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EFFECT OF IRRIGATION INTERVALS ON GROWTH AND YIELD OF SESAME (*Sesamum indicum* L.) IN NORTHERN SUDAN

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Abstract: Field studies were conducted during 2003/04 and 2004/05 seasons at the Faculty of Agriculture Farm, Nile Valley University, Darmali, Northern Sudan. The water – use characteristics, performance and yield of sesame (*Sesamum indicum* L., var. Shuak) were investigated. Treatments consisted of three irrigation intervals (7, 14 and 21 days). Measured traits were number of leaves per plant, height above ground to first capsule, plant height, number of branches per plant, number of capsules per plant, 1000-seed weight and seed yield per unit area. Results revealed that, the number of leaves per plant was increased at 50% flowering and showed a significant ($p<0.01$) difference among irrigation intervals. Irrigation regime of 7-day interval gave the highest number of leaves (46-51) per plant. The mean height to first capsule was not significantly ($P< 0.01$) different due to irrigation intervals. Plant height was decreased with increasing irrigation intervals. While the number of branches per plant was increased with increasing length of irrigation intervals, number of capsules per plant on the other hand was decreased. 1000-seed weight was not significantly affected by irrigation intervals. However, applying irrigation interval of 7 days produced the highest seed yield (836-923 kg/ha) compared to other longer intervals.

Key words: Sesame, irrigation interval, seed yield.

Introduction

Sesame (*Sesamum indicum* L.) is the most important oil seed crop in Sudan; it is grown mainly in two farming systems, either traditionally or mechanized. The first is under traditional rainfed (350-800 mm) on the sand dunes of Kordofan and Darfur States, which contributes about 28% of the sesame production. The second is the mechanized rainfed system (400-800 mm) in Gedarif and Damazine clay plains and in Northern Upper Nile and contributes about 53% of the sesame (Abdalla and Abdel Nour, 2001).

Information on sesame irrigation is very scarce, mainly because it is seldom grown commercially under irrigation. This is not only applies to the gross amount of water required to produce a crop, but also to the rate of water absorption at various growth stages. Moreover, this is due in part to the very large number of local cultivars and their behavior under similar environmental conditions (Weiss, 1983). Sesame crops are generally more sensitive to water deficit at growth stages and the critical periods are when reproductive processes occur, also the effects of stress are dependent on the timing, intensity and duration of the stress period. The height of the first capsule and plant height were the greatest with irrigating at 15 days interval, whereas, irrigating at 20 or 30 days intervals increased the number of primary and secondary branches at harvest compared with 15 days interval (Ayyaswamy and Kulandaivelu, 1992).

Mitra and Pal (1999) concluded that summer sesame crop should be irrigated at branching, flowering and development stages. The crop yield can be increased by improving mobilization of assimilations to seeds and losses under limited supply of water can be minimized by providing irrigation during the reproductive phase (Yadav and Srivastava, 1997). Osman (1980) observed a high significant difference in all traits. Short watering intervals had been shown to give higher yields than long intervals on the predominant soil type. Mondal *et al.* (1997) reported that the plant height, number of capsules per plant, 1000-seed weight and seed yield increased as irrigation frequency and nitrogen fertilizer rates were increased.

Sesame has been introduced recently into Northern Sudan as a new crop, and will need more research and extension work to convince the local farmer community of its promising productivity under irrigation conditions. Hence, it is necessary to produce the maximum plant yield and profit from per unit area by developing the most suitable irrigation schedule for this ecological region. The crop rotation in Northern Sudan is unbalanced and farmers put more emphasis on the winter crops with limited agricultural activities during the summer season (Hamdan an Abdalla, 1999). Thus sowing sesame as an irrigated summer crop could fill this gap. Therefore, the objective of this study was to assess the production potential of sesame under different irrigation intervals in Northern Sudan.

Materials and Methods

The experiment was carried out during the 2003/2004 and 2004/2005 growth seasons, at the

Faculty of Agriculture Farm, Nile Valley University, Darmali, Northern Sudan (latitude 17°48 N, longitude 34° 00E and altitude 346.5 meter above sea level). The soil of the experimental plots was calcareous matrix strongly alkaline with low permeability to water and low in nitrogen and humus content (Table 1).

The experiment was designed to study the effect of applying different irrigation intervals on growth, yield and yield attributes of sesame. The Land was prepared by disc plough and disc harrow, leveled and ridged. The experiment was laid out in a randomized complete block design with four replications. Sesame Shuak variety was sown on the 1st of July 2003 in the first season and on 2nd. of July 2004 in the second season. It was irrigated three times for establishment before the start of the differential watering regime. The plot size was 4.2×7 m with six ridges and 70 cm spacing between ridges. The growing plants were thinned to specify the plant density and the crop was kept clean by hand weeding two and three weeks after sowing. Nitrogen was applied at the rate of 48 Kg/ha in two equal doses after third and fourth weeks from sowing date.

Collected data included number of leaves per plant with time to physiological maturity. Ten plants were randomly selected from harvest area for measurement of height above ground to first capsule, plant height, (soil surface to tip of growing point), number of branches per plant and number of capsules per plant. Seed yield per unit area (kg/ha) was obtained from the center rows of each plot leaving 1 m from both ends of the plots as margins. Harvesting was done manually by cutting at the soil surface. Then the harvest bound and air dried for twenty days and converted to seed yield per unit area and hence, 1000-seed weight was recorded.

Analysis of variance was used to test the significance of treatment effects. Least Significant Difference Test was used to compare treatment means using the computer program MSTAT-C (MSTAT-C, 1991).

Results

Results indicated that the number of leaves per plant was increased progressively with time and then declined towards maturity in both seasons. However, the number of leaves per plant was increased at 50% flowering and showed a significant ($p<0.01$) difference among irrigation intervals in both seasons (Fig.1). Irrigation every 7 day interval gave the highest number of leaves (51 and 46 per plant) compared to other intervals, in the 1st and 2nd seasons, respectively.

Table(1): Physical and chemical characteristics of soil in the experimental site

Determination	
Sand (%)	20.1
Silt (%)	21.3
Clay (%)	58.6
Organic carbon (%)	0.203
ECe	0.38
PH	8.8
Extractable N (ppm)	286
Extractable P (ppm)	2.4

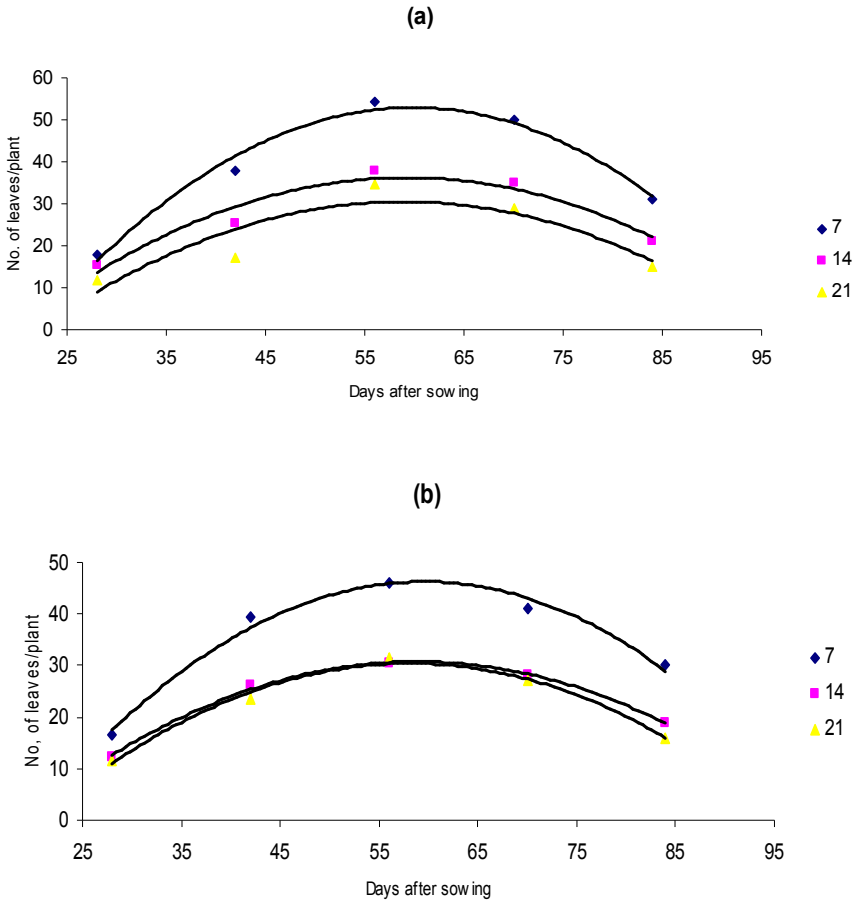

Fig.(1): Number of leaves per plant of sesame with time as affected by irrigation intervals (7, 14 and 21 days) grown during the 2003/04 (a) and 2004/05 (b) seasons in Northern Sudan.

While the mean height to first capsule was not significantly ($P< 0.01$) affected by irrigation intervals, a decrement in plant height above ground to first capsule was observed as irrigation interval was increased (Table 2).

Results in (Table 2) indicated that the mean plant height was significantly affected by applying different irrigation intervals. It was observed that plant height was decreased with increasing irrigation intervals and irrigating at 7 day interval gave significantly taller plants than other applied water regimes.

The number of branches per plant was significantly affected by irrigation intervals in both seasons (Table 3). The highest number of branches per plant was produced when the plants were irrigated at 14 day interval in the first season and at 21 day interval in the second one. It is observed that, there were no significant differences between 14 and 21 day intervals in both seasons.

The number of capsules per plant was significantly ($p\leq 0.001$) affected by irrigation intervals (Table 3). Increasing the length of irrigation interval reduced the number of capsules per plant and consequently, the highest number of capsules per plant (29.7) was recorded when the crop was irrigated every 7 days in both seasons.

In both research seasons, the differences on 1000-seed weight due to irrigation intervals were not significant ($p\leq 0.05$). The heaviest 1000-seed weight (2.62-2.74 g) was recorded when applying 7 day irrigation interval (Table 4) in both seasons.

Sesame seed yield was significantly ($P< 0.01$) affected by irrigation intervals. The 7 day irrigation regime gave the maximum seed yield (836-923kg/ha), while other intervals did not improve the seed yield (Table 4) in both seasons.

Discussion

Irrigating sesame plant at 7 day interval produced the tallest plants. This could be explained by moisture availability. Similar findings were reported by Ayyaswamy and Kulandaivelu (1992) and Subarhmaniyan and Arulomozhi (1998). The height to first capsule was reduced when applying longer irrigation intervals. The highest number of branches per plant was recorded when the crop was irrigated every 14 and 21 days. These results agreed with those obtained by Mitra and Pal (1999). Number of leaves per plant was significantly increased when irrigating at 7 day interval during vegetative growth until 50% flowering stage. The same trend was reported by Yadav and Srivastava (1997). The maximum number of capsules per plant was obtained when the crop was

Table(2): Effect of irrigation intervals on the plant height to the first capsule and plant height for sesame during two seasons.

Treatment	Season	
	٢٠٠٣/٠٤	٢٠٠٤/٠٥
Irrigation interval (Days)	Height to 1st capsule (cm)	
7	65.1	59.6
14	54.5	52.8
21	53.0	47.1
CV(%)	11.31	11.42
$LSD_{(0.05)}$	N.S	N.S
Irrigation interval (Days)	Plant height (cm)	
7	112.7	125.4
14	88.9	89.7
21	70.1	95.5
CV(%)	10.22	12.82
$LSD_{(0.05)}$	21.20	23.32

Table(3): Effect of irrigation intervals on number of branches and number of capsules/plant of sesame during two seasons.

Treatment	Season	
	٢٠٠٣/٠٤	٢٠٠٤/٠٥
Irrigation interval (Days)	Number of branches/plant	
7	2.6	2.0
14	3.6	2.7
21	3.3	3.0
CV(%)	11.10	12.00
$LSD_{(0.05)}$	0.525	0.531
Irrigation interval (Days)	Number of capsules/plant	
7	29.7	29.0
14	22,6	25.9
21	17.8	19.7
CV(%)	11.73	12.03
$LSD_{(0.05)}$	0.93	1.20

Table(4): Effect of irrigation intervals on 1000-seed weight and seed yield of sesame during two seasons.

Treatment	Season	
	٢٠٠٣/٠٤	٢٠٠٤/٠٥
Irrigation interval (Days)	1000-seed weight (g)	
7	2.62	2.74
14	2.31	2.58
21	2.40	2.57
CV(%)	6.17	7.07
$LSD_{(0.05)}$	0.24	N.S
Irrigation interval (Days)	Seed Yield (kg/ha)	
7	836	923
14	355	401
21	262	296
CV(%)	10.72	10.02
$LSD_{(0.05)}$	23.90	22.37

irrigated every 7 day and, consequently, this trait was decreased by longer irrigation frequencies. Similarly, it is observed that water stress adversely affected the growth and the number of capsules per plant in this study, and in that attended by Yadav and Srivastava (1997) and Duraisamy *et al*. (1999). The reduction in number of capsules per plant could be due to the effect of water stress during the reproductive phase. Using different irrigation intervals did not significantly affected 1000-seed weight. The minimum seed yield was obtained when the crop suffered from moisture stress as a result of longer irrigation intervals, and the stress adversely affected the growth and yield attributes and ultimately the seed yield.

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تأثير فترات الري على نمو ومحصول السمسم في شمال السودان

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أجريت هذه الدراسة خلال موسمي٢٠٠٣ /٠٤ و٢٠٠٤ /٠٥ بمزرعة كلية الزراعة جامعة وادي النيل بدار مالي، شمال السودان، هدفت هذه الدراسة إلى تقييم صنف السمسم شوك تحت تأثير ثلاث فترات مختلفة للرى (٧ ،١٤ و٢١ يوم). والقياسات التي تمّ دراستها شملت عدد الأوراق للنبات، ارتفاع أول كبسولة عن سطح التربة، طول النبات، عدد الفروع في النبات، عدد الكبسولات في النبات، وزن الألف حبة والمحصول لوحدة المساحة. أثرت فترات الرى تأثيرا معنويا في عدد الأوراق بالنبات وقد زادت عند ٥٠% من التزهير وأمكن الحصول على اعلي عدد من الأوراق عند الري كل ٧ أيام. لم يتأثر معنويا متوسط ارتفاع أول كبسولة من سطح التربة بفترات الرى كما أدت زيادة فترات الرى لنقصان في طول النبات. تم الحصول على اكبر عدد من الفروع في النبات عند الرى كل ١٤ و٢١ يوم كما ان زيادة طول فترة الرى أدى إلى نقص في عدد الكبسولات في النبات. لم يتأثر وزن الألف حبة معنوياً بفترات الرى وأعطت فترة الرى كل ٧ أيام أعلى محصول في وحدة المساحة.