J. of Plant Production, Vol. 1 (2): 251 - 264, 2010

PHENOLOGICAL AND PRODUCTIVITY CHARACTERISTICS OF SESAME (*Sesamum indicum* L.) AS AFFECTED BY NITROGEN RATES UNDER SANA'A CONDITIONS

Abdalsalam, A. A . and Y. A. Al-Shebani *
Dept.of Plant Protection (Botany and Plant Pathology), Fac. of Agric., Sana'a Univ., Yemen
*** Dept. of Agronmy and Pastures, Fac. of Agric., Sana'a Univ., Yemen**

ABSTRACT

Two field experiments were conducted during 2008 and 2009 cropping seasons at the Educational Farm, Faculty of Agriculture, Sana'a University. Phenological and productivity characteristics of two sesame (*Sesamum indicum* L.) cultivars under different nitrogen rates were investigated. The experiments were laid out in a split plot design with N levels of 0, 50, 100 and 150 kg N/ ha^{-1} assigned to the main plots and the two sesame cultivars (Kod-94 and Local) assigned to the subplots. The interaction effects between used nitrogen levels and cultivars were tested. Plants growth and development behavior was studied during the different periods from seedling to harvest time. Data indicated that increasing nitrogen rates by 0, 50 and 100 up to 150 kg N per hectare significantly increased growth of plant traits, yield/ha and yield components. Both tested cultivars of sesame differed significantly in number of leaves per plant, 1000 seed weight, length of capsule and oil percentage. Sesame cultivar Kod-94 was superior in yield/ha and yield components over sesame cultivar Local. Growth characters, yield/ha and yield components significantly enhanced the positive interaction between N fertilizer levels and sesame cultivars. The maximum value (1.26) seeds yield ton/ha and oil percentage (51.7%) were obtained when sesame cv. Kod-94 was fertilized by 150 kg N/ha. While, the lowest values of these two characters were recorded in plots with zero nitrogen whatever the sesame cultivar grown was. Data showed clearly that the local cultivar was very susceptible to powdery mildew, while sesame cv. Kod-94 was very resistant as no symptoms of the disease was recorded at all growth stages and with all nitrogen fertilizer treatments.

Keywords: Behaviour of Plants Growth, Cultivars, Nitrogen, Phenological characters, Productivity, Seed Yield, Sesame, *Sesamum indicum* L., Yield Components.

INTRODUCTION

Sesame (*Sesamum indicum* L.**)** is a major oil crop in Yemen and all over the world. The estimated yield of sesame on farmer's fields in Yemen is about 600 kg/ha, which is low as compared to 1083 kg/ha in Saudi Arabia, 1960 kg/ha in Venezuela, 1295 kg/ha in Nigeria (Okpara *et al.*, 2007) under experimental conditions. The total production is not sufficient for local consumption, sesame seeds crop has been considered as a source for fatty acids and oil. Therefore, efforts are focused on increasing productivity through growing high yielding cultivars and improving agricultural practices in sesame production areas. Factors that determine sesame production are numerous, among these nitrogen fertilization and used cultivar are essential factors. Studies on the effect of nitrogen fertilizer on sesame productivity showed that continued use of nitrogen fertilizers may result in increasing the production of sesame (Rao *et al.,* 1994). They also reported that cultivars and nitrogen fertilization factors limited the sesame yield. According to Ngeze (1998) the elongation of stem and leaves raises plant yield. Similarly, Ahmad *et al.* (2002) reported increase in yield and yield attributes of sesame with the application of 60 kg N/ha. In this respect, Olowe and Busari (2000) reported that the number of capsules per plant of sesame increased from 31 at 0 kg N/ha to 42 capsules with the application of 90 kg N/ha. They also found that the increase in plant height at maturity from 104.6 cm with 0 kg N per hectare to 122.9 cm with the application of 90 kg N per hectare. Similarly, Malik *et al.* (2003) reported a significant increase in the number of capsules per plant (97.88) with the application of 80 kg N per hectare, also. They observed a significant increase in seeds yield (0.794 t/ha) with the application of 80 kg N per hectare. Haggai (2004) reported an increase in the number of capsules from 18 to 44 with the application of 90 kg N per hectare (from 0 kg N/ha), also he reported an increase in seeds yield from 472 kg /ha with 0 kg N/ha to 779 kg/ ha with 90 kg per hectare. In the same trend, El Mahdi *et al.,* (2007) showed a significant effect on the number of branches, number of capsules per plant and seeds yield per unit area.

Low sesame crop yield /ha in Yemen is due to the fact that it is grown in the marginal lands, with low plant density, heavy weed infestation, non-availability of promising and improper fertilization of crop. Therefore, increase the seed production of sesame in Yemen is needed to fill the gap between production and consumption requirements. This could be achieved through increasing the area of sesame and the use of promising sesame cultivars. Sesame crop is not a part of the cropping system commonly encountered in the highlands of Yemen agriculture. Therefore, the present investigation aimed to study the suitability of various sesame cultivars and the effect of different nitrogen rates on morphological characters, yield components and seeds yield/ha under Sana'a conditions.

MATERIALS AND METHODS

A field experiment was conducted at the Educational Farm (latitude N, 45º 57^{min} 15^{sec} and longitude 53º 92^{min} 44^{sec} at E, at an altitude of 2265 m above sea level), Faculty of Agriculture, Sana'a University in the two successive seasons of 2008 and 2009. Each experiment included 8 treatments, which were the combinations of four N fertilization levels (0.0, 50, 100 and 150 kg N /ha) and two sesame (*Sesamum indicum* L.) cultivars (Kod-94 and Local). The experiment was laid out in a randomized complete block design with split-plot arrangement; nitrogen was assigned to main plots and cultivars in subplots. Nitrogen was applied as urea (46% N) after 1st irrigation (3 weeks after sowing). Net plot size was 2m x 3m (6 m^2) containing 5 rows (2m long and 60 cm apart). Sesame seeds of the two cultivars were seeded on 15 and 20 April in the first and second season, respectively. Thinning to two plant/hill was practiced 21 days from planting. The preceding crop was wheat and corn in the first and second cropping seasons, respectively. The agricultural practices usually recommended for sesame, except the experimental treatments, were performed. The crop of sesame was harvested manually at its physiological maturity in late September in 2008 and 2009 seasons. Samples of ten guarded plants were taken at random (from each plot for three replicates) to measure growth characters; namely plant height at maturity, number of primary and secondary branches per plant, number of leaves per plant, total number of capsule per plant, length of capsule and stem diameter at the middle of the main stem. In addition; at harvest, seed yield and its components were determined using the plants of three rows from each plot. Plants growth and development behaviour was studied during the different periods from seedling to harvest time. Determination of oil percentage, was determined by using Soxhlet apparatus and petroleum ether 40-60 ^{o}C as a solvent in the Laboratory of Food Science and Technology Department, Faculty of Agriculture Sana'a University according to A.O.A.C. (1988).

Powdery mildew disease assessment was recorded at first sign of disease symptoms, and action of fungicide spray was undertaken immediately three times with Anthrcol.

Data of each season were subjected to the statistical analysis of variance (ANOVA), and the combined analysis was performed according to (Steel and Torrie, 1980), using the split plot design method of MSTAT-C Program for Windows. Least significant difference (LSD) at 0.05 level of probability was used for the comparison between means.

RESULTS AND DISCUSSION

1. Sesame description:

In accordance of the vegetative growth of the two tested cultivars, after completion of seedling stage, which lasted for three weeks from sowing date, the plumule started its development to produce the shoot. The two cultivars under study are annual herbaceous plants, the stem is erect, solid, polygonal in shape at the cross section. It is green in colour and much branched. Growth of plants was relatively slow at the early growth stages, consequently, the basal internodes elongated and became distinct and plants continued their active growth. Accordingly, length of the main stem increased and the auxiliary buds at nodes of the lower portion of the main stem began to burst to give lateral branches of the first order in acropetal succession. Auxiliary buds at the primary branches actively developed into secondary branches. Lateral branches continued their elongation to reach their final length, then terminated in inflorescences. Noteworthy, that the actual height of the plant is referred to the main stem. The lateral branches have a major role in yield production since each of them terminates in an inflorescence.

In respect of leaves, during the vegetative growth stage of the two tested cultivars, the embryonic leaves; *i.e.*, the two cotyledons are brought above the ground after 7 to 8 days after sowing. It is important that, three types of foliage leaves are formed at successive stages of growth on the main stem and lateral branches. The basal leaves are having distinctive features, they are simple, petiolate, extipulate, the blade is tongue form, of opposite-decussate arrangement, venation pinately netted and margin entirely to denticulate. The following leaves at the median portion of the main stem and the lateral branches have their own features and form the major part of the leaves. These leaves are simple, petiolate, exstipulate, palmately lobes, opposite-decussate arranged, venation palmately netted and margin dentate. However, leaves formed at the upper portion of the main stem and the lateral branches are small in size and have characteristic features. They are simple, petiolate, exstipulate, the blade is lorate in shape, opposite to alternately arranged, venation pinately netted and margin entire.

The inflorescence formation in the two tested cultivars started when plants were 3 months old. The development of vegetative and reproductive organs continued parallel to each other. Flowers developed acropetally in racemes, which are white in colour and pistil 4-carpelled. Noteworthy, two nectar glands developed at base of the flowers, fruit is capsule, shortly stipulate, green in colour, a short beak formed at the upper part of the capsule. Noteworthy, this beak formed on the two lobes and scar black in colour at the apex and noticed only at the capsule of sesame cv. Kod-94 compared to the Local cultivar. At maturity the capsule dehisces from the apex to base of the two cultivars.

2. Effect of nitrogen rates:

2.1. Vegetative plant growth:

Data on the effect of nitrogen rates on plant height are presented in Table (1). Data indicate that plant height was significantly affected by tested nitrogen levels. Though no significant differences between 0, 50 and 100 kg N/ha treatments were detected, significant effect was observed in comparison with zero nitrogen (control) treatment and 150kg N/ha treatment. Nitrogen rates of 100 and 150 kg/ha did not significantly affect plant height trait. Data in Table (1) also reveal that the maximum plant height (143.00 cm) was recorded at 150 kg N/ha treatment, followed by 100 kg N/ha treatment (135.67 cm). The least plant height (132.25 cm) was given by the control treatment. Due to application of nitrogen, the increase in plant height might be attributed to the stimulation effect of nitrogen on internodes elongation during vegetative growth. such results are in conformity with the findings of Majumdar *et al*. (1987); Malik *et al.* (1988); Sinharoy *et al.* (1990); Devasagayam and Jayapaul (1997); Ashfaq *et al.* (2001) ; Asghar Malik *et al.* (2003) and Muhamman and Gungula (2008) in which they all reported that plant height significantly increased with increasing levels of nitrogen. In contrastingly, Odeny *et al.* (1994) in Kenya stated that N application did not significantly affect plant height.

The effect of N treatment on number of primary and secondary branches per plant and stem diameter (Table, 1) was significant. The differences detected within 50, 100 and 150 nitrogen levels/h treatments were insignificant, but it was significant only within any of them and the control treatment. The highest number of primary and secondary branches per plant (14.00 and 16.54, respectively) were recorded in treatment of 150 kg N/ha. While the least values of these traits (8.25 and 9.00, respectively) were produced by zero nitrogen check. Similarly, data also reveal that the highest stem diameter (1.01 cm) was recorded in case of 150 kg N/ha treatment, followed by 0.98 cm given by 100 kg N/ha treatment. While the control showed the least stem diameter (0.83 cm). Increasing N fertilizer levels from 50 to 100 and 150 kg N/ha significantly increased number of primary branches per plant by 49.79, 61.31 and 69.80%, respectively compared with unfertilized treatment as well as by 27.85, 12.12 and 83.88%, with using 50, 100 and 150 kg N/ha, respectively for the number of secondary branches per plant, being 7.23, 18.07 and 21.69%, respectively for stem diameter at the same respective nitrogen levels.

Table (1): Effect of nitrogen fertilization levels, cultivars and their interaction on sesame vegetative growth characters (Average of 2008 and 2009 seasons)

Factors		Growth characters				
		Plant height (cm)	No. of primary branches per plant	No. of secondary branches per plant	No. of green leaves per plant	Stem diameter (cm)
Cultivars:						
	Kod-94	136.71	12.74	11.71	61.87	0.934
	Local	135.29	11.21	11.86	59.67	0.914
L.S.D. at 5%		**N.S**	**N.S**	**N.S**	**1.29**	**N.S**
Nitrogen levels (kg/ha):						
	0	132.25	8.25	9.00	52.17	0.83
	50	133.08	12.35	11.50	60.42	0.89
	100	135.67	13.30	10.09	63.58	0.98
	150	143.00	14.00	16.54	66.92	1.01
L.S.D. at 5%		**8.91**	**2.37**	**7.19**	**3.15**	**0.14**
Effect of interaction:						
Kod-94 cultivar	**0**	132.17	7.66	10.16	53.33	0.80
	50	136.33	13.70	12.00	62.50	0.87
	100	134.17	14.60	7.34	62.83	1.03
	150	144.17	15.00	17.32	68.83	1.04
Local cultivar	**0**	132.33	8.83	7.83	51.00	0.86
	50	129.83	11.00	11.00	58.33	0.90
	100	137.17	12.00	12.83	64.33	0.93
	150	141.83	13.00	15.76	65.00	0.97
L.S.D. at 5%		**12.61**	**3.36**	**10.16**	**4.46**	**0.10**

Such increase in number of primary and secondary branches per plant might be attributed to the effect of N on increasing the vegetative growth, photosynthetic accumulation, meristematic activity of sesame plants tissues and consequently the increases of number of branches per plant.

The increase in stem diameter due to the increase of N levels is attributed to the stimulation effect of nitrogen on stem internodes structure during the vegetative growth, as well as on enhancing and accelerating the rate of stem cell division and enlargement. Also, increasing nitrogen levels increased accumulation of carbohydrates in stem internodes during the vegetative growth period before flowering. This is the result of increasing photosynthetic products manufactured and translocated from leaves to stem and roots. These results are similar to those of Sinharoy *et al*. (1990) and Tiwari *et al.* (2000); El-Mahdi *et al.,* (2007) and Muhamman and Gungula, (2008) for number of primary and secondary branches per plant. In regard to number of leaves per plant, results indicated that number of leaves per plant differed significantly at tested nitrogen levels. Noteworthy, increasing N levels from 50 to 100 and 150 kg N/ha over the control treatment significantly increased number of leaves per plant by 15.81, 21.87 and 28.27%, respectively. Maximum number of leaves per plant (66.92) was produced at the nitrogen level of 150 kg N/ha, followed by100 kg N/ha which produced 63.58 leaf per plant. Minimum number of leaves per plant (52.17) was recorded in control treatment. Also, Muhamman and Gungula (2008) reported that number of leaves per plant was significantly increased due to increasing nitrogen levels. In the same trend, Muhamman *et al.* (2009) showed that application of N significantly affected some growth characters such as number of leaves per plant at harvest. Moreover, results showed that application of N had a positive effect on number of leaves per plant which indicated the vital role of N on plant growth.

2.2. Yield characteristics:

Results of the effects of N levels, sesame cultivars and their interaction on yield components are presented in Table (2). Number of capsules per plant was significantly affected by application of nitrogen levels. Moreover, 50 and 100 kg N/ha showed insignificant effect on number of capsules per plant. However, increasing N fertilizer levels from 50 to 100 and 150 kg N/ha over the control treatment significantly increased number of capsules per plant by 70.16, 94.22 and 135.38%, respectively. Maximum number of capsules per plant (163.00) was set at the nitrogen level of 150 kg N/ha, followed by134.50 capsules given at 100 kg N/ha dose. On the other hand, data indicated that number of capsules per plant was markedly decreased (69.25 capsule) when no N fertilization was applied. It is evident that the role of N as an essential element in formation of sesame number of capsules per plant due to its effect on number of lateral branches per plant, which produced greatly bud fruit and to its positive effect on plant growth. Data obtained are in line with those reported by Sharma and Kewat (1995); El-Emam *et al.* (1998); Asghar Malik *et al.* (2003) and Muhamman *et al.* (2009) who showed that application N significantly affected number of capsules per plant at harvest.

Results presented in Table (2) reveal that there was a significant effect with N rates application on yield per capsule and per plant as well as on 1000-seed weight. For seeds yield per capsule and per plant insignificant differences were revealed between either 0.00 and 50 kg N/ha or 100 and 150 kg N/ha. On the other hand, seeds weight per capsule increased significantly over the check (6.00, 16.37 and 14.60%) by applying 50, 100 and 150 kg N/ha weight of treatment, respectively. Yield of seeds per plant was 29.08, 49.36 and 71.15%, for the three rates of nitrogen, respectively. Maximum seeds yield per capsule and per plant (0.427 and 61.20 gm) were produced when nitrogen was applied at the rate of 100 kg N/ha and 150 kg N/ha, respectively. Minimum seeds yield per capsule and per plant (0.367 and 35.76 gm respectively) were produced in case of zero N (control treatment).

Increases of 1000-seeds weight at 46.81, 68.69 and 97.43%, respectively over the control treatment by the three N levels were detected. The highest 1000-seed weight (4.887 gm) was recorded in 150 kg N/ha treatment, followed by 4.175 gm produced at 100 kg N/ha treatment. While control gave the least 1000-seed weight (2.475 gm).

These results are in line with those reported by Mankar *et al*. (1995) who found that 1000-seed weight increased with increasing rate of nitrogen, and is attributed to the effect of nitrogen fertilization on dry matter formation stored in seeds. It is well known that increasing nitrogen levels increased total dry matter production as a result of better vegetative growth and higher photosynthetic rates. Similar findings were reported by Deshmukh *et al.* (1990) and Sinharoy *et al*. (1990) who found that seeds yield per capsule as well as per plant increased with increasing N levels up to 120 kg N/ha. Moreover, in India the heaviest seed yield was obtained by adding 60 kg N/ha (Majumdar *et al*., 1987), 80 kg N/ha (Asghar Malik, 2003), and 120 kg N/ha (Deshmukh *et al.*, 1990). Concerning the effect of the N levels on capsule length, data in Table (2) indicate that applying 50, 100 and 150 kg N/ha significantly increased length of capsule over the control treatment by 13.16, 16.53 and 24.69%, respectively.

On the other hand, the treatment 150 kg N/ha produced maximum length of capsule (3.407 cm), followed by 3.184 cm given at 100 kg N/ha treatment. Minimum capsule length (2.732 cm) was noted in case of N_0 (control) treatment. Such increase might be attributed to increase of cell division and elongation activities of sesame fruits bud. In Egypt, El-Emam *et al.* (1998) found that the length of fruiting zone increased as N level increased from 30 to 60 kg N/feddan.

Yield characteristics as shown in Table (3) display that there was significant effect with N rates application on harvest index (%), biological yield per hectare, straw yield per hectare, capsules yield per hectare, oil percentage (%) and seeds yield per hectare. Data in Table (3) clearly indicate that increasing nitrogen fertilization levels from 50 and 100 up to 150 kg. Nha significantly increased harvest index by 43.93, 46.82 and 72.99%, respectively over the unfertilized treatment, being 55.68, 83.75 and 110.05%, for the three respective nitrogen levels with respect to biological yield were given. Therefore, straw yield significantly increments were 19.59, 40.69 and 32.01% at the same respective nitrogen levels. Nitrogen fertilizer levels used (50, 100 and 150 kg N/ha) did not significantly affect the harvest index and straw yield/ha. In the same trend, results in Table (3) show that 0.0 and 50 kg N/ha treatments did not show significant differences on straw yield/ha.

Furthermore, the maximum harvest index (42.310%) and biological yield (2.832 t/ha) were produced at the nitrogen level of 150 kg N/ha, followed by 35.910% harvest index and 2.477 t/ha biological yield given at100 kg N/ha. While, minimum harvest index (24.458%) and biological yield (1.348 t/ha) were given by control treatment. Maximum straw yield (1.30 t/ha) was produced by 100 kg N/ha treatment, however, the minimum straw yield (0.92 t/ha) was noted in case of N_0 (control treatment).

Table (2): Effect of nitrogen fertilization levels, cultivars and their interaction on yield components of sesame plants (Average of 2008 and 2009 seasons)

Factors		Yield components				
		No. of capsules per plant	Seeds yield per capsule (gm)	Seeds yield per plant (gm)	1000 seed weight (gm)	Length of capsule (cm)
Cultivars:						
	Kod-94	122.42	0.42	52.22	4.09	3.24
	Local	119.88	0.38	46.05	3.49	2.97
L.S.D. at 5%		**N.S**	**N.S**	**0.36**	**1.227**	**0.547**
Nitrogen levels (kg/ha):						
	0	*69.25*	0.367	35.760	2.475	2.732
	50	*117.84*	0.389	46.160	3.634	3.092
	100	*134.50*	0.427	53.410	4.175	3.184
	150	*163.00*	0.420	61.205	4.887	3.407
L.S.D. at 5%		**21.920**	**0.039**	**5.831**	**1.415**	**0.514**
Effect of interaction:						
Kod-94 cultivar	**0**	81.50	0.403	37.38	2.675	2.897
	50	115.50	0.427	46.57	3.542	3.133
	100	129.50	0.450	59.67	4.575	3.290
	150	163.17	0.417	65.24	5.573	3.630
Local cultivar	**0**	57.00	0.330	34.14	2.275	2.567
	50	120.17	0.350	45.75	3.725	3.050
	100	139.50	0.403	47.15	3.775	3.077
	150	162.83	0.423	57.17	4.200	3.183
L.S.D. at 5%		**31.00**	**0.056**	**0.72**	**0.727**	**0.125**

Table (3): Effect of nitrogen fertilization levels, cultivars and their interaction on yield characters of sesame plants (Average of 2008 and 2009 seasons)

Factors		Yield characters					
		Harvest index (%)	Biological yield ton per hectare	Straw yield ton per hectare	Capsules yield ton per hectare	Oil (%)	Seeds yield ton per hectare
Cultivars:							
	Kod-94	36.911	2.208	1.07	1.139	47.5	0.84
	Local	32.029	2.170	1.20	0.970	45.7	0.72
L.S.D. at 5%		**N.S**	**N.S**	**N.S**	**N.S**	**0.731**	**N.S**
Nitrogen levels (kg/ha):							
	0	24.458	1.348	0.92	0.425	44.0	0.32
	50	35.202	2.099	1.10	0.995	45.7	0.74
	100	35.910	2.477	1.30	1.182	46.6	0.88
	150	42.310	2.832	1.22	1.617	50.2	1.20
L.S.D. at 5%		**7.682**	**0.375**	**0.35**	**0.119**	**0.319**	**0.08**
Effect of interaction:							
Kod-94 cultivar	**0**	27.163	1.153	0.75	0.397	44.4	0.29
	50	38.720	2.150	1.03	1.123	46.8	0.83
	100	37.113	2.697	1.36	1.337	47.2	0.99
	150	44.647	2.830	1.13	1.700	51.7	1.26
Local cultivar	**0**	21.753	1.543	1.09	0.453	43.6	0.34
	50	31.683	2.047	1.18	0.867	44.7	0.64
	100	34.707	2.257	1.23	1.027	45.9	0.76
	150	39.973	2.833	1.30	1.533	48.6	1.13
L.S.D. at 5%		**10.860**	**0.530**	**0.49**	**0.168**	**1.034**	**0.125**

The effect of N on harvest index is the outcome of its effect on number of capsules per plant, yield per capsule and per plant as well as 1000-seed weight and seeds yield per hectare. It could be concluded that N is the most essential nutritive element for sesame plant growth. It is quite clear that increasing N fertilization levels from 50 to100 and 150 kg N/ha significantly increase capsules yield/ha by 134.12, 178.12 and 280.35%, respectively in comparison with the check (control) treatment (Table 3). The increase in seeds yield by 133.81, 177.78 and 279.84%, respectively over the control treatment for the three respective nitrogen levels also was noticeable. On the other hand, maximum seeds yield (1.20 t/ ha) and yield of capsules (1.617 t/ha) were produced by 150 kg N/ha treatment, followed by 0.88 t/ha and 1.1882 t/ha seeds yield and capsules yield, respectively given by 100 kg N/ha treatment. Minimum seeds yield (0.320 t/ha) and capsules yield (0.425 t/ha) were only noted in case of N_0 (control) treatment. Such effect of nitrogen fertilization on seeds and capsules yield per unit area was due to its positive effect on plant height, capsule length, seeds yield per capsule and per plant and totally affecting 1000- seed weight. Moreover, the positive response to nitrogen levels is due to the fact that nitrogen has the most profound effect on the development of the vegetative parts of plant. Consequently, the beneficial effect of increasing supply of nitrogen on seeds and capsules yield is due to better growth of capsules, increase number of capsule per plant and larger size of sesame seeds since nitrogen is one of the most important components of cytoplasm, nucleic acid and chlorophyll. Increase in seeds yield with increasing level of nitrogen has been reported by Parihar *et al*. (1999); Olowe and Busari (2000); Tiwari *et al*. (2000); Asghar Malik (2003) and El Mahdi *et al.,* (2007). Concerning seeds yield and capsules yield per hectare, similar trend are observed in India by Sarma and Kakati (1993); Sarma (1994); Ashok *et al.* (1996) and Dutta *et al.* (1996). Also, the increase in harvest index as a result in increasing nitrogen level was observed by Ashfaq *et al*. (2001). On the contrary, Muhamman *et al*. (2009) showed that application of N insignificantly affected both capsules and seeds yield/ha.

A perusal of Table (3) exhibits that different nitrogen levels significantly affected seed oil percentage at all nitrogen doses given as increases in oil percentage of 3.94, 5.87 and 14.02%, respectively over the control for the three respective N levels were detected. Nitrogen level of 150 kg N/ha produced the highest significant oil percentage (50.15 %), followed by 46.57 % given at the level 100 kg N/ha. Meanwhile, minimum oil percentage (44.00 %) was noted in case of N_0 (control) treatment. Moreover, these results indicate clearly that the role of N is a major nutritive element for sesame plants. It is known that N is a constituent of nucleic and fatty acids and phospholipids, therefore, nitrogen fertilizer played actual role in promoting oil quantity. Such favorable effects of N fertilizer on seeds yield/ha could be attributed to the stimulation effect of nitrogen on number and weight of capsules per plant as well as 1000-seeds weight and oil quantity. These results are in accordance with those given by Tiwari *et al.,* (2000) and Asghar Malik (2003) who reported an increase in seed oil content with the increase of nitrogen application rate, while in contrary with those of Cheema *et al*. (2003) who recorded a decrease in seed oil content with increasing rate of nitrogen.

3. Effect of cultivars:

Data on the effect of cultivars on vegetative and yield components are tabulated in Tables 1, 2 and 3. Data reveal that cultivars differed insignificantly in plant height, number of primary and secondary branches per plant as well as stem diameter (Table 1). Also, data showed that cultivars differed significantly in number of green leaves per plant. Sesame cultivar Kod-94 revealed the highest values of vegetative growth traits in comparison with the Local cultivar. Odeny *et al.* (1994); Devasagayam and Jayapaul, (1997) and El Mahdi *et al.* (2007) reported significant differences among cultivars concerning plant height, number of primary and secondary branches per plant.

Results presented in Table (2) show that cultivars differed significantly in 1000 seed weight, capsule length and seeds yield per plant. In contrast, cultivars differed insignificantly in yield of seeds per capsule and number of capsule per plant, but El Mahdi *et al.* (2007) showed that cultivars significantly varied in number of capsules per plant as well as 1000-seed weight. However, results revealed that the least values of yield of seeds per capsule and per plant, 1000-seed weight and capsule length were observed on Local cultivar, while the greatest values of these traits were recorded on sesame cultivar Kod-94. The differences among the studied cultivars in 1000-seed weight, seeds yield per plant and length of capsule could be attributed to the definite genetically differences between the two cultivars under study. On the other hand, the differences between cultivars in 1000-seed weight and length of capsule were observed by Odeny *et al.* (1994) in Kenya and Ashfaq *et al.* (2001). In this respect, in Egypt, El-Emam *et al.,* (1998) found that Giza-32 and B-32 promising line did not show significant difference.

Furthermore, yield characteristics given in Table (3) indicate that cultivars differed insignificantly in harvest index, biological yield/ha, straw yield/ha, capsules yield/ha and seeds yield/ha. Moreover, results indicated that cultivars differed significantly more in oil percentage (%) produced. Similar trend, has been reported in Kenya by Odeny *et al.* (1994). Conversely in Egypt, El-Emam *et al.* (1998) found that genotypes of sesame plant were not significantly different in characters studied, but El Mahdi *et al.* (2007) showed that cultivars of sesame significantly varied in seeds yield per hectare.

The differences between sesame cultivar Kod-94 and the Local one may be due to the differences between cultivars in partitioning and migration of photosynthates among plant organs (Ahmad *et al.,* 2002) Moreover, data obtained are in full agreement with those given by El-Karamany *et al.* (2000) , Abdul Galil and Mowafy (2003) on sesame. In addition data in Table (3) show that sesame cultivar Kod-94 significantly surpassed the local cultivar in some growth yield and yield characters.

4. Cultivars powdery mildew disease reaction:

Observations on powdery mildew cultivars reaction showed that the local cultivar reaction was very susceptible to powdery mildew at a range of 60-75% capsules set. Sesame cultivar Kod-94 showed to be very resistant as no sign of powdery mildew infection was recorded at all growth stages and with all treatments.

5. Interaction effects:

Data in Table (1) indicate that the effect of interaction between N levels × cultivars on growth of plant characters was significant. Therefore, the maximum plant height (144.17 cm), number of primary branches per plant (15.00), secondary branches per plant (17.32), number of leaves per plant (68.83) and stem diameter (1.04 cm) were obtained by sesame cultivar Kod-94 when fertilized with application of 150 kg N/ha. Data also showed that all yield component significantly responded to the interaction between N fertilization levels × cultivars. Greatest capsules number per plant (163.1), yield of seeds per plant (65.24 gm), 1000 seed weight (5.573 gm) and length of capsule (3.63 cm) were obtained when sesame cultivar Kod-94 was fertilized by 150 kg N per hectare. However, the treatment of 100 kg N/ha with sesame cultivar Kod-94 produced maximum seeds yield per capsule (0.45 gm). It is noteworthy to mention that minimum number of capsules per plant (57.00), yield of seeds per capsule (0.33 gm), seeds yield per plant (34.14 gm), 1000 seed weight (2.275 gm) and length of capsule (2.567 cm) were produced by the local cultivar when fertilized with N_0 (control) treatment.

Data in Table (3) show the significant effect of the interaction between N levels × cultivars on yield traits. Therefore, the highest harvest index (44.647%), biological yield (2.830 t/ha), capsules yield (1.700 t/ha), oil percentage (51.70%) and seeds yield (1.26 t/ha) were clearly observed when sesame cultivar Kod-94 was fertilized with the application of 150 kg N/ha. Moreover, the treatment 100 kg N/ha with sesame cultivar Kod-94 produced maximum straw yield (1.30 t/ha) at the same rate of fertilizer. Meanwhile, the lowest values of these characters were recorded in the unfertilized plots whatever the two cultivars were.

REFERENCES

Abdul Galil, A.A. and S.A.E. Mowafy (2003). Yield potentiality of sesame as affected by farmyard manuring and nitrogenus fertilization under sandy soil conditions. J. Agric. Sci. Mansoura Univ. 28 (5): 3299-3315.

Ahmad, R.; T. Mahmood; M. Farrukh Saleem and S. Ahmad (2002). Comparative performance of two sesame (*Sesamum indicum* L.) varieties under different row spacing. Asian Journal of plant Sciences. 1 (5): 546-547.

A.O.A.C. (1988). Official Methods of Analysis. 21st Ed. Association of Official Analysis Chemists, Washington, D.C., U.S.A.

Asghar Malik, M.; S.M. Farrukh; A. C. Mumtaz and A. Shamim (2003). Influence of different nitrogen levels on productivity of sesame (*Sesamum indicum* L.) under varying planting. International J. of Agric. and Biology. 1560–8530/05-4 : 490-492.

Ashfaq, A. ; A. Mahboob; E. Abid Hussain and M. Musaddique (2001). Genotypic response of sesame to nitrogen and phosphorus application . Pak. J. Agri. Sci. fiJl. 38 (1-2).

Ashok, K.; T.N. Prasad; U.K. Prasad and A. Kumar (1996). Effect of irrigation and nitrogen on growth yield, oil content, nitrogen uptake and water-use of summer sesame (*Sesamum indicum* L.).Indian J. of Agron. 41 (1): 111-115.

Cheema , M.A.; A. Ali; M.F. Saleem and M. Din (2003). Interactive effects of nitrogen and sulphur on growth, seed yield and oil quality of canola. Pakistan J. life Soc. Sci. 1: 9–12

Deshmukh, V.A.; D.A. Chavan and G.T. Sugave (1990). Response of sesame (*Sesamum indicum* L.) to nitrogen and phosphate. Indian J. of Agron. 35(3) : 314.

Devasagayam, M.N. and Jayapaul (1997). Influence of varieties of sesame on Nyse efficiency and apparent N recovery. Sesame and Safflower Newsletter, (12): 4-50.

Dutta, D.; G. Sovnda; P.K. Panda and P. Ghosh (1996). Responses of N and P on oil yield of sesame and economics of fertilizer application. Environment and Ecol. 14 (4): 777-778.

EL-Emam, M.; S.T. EL-Serogy and B.A. EL-Ahmer (1998). Effect of N K levels on economic characters of sesame (*Sesamum indicum* L.). Sesame and Safflower Newsletter. (13): 101-107.

El-Karamany, M.F.; M.O. Kabesh; M. K. Ahmed and A.B. Amany (2000). Utilization of biofertilizers in field crop production. 13-Effect of organic manuring, chemical and biofertilizerson yield nutrient content of sesame grown in newly reclaimed soil. Egypt. J. Appl. Sci. 15 (15): 137-155.

EL Mahdi A.A.; M.E. Saif Eldin and G. A. Faisl (2007). Effect of sowing date on the performance of sesame (*Sesamum indicum* L.) genotypes under irrigation conditions in northern Sudan. African Crop Science Conference Proceedings Vol. 8. p. 1943-1946. Egypt.

Haggai P. T. (2004). Effects of nitrogen and phosphorous application on yield attributes and seed yield of sesame (*Sesamum indicum* L.) in Northern Guinea savanna of Nigeria. Proceedings of 38th Annual Conference of the Agricultural Society of Nigeria (ASN). Lafiya, Nasarawa State, Nigeria. p 150-157.

Majumdar, S.K.; K.C. Barik; P.S. Bera and D.C. Ghosh (1987). Growth and yield of sesame as influenced by nitrogen and potassium nutrition. Fertilizer News 33 (3): 41-43.

Malik, M.A.; G. Abbas; Z.A. Cheema and K.H. Hussani (1988). Influence of NPK on growth yield and quality of sesame (*Sesamum indicum* L.). J. Agric. Res. 26: 59–1.

Malik, A M.; M. F. Saleem; M. A. Cheema and S. Ahmed (2003). Influence of different nitrogen levels on productivity of Sesame (*Sesamum indicum* L.) under varying planting patterns. International Journal of Agriculture and Biology. 4:490-2.

Mankar, D.D.; R.N. Satao; V.M. Salanke and P.G. Ingole (1995). Effect of nitrogen and phosphorous on quality, uptake and yield of sesame. PKV. Res. J. 19: 69–70.

Muhamman, M.A. and D.T. Gungula (2008). Growth parameters of sesame (*Sesamum indicum* L.) as affected by nitrogen and phosphorous levels in Mubi. Nigeria. J. of Sustainable Development in Agriculture and Environment. 3(2):80-86.

Muhamman, M. A.; D. T. Gungula and A. A. Sajo (2009). Phonological and yield characteristics of sesame (*Sesamum indicum* L.) as affected by nitrogen and phosphorous rates in Mubi, northern Guinea savanna ecological zone of Nigeria. Emir. J. Food Agric. 21 (1): 01-09

Ngeze, P. B. (1998). Artificial Fertilizers and How to Use Them. Stantex Publishers, Nairobi, Kenya and CTA. 55pp.

Odeny, D.A.; J.O. Nyabundis and P.O. Ayiecho (1994). Effect of N and P fertilization on sesame (*Sesamum indicum* L.) yield and yield components. Sesame and Safflower Newsletter, (9): 12-17.

Okpara, D. A.; C. O. Muoneke and T. O. Ojikpong (2007). Effects of nitrogen and phosphorous fertilizer rates on the growth and yield of sesame (*Sesamum indicum* L.) in the southeastern rainforest belt of Nigeria. Nigerian Agricultural Journal. 38:1-811.

Olowe V. I. O. and L. D. Busari (2000). Response of sesame (*Sesamum indicum* L.) to nitrogen and phosphorous application in southern Guinea savanna of Nigeria. Tropical Oilseed Journal. p. 30–37.

Parihar, S.S.; D. Padey and R.K. Shukla (1999). Response of summer seasame (*Sesamum indicum* L.) to irrigation schedule and nitrogen level in clay loam soil. Int. J. Trop. Agric. 17: 189–3.

Rao, V.P.; S.V. Raikhelkar and V.D. Sondage (1994). Nutrient uptake and fertilizer use efficiencies in sesame (*Sesamum indicum* L.) as influenced by irrigation and fertilization. Ann. of Agri. Res. 15(5): 280-285.

Sarma, N.N. and N.N. Kakati (1993). Response of summer sesame (*Sesamum indicum* L.) to levels of nitrogen and spacings. Indian J. of Agron., 38 (4); 659-661.

Sarma, N.N. (1994). Response of sesame (*Sesamum indicum* L.) varieties to levels of nitrogen and spacing. Ann. of Agric. Res. 15 (1): 107-109.

Sharma, R.S. and M.L. Kewat (1995). Response of sesame to nitrogen. JNKVV. Res. J. 27: 129–30

Sinharoy, A.; R.C. Samui; A.K. Ahasan and B. Roy (1990). Effect of different sources and levels of nitrogen on yield attributes and yield of sesame varieties. Environment and Ecology. 8 (1A): 211-215.

Steel, R.G.D. and J.H. Torrie (1980). Principles and Procedures of Statistics: A Biometrical Approach. 2nd ed. McGraw-Hill Book Company, N.Y., U.S.A.

Tiwari, R.K.; K.N. Namdeo; J.A. Girish and G. Jha (2000). Effect of nitrogen and sulphur on growth, yield and quality of sesame (*Sesamum indicum* L.) varieties. Res. Crops. 1: 163–7.

الصـفات المورفولوجيـة والإنتاجيـة للسمسـم (*Sesamum indicum* L.) المتأثرة بالتسميد النتروجيني تحت ظروف صنعاء

عبد الله أمين عبد السلام و يوسف أحمد الشيباني*
قسم وقاية النبات (النبات وأمراض النبات) ـ كلية الزراعة ـ جامعة صنعاء- اليمن
*** قسم المحاصيل والمراعى- كلية الزراعة ـ جامعة صنعاء- اليمن.**

أجريت تجربة حقلية في المزرعة التعليمية التابعة لكلية الزراعة ـ جامعة صنعاء (اليمن) خلال موسمي ٢٠٠٨ و ٢٠٠٩م لدراسة تأثير أربعة مستويات من التسميد النتروجيني (صفر و ٥٠ و ١٠٠ و١٥٠ كجم ن/ هكتـار) وصـنفين مـن السمسـم (كـود – ٩٤ وبلـدي) والتفاعـل بينهمـا علـى صـفات النمـو والمحصـول ومكوناته. تم تتبع ودراسة سلوك نمو النباتات خلال فترات النمو المختلفة منذ ظهور البادرات وحتى الحصاد، اشـتملت الدراسـة علـى ثمـانى معـاملات وهـي عبـارة عـن التوافيـق بـين عـاملي الدراسـة (أربعـة معـدلات نيتروجين× صنفين من السمسم). نفذت التجربة بتصميم القطاعات كاملة العشوائية ذو قطع منشقة في ثلاثة مكررات, وخصصت القطع الرئيسية لمستويات التسميد النتروجيني بينما وزّعت الأصناف النباتية في القطع المنشقة. كانت مساحة القطعة التجريبية ٦ م٢ واحتوت القطعة التجريبية الواحدة على خمسة خطوط المسافة بينها ٦٠ سم.

وتتلخص أهم نتائج الدراسة من التحليل التجميعي للموسمين فيما يلـــي:

بصفة عامة أظهرت النتائج المتحصل عليها أن زيادة مستويات التسميد النتروجيني صفر إلى ٥٠ و ١٠٠ و ١٥٠ كجم ن/هكتار أدت إلى زيادة قيمة كل من صفات النمو والمحصول ومكوناته زيادة معنوية.

أثر صنفى السمسم تأثيراً معنوياً فقط على صفات عدد الأوراق/ نبات ووزن ١٠٠٠ بذرة وقطر الثمرة ونسبة محتوى البذور من الزيت. كما تشير النتائج المتحصل عليها أنه كان للتداخل بين عاملي الدراسة (مستويات التسميد النتروجيني والأصناف) تأثيراً معنوياً على جميع الصفات تحت الدراسة (صفات النمو والمحصول ومكوناته). بينما أدت زراعة نباتات السمسم عند استخدام المعاملة الصنف كود-٩٤ مع التسميد بالمعدل ١٥٠ كجم نيتروجين/ هكتار إلى الحصول على أعلى القيم لصفات النمو والمحصول ومكوناته، وقد بلغت أعلى قيمة محصول البذور (١.٢٦ طن/ هكتار) ونسبة الزيت (٥١.٧٠%) عند استخدام نفس المعاملة.

أظهرت النتائج المتعلقة بتفاعل الصنفين تحت الدراسة مع مرض البياض الدقيقي, أن الصنف المحلي حساس جداً للإصابة، بينما الصنف كود- ٩٤ مقاوم جدا لذات المرض.

الكلمات الدالة : سمسم ، *Sesamum indicum* L. ، مستويات تسميد، نيتروجين، أصناف، صفات النمو، صفات المحصول، مكونات المحصول, سلوك نمو النباتات.

قام بتحكيم البحث

أ.د / عرفة احمد عرفة	**كلية الزراعة – جامعة المنصورة**
أ.د / قاسم فؤاد السحار	**كلية الزراعة – جامعة القاهره**