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Effect of Irrigation and Nitrogen Levels on Yield and Water Use Efficiency of Summer Sesame

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Abstract: A field experiment was conducted on summer sesame during summer season at Agronomy Department Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, to study the effect of irrigation and nitrogen levels on yield and water use efficiency (WUE) of summer sesame. The results revealed that yield contributing characters and moisture studies were 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 over rest of the combinations and significantly lowest observed in irrigation scheduling at 0.4 IW/CPE combined with treatment 30 kgNha^{-1}.

Key words: Irrigation · Sesame · IW/CPE · WUE

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}) [1]. During the year 2010, Maharashtra produced 0.775 metric tons sesame from an area of 3.79 thousand hectare with the a verage productivity of 205 kg ha^{-1} [2]. 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 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 [3]. Keeping in view the above facts a study was undertaken to find out the effect of irrigation and nitrogen levels on yield and water-use efficiency of summer sesame.

MATERIALS 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. Experimental soil was clay loam 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 kg ha^{-1}), medium in organic carbon (0.43%), medium in available phosphorus (16.86 kg ha^{-1}) and high in available potassium (387.25kgha^{-1}).

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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 (Irrigation water amount/Cumulative pan evaporation) ratios) 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 is converted in to quintal per hectare by using hectare factor.

The moisture percentage was calculated by using following formula:

$$Pw = \frac{WS_1 - WS_2}{WS_2} \times 100$$

where,

P_W - Moisture percent of soil sample,
WS_1 - Weight of wet soil sample,
WS_2 - Weight of dry soil sample).

Consumptive use of water under each irrigation treatment was calculated by using following formula,

$$Cu = \sum_{i=1}^{n} \frac{(Mai-Mbi)}{100} \times A_i \times Di$$

where, Cu = consumptive use of water in mm, for the period between two consecutive irrigations, Mai = soil moisture (%) after irrigation, Mbi = soil moisture (%) just before irrigation, n = Number of soil layer, A_i = Apparent specific gravity of i^{th} layer of soil, D_i = Soil depth of the i^{th} layer of two consecutive sampling periods).

Water use efficiency for various treatments was calculated by following formula,

$$WUE = \frac{Y}{ET}$$

where, WUE = Water use efficiency (kg ha^{-1}) Y = Economic yield (kg ha^{-1}) in a particular treatment, ET = Total evapo-transpiration (mm) i.e. CU in concerned treatment

RESULTS AND DISCUSSION

Yield Attributes:

Effect of Irrigation Levels: The variation imposed through various treatments significantly influenced of yield and all yields attributes (Table 1). Yield attributes like number of capsules $plant^{-1}$, 1000 seeds weight and seed yield 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 IWCPE ratios. The increase in yield attributes 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 those obtained by Ashok Kumar *et al*. [4], Ravinder *et al.* [5], Duraisamy *et al.* [6], Dutta *et al*. [7], Muthusankaranarayanan *et al.* [8], Banjara and Pandey [9], Sarkar *et al.* [10] and Zeinolabedin and Moosavi [11].

Effect of Nitrogen Levels: Data presented in Table 1 revealed that yield attributes were significantly influenced with nitrogen levels. The maximum number of capsules $plant^{-1}$, 1000 seeds weight and seed yield $plant^{-1}$ were 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 growth stages of sesame crop. 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 in improved weight of 1000 seeds. These results are in agreement with Jadhav *et al.* [12], Subrahamaniyan and Arulmozhi [13], Malik *et al.* [14], Abdalsalam and Al-Shebani [15], Sarkar *et al.* [10] and Zeinolabedin and Moosavi [11].

Interaction: Irrigation and nitrogen levels interacted significantly in respect of seed yield of sesame (Table 2). 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 Irrigation at 1.0 IW/CPE ratio with 90 kg N ha^{-1} ($I_4 \times N_3$) combination 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 seed yield with the interaction between irrigation and N levels, might be due to the availability of water and N provides optimum ground for plant vegetative growth and increases plant photosynthesis area, assimilate production, capsules number $plant^{-1}$ and seed numbers $capsule^{-1}$ and finally, significantly increases seed yield. Similar results were also reported by Kashwed *et al*. [16] and Zeinolabedin Jouyban *et al*. [11].

Table 1: Yield attributes and Consumptive use (mm) and Water use efficiency (Kg ha^{-1} mm) as influenced by various treatments

Treatments	No. of capsules plant^{-1}	Test weight (g)	Seed yield (kgha^{-1})	Consumptive use (mm)	Water use efficiency (kg ha^{-1} mm)
Main Plot					
A. Irrigation levels					
I_1- 0.4 IW/CPE	31.57	2.35	385	237	1.63
I_2- 0.6 IW/CPE	35.31	2.49	457	285	1.60
I_3- 0.8 IW/CPE	45.60	3.19	497	325	1.53
I_4- 1.0 IW/CPE	49.16	3.39	523	455	1.15
SE (m) ±	1.62	0.05	9	-	-
CD (P=0.05)	5.60	0.17	32	-	-
Sub Plot					
A. Nitrogen levels					
N_1- 30Kg Nha^{-1}	36.35	2.71	445	323	1.42
N_2- 60Kg Nha^{-1}	40.17	2.83	456	325	1.46
N_3- 90Kg Nha^{-1}	44.72	3.02	496	328	1.55
SE (m) ±	0.52	0.06	5	-	-
CD (P=0.05)	1.55	0.17	16	-	-
Interaction effect					
SE (m) ±	1.04	0.11	10.65	-	-
CD (P=0.05)	3.11	NS	31.94	-	-
General mean	40.41	2.85	466	325	1.47

Table 2: Interaction effect of irrigation and nitrogen levels on seed yield (kg Ha^{-1}) of sesame

	N		
Irrigation levels	N_1	N_2	N_3
I_1	363	394	399
I_2	450	451	468
I_3	467	472	553
I_4	498	507	565
Mean	445	456	496
SE(m) ±	10.65		
CD at 5%	31.94		

Moisture Studies

Consumptive Use: From the data presented in Table 3, it is observed that mean total consumptive use was 325 mm. A higher frequency of irrigation increased the consumptive use of water. THE highest consumptive use of 455 mm was observed under 1.0 IW/CPE treatment followed by 325 mm under 0.8 IW/CPE, 285 mm under 0.6 IW/CPE and 237 mm under 0.4 IW/CPE. The above results are in line with the findings of Dutta *et al.* [7] and Sarkar *et al.* [10].

Different nitrogen levels had shown slight difference in total consumptive use. The highest consumptive use of 328 mm was recorded in 90 kg N ha^{-1} treatment followed by 325 mm under 60 kg N ha^{-1} and 323 mm under 30 kg N ha^{-1} treatment. The above results are in line with the findings of Sarkar *et al.* [10].

Water Use Efficiency: The mean value of water use efficiency was found to be 1.47 kg ha^{-1} mm. The highest water use efficiency 1.63 kg ha^{-1} mm was recorded under 0.4 IW/CPE followed by 0.6 IW/CPE with 1.60 kg ha^{-1} mm, 1.53 kg ha^{-1} mm with 0.8 IW/CPE and 1.15 kg ha^{-1} mm with 1.0 IW/CPE. The above results are in line with the findings of Sharma *et al.* [17], Dutta *et al.* [7].

The water use efficiency was increased in the levels of nitrogen. It was highest with treatment 90 kg N ha^{-1} (1.55 kg ha^{-1} mm) followed by 60 kg N ha^{-1} (1.46 kg ha^{-1} mm) and 30 kg N ha^{-1} (1.42 kg ha^{-1} mm).

REFERENCES

1. Anonymous, 2010. Food and Agriculture Commodities Production, FAOSTAT.
2. 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 Cooperation, Ministry of Agriculture, Government of India.
3. Wu, Y.C., S.L. Zhou, Z.M. Wang and H.Y. Feng, 2009. Recovery of Residual Fertilizer-Nitrogen by wheat in a winter wheat-summer maize rotation in the North China plain: A soil column study. Agronomy Journal, 101-155(4): 925-932.
4. Ashok Kumar, T.N. Prasad and U.K. Prasad, 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.

5. Ravinder, N., V. Satyanarayana, V.P. Rao, A. Latchanna and P.V. Vararprasad, 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.
6. Duraisamy, K., G. Kathiresan and A. Balasubramanian, 1999. Effect of irrigation frequency and coir pith application in sesame (*Sesamum indicum* L.). Indian J. Agron., 44(2): 416-418.
7. Dutta, D., P.K. Jana, P. Bandyopadhyay and D. Maity 2000. Response of summer sesame (*Sesamum indicum* L.) to irrigation. Indian J. Agron., 45(3): 613-616.
8. Muthusankaranarayanan, A., S. Anand Kumar and B.J. Panadian, 2001. Optimum time of sowing and nitrogen management for summer irrigated sesame (*Sesamum indicum* L.). Food and Agriculture of the United Nations. Sesame and Sunflower Newsletter, pp: 16.
9. Banjara, G.P. and N. Pandey, 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. Agric. Issues., 11(2): 97-99.
10. Sarkar, A., S. Sarkar A. Zaman and S.K. Rana, 2010. Performance of summer sesame (*Sesamum indicum* L.) under different irrigation regimes and nitrogen levels. Indian J. Agron., 55(2): 143-146.
11. Zeinolabedin and S.G. Moosavi, 2011. Study of effect of different levels of irrigation interval, nitrogen and super absorbent on seed yield and morphological traits of sesame. Australian Journal of Basic and Applied Sciences, 5(10): 1917-1923.
12. Jadhav, A.S., G.T. Sugave and D.A. Chavan, 1991. Effect of nitrogen and phosphate levels on summer Sesamum. Indian J. Agron., 36(4): 618-619.
13. Subrahmaniyan, K. and N. Arulmozhi 1999. Response of sesame (*Sesamum indicum* L.) to plant population and nitrogen under irrigated condition. Indian J. Agron., 44(2): 413-415.
14. Malik, M.A., 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. Int. J. Agric. Biol., 5(4): 490-492.
15. Abdal Salam, A.A. and Y.A. Al-Shebani, 2010. Phonological and productivity characteristics of sesame (*Sesamum indicum* L.) as affected by nitrogen rates under SANA'A conditions. J. Plant Production., 1(2): 251-264.
16. Kashved, S.M., B.S. Raskar and B.D. Tamboli, 2010. Effect of integrated nitrogen management and irrigation regimes on productivity of mustard (*Brassica juncea* L.) J. Maharashtra Agric Univ., 35(3): 349-353.