International Journal of Agricultural Sciences
Volume **11** | Issue 2 | June, 2015 | 301-306 ■ e ISSN-0976-5670
DOI:10.15740/HAS/IJAS/11.2/301-306
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RESEARCH PAPER

Yield, growth and quality of summer sesame (*Sesamum indicum* L.) as influenced by irrigation and nitrogen levels

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Abstract : A field study aimed to evolve efficient and economically viable irrigation schedule and nitrogen management for improving quality, yield and growth of summer sesame var. AKT 101 was conducted at Agronomy Department Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during summer season of 2012. Experimental results revealed that growth characters, yield contributing characters and quality significantly higher with irrigation scheduling at 1.0 IW/CPE (Irrigation water amount/ Cumulative pan evaporation) and nitrogen application at 90 kg N ha^{-1}. Similarly, treatment 1.0 IW/CPE combined with nitrogen application at 90 kg N ha^{-1} recorded significantly highest seed yield and oil yield (kg ha^{-1}) over rest of the combinations and significantly lowest was observed in irrigation scheduling at 0.4 IW/CPE combined with treatment 30 kg N ha^{-1}.

Key Words : Irrigation, IW/CPE, Quality, Sesame, Yield

View Point Article : Damdar, Rupali R., Bhale, V.M. and Deshmukh, K.M. (2015). Yield, growth and quality of summer sesame (*Sesamum indicum* L.) as influenced by irrigation and nitrogen levels. *Internat. J. agric. Sci.*, **11** (2) : 301-306.

Article History : Received : 08.04.2015**; Revised :** 24.05.2015**; Accepted :** 31.05.2015

INTRODUCTION

Sesame (*Sesamum indicum* L.) is an ancient oilseed crop, first recorded as a crop in Babylon and Assyria over 4,000 years ago. It is called as queen of oilseeds because of its quality. The biggest area of production is currently believed to be India, but the crop is also grown in China, Korea, Russia, Turkey, Mexico, South America and several countries in U.S. and Africa. India ranks first in its area and production in world. In India sesame is cultivated on 1.86 million ha area with annual production of 0.81 million ton. Its average productivity (437 kg ha^{-1}) is below than that of the world (489 kg ha^{-1}) (Anonymous, 2010). During the year 2010, Maharashtra produced 0.775 metric tons sesame from an area of 3.79 thousand hectare with the average productivity of 205 kg ha^{-1} (Anonymous, 2010). In Maharashtra, sesame is grown as semi-*Rabi* crop in Gadchiroli, Chandrapur, Nagpur, Wardha, and Nanded districts. Vidarbha region comprising Nagpur and Amaravati revenue divisions are the most important sesame growing area.

Sesame is probably the second most important oilseed crop next to groundnut. Sesame seeds are rich source of food nutrition, edible oil (48-52%), protein (18-20%). Among agronomic inputs, irrigation and nitrogen are the most important input for boosting the yield and

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quality of summer sesame. Irrigation scheduling plays an important role in the higher production of summer sesame. Nitrogen is a structural constituent of plant cell and constitutes amino acids, proteins, nucleic acids, etc. It plays important role in plant metabolism and judicious use of limited water for economical crop production with the objective of effective wetting of root zone (Wu *et al.*, 2009). Keeping in view the above facts, a study was undertaken to find out the effect of irrigation and nitrogen levels on growth, yield and quality of summer sesame.

MATERIAL AND METHODS

A field experiment was conducted on AKT 101 sesame at University Department of Agronomy Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during summer season of 2012. Experimental soil was clay lome in texture and slightly alkaline in reaction (pH 7.96), however, good for EC (0.37). It was analyzed low in available nitrogen (221.47 $kgha^{-1}$), medium in organic carbon (0.43 %), medium in available phosphorus (16.86 $kgha^{-1}$) and high in available potassium (387.25 $kgha^{-1}$).

The experiment was laid out in Split Plot Design with three replications. Treatments consisted of four levels of irrigation (Irrigation at 0.4 (I_1), 0.6 (I_2), 0.8 (I_3), and 1.0 (I_4) IW/CPE ratios. (Irrigation water amount/ Cumulative pan evaporation) were taken as main plot treatment while three levels of nitrogen (30 kg (N_1), 60 kg (N_2) and 90 kg (N_3) N ha^{-1}) were taken as sub plot treatments. The crop was subjected to recommended package of agronomic practices to obtain a healthy crop. The net plot yield was converted into quintal per hectare by using hectare factor.

The oil percentage in grain was estimated separately as per treatment by Sauxhlet apparatus and recorded. From oil percentage seed oil yield was worked out by using following formula:

$$\text{Oil yield ha}^{-1} = \frac{\text{Seed yield (kg ha}^{-1}) \times \text{oil content (\%)}}{100}$$

Statistical analysis :

The obtained data was analyzed by statistical significant at P<0.05 level, S.E. and C.D. at 5 per cent level by the procedure given by (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Growth attributes :

Effect of irrigation levels :

Growth attributes like plant height, number of

Table 1 : Effect of irrigation and nitrogen levels on growth attributes

Treatments	Plant height (cm)	Number of branches $plant^{-1}$	Number of functional leaves $plant^{-1}$	Total dry matter accumulation $plant^{-1}$ (g)
Main plot				
Irrigation levels				
I_1- 0.4 IW/CPE	86.24	2.80	82.93	13.62
I_2- 0.6 IW/CPE	97.58	3.72	89.76	17.96
I_3- 0.8 IW/CPE	97.78	3.94	93.04	21.30
I_4- 1.0 IW/CPE	102.78	4.16	98.56	24.11
S.E. ±	1.36	0.07	1.75	0.47
C.D. (P=0.05)	4.71	0.23	6.07	1.63
Sub plot				
Nitrogen levels				
N_1- 30 kg Nha^{-1}	91.72	3.25	86.73	17.34
N_2- 60 kg Nha^{-1}	96.00	3.70	90.41	19.77
N_3- 90 kg Nha^{-1}	100.57	4.04	96.06	20.63
S.E. ±	0.81	0.06	1.23	0.18
C.D. (P=0.05)	2.42	0.17	3.69	0.55
Interaction effect				
S.E. ±	1.62	0.11	2.46	0.37
C.D. (P=0.05)	4.85	0.34	7.37	1.10
General mean	96.09	3.66	91.07	19.24

branches plant^{-1}, functional leaves plant^{-1} (At 75 DAS) and dry matter accumulation plant^{-1} was influenced greatly by levels of irrigation (Table 1). All the growth parameters were increased steadily with the increase in irrigation levels. Plant height, number of branches plant^{-1}, functional leaves plant^{-1}, dry matter accumulation plant^{-1} were recorded significantly higher with irrigation at 1.0 IW/CPE ratio which was significantly superior over 0.8 IW/CPE, 0.6 IW/CPE and 0.4 IW/CPE ratios.

This might be due to attributed to better soil moisture status due to irrigations at a narrower interval, which might have resulted in better cell division and cell elongation. Increase in the levels of irrigation scheduling, number of leaves increased markedly, which might be due to increased rate of cell division and cell enlargement. Besides this adequate moisture supply throughout the crop growth period might have resulted in optimum cell division ultimately led to proper growth and thereby more plant height and number of branches as well as more irrigation frequencies increased in number of branches, number of leaves, leaf area and capsules plant^{-1} where the photosynthates produced and accumulated at higher rate and thus, the quantity through the process of plant metabolism ultimately replaced in dry matter production at higher rate. There was decrease in dry matter production plant^{-1} at harvest due to falling of leaves. The above results are in agreement with the findings reported by Duraisamy *et al.* (1999); Dutta *et al.* (2000); Muthusankaranarayanan *et al.* (2001); Banjara and Pandey (2006); Zagade *et al.* (2007); Sarkar *et al.* (2010) and Zeinolabedin and Moosavi (2011).

Effect of nitrogen levels :

Data presented in Table 1 revealed that growth attributes were significantly influenced with nitrogen levels. Maximum plant height, number of branches, functional leaves plant^{-1} (at 75 DAS) and dry matter was recorded significantly higher with treatment 90 kg N ha^{-1} which was superior over treatment 60 kg N ha^{-1} and 30 kg N ha^{-1} at all the stages of crop growth. This may due to more availability of nitrogen during crop growth, nitrogen being the major structural constituent of the plant cell and an essential constituent of all the metabolic activities, had a positive effect on plant growth and development which might have resulted in optimum cell division and stem elongation. The increase in number of leaves might be due to the fact that nitrogen influence and encourage formation of new cells, thereby helps in increasing the nutrient absorption and hastening leaf development. Furthermore, nutrient

Table 2 : Effect of irrigation and nitrogen levels on yield and quality of sesame

Treatments	Seed yield (kg ha^{-1})	Oil %	Oil yield (kg ha^{-1})
Main plot			
Irrigation levels			
I_1- 0.4 IW/CPE	385	47.18	183
I_2- 0.6 IW/CPE	457	48.06	219
I_3- 0.8 IW/CPE	497	48.68	242
I_4- 1.0 IW/CPE	523	48.87	266
S.E. ±	9	0.40	4.86
C.D. (P=0.05)	32	NS	16.82
Sub plot			
Nitrogen levels			
N_1- 30 kg Nha^{-1}	445	48.00	216
N_2- 60 kg Nha^{-1}	456	48.24	226
N_3- 90 kg Nha^{-1}	496	48.36	241
S.E. ±	5	0.27	2.63
C.D. (P=0.05)	16	NS	7.89
Interaction effect			
S.E. ±	10.65	0.54	5.26
C.D. (P=0.05)	31.94	NS	15.78
General mean	466	48.19	228

NS=Non-significant

in the form of nitrogen enhance the physiological process and involved in boosting of number of branches through participating in cell enlargement and development of auxiliary buds in plants. These results obtained are conformity with findings of Jadhav *et al.* (1991); Subrahamaniyan and Arulmozhi (1999); Pravakar *et al.* (2002); Malik *et al.* (2003); Abdalsalam and Al-Shebani (2010); Sarkar *et al.* (2010) and Zeinolabedin and Moosavi (2011).

Interaction effect :

The interaction effect between irrigation and nitrogen levels was significant in respect of plant height, number of branches, functional leaves plant^{-1} and dry matter accumulation at all crop growth phases (Table 3). The plant height at harvest, number of branches at 75 DAS, functional leaves plant^{-1} and total dry matter accumulation at 75 DAS were observed maximum with combination of irrigation at 1.0 IW/CPE ratio with higher nitrogen level N_3 (90 kg N ha^{-1}), which was at par with combination 60 kg N ha^{-1} and 1.0 IW/CPE ratio and was found significantly superior over rest of the combination. Increased N level had positive response with increased irrigation levels. This may be because of higher response of nitrogen with sufficient moisture also increased irrigation level increased dry matter with increased nitrogen levels indicates positive response of applied nitrogen. The requirement of nitrogen was increased with irrigation.

Yield attributes :

Effect of irrigation levels :

The variation imposed through various treatments significantly influenced yield (Table 2). Seed yield was recorded significantly higher with irrigation at 1.0 IW/CPE ratio which was significantly superior over 0.8 IW/CPE, 0.6 IW/CPE and 0.4 IWCPE ratios. Seed yield increase might be due to availability of water at reproductive phase when plant needs more moisture. As well as it might be due to favourable temperature during their growth period resulting in better growth and beneficial effect on flowering, better capsule setting and seed filling. These results are in agreement with Kumar *et al.* (1996); Ravinder *et al.* (1996); Duraisamy *et al.* (1999); Dutta *et al.* (2000); Muthusankaranarayanan *et al.* (2001); Banjara and Pandey (2006); Sarkar *et al.* (2010) and Zeinolabedin and Moosavi (2011).

Effect of nitrogen levels :

Data presented in Table 2 revealed that yield attributes were significantly influenced with nitrogen levels. Maximum seed yield accumulation plant^{-1} was recorded significantly higher with treatment 90 kg N ha^{-1} which was superior over treatment 60 kg N ha^{-1} and 30 kg N ha^{-1} at all the stages of crop growth. This may due to more accumulation of nitrogenous substances and their translocation to reproductive organs. As well as it might be due to efficient seed filling by better translocation of photosynthates by application of nitrogen dose resulted

Table 3 : Interaction effect of irrigation and nitrogen levels on different plant character of sesame

Interaction (Irrigation × N level)	Plant height (cm)	Number of branches plant^{-1}	Mean number of leaves plant^{-1}	Dry matter accumulation plant^{-1} (g)	Seed yield (kg ha^{-1})	Oil yield (kg ha^{-1})
I_1N_1	78.47	2.23	74.67	11.67	363	168.29
I_1N_2	88.67	2.73	82.47	14.2	394	188.68
I_1N_3	91.6	3.43	91.67	15	399	188.74
I_2N_1	96.4	3.4	87	16.6	450	216.25
I_2N_2	97.33	3.67	88.8	18	451	216.91
I_2N_3	99	4	93.47	19.27	468	225.3
I_3N_1	95	3.27	90.2	20.1	467	227.16
I_3N_2	97.33	4.2	94.4	21.2	472	229.76
I_3N_3	101	4.37	94.53	22.6	553	269.53
I_4N_1	97	4.13	95.07	21	498	21
I_4N_2	100.67	4.33	96	25.67	507	25.67
I_4N_3	110.67	4.47	104.6	25.67	565	25.67
S.E. ±	1.62	0.11	2.46	0.37	10.65	0.37
C.D. (P=0.05)	4.85	0.34	7.37	1.1	31.94	1.1

in improved weight of 1000 seeds. These results are in agreement with Jadhav *et al.* (1991); Subrahamaniyan and Arulmozhi (1999); Malik *et al.* (2003); AbdalSalam and Al-Shebani (2010); Sarkar *et al.* (2010) and Zeinolabedin and Moosavi (2011).

Interaction :

Irrigation and nitrogen levels interacted significantly in respect of seed yield of sesame (Table 3). Irrigation at 1.0 IW/CPE ratio with 90 kg N ha^{-1} ($I_4 \times N_3$) combination recorded significantly higher seed yield (565 kg ha^{-1}) than all other combinations. However, seed yield was at par with irrigation at 0.8 IW/CPE with same level of nitrogen ($I_3 \times N_3$) (553 kg ha^{-1}).

The increase in grain yield with interaction of irrigation and N level, might be due to the availability of water and N provides optimum ground for plant vegetative growth and increases plant photosynthesis area, assimilate production, capsule number $plant^{-1}$ and grain number $capsule^{-1}$ and finally, significantly increased grain yield. Similar results were also reported by Kashved *et al.* (2010) and Jouyban *et al.* (2011).

Quality :

Oil content (%) :

The data shown in the Table 2 revealed that oil percentage was found to be non-significant. However, irrigation at 1.0 IW/CPE and nitrogen 90 kg ha^{-1} reported highest oil percentage, followed by other treatments. These results are in line with the findings of Kumar *et al.* (1996); Purohit *et al.* (2006); Malik *et al.* (2003) and Abdalsalam and Al-Shebani (2010).

Oil yield (kg ha^{-1}) :

Data presented in Table 2 revealed that oil yield ha^{-1} were significantly influenced with irrigation and nitrogen levels. Irrigation scheduling at 1.0 IW/CPE ratio and nitrogen 90 kg ha^{-1} reported highest oil yield, followed by other treatments. These results are in line with the findings of Dutta *et al.* (2000) and Sarkar *et al.* (2010).

Interaction :

Irrigation and nitrogen levels interacted significantly in respect of oil yield of sesame (Table 3). Irrigation at 1.0 IW/CPE ratio with 90 kg N ha^{-1} ($I_4 \times N_3$) combination recorded significantly higher oil yield than all other combinations. However, it was at par with irrigation at 0.8 IW/CPE with same level of nitrogen [($I_3 \times N_3$).

REFERENCES

Abdalssalam, A.A. and Al-Shebani, Y.A. (2010). Phonological and productivity characteristics of sesame (*Sesamum indicum* L.) as affected by nitrogen rates under SANA'A conditions. *J. Pl. Produc.,* **1** (2) : 251-264.

Ahmed, M., Naim, E.L. and Mahmoud, F. Ahmed (2010). Effect of irrigation on consumptive use, water use efficiency and crop co-efficient of sesame (*Sesamum indicum* L.). *J. Agric. Extn. Rural Dev.,* **2** (4) : 59-63.

Anonymous (2010). Area, production and yield of total oil seeds during 2008-2009 in major producing states along with coverage under irrigation. Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, Governent of India.

Anonymous (2010). Food and Agriculture Commodities Production, FAOSTAT.

Banjara, G.P. and Pandey, N. (2006). Effect of irrigation fertility and conjunctive use of FYM and chemical fertilizer on grain yield and nutrient status in plant and soil of summer sesame (*Sesamum indicum* L.). *J. Agril. Issues,* **11** (2) : 97-99.

Duraisamy, K., Kathiresan, G. and Balasubramanian, A. (1999). Effect of irrigation frequency and coir pith application in sesame (*Sesamum indicum* L.). *Indian J. Agron.,* **44** (2) : 416-418.

Dutta, D., Jana, P.K., Bandyopadhyay, P. and Maity, D. (2000). Response of summer sesame (*Sesamum indicum* L.) to irrigation. *Indian J. Agron.,* **45** (3) : 613-616.

Jadhav, A.S., Sugave, G.T. and Chavan, D.A. (1991). Effect of nitrogen and phosphate levels on summer sesamum. *Indian J. Agron.,* **36** (4) : 618-619.

Jouyban, Zeinolabedin, Moosavi, Seyyed Gholamreza and Seghatoleslami, Mohammad Javad (2011). Seed yield and nitrogen use and agronomic efficiency of sesame as affected by irrigation levels, nitrogen and superabsorbent. *Australian J. Basic & Appl. Sci.,* **5**(12):697-702.

Kashved, S.M., Raskar, B.S. and Tamboli, B.D. (2010). Effect of integrated nitrogen management and irrigation regimes on productivity of mustard (*Brassica Juncea* L.) *J. Maharashtra Agric. Univ.,* **35** (3) : 349-353.

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

Malik, M.A., Saleem, M.F., Cheema, M.A. and Ahmed, S. (2003). Influence of different nitrogen levels on productivity of sesame (*Sesamum indicum* L.) under varying planting patterns. *Internat. J. Agril. Biol.,* **5** (4) : 490-492.

Muthusankaranarayanan, A., Anand Kumar, S. and Panadian, B.J. (2001). Optimum time of sowing and nitrogen management for summer irrigated sesame (*Sesamum indicum* L.). Food and Agriculture of the United Nations. *Sesame & Sunflower Newslr.,* **16**.

Pravakar, Jhapat Singh, Sarawgi, S.K., Saxena, R.R. and Singh, Lalji (2002). *Effect of nitrogen and sulphur on the performance of sesame (Sesamum indicum) under shisham (Dalbergia sissoo roxb.) Bas*. Indira Gandhi Krishi Vishwavidyalaya Raipur, C.G. (INDIA).

Ravinder, N., Satyanarayana, V., Rao, V.P., Latchanna, A. and Vararprasad, P.V. (1996). Influence of irrigation and fertilization on seed yield, nutrient uptake and fertilizer use efficiencies in summer sesame (*Sesamum indicum* L.). *J. Oilseeds Res.,* **13** (2) : 173-177.

Sarkar, A., Sarkar, S., Zaman, A. and Rana, S.K. (2010). Performance of summer sesame (*Sesamum indicum* L.) under different irrigation regimes and nitrogen levels. *Indian J. Agron*., **55** (2) : 143-146.

Snedecor, G.W. and Cochran, W.G. (1994). *Statistical methods*. 1994 Eighth Edition. East-West Press Pvt. Ltd., NEW DELHI, INDIA.

Subrahmaniyan, K. and Arulmozhi, N. (1999). Response of sesame (*Sesamum indicum* L.) to plant population and nitrogen under irrigated condition. *Indian J. Agron.* **44**(2) : 413-415.

Wu, Y.C., Zhou, S.L., Wang, Z.M. and Feng, H.Y. (2009). Recovery of residual fertilizer-nitrogen by wheat in a winter wheat-summer maize rotation in the North China plain: A soil column study. *Agron. J.,* **101**(4) : 925-932.

Zagade, M.V., Chavan, S.A., Thorat, S.T., Shaikh, M.S.I., Bhagat, S.B. (2007). Effect of irrigation levels, polythene mulch and plant populations on yield and economics of *Rabi* groundnut. *J. Maharashtra Agric. Univ.,* **32**(2):198-201.

Zeinolabedin and Moosavi, S.G. (2011). Study of effect of different levels of irrigation interval, nitrogen and super absorbent on seed yield and morphological traits of sesame. *Australian J. Basic & Appl. Sci.,* **5**(10) : 1917-1923.