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Evaluation of Weeds Interference Period on Yield and some Traits of new Varieties of Safflower in Birjand

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ABSTRACT: In order to study the effect of weeds interference and variety on yield and some traits of safflower, a factorial experiment was carried out at the centre of agricultural research and natural resource of Khorasan Jonoobi, Iran in 2013 based on a randomized complete block design with three replications. Factors of the experiment included three variety of safflower (Goldasht, Padideh and Golsefid) and six levels of weed interference (complete control of weeds during the whole growth season, interference until stem elongation, until the production of sub branches, untill the start of flowering, until the end of grain fill and during the whole growth season). The results showed that variety of Padideh had the highest grain yield and increase in the period of weed interference leads to significant decrease in grain yield of different varieties of safflower. Based on the results of the experiment, Padide and Goldasht varieties are suggested to be used in Birjand condition because of their better higher yield. Moreover, weed control in safflower should take place during production of sub branches and if possible, during stem elongation.

Key words: Safflower, Weed interference, Yield.

INTRODUCTION

Oil grains are the world's second food resource after cereals (Shariaty and Ghazi Shahni Zadeh, 2000). Safflower (*Carthamus tinctorius* L.) having 25-40 percen oil of which 90 percent are unsaturated fatty acids particularly linolic acid and having relatively 12 to 22 percent protein, has always been regarded as an important oil grain (Jamshi-Moghadam and Pourdad, 2006). Weeds are the main barier in agriculture systems and if they are not controlled in farms, the yield of plants will reduce from 10 to 100 percent depending on the weed competition potentials (Auskarniene *et al.,* 2010). Considering that the weed growth time and the period of competition with the plant affects crop yield (Lance, 2003), hence determination of proper time for weed control can play an important role in management of weeds (Ahn *et al.,* 2005). Determination of this time takes place through functional relation of two competitive parts of weeds including determining weed interference period to the start and weed control periods to finish this time (Everman *et al.,* 2008). Among agronomic practices for weed management, identifying potential rival varieties with high tolerance and ability to prevent weed growth is of great importance. In addition to decrease in weed competitive ability and the use of herbicides, using this kind of rival plants decreases labor and fuel costs (Zimdahl *et al.,* 2004). The results of an experiment done by Hamzehei *et al.* (2005) on 3 varieties of winter rapeseed showed that grain yield has decreased with increasing of weeds interference time. Zarghani *et al.* (2011) indicated that increase in the interference period, decreases the yield and yield components of sesame, significantly. Also, Ehteshami *et al.* (2005) observed that the number of soybean pods in treatment of infected weeds until the end of the growth season were 67 % less in comparison with weeds control treatment during the whole season. Amare *et al.* (2009) studied the effect of weeds interference on sesame and concluded that the highest grain yield (916 kg/ha) observed in treatment of weeds interference until 10 days after emergence of sesame and with weeds interference until 70 days after emergence, yield decreased to 174 kg/ha. Also, Eyherabide and Cendoya (2002) in soybean showed that the competition of weeds in whole growth season has reduced the yield of grain by 40%. Weeds are of effective factors in decrease of safflower yield and are able to reduce the yield of safflower dranatically or destroy the whole yield (Li-Dajue and Mundel, 1996; Singh *et al.,* 2006). Timely control of weeds in safflower farm is essential and the success in production depends on efficient control of weeds (Unger and Miller, 1999). The current study was carried out in order to investigate the effects of different levels of weeds interference on yield of 3 varieties of safflower in Birjand.

MATERIALS AND METHODS

This experiment was carried out during 2013-2014 year at Agriculture and Natural Resources Research Center of Khorasan Jonoobi, located in geographical longitude of 58°59′ northern and latitude of 32°52′ east, with an elevation of 1382 meter above sea level.

Yearly rainfall was 150 mm and the farm soil of the experimental was clay-loam with pH = 8.18. The experiment was conducted based on a randomized complete block design with three replications. Factors of the experiment included three variety of safflower (Goldasht, Padideh and Golsefid) and six levels of weed interference (complete control of weeds during the whole growth season, interference until stem elongation, until the production of sub branches, untill the start of flowering, until the end of grain fill and during the whole growth season).

After determination of the results of soil analysis, preparation process for planting was done.

According to the results of soil test, 200 kg/ha potassium sulfate (42% P_2O_5) and 150 kg/ha triple super phosphates (46% K_2O) was applied to the soil before final disking. Also, 150 kg/ha urea fertilizer was applied (one third while plantation, one third at the end of rosette stage, one third before flowering).

Seeds disinfected by fungicide carboxinthiram (2:1000), then the seeds were dry-sown at the depth of 2-3 cm. The spacing between the rows was 60 cm and the distance of between plants was 10 cm. Sowing date was 12 April of 2013. Each plot was 3 × 4.2 meter with 4 rows. The spacing between plots was 60 cm and between replications was 1.5 m.

In order to calculate the yield and other traits, an area of 2 m2 was harvested from the middle of each plot. Weed control happened based on interference levels. Final harvest at the end of the growing season carried out on an area of 2 m^2 was harvested from the middle of each plot. At the end, the data were analyzed by statistical software MSTAT-C and the means were compared by Duncan Multiple Range Test at 5% level.

RESULTS AND DISCUSSION

A. Number of head per plant

Safflower varieties had significant difference in head number per plant (Table 1). This trait was significantly influenced by weed interference period (Table 1). Comparison of safflower varieties showed that Padide (17.27) and Goldasht (12.72) had the most and the least number of head per plant, respectively (Table 2). It may be related to the genetically characteristics differences in varieties of safflower.

Table 1: Analysis of variance of traits in safflower as affected by varieties and weed interference periods.

Sources of variation	df	MS					
		Number of head per plant	Total head weight	Head straw weight	Seed yield	Harvest index of grains per head	Petal weight
Replication	2	12.42	3954.47	553.69	1710.38	6.28	19.61
Variety (A)	2	93.22**	116513.89**	62859.88**	13327.45**	1032.33**	1326.14**
Interference (B)	5	40.82**	51242.98**	11921.51**	13872.10**	91.77**	73.47*
A×B	10	9.88 ns	2479.22 ns	750.10 ns	1230.97 ns	32.87 ns	13.54 ns
Erorr	34	10.35	1782.15	608.33	926.40	23.09	22.19
CV (%)	-	21.35	10.40	16.44	11.89	7.44	25.01

ns, * and ** are non-significant and significant at 5 and 1% probability levels, respectively

Table 2: Means comparison of simple effect of traits in safflower as affected by varieties.

Variety	Number of head per Plant	Total head weight (g/m^2)	Straw head weight (g/m^2)	Seed yield (g/m^2)	Harvest index of grains per head (%)	Petals weight (g/m^2)
Goldasht	12.72 b*	331.79 c	107.10 c	224.69 b	69.39 a	12.06 c
Paddyde	17.27 a	491.51 a	217.43 a	274.08 a	55.88 b	28.49 a
White Flower	15.21 a	394.75 b	125.57 b	269.18 a	68.57 a	15.95 b

* Means with same letters for each column have not significantly different at 5% probability level based on Duncan's Multiple Range

Means comparison showed that increasing time of weeds competition reduces the number of head per safflower plant. The highest and least of head number per plant (17.78 and 12.24) was related to the treatments of Weeds-free and infected with weeds during the whole growth season, respectively. Interference with weeds in the whole growth season, the number of head per plant in comparison with weed free treatment was decreased by 31.10% (Table 3).

High number of head in plant in treatment of weed free in the whole growth season can be due to the high photosynthesis of plants and providing more water and food parameters while there is no weed. Researchers reported that in bean plant the increas of interference period leads to reduced number of pods in plant. (Ngouajio *et al.*, 1997; Woolley *et al.*, 1993). Also, Bonyadi *et al.* (2011) showed that as the weeds interference period increases the number of head in safflower plant reduced significantly (61/5%).

Table 3: Means comparison of simple effect of traits in safflower as affected by weed interference period.

Interference	Number of head per Plant	Total head weight (g/m^2)	Straw head weight (g/m^2)	Seed yield (g/m^2)	Harvest index of grains per head (%)	Petals weight (g/m^2)
1**	17.78 a*	486.01 a	189.64 a	296.37 a	61.14 c	20.86 ab
2	17.09 a	480.90 a	184.62ab	296.27 a	62.23 c	20.42 ab
3	15.29 ab	430.88b	162.86bc	268.02ab	63.22 bc	22.57 a
4	14.68 ab	395.33 b	146.81 c	248.52bc	64.09 bc	17.52 bc
5	13.31 b	348.38c	117.42d	230.96c	67.87 ab	16.25 bc
6	12.24 b	294.62d	98.85 d	195.77d	69.14 a	15.39 c

* Means with same letters for each column have not significantly different at 5% probability level based on Duncan's Multiple Range, ****** 1- weeds free in the whole growth season, 2-Interfrence until stem elongation stage, 3- Until lateral stem emergence stage, 4- until beginning of flowering stage, 5- until end of seed filling stage and 6- until whole drowth season

B. Total head weight

The variety had significant impact ($P<0.01$) on total head wheight in area unit (Table 1). The results indicated that the highest total head wheight was for Padide with a mean of 491.51 gr/m^2 and the lowest was for Goldasht with a mean of 331.79 gr/m^2 (Table 2).

Weeds interference had a significant impact ($P<0.01$) on total weight of the head of safflower (Table 1). Total weight of safflower significantly reduced by increase in weeds interference period. The highest total weight of head with a mean of 486.01 gr/m^2 was achieved in treatment of weed free in the whole growth season and the increase of the weeds interference period during growth season total weight of head decreased by 39.38% (Table 3). Low weight of total head in weed interference treatments in growth season is due to shadow and competition of weeds with safflower, and allocation of photosynthetic substances to flowers. Then due to the need for maintenance of balance between source and store some of the flowers have fallen and the number of grain in head and total weight of the head has decreased.

C. Straw weight of the head

The variety of safflower had a significant effect ($P<0.01$) on straw weight of the head (Table 1). The results indicated that the most straw weight of the head with a mean of 217.43 gr/m^2 is for Padide variety and the least one is for Goldasht variety with a mean of 107.10 gr/m^2 (Table 2). The comparison of straw weight mean in weed interference treatments showed increase in intensity of weed interference with safflower leads to decrease of straw weight of the head in comparison with treatment of weed free in the whole growth season by 48.06% (Table 3).

D. Petals weight

The variety had significant impact ($P<0.01$) on the weight of petals in safflower plant (Table 1). Mean comparison showed that Padide variety had the most weight of petals with 28.49 gr/m^2 and Goldasht variety with 12.06 gr/m^2, had the lowest weight of petals (Table 2).

Moosavifar *et al.* (2009) reported similar results about different varieties of saffron. Different periods of weeds interference had significant effect on the weight of petals in 5 % level (Table 1). There was no significant difference among control treatments, interference until the beginning of shoot growth and the production of sub branch regarding the petals weight and the interference untill the beginning of sub branch production had the highest weight of petals in plant with 22.7 gr/m^2. With increase in the weeds interference period in the weight of petals in plant is reduced significantly and reached to 10.39 gr/m^2 in interference treatment untill the end of growth season (Table 3). The main reason of decrease in petal weight in weeds interference treatments in comparison with control was long term stability of weeds in farm and intensification of competition for growth sources, particularly during grain filling stage.

E. Grain yield

The results indicated that grain yield in different varieties of safflower were influenced by weed interference periods (Table 1). Padide variety had better yield in comparison with other two varieties (Table 2), because yield components were higher in padideh variety. Studies by Mohasel and Behdani (1994), Kazato *et al.* (2001) and Ehsan Zadeh and Zareiyan (2003) also shows that there is significant difference, in case of grain yield among different varieties of safflower. Safflower grain yield reduced significantly by increasing the length of weed infection period.

Treatment of weeds free in the whole growth season had the highest yield (296.37 gr/m^2) during the whole growth season that decreased by 33.9% with by increase of interference period in comparison with interference in the whole growth season (Table 3). Decrease in yield due to increase in weed interference period is caused by reduction of accessibility to light, water, food and space. Delay of control over weeds untill the shoot growth did not lead to significant reduction in grain yield (Table 3).

In fact, sufficient resources and small size of the plants at the beginning of the growth season leads to decrease in intensity of interference of plant and weed hence the plant yield is affected less (Mohammadi, 2004). These results are sililar to the studies of Ebrahimi and *et al.* (2012), Zarghani *et al.* (2012), Miri and Ghadiri (2006), Ebtali *et al.* (2009) and Jannikrt *et al.* (2000). They also reported that increase in interference period leads to decrease in grain yield.

F. Harvest index of grains per head

Harvest index is a measure of the efficiency of transference of photosynthetic substances produced in plant to grains. The effect of variety on grain harvest index in head was significant (Table 1). The index of grain harvest in Goldasht variety (69.39%) and Golsefid (68.57%) was higher and were place in suoereme group and Padide variety had a lower harvest index (Table 2).

Mean comparison showed that weed interference with safflower had significant ($P<0.01$) on grain harvest index (Table 1). By increasing interference period, grain harvest index increased so that control treatment in the whole growth season and interference untill shoot growth were in the lowest group and interference treatments untill the end of grain filling and the end of growth season were in superior group (Table 3) and it means that the increase of weed interference period had more impact on the reduction of plant vegetative growth in comparison with reproductive growth.

CONCLUSION

The results indicated that Padida and Golsefid varieties of safflower are more appropriate for Birjand region, due to their higher yield. The weed control should take place at sub branch production stage or at the beginning of shoot growth.

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