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Effects of Cut off the Irrigation in Different Growth Stages on Yield and Yield Components of Rapeseed Cultivars

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Abstract

Iran is a country of water scarcity due to general low precipitation, high evaporation and the temporal and spatial distribution of rainfall. In order to determine the effects of disruption of irrigation in different growth stages of autumn's rapeseed cultivars, an experiment was conducted in 2009-2010 at Isfahan agriculture research station. A split plot layout within a randomized complete block design 3 replications was used. Main plots were seven levels of cut off irrigation namely, D1= current irrigation or irrigation after 80 millimeter vaporize from class A basin to physiological maturity, D2= cut off irrigation from stem elongation phase and then on, D3= cut off the irrigation from flowering and then on, D4= cut off the irrigation from pod formation phase and then on, D5= cut off the irrigation in stem and flowering phase, D6= cut off the irrigation in stem and pod phase, D7= cut off the irrigation in flower and pod formation, and sub plots were two rapeseed cultivars, namely, Zarfam and Okapi. With increasing the number of irrigation, rapeseed yield will increase, but if the water lacks occurred, it is better not to cut off irrigation in flower and stem phase, in order to get acceptable seed and oil yield. Zarfam had the highest oil and seed yield in withheld irrigation conditions and also have the best adaptation in water deficit conditions.

Keywords: irrigation, yield and yield components, rapes seed, cultivars

1. Introduction

Rapeseed oil is known as an important source of health-related compounds in the human diet (Harbaum-Piayda et al., 2010). Many arid and semi arid regions of the world need to implement on-farm water management, to meet the water conservation, sustainable food production, farm profitability, and environmental quality (Brian et al., 2002; Zhang et al., 2007). Limited irrigation controls soil water deficit at certain stages of crop growth and is a very important practice in recent years in place where water resources are limited (Fabeiro et al., 2002). Richter et al., (2010) reported that rapeseed (*Brassica napus*) oils differing in cultivars and sites of growth. Naeemi et al. (2007) concluded that withholding irrigation treatment decreased secondary branches number (8%), silique number per plant (31%), grain yield (29%) and oil yield (28%), whereas had not significant effect on plant height, silique height and 1000 seed weight. However, drought is one of the major constrain to agricultural production under semi arid climatic condition of Esfahan. This study aimed to evaluate the effect of disruption of irrigation on yield and yield components of autumn's rapeseed cultivars in a semi-arid area of Isfahan province, Iran, to provide some information on how to manage irrigation during various crop growth stages.

2. Materials and Methods

In order to evaluate the effects of cut off irrigation in different growth stages of autumn's rapeseed cultivars, an experiment was conducted in 2009-2010 at Esfahan agriculture research station (Latitude 32^{o} 30' N, Longitude 51^{o} 49' E, and 1541 m elevation). A split plot layout within a randomized complete block design 3 replications was used. Main plots were seven levels of cut off irrigation namely, D1= current irrigation or irrigation after 80 millimeter vaporize from class A basin to physiological maturity, D2= cut off irrigation from stem elongation phase and then on, D3= cut off the irrigation from flowering and then on, D4= cut off the irrigation from pod formation phase and then on, D5= cut off the irrigation in stem and flowering phase, D6= cut off the irrigation in stem and pod phase, D7= cut off the irrigation in flower and pod formation, and sub plots were two rapeseed cultivars, namely, Zarfam and Okapi. Soil texture was clay loam. Long term average precipitation was 150 mm. Soil fertilizer was used on the basis of plant's need. Plots were 7 m long with 6 rows spaced 24 cm apart. The

distances for main plots in order to fertilizer treatment were 2 m. The seeds were seeded on 1 November. Harvest index was computed as the ration of the seed yield to aboveground dry matter at harvest. Oil content was determined by nuclear magnetic resonance analyzer (NMR) (Omidi et al., 2010). Analysis of variance (ANOVA) was used to determine the significant differences. The Multiple Range Test of Duncan performed the separation means. All statistics was performed with MSTAT-C program (version 2.10).

3. Results and Discussion

The effects of cut off the irrigation was significant on the number of pods per plant, the number of seed per pod, a thousand seed yield, seed yield, biological yield, harvest index and oil yield. Cultivars also had significant influence on all experimental traits. The number of pods per plant influenced by interaction between disruption of irrigation and cultivar (Table 1). To produce adequate seed and oil yield, irrigation must be done at two vital growth stages, namely stem elongation and flowering stage. Naeemi et al. (2007) also reported that withheld of irrigation trait had undesirable effects on yield of rapeseed cultivars. The results of this experiment indicated that provide of sufficient water at the terminal stages of reproductive growth have specially importance to obtain high grain and oil yield. When plants encounter water deficit, there is a decline in photosynthesis, this can be due to a reduction in light interception as leaf expansion is reduced or as leaf senescence is accelerated (Block et al., 2006). Khomari et al. (2008) also reported that watering at flowering stage is the most important parameter for improving sunflower grain yield. Generally, Zarfam cultivar in all mentioned qualities had main different with Okapi cultivar. Zarfam had the highest oil yield in withheld irrigation conditions and also have the best adaptation in water deficit conditions. Naeemi et al. (2007) demonstrated that the highest seed yield in water deficit conditions was produced in Opera and Zarfam cultivars, (2058 kg per ha) and (1896 kg per ha), respectively. Zarfam seed yield and oil yield was 3413 kg/ha and 1543.8 kg/ha, respectively (Table 2). Increasing knowledge about irrigation interval and vital rapeseed growth stages in irrigated agriculture play a significant role in maintaining food security (Deng et al., 2006).

Table 1. Analysis of variance the number of pods per plant, the number of seed per pod, a thousand seed yield, seed yield, biological yield, harvest index, oil percentage, oil yield

S.O.V	d.f.	The number of pods per plant	The number of seed per pod	A thousand seed weight	Seed yield	Biological yield	Harvest index	Oil percentage	Oil yield
Replication	2	15.92	9.5*	0.019	906.7	109810.7	0.0001	5.062	5955.5
Cut off irrigation	6	670.77**	162.413**	0.813**	5359312.3**	78356362.2**	0.001**	1.098	1038643.6**
Error (a)	12	5.734	1.722	0.027	19621.9	1498972.8	0.0001	3.555	8991.4
Cultivar	1	123.42**	59.524**	0.482**	418601.2**	49060105.9**	0.002**	17.357*	181897.5**
Cut off irrigation× cultivar	6	3.817*	1.079	0.0005	2102.2	181036.3	0.0001	1.958	1366.6
Error (b)	14	1.333	0.5	0.003	8131.6	218279.6	0.001	2.585	3876.7

*significant at 0.05 significance in F-tests;

**significant at 0.001 significance in F-tests.

Table 2. Mean comparison of the number of pods per plant, the number of seed per pod, a thousand seed yield (g), seed yield (kg/ha), biological yield (kg/ha), harvest index (%), oil percentage, oil yield (kg/ha)

Treatment	The number of pods per plant	The number of seed per pod	A thousand seed weight	Seed yield	Biological yield	Harvest index	Oil percentage	Oil yield
Irrigation								
Current irrigation (control)	78.67a	37.83a	3.917a	4838a	20540a	18.8a	44.2a	2138a
Cut off irrigation from stem elongation	45.33e	22.17e	3.067de	1993e	10960e	15.5c	44a	877.5e
Cut off irrigation from flowering	51.67d	25.5d	3.4b	2529d	11310e	18.5a	45.1a	1140d
Cut off irrigation from pod formation	62b	30c	2.867e	2798c	13480d	17.2b	45.2a	1264c
Cut off irrigation in stem and flowering stage	56.17c	30.83c	3.733a	3764b	18600b	16.8b	44.7a	1682b
Cut off irrigation in stem and pod formation	64.17b	34.33b	3.317bc	3649b	16720c	18ab	44.6a	1630b
Cut off the irrigation in flower and pod formation	58c	30.33c	3.183cd	3622b	15300c	19.2a	44.6a	1615b
Cultivar								
Okapi	57.714b	28.952b	3.248b	3213b	14192b	18.4a	43.9b	1412.2b
Zarfam	61.143a	31.333a	3.642a	3413a	16354a	17.0b	45.2a	1543.8a

Common letters within each column do not differ significantly.

4. Conclusions

Generally, with increasing the number of irrigation, rapeseed yield will increase, but if the water lacks occurred, it is better not to cut off irrigation in flower and stem phase, in order to get acceptable seed and oil yield.

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