful in north western of Iran and also the highest seed yield, biomass, flower yield and oil yield was achieved in 21June sowing and Isfahan cultivar as arrangement: 1626.63, 8753.43, 193.55 and 550.33 kg/ha. Finally the period of growing safflower cultivars was ended in beginning of October to beginning of November and seed bed was prepared rapidly for sowing winter cereals.

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