

Irrigation Interval and Nitrogen Level Effects on Growth and Yield of Canola (*Brassica napus L.*)

Khaled M. Al-Barrak

Soil and Water Dept., College of Agric. and Food Sciences, King Faisal University,
Al-Hassa, Saudi Arabia

Abstract :

A field experiment was carried out to determine the effect of irrigation intervals and nitrogen levels on canola "cv. Fido" on a sandy loam soil during 2000/2001 and 2001/2002 seasons. Irrigation intervals had significant effects on growth characters as well as seed and oil yields/ha, but it did not induce marked effect on seed oil percentage. The highest values of plant height, stem diameter, number of pods/plant, number of seeds/pod, seed weight/plant as well as seed and oil yields/ha were produced with irrigation every 7 or 14 days. Nitrogen rates had significant effects on all estimated characters, except the harvest index and seed oil percentage. The highest nitrogen rates (120-180 kg N/ha) were associated with an increase in all estimated characters, except seed oil percentage, which took the reverse trend. The interaction between irrigation intervals and nitrogen rates had significant effects on seed and oil yields/ha. Irrigation canola every 7 or 14 days and fertilizing with 120-180 kg N/ha produced the highest seed and oil yields/ha. The optimum water use efficiency was obtained with the irrigation every 14 days, particularly with the addition of 180 kg N ha⁻¹.

In general, it can be concluded that irrigation canola plants at the regular interval of 14 days with 650 m³ water/irrigation/ha and adding nitrogen fertilizer with the rate of 120-180 kg N ha⁻¹ produced the highest seed and oil yield/ha and increase the water use efficiency under the environmental condition of Al-Hassa region.

Introduction :

Water is becoming scarce not only in arid and drought prone areas but also in regions where rainfall is abundant (Malano and Burton 2001). Water scarcity concerns the quantity of resource available and the quality of the water because degraded water resources become unavailable for more stringent requirement. Water scarcity may be due to different causes, relative to different xeric regimes, nature produced and man-induced (Pereira 1999). New crops with high water use efficiency and increased drought tolerance are being sought for production in arid regions. One plant species with excellent potential as alternative to more traditional crops grown under irrigated conditions is canola. This crop grows well in dry environments and can also tolerate moderately

saline soil conditions (Nielson, 1997). Canola (*Brassica napus L.*) recently moved up to the world's, third most important edible oil source after soybean and palm, and have the largest annual growth rate of the 10 major edible oils (Downey 1990). Its oil also has potential in the developing biodiesel market (Economic Research Service, 1996).

Little information is available in the literature on the suitable irrigation interval for growing canola under Saudi Arabian conditions, particularly with regard to increasing their vegetative growth. Irrigation studies on this plant have focused on increasing seed yields in canola (Taylor *et al.*, 1991; Boochereau *et al.*, 1996; Champolivier and Merrien, 1996).

Sims *et al.*, (1993) reported that canola yields in Montana increased greatly with increased availability of water, but higher water content lowered mean oil content. Although most growers would irrigate this crop using flood or furrow irrigation, subsurface drip irrigation was used to minimize losses caused by evaporation, runoff and deep percolation when estimating crop water requirements (Phene *et al.*, 1990). Leilah *et al.*, (2002) stated that irrigation canola plants every 14 days associated with the highest values of water use efficiency (WUE) in the two seasons of study. Al-Habeeb and Al-Hamdan (2002) found that the optimum seasonal irrigation volume as 3000 m³ per hectare.

Nitrogen (N) and phosphorous (P) fertilizers play a vital role in enhancing canola yield. A high rate of N application increases leaf area development, improves leaf area duration (LAD) after flowering and increases overall crop assimilation, thus contributing to increased seed yield (Wright *et al.*, 1988). Allen and Morgan (1972) concluded that N fertilizer increases yield by influencing a variety of growth parameters such as the number of branches per plant, the number of pods per plant, the total plant weight, the leaf area index (LAI), and the number and weight of pods and seeds per plant. Excess nitrogen rate, however, can reduce seed yield and quality appreciably. Leilah *et al.* (2002) considered the most effective dose in maximizing the final canola yield/ha was 150 kg N ha⁻¹ with no significant differences appeared when N fertilization increased to 200 kg N ha⁻¹ under Al-Hassa condition. Ibrahim *et al.* (1989) concluded that yield increased with rates of N up to 213 kg N ha⁻¹. High N applications were found to cause lodging (Sheppard and Bates 1980; Wright *et al.*, 1988; Bailey 1990). Taylor *et al.* (1991), working in Australia, observed that split applications of N were not more effective than application of the total amount of N at seeding.

The interaction between irrigation treatments and nitrogen rates had significant effects on seed and oil yields ha^{-1} (Leilah *et al.*, 2003). The highest seed and oil yields ha^{-1} were obtained with irrigation canola plants every 7 or 14 days and fertilizing with 150- 200 kg N ha^{-1} .

The objectives of this study were to determine: (1) the suitable irrigation intervals, optimum nitrogen fertilizer rates and their interaction on growth, yield components, seed oil content as well as seed and oil yields/ha under Al-Hassa conditions.

Materials and methods :

A field experiment was conducted on canola "CV. Fido" at the Agricultural and Veterinary Training and Research Station, King Faisal University, Al-Hassa (latitude $25^{\circ} 21'$ and $25^{\circ} 37'$ N and longitude $49^{\circ} 33'$ and $49^{\circ} 46'$ E) during the winter seasons of 2000/2001 and 2001/2002. A split plot design with four replicates was used. Four irrigation intervals (7,14, 21 and 28 days) were assigned to the main plots and three nitrogen fertilizer rates (60, 120 and 180 kgN/ha) were assigned to the subplots. Each subplot included 5 ridges; each ridge was 3.5 m long and 0.60 m (2.1 m^2).

The soil of the experiment site was sandy loam with soil pH = 7.8, EC= 4.4 dS m^{-1} , Total soluble solid (TSS) between 0.60%-0.74%, N, Na, K and Ca average contents were 16.0, 14.1, 27.3 and 12.1 meq/l, respectively, over the two seasons.

Canola seeds used in this study were obtained from the Agricultural Research Center, Giza, Egypt. Seeds were sown during the last week of October in both seasons period, which were placed in hills, 15 cm apart within ridges, plants were thinned two times, the last one was at 35 days after emergence, leaving one plant/hill. Nitrogen in the form of Urea (46%) as aforementioned rates was manually sidedressed into three equal portions, the first was added prior of planting. The second portion was applied after thinning (30 days after sowing) and the rest was added at the first of flowering stage. Plots were weeded as needed through hand hoeing. Other normal agronomic practices for canola production were followed as recommended for ordinary canola production, except the studied treatments.

Flood system irrigation which is the normal irrigation system used by farmer in Al-Hassa area was performed in this study. The water from reservoir was pumped with an electrical pumped to the irrigation system for irrigation. The water was measured through a flow meter installed at the beginning of the

main irrigation pipe. Plants were irrigated every 7, 14, 21 and 28 days after sowing with amount of 500, 650, 800, and 950 m³/ha water, consuming 11000, 7850, 6800 and 5800 m³/ha/season, with 18,9,6, and 4 times of irrigation, respectively (Table 1). These amounts were justified to represent the range amount of flood irrigation usually used in Al-Hassa Oasis.

Table (1)
Volumes of water in the evaluated four irrigation regimes

Irrigation regime	Volume of water (m ³ /ha) received before treatments application ⁺⁺	Volume of water (m ³ /ha) received after treatments application	Total volume of water (m ³ /ha) received during season ⁺	irrigation Number
Irrigation every 7 days	2000	9000	11000	18
Irrigation every 14 days	2000	5850	7850	9
Irrigation every 21 days	2000	4800	6800	6
Irrigation every 28 days	2000	3800	5800	4

+ Rainfall not included, however it was rare (may be neglected) during both seasons of study.

++ Volume of water before treatments application (2000 m³/ha) was 1000 m³/ha, immediately after sowing and two irrigations were applied at 10 and 20 days after sowing, each with 500 m³/ha.

Hand hoeing was done twice to keep the crop free from weeds. Urea was used as N fertilizers at rates of 60, 120 and 180 kg N/ha. Air-dried soil samples were analysed for physical and chemical properties (Table 2) according to Rowell (1994). Irrigation water was analysed (Table 3) according to Rowell (1994). All measurements relating to growth and yield data were uniform in the two seasons. The total dry weight was determined after oven drying at 70 °C to a constant weight.

Table (2)
Some physical and chemical properties of experimental soil field at depth 0-45 cm

Sand %	Silt %	Clay %	Texture	CaCO ₃ %	pH	T.S.S %
46.2	38.9	14.9	Sandy loam	22.6	7.8	0.68
Av. P, ppm	Total N %	O.C. %	O.M %	F.C %	P.W.P %	Av. Mois. %
2.9	0.14	0.048	0.083	23.13	13.8	9.3

Av. P, ppm= Available phosphor O.C.= Organic Carbon, O.M.= Organic matter, F.C.= Field capacity, P.W.P.= Permanent wilting point. Av. Mois. = Available moisture.

Table (3)
The chemical analysis of the used irrigation water

pH	7.40	Na ⁺ (meq/l)	8.90	Cl ⁻ (meq/l)	10.20
EC (dSm ⁻¹)	2.03	K ⁺ (meq/l)	0.60	SO ₄ -2(meq/l)	5.80
Ca ⁺² (meq/l)	5.80	CO ₃ -2(meq/l)	Trace	SAR	4.00
Mg ⁺² (meq/l)	4.20	HCO ₃ ⁻ (meq/l)	1.50	Class	C3-S1

Estimated characters: Plants were harvested at 155 days after sowing (first week of April), i.e. when plants turned a straw color and seeds became dark brown. 10 guarded plants were taken at random from each sub plot to estimate the following characters: Plant height (cm), stem diameter (cm), number of lateral branches/plant, number of pods/plant, number of seeds/pod, seed weight/plant (g) and 1000-seed weight (g). Seed counter was used to count the number of 1000-seed. Plants in the two central ridges in each sub-plot were harvested for biological and seed yields/m², which was converted to recorded seed yields (t/ha). Seed oil content was estimated using Soxhlet apparatus, according to A.O.A.C. (1980). Oil yield was estimated by multiplying seed yield by seed oil content. Water use efficiency (WUE) was calculated as oil yield (kg)/ irrigation water (m³).

Statistical analysis: Collected data for each season were statistically analysed by analysis of variance (ANOVA) for the split plot design, thenafter the assumption of normality and the homogeneity of variances of the experimental errors was checked according to Bartlett method which reported an appropriate homogenous of errors variance according to the method stated by Gomez and Gomez (1984). Therefore, the combined analysis was done using the SAS statistical program 8.0 (SAS Institute Inc., NC, USA). The least significant differences (LSD) at the 0.05 probability level was applied to compare treatment means according to Waller and Duncan (1969).

Results and discussion

Physical and chemical properties of studied area are presented in Table 2. The experimental site soil was characterized by sandy loam texture, calcareous soil with low organic matter, low available moisture which is probably due to the texture of soil. Soil had low available phosphorous and total nitrogen which might be due to the low fixation of P and N under calcareous soil conditions and with nearly neutral to slightly alkaline pH. The soil salinity is mainly characterized by the high concentration of Ca⁺², Mg⁺², Na⁺, K⁺ due to the

relatively bad permeability of the soil in connection with the existing efficient drainage system the salt balance in the root zone could be kept on desired low level by leaching. The irrigation water was mainly characterized by the low concentration of Ca^{+2} , Mg^{+2} , Na^{+} , K^{+} , HCO_3^{-} , Cl^{-} and SO_4^{2-} . The corresponding electrical conductivity value was 2.03 dSm-1. The SAR value of 4.4 indicates a medium sodium hazard.

Effect of Irrigation:

Growth parameters: Plant height and stem diameter were significantly decreased as irrigation intervals increased with no significant differences obtained between 7 and 14 days. Higher plant height was reported at 7 and 14 days compared with 21 and 28 days. This trend was also reported in stem diameter but the negative effects of long irrigation intervals have been occurred in 21 days interval. This may indicate role of water available in cell elongation. Number of branch/plant showed similar trend as reported for plant height (Table 4).

Generally, a shorter interval gave significantly higher total plant weight than the longer period of irrigation interval (21 days and more), as shown in Table 4. Similar results were found in Brassica crops, which were reported by others (Kjellstrom 1993; Nielson, 1994; AlJaloud *et al.*, 1996). Higher dry matter production with shorter irrigation were also reported in canola by others (Krogman and Hobbs, 1975 ; Singh *et al.*, 1991). Overall, canola and other Brassica spp. appear very responsive to soil water availability. At end of harvest, the average of total plant weight varied from 162.9 g/plant in longer interval (28 days) to 284.5 g/plant in shorter interval (7 days). However, Taylor *et al.*, (1991) reported that despite seasonal differences, shoot dry matter significantly increased as more irrigation water was applied. Marked differences in total dry weight yield among different interval irrigation period application, especially between shorter and longer period, were probably caused by differences in plant height, stem diameter and number branches (Table 4).

Table (4)

Effect of irrigation intervals and nitrogen levels on plant height (cm), stem diameter (cm), total weight (g/plant), number of branches and pods/plant and number of seeds/pod (Combined means, over both seasons).

Treatments	Plant height	Stem diameter	Branches /plant (No.)	Total weight. (g/plant)	Pods/plant (No.)	Seeds/pod (No.)
A: Irrigation intervals						
7 days	149.85	2.45	16.80	284.50	218.25	51.75
14 days	148.70	2.50	16.80	276.50	214.60	49.10
21 days	134.55	2.15	13.85	211.60	170.40	42.95
28 days	117.80	1.85	12.05	162.90	160.10	39.75
LSD(5%)	8.75	0.35	0.90	24.95	25.05	4.95
B: Nitrogen levels						
60 kg N/ha	121.05	2.10	13.80	214.45	161.15	37.00
120 kg N/ha	140.60	2.25	15.15	233.95	195.75	48.75
180 kg N/ha	151.55	2.40	15.65	253.30	215.60	51.90
LSD(5%)	5.65	0.10	0.70	22.21	21.25	3.10

Yield and yield components: Significant differences in the mean number of pods per plant were observed amongst the different irrigation intervals. The average number of pods per plant decreased with increasing irrigation intervals. The 7 and 14 days intervals treatments produced a significantly higher number of pods than any of the other treatments (Table 4). These results are consistent with those reported by Wright *et al.*, (1988); AlJaloud, *et al.*, (1996); Nielson, (1997) and Leilah *et al.*, (2002). The higher number of pods/plants under shorter intervals could be attributed to higher number of flower/plant.

Significant differences were found in the mean number of seeds per pod amongst the irrigation intervals. The shortest interval (7 days) produced more seeds per pod than any of the other treatments and the second treatment (14 days) gave the next highest (Table 4). Similar results were reported by El-Saidi, *et al.*, (1992); Barszczak, *et al.*, (1993) and Abbas, *et al.*, (1999).

There were marked differences found in 1000-seed weight amongst the irrigation intervals, except 7 and 14 days intervals. Both 7 and 14 days intervals gave significantly higher mean seed weights than any of the other

treatments, but mean seed weight did not differ significantly between them (Table 5). These results support the findings of Tayo and Morgan (1975), who reported an average 1000-seed weight of 3.28 g in *Brassica napus*.

Table (5)

Effect of irrigation intervals and nitrogen levels on weight of seeds/plant (g), 1000-seed weight, seed oil percentage as well as seed and oil yields/ha and WUE (Combined means, over both seasons).

Treatments	Seeds weight (g/plant)	1000-seed weight.(g)	Seed oil (%)	Seeds yield (ton/ha)	Oil yield (Kg/ha)	WUE (kg/m ³ water)	
						Seeds	Oil
A: Irrigation intervals							
7 days	33.4	2.95	40.4	4.067	1637.35	0.37	0.15
14 days	30.2	2.85	40.3	4.0105	1608.55	0.51	0.20
21 days	18.8	2.55	38.7	3.002	1156.8	0.44	0.17
28 days	14.9	2.35	37.85	2.505	944.8	0.43	0.16
LSD (5%)	3.50	0.20	N.S	0.2335	156.6	0.11	0.03
B: Nitrogen levels							
60 kg N/ha	14.6	2.45	40.5	2.769	1127.6	0.36	0.14
120 kg N/ha	25.8	2.70	39.15	3.4295	1349.8	0.44	0.17
180 kg N/ha	32.6	2.90	38.3	3.9895	1533.2	0.52	0.20
LSD (5%)	2.8	0.20	N.S	0.163	138.1	0.08	0.02

Differences in mean seed weight may be much related to a shorter period between anthesis and maturity. At this time, the supply of assimilates to the pod (seed) plays a crucial role in the development of the seed, and plants supplied with more nutrients and water are probably at an advantage over those supplied with less (Taylor *et al.*, 1991; Gary, 2001) which seems to be occurred under shorter intervals of the present study.

In the present study, seed yield of canola increased in response to shortening irrigation intervals with maximum yields (4.067 t ha⁻¹) being attained with 7 days irrigation intervals. However, these were no significant differences between 7 and 14 days irrigation intervals. This indicates that with shortening irrigation intervals increase in seed yield was not proportional. This increase was 25% between 21 and 14 days and it was just 1.4% between 14

and 7 days. The seed yield obtained under this irrigation was comparable with these obtained by Leilah et al. 2003 and Leilah et al. 2004, in Saudi Arabia, Wright 1988, in Australia, Elsaidi et al. 1992, in Egypt. These results raise the possibility of little or no further increase will be gained for shortening irrigation intervals. Other studies reported similar results (Muchow and Wood, 1980; El-Saidi et al., 1992,). The higher seed yield for 7 and 14 days interval could be largely due to the greater number of pods per plant and number of seeds per pod (Table 4). The higher seed yield in canola may be associated with higher leaf area (Wright et al., 1988; Nielson, 1994 and Howell, 2000). Although leaf area was not estimated in the present study, leaf area is largely expected to be associated with both plant height and number of branches/plant. Irrigation interval did not significantly affect seed oil content (Table 5). The highest oil content of 40.4 % was found at 7 days interval of irrigation with no significant differences detected between 7, 14, 21 and 28 day intervals. The longer interval of irrigation reduced the oil content relative to the lower moisture content available. Similar results have been reported in canola (Barszczak et al., 1993). Decreasing interval of irrigation significantly increased oil yield. The lowest oil yield was produced by the 28 days interval of irrigation (Table 5). The higher oil yield with shorter interval of irrigation application was probably due to higher seed yield. Similar results were found by Barszczak et al. (1993) and AlJaloud et al., (1996).

Water use efficiency (WUE) for the evaluated irrigation treatments (Table 5 & Fig. 1 and 2) recognize the ratio between seed yield and oil yield and volume of irrigation water. It reveals that irrigation canola plants every 14 days associated with the highest values of WUE over both seasons of study. So, it can be reported that with absent of significant differences in both seed yield and oil yield between 7 and 14 days, irrigation canola every 14 days was the most benefit irrigation treatment under the conditions of this study. Leilah and Al-Khateeb (2003) came to similar conclusion in other canola cultivars grown under Saudi Arabia condition.

Effect of N fertilizer: Growth parameters: The maximum rate of fertilizer application (180 kg N ha^{-1}) produced a significantly higher plant height and stem diameter than all other rates. Similar results were reported by Kumar et al. (1997) in India and by Allen and Morgan (1975) in the United Kingdom. This trend was also observed on number of branches/plant without significant difference between 180 and 120 kg N/ha. The highest rates of fertilizer application gave significantly higher total dry weight than the lowest rate of

fertilizer application (Table 4). Similar results were reported by Allen and Morgan (1975); Singh *et al.* (1991) and Kjellström (1993). Taylor *et al.* (1991) reported that despite seasonal differences, shoot dry matter significantly increased as application rate of fertilizer increased. Kumar *et al.* (1997) also reported higher total dry matter production with increased rate of fertilizer application.

Yield and yield components: Significant differences in the number of pods per plant were observed amongst the different fertilizer rates. The number of pods per plant increased linearly with increasing rates of N up to 180 kg N ha⁻¹ (table 4). The higher number of pods in this treatment could be largely due to higher leaf area index throughout development. These results are consistent with those reported by Mudholkar and Ahlawat (1981), Basak *et al.* (1990), Chauhan *et al.* (1995), Arthamwar *et al.* (1996) and Nielson (1997).

Number of seeds per pod was significantly increased with increasing levels of nitrogen fertilizer application. Similar results were reported by others (Allen and Morgan 1972, Scarisbrick *et al.*, 1980; Chauhan *et al.*, 1995; Arthamwar *et al.*, 1996). 1000-seed weight was significantly increased as nitrogen level increased. Results of the present study are in close agreement with findings of Tayo and Morgan (1975), who reported an average 1000-seed weight of 3.28 g in *Brassica napus* (Table 5).

Seed yield of canola increased in response to higher nitrogen fertilizer application, with maximum yields (3.99 t ha⁻¹) being attained under the highest N rate, as shown in Table (5). Similar result of seed yield was reported by other authors (Mendham, *et al.*, 1984; Hocking *et al.*(b), 1997; Kumar *et al.*, 1997). Gammellvind *et al.* (1996), working in Copenhagen, reported a higher seed yield, varying from 2.8 to 4.8 t ha⁻¹, in winter oilseed rape. An adequate application of N fertilizer enables the crop to produce rapid leaf growth which may positively contribute in seed filling. This is reflected in efficient partitioning of assimilate into economic yield. The higher seed yield for the third treatment than for any of the other rates of fertilizer application was largely result from the greater number of pods per plant and number of seeds per pod (Table 4). This trend is supported by the findings of previous studies (Allen and Morgan 1975; Tayo and Morgan 1975; Mendham, *et al.*, 1984). Fertilizer application did not significantly affect the seed oil content, but the highest rate was associated with light decrease in seed oil content similar results have been reported in canola by Hocking *et al.* (1997 a) and Leilah and Al-Khateeb (2003) working under Saudi Arabian condition. The reduction in

seed oil percentage with the increase of N fertilizer levels could be attributed to the disturbance of carbohydrates translocation mechanism (Salisbury and Ross 1994).

Interaction between irrigation interval and rate of nitrogen fertilizer: The interaction between irrigation intervals and nitrogen fertilizer rates had significant effects on seed and oil yields/ha. Data presented in Table (6) revealed that the highest seed yield/ha was obtained with irrigation canola plants every 7 or 14 days and addition nitrogen fertilizer with the rate of 180 kg N/ha, while the lowest seed yield was noticed with the irrigation every 28 days and fertilization with the rate of 60 kg N/ha. Oil yield/ha was significantly higher under irrigation every 7 or 14 days and fertilization with 120 and 180 kg N/ha. Great reduction in oil yield/ha was noticed with longer irrigation interval to 28 days and adding the lowest nitrogen level (60 kg N ha⁻¹). Data graphically depicted (Figures 1 and 2) show effects of the evaluated irrigation intervals and nitrogen fertilizer rates on water use efficiency, expressed as seed and oil yields. The highest WUE value was produced with the irrigation interval of 14 days, particularly in case of application the highest N rate (180 kg N ha⁻¹). However, the irrigation period of 7 days was associated with the lowest WUE in its corresponding N fertilizer rate. The difference in WUE with irrigating canola plants every 21 and 28 days did not reach the level of significant. Lower WUE with increasing irrigation interval more than 14 days (21 and 28 days) could be due to the decrease in seed and oil yields with increasing the drought period. Similar results were reported by Leilah and Al-Khateeb (2003) under the same conditions.

Table (6)

Effect of the interaction between irrigation treatments and nitrogen levels on seed and oil yields /ha (Combined means, over both seasons)

N levels	Seed yield (t/ha)				Oil yield (t/ha)			
	7 days	14 days	21 days	28 days	7 days	14 days	21 days	28 days
60 N	3.322	3.146	2.587	2.025	1.382	1.313	1.036	0.7801
120 N	4.124	4.101	2.936	2.559	1.668	1.641	1.122	0.9690
180 N	4.756	4.786	3.486	2.931	1.863	1.872	1.313	1.086
F.Test	**				**			
LSD (5%)	0.326				0.2762			

In conclusion, canola crop responded positively to shortening irrigation interval and increasing nitrogen fertilizer rate. A seed yield up to 4.786 t ha⁻¹ and oil yield up to 1.872 t ha⁻¹ can easily be obtained at 14 days interval irrigation with the application of 180 kg N ha⁻¹. The benefit of nitrogen application and irrigation intervals are integrated by greater seed and oil yields and higher WUE under the condition of this investigation.

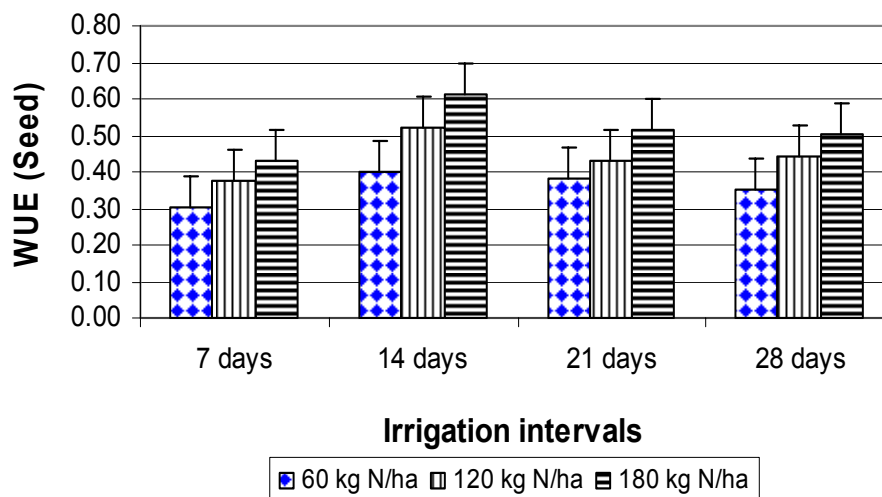


Fig. (1): Water use efficiency (kg seed/m³ water) for the evaluated irrigation treatments (Combined means, over both seasons). Bars = LSD (5%).

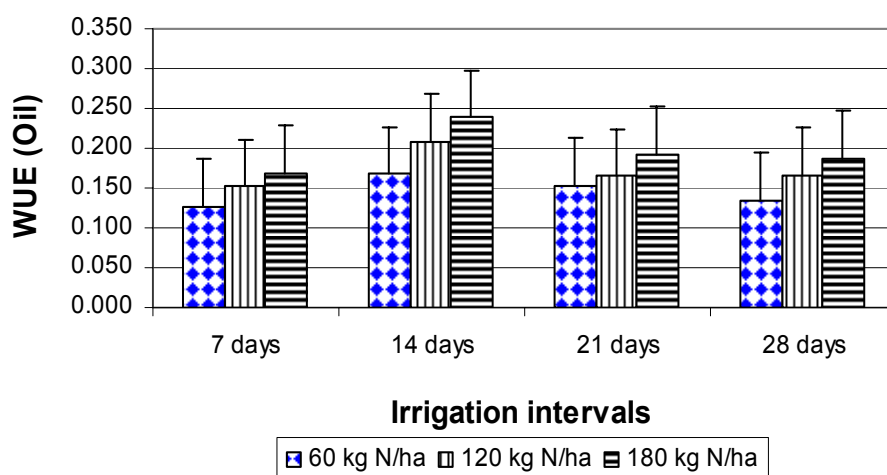


Fig. (2): Water use efficiency (kg oil/m³ water) for the evaluated irrigation treatments (Combined means, over both seasons). Bars = LSD (5%).

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تأثير فترات الريّ ومستويات النتروجين على نمو ومحصول الكانولا "صنف فيدو"

خالد بن محمد البراك

قسم الأراضي والمياه - كلية العلوم الزراعية والأغذية - جامعة الملك فيصل
الأحساء - المملكة العربية السعودية

الملخص :

نفذت تجربة حقلية لدراسة تأثير فترات الريّ ومستويات النتروجين على نمو ومحصول نبات الكانولا "صنف فيدو" في تربة طميية رملية خلال موسمي ٢٠٠١/٢٠٠٠ و ٢٠٠٢/٢٠٠١. وقد أشارت النتائج أن فترات الريّ أثرت معنوياً على جميع صفات النمو ومحصول الزيت والبدور، ماعدا نسبة الزيت في البذور. أدى الريّ كل ٧ أو ١٤ يوم إلى زيادة معنوية في طول النبات، قطر الساق، عدد القرون/نبات، عدد البذور/القرن، وزن بذور/ نبات بالإضافة إلى محصول الزيت والبذور/ هكتار. كما أظهرت النتائج أن معدلات التسميد النيتروجيني قد أحدثت تأثيراً معنوياً على جميع الصفات المقدره، ماعدا نسبة لزيت في البذور. وقد أدت إضافة بمعدلات عالية من النتروجين (١٢٠ - ١٨٠ كيلوغرام نيتروجين/ هكتار) إلى زيادة واضحة في جميع الصفات المقدره، ماعدا نسبة الزيت في البذور والتي قد أخذت الاتجاه العكسي. كما أشارت النتائج أن التفاعل بين فترات الريّ ومعدلات النيتروجين أثر معنوياً على محصول الزيت والبذور للهكتار. وقد أدت معاملة الريّ كل ٧ أو ١٤ يوم مع التسميد بمعدل ١٢٠ - ١٨٠ كيلوغرام نيتروجين/هكتار إلى الحصول على أعلى محصول للبذور والزيت. زادت كفاءة استخدام الماء معنوياً بالري على فترة ١٤ يوماً، وقد بلغت هذه الزيادة أقصاها مع الزيادة في معدل التسميد النيتروجيني (١٨٠ كجم ن/هكتار).

توصي الدراسة بري الكانولا كل ١٤ يوماً بمعدل ٦٥٠ م^٣ ماء / رية /هكتار و التسميد النيتروجيني بمعدل ١٢٠ - ١٨٠ كجم ن/هكتار للحصول على أعلى محصول من البذور والزيت ولرفع كفاءة استخدام ماء الري تحت ظروف منطقة الأحساء.