INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 3, No. 6, p. 198-203, 2013

RESEARCH PAPER OPEN ACCESS

The impact of change in irrigation regime on canola (*Carthamus tinctoriusb* L.) in Kashan region

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Key words: Canola, irrigation regime, grain yield, oil percentage.

doi: http://dx.doi.org/10.12692/ijb/3.6.198-203 Article published on June 22, 2013

Abstract

Canola (*Carthamus tinctoriusb* L.) is a plant with long day, deep and expanded root. This plant tolerates drought stress. It is less resistant than barely. In order to investigate the different irrigation regimes of 5,10, 15 and 20 days and effect of drought stress on yield of three canola cultivars of spring Isfahan native, Isfahan and IL 111 an experiment was conducted as split plot design by four duplications in Kashan agriculture research field. The results show that increase in moisture level absorbed by plant and drought stress reduce the traits like grain per plant yield, number of fertile head per plant, number of grain per plant in head and number of infertile head. Ten days irrigation period had positive effect on the traits and increased yield %21.5. Since Isfahan cultivar 14 has more infertile head per plant and grain yield per plant it can be expected that grain yield of this cultivar is high relative to two other cultivars and this difference can be considered due to genetic potential and environmental compatibility.

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Introduction

Canola (*Carthamus tinctoriusb* L.) is from Aeteraceae family (Poordad et *al.*, 2008). It is a plant with medical, industrial ,food stuff, high quality oil optimal properties due to possessing more than eighty percent unsaturated fat especially acid linoleum and oleic, high resistance to salt and drought, need to low moisture content and compatibility with low winter temperature and high summer temperature, low growth season in summer planting that lead to considering it as valuable plant(Shams *et al.*, 2008).The root of this plant is deep and its leaves are thorny that cause to increase drought and heat resistance (Poordad *et al.*, 2008).Canola has been used as a resource of oil and it contains 20-45 percent oil(Yau, 2005).Drought is the main non biologic factor that reduces agriculture plant production. Therefore, it is expected that drought will be increased in future(Baoe *et al.*, 2009).

In agricultural view point ,drought is a period that the precipitation is reduced and the plant could not meet its needs and under such conditions water deficit stress damages the plants(Katerji *et al.*,2009).Drought is harmful for plant growth and yield .But in some plants under drought stress in early growth season it increases the plant resistance(Puangbut *et al.*, 2009).When organs growth and productive growth stages are accompanied by alternative drought and hot weather, germination and phonologic disorder is observed and grain filling period and finally harvest index is reduced (Ganjali *et al.*, 2009).

Farid and Ehsan zadeh (2006) studied drought stress (irrigation after reaching water potential to -15 compared to -7) in canola and they concluded that moisture stress, number of days since planting to growth are decreased %14 and number of days to physiologic growth is reduced %6.5. Soil moisture in different growth stages is necessary for high yield in canola. This plant becomes sensitive to soil moisture stress gradually at the end of growth stage and since appearance of the first corymbs to middle growth stage it becomes sensitive to moisture stress. moisture stress in these stages leads to reduction of secondary stems, number of fertile head, number of grain in head, grain weight and finally grain and oil content (Ashrafi and Razmjoo, 2010). Drought stress decreases root, stem and leaves growth, leaf area, height, dried weight and yield components (Hydarizadeh and Khajehpour, 2008). Behdani and Jami Alahmadi (2010) in an experiment on three cultivars of canola(Kose, pi and IL111) and different irrigation intervals(7,14 and 21 days) obtained high grain yield in Kose cultivar by irrigation of 7 days .Twenty one days irrigation reduced the grain yield in three cultivars.

The aim of this study is to investigate tolerance of three genotypes of spring canola by using different indices for selection of optimal genotypes and also optimal indices in order to identify resistant genotype to moisture stress infield conditions.

Materials and method

Materials

In order to investigate the effect of change in irrigation regime on yield components and yield in three cultivars of canola in arid region of Kashan in 2009-2010 in longitude of 33 30 50 50 and height of field 950-970 meter from sea level and average annual precipitation 139 mm and annual average 19.1 temperature an experiment was conducted as randomly split plot in four duplications .

Method

Irrigation was considered as main factor in four irrigations levels(irrigation in every 5 ,10, 15 and 20 days) and cultivars as secondary factors in three levels of (Isfahan native 2819), Zenderoud (Isfahan 14), cultivar IL.111).The plot dimensions were 3.4 meter with four rows by interval of 50 cm between two rows and 3 meters in each duplication. The nitrogen discharge level is high due to hot weather in Kashan and nitrogen absorption is increased in the field soil, so C/N ratio is imbalanced. For doing so, one third of required nitrogen (34 kg/hec) during planting and the other one third(33 kg/hec) before growth of stem(one month after growth) and the remainder one third of

nitrogen(33 kg/hec) after two months of growth were considered as abundance. At first, 30 kg phosphorous (p205) in one hectare and 100 kg potassium (k 20) in one hectare (k20) were distributed on soil. In order to obtain samples and measure the traits four bushes of each cultivar in main plot were selected from middle rows randomly and number of fertile head, number of infertile head,number of secondary branch, number of grain in head and grain yield were measured. The statistical analysis was done by SPSS and mean comparison was conducted by Doncan test in probability level of %.The Excel software was used for drawing of graphs.

Results and discussion

The results of analysis of variance show that in duplications ,number of fertile heads , number of grain in head and grain yield were significant (p<%1).The effect of irritation regime was significant on number of fertile heads ,number of infertile heads(p<%5), number of grain in head and grain yield(p<%1).The effect of variety was significant on number of fertile heads and number of infertile heads(p<%1) and number of grain in head and grain yield(p<%5).The reciprocal effect of variety was significant on number of fertile infertile heads and and number of grain in head (p<%1)(Table 1).

Table 1. analysis of variance of irrigation period change effect on canola cultivar yield components

conversion	df	Number of fertile head	Number of infertile head	Number of grain in head	Grain yield
Duplication	3	0.655	0.936**	258.941*	3292537.43**
Irrigation regime	3	14.176	2.757**	287.263*	3061292.673**
Error	9	1.49	0.216	48.792	656350.537
Variety	2	39.736**	0.750*	57.519	2942043.773*
Variety * Irrigation regime	6	10.601*	1.540*	77.781	761830.707
Experimental error	24	-	-	-	-

*and ** indicate significant difference and confidence level of 1 and 5 percent

Number of fertile head

Mean comparison shows that increase in plant water level the number of fertile head was increased %21.2. The lowest head number was achieved in irrigation period of 20 days by 8.9 and the highest number was obtained in irrigation period of five days by 11.3. Meanwhile periods of 5, 10 and 15 days had similar effects on number of fertile head per plant. So by increase of output irrigation period of 15 days was introduced as the best regime for increase of fertile head .The results show that drought stress threshold is irrigation regime of 20 day and number of fertile head is increased. Average of fertile head in Isfahan 14 cultivar was high by 11.5 and the lowest was reported in IL.111 by 8.5. In other hand, number of fertile head in Isfahan 14 cultivar is about %26.1 that it is higher than IL.111 cultivar. Meanwhile Isfahan 14 and Isfahan native cultivars did not show difference from statistical view point. High genetic potential of Isfahan 14 cultivar and its compatibility in the region have caused to optimal growth by high fertile head per plant (Fig. 1).

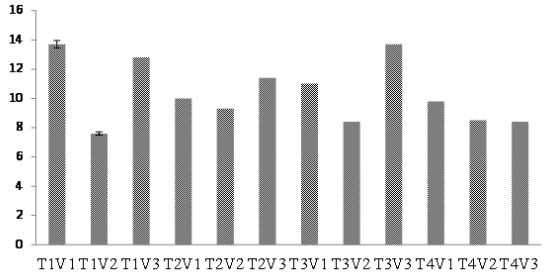

Fig. 1. V1: Isfahan native cultivar: V2:IL111 cultivar. V3: Isfahan 14 cultivar

I1: 5 days irrigation regime: I2: 10 days irrigation regime: I3: 15 days irrigation Regime: I4: 20 days irrigation regime

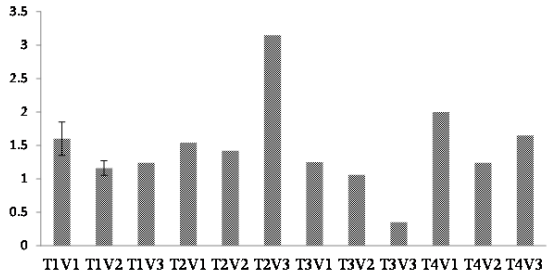

Fig. 2. V1: Isfahan native cultivar: V2:IL111 cultivar. V3: Isfahan 14 cultivar
I1: 5 days irrigation regime: I2: 10 days irrigation regime: I3: 15 days irrigation regime: I4: 20 days irrigation regime.

Table 2. mean comparison of effect of irrigation regimes.

Irrigation regime/traits	Number of grain in head	Grain yield
Irrigation in five days	36.1 b	5.1 a
Irrigation in 10 days	44.8 a	5.0 a
Irrigation in 15 days	42.6 ab	4.2 ab
Irrigation in 20 days	40.3 b	4.0 b

Table 3. mean comparison of canola genotype effect Minimum common in one letter lack statistical significance.

Cultivars	Grain yield
Isfahan 14	5.2 a
IL.111	4.4 b
Isfahan native	4.6 b

Number of grain in head increases grain yield as one of the main traits. By increase of number of grain in head the number of grain per plant and finally grain yield are increased. In irrigation regime of 75 percent of required water in Isfahan native cultivar 17.25 grain are achieved. It seems that water consumption efficiency in Isfahan native is high in optimal and stress conditions (Farast and et al, 2012).Hydarizadeh and Khajehpour (2008) and Kaffi and Rostami (2008) suggested that number of grain in head and bush is affected by cultivar. It seems that number of fertile head in canola bush is decreased due to water deficit stress and reduction of photosynthesis materials before and after formation of reproductive organs. Farid and Ehsan zadeh (2006) concluded that number of head in canola bush is reduced significantly because of water deficit stress.

Number of infertile head

Mean comparison show that this trait is affected by irrigation regime and cultivar. Among three cultivars, Isfahan 14 cultivar produced more infertile head in ten days irrigation about 3.2. But this cultivar produced low infertile head about 0.4 in 15 days irrigation per plant. According to the results irrigation regime influences these traits (Fig. 2).

Behdani and Jami Al Ahmadi (2010) obtained the highest number of grain in head in 7 days irrigation regime in Koseh cultivar. In general, by increase of irrigation interval number of grain per head is decreased since water deficit especially in flowering stage (germination) causes to reduction of number of grain due to deepening of grain and non inoculation in flowers. Pasban eslam (2011) investigated physiologic indices of five genotypes of spring canola and showed that by water deficit stress number of grain in head, 100 grains weight and yield are increased. Mosavifar and et al(2010) studied irrigation level effect on three spring canola cultivars(Isfahan native, Isfahan 18,IL111) and concluded that irrigation interrupt leads to early growth, reduction of growth period, product growth speed and grain yield in three cultivars. Formation of head stage is sensitive to water deficit and stress causes to sever reduction of growth period and finally grain yield in canola.

Number of grain in head

Mean comparison show that by increase of irrigation regime from 5 days to 10 days the mean number of grain was increased from 36.1 to 44.8.in other hand about %19.4 number of head grain was increased indicating optimality of ten days irrigation regime

relative to five days regime. Probably the plant was damaged in five days irrigation and it led to delay in growth. Finally number of grain in head decreased significantly in 20 days irrigation that indicates drought stress related to number of grain in head (table 2).Khajavinejad and et al (2004) studied three cultivars of soy bean and concluded that less moisture during formation of pot reduced number of seed in pot in addition to reducing pot. Miladi Lari and Ehsan zadeh (2010) concluded that irrigation regime has significant effect on number of grain since drought stress reduces number of grain in head about %26.

Grain yield

in this study reduction of moisture of plant reduced grain yield %21.5 in area unit accompanied by reduction of number of fertile head per plant, grain yield per plant due to reduction of moisture in soil (table 2).Irrigation regime reduces canola grain yield significantly since reduction of yield component increases yield (Abdolhassani and Saedi, 2007).Drought stress decreases canola grain yield 29.4. In general by decrease of water by 80, 60 and 40 percent of agricultural capacity the grain yield in canola bush is reduced significantly. It seems that reduction in canola grain yield is affected by drought stress due to reduction of water absorption and nutrients that leads to decrease in plant growth, expansion of leaf and light absorption and photosynthesis potential (Mohamadi et al, 2012).

Grain yield in unit area in Isfahan 14 cultivar is 15.4 percent higher than IL.111 and it is 11.5 percent higher than Isfahan native. Since Isfahan 14 produces more fertile head per plant it can be expected that grain yield of this cultivar is high relative to other two cultivars due to genetic potential and compatibility with environment in Isfahan 14 cultivar (table 3). Decrease in level of moisture in soil reduces grain yield and oil content and dried flower in canola. It means that canola is drought resistance because of having deep and expanded root. Therefore, this plant is sensitive to water deficit in the studied field soil and its optimal yield requires to sufficient moisture in the soil. According to the results it seems that in order to spring canola in Kashan region the best cultivar is Isfahan 14 cultivar with irrigation regime of 15 days.

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