

Original Research Article

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Influence of Irrigation Regimes and Nitrogen Levels on Growth, Yield and Economics of Summer Sesame

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ABSTRACT

A field experiment was conducted during summer season of 2011 at department of Agronomy Farm, Dr. PDKV, Akola, to study the effect of irrigation and nitrogen levels on performance of summer sesame (*Sesamum indicum* L). The experiment was laid out in split plot Design with three replications each having nine treatment combinations comprising three irrigation scheduling on the basis of IW/CPE ratio viz., irrigation at 0.6, 0.8 and 1.0 IW/CPE ratios (I₁, I₂ and I₃, respectively) and one irrigation scheduling based on critical growth stages of sesame (I₄), in main plot and three nitrogen levels 0, 30 and 60 kg N ha⁻¹ (N₀, N₁ and N₂, respectively) in subplot. The result showed that plant height, number of branches, number of leaves, leaf area and dry matter accumulation were maximum in irrigation scheduling at 1.0 IW/CPE ratio, which significantly superior over 0.6 IW/CPE ratio and irrigation at critical growth stages but were statistically at par with irrigation at 0.8 IW/CPE ratio. Nitrogen levels, application of 60 kg N ha⁻¹ were recorded significantly superior growth parameters and growth over treatment 30 kg N ha⁻¹ and 0 kg N ha⁻¹. In case of yield attributes viz., No. of capsules plant⁻¹, test wt., grain yield and Stalk yield (q ha⁻¹) were maximum in irrigation scheduling at 1.0 IW/CPE ratio and were significantly superior over 0.8 IW/CPE ratio, 0.6 IW/CPE ratio and irrigation at critical growth stages. Application of 60 kg N ha⁻¹ increased all yield attributing characters over application of 30 and 0 kg N ha⁻¹. In case of economics of crop same trend was found and the highest B:C ration was obtained in irrigation scheduling at 1.0 IW/CPE ratio. Whereas, application of 30 kg N ha⁻¹ was recorded highest B:C ration. Interaction effect were found to be non significant in summer season.

Keywords

Irrigation regimes,
Nitrogen levels
and summer
sesame.

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Introduction

Sesame (*Sesamum indicum* L.) is most ancient and multipurpose oilseed crop which is cultivated almost throughout India for its high quality oil and tremendous potential to export sesame in the world. India is the largest oilseed growing country with 20% of world's area, but third in oilseed production due to inferior productivity. 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 much below than that of the world (489 kg ha⁻¹) (FAO, 2009). Lower production of sesame is due to the predominant cultivation under conditions of low and uncertain rainfall and input starvation with poor management. Water is immortal input, irrigation scheduling on the basis of IW/CPE ratio has an important

influence on growth and productivity of the crop because it provides accurate water requirement to meet the demands of evaporation, transpiration and metabolic needs of the crop. Assured supply of water through efficient irrigation practice is an essential basic input for obtaining higher yield. To achieve higher productivity potential, irrigation scheduling and balanced fertilization are the key factors. Narang and Gill (1998) reported that seed yield of summer sesame increased with increase in number of irrigations. Keeping in view, fast ever diminishing water resources and increasing competition from and within agriculture for water, its economical and efficient utilization becomes quiet imperative. Under limited water supply, higher yield can be obtained by proper irrigation scheduling (Choradia and Gaur, 1986).

Nitrogen is the most limiting nutrient for crop production in many regions of the world and nitrogen fertilizer is an effective but expensive input used by farmers to achieve desired crop yields. Nitrogen plays an important role in almost all plant metabolic processes and also needed for the synthesis of chlorophyll which is required for photosynthesis. New leaves may contain up to 6% N. It is a very mobile nutrient and moves from older to newer leaves as the plant ages. Nitrogen is taken up throughout the growing season and it is transported and stored in the leaves. The N requirements for capsule development are partially met from N stored in the leaf canopy. The deficiency of nitrogen results in poor growth and yield. Nitrogen is one of the factors that directly influence vegetative growth and dry matter production (Malik *et al.*, 2003). It is well established fact that there is positive correlation between nitrogen application and productivity. Hence, summer cultivation was practiced with irrigation scheduling and nitrogen application in split, which plays important role in summer sesame production. The present experiment

was carried out to study the effect of different irrigation regimes and nitrogen levels on growth and productivity of summer sesame.

Materials and Methods

A field experiment was conducted during summer season of 2011 at department of Agronomy Farm, Dr. PDKV, Akola, to study the effect of irrigation scheduling and nitrogen levels on performance of summer sesame (*Sesamum indicum* L.). The soil of experimental field was clay loam in texture and slightly alkaline in reaction (pH 7.79), however, good for EC (0.374). It was analyzed low in available nitrogen (221.41 kg ha⁻¹), medium in organic carbon (0.43 g kg⁻¹), medium in available phosphorus (16.86 kg ha⁻¹) and high in available potassium (365.25 kg ha⁻¹). The treatments comprised of three irrigation scheduling on the basis of IW/CPE ratio viz., irrigation at 0.6, 0.8 and 1.0 IW/CPE ratios (I₁, I₂ and I₃, respectively) and one irrigation scheduling based on critical growth stages of sesame (I₄), in main plot and three nitrogen levels 0, 30 and 60 kg N ha⁻¹ (N₀, N₁ and N₂, respectively) in subplot. All these treatments were tested in split plot design with three replications. The Sesame variety AKT -1 was sown on 23 February and harvested on 30 May 2011.

During the crop period, mean maximum temperature varied from 33.5⁰ C to 43.4⁰ C and mean minimum temperature varied from 15.3⁰ C to 28.7⁰C. The total evaporation during crop growth period was recorded 219.08 mm.

Results and Discussion

Growth parameters

Maximum plant height, number of branches, number of leaves, leaf area and dry matter accumulation were recorded by irrigation scheduling at 1.0 IW/CPE ratio and was

significantly superior over 0.6 IW/CPE ratio and irrigation at critical growth stages but statistically at par with irrigation at 0.8 IW/CPE. It might be due to adequate moisture supply throughout the crop growth period due to irrigations at a narrower interval, which might have resulted in better cell division and cell elongation, higher interception of solar radiation and more carbon partitioning, soil moisture and light are not limiting and higher temperature accelerates growth processes. Similar findings were also reported by Dutta *et al.*, (2000), Sarkar *et al.*, (2010) and Zeinolabedin and Moosavi (2011).

Application of nitrogen had significant influence on plant height, number of branches, number of leaves, leaf area and dry matter accumulation at all the stages of crop

growth. There were significant increases with increase in level of nitrogen up to 60 kg N ha⁻¹. Maximum of these parameters were recorded with application of 60 kg N ha⁻¹ which were superior over treatment 30 kg N ha⁻¹ and the lowest values were recorded with treatment 0 kg N ha⁻¹. Nutrient nitrogen might have increased vegetative growth and meristematic activity of sesame which resulted into better gain in the weight of the plant involved in boosting of number of branches through participating in cell enlargement and encourages formation of new cells, thereby increasing the nutrient absorption and development of auxiliary buds in plants. Similar results were also reported by Subrahmaniyan and Arulmozhi (1999), Malik *et al.*, (2003), Sarkar *et al.*, (2010) and Zeinolbedin and Moosavi (2011).

Table.1 Effect of irrigation and nitrogen levels on growth parameters of summer Sesame

Treatments	Plant height (cm)	No. of Branches plant ⁻¹	No. of leaves plant ⁻¹	Leaf area (dm ²)	Total dry matter accumulation (g)
Irrigation scheduling					
I ₁ - 0.6 IW/CPE	77.60	4.20	77.49	7.24	15.86
I ₂ - 0.8 IW/CPE	82.58	4.28	81.47	8.17	19.20
I ₃ - 1.0 IW/CPE	84.27	4.48	84.27	8.22	21.19
I ₄ - ICGS	77.42	3.58	77.42	7.02	14.48
SE (m) ±	1.38	0.073	1.35	0.17	0.64
CD (P=0.05)	4.80	0.25	4.67	0.60	2.22
Nitrogen levels					
N ₀ - 0KgNha ⁻¹	76.26	3.98	76.18	7.03	16.16
N ₁ - 30KgNha ⁻¹	80.45	4.14	80.45	7.82	17.62
N ₂ - 60KgNha ⁻¹	84.68	4.30	84.68	8.14	19.25
SE (m) ±	1.20	0.070	1.16	0.15	0.26
CD (P=0.05)	3.61	0.21	3.49	0.44	0.78
Interaction effect					
SE (m) ±	1.63	0.04	1.93	0.45	0.77
CD (P=0.05)	NS	NS	NS	NS	NS

Table.2 Effect of irrigation and nitrogen levels on yield and economics on summer sesame

Treatments	No. of capsules pl^{-1}	Test Wt. (g)	Grain yield ($q\ ha^{-1}$)	Stalk yield (qha^{-1})	GMR ($Rs.ha^{-1}$)	NMR ($Rs.ha^{-1}$)	B:C ratio
Irrigation scheduling							
I ₁ - 0.6 IW/CPE	33.72	2.50	4.33	42.64	31942	14232	1.84
I ₂ - 0.8 IW/CPE	42.75	3.20	4.46	44.84	33097	14714	1.84
I ₃ - 1.0 IW/CPE	47.85	3.30	5.22	54.61	39118	18527	1.95
I ₄ - ICGS	29.17	2.30	4.07	40.10	30050	11100	1.61
SE (m) ±	1.31	0.05	0.15	1.73	994.36	1214.4	-
CD (P=0.05)	4.53	0.19	0.53	5.99	3444.62	4202.6	-
Nitrogen levels							
N ₀ - 0KgNha ⁻¹	35.88	2.55	4.27	39.92	30489	12588	1.71
N ₁ -30KgNha ⁻¹	37.99	2.76	4.50	45.63	32524	15213	1.88
N ₂ -60KgNha ⁻¹	41.25	3.17	4.79	51.10	34838	16130	1.86
SE (m) ±	0.67	0.07	0.084	0.68	563.7	600	-
CD (P=0.05)	2.02	0.21	0.25	2.04	1690.1	1799.1	-
Interaction effect							
SE (m) ±	1.59	0.21	0.06	0.87	379.98	609.08	-
CD (P=0.05)	NS	NS	NS	NS	NS	NS	-

Yield and economics

Effects of irrigation levels on yield attribute were found to be significant. Irrigation at 1.0 IW/CPE ratio recorded the highest No. of capsules $plant^{-1}$, Test wt., Grain yield and Stalk yield (qha^{-1}) which were significantly superior over 0.8 IW/CPE, 0.6 IW/CPE and irrigation at critical growth stages. Higher irrigation frequencies provided proper availability of water at reproductive phase when plant needs more moisture, favorable temperature during their growth period resulting better translocation of photosynthates and accumulation of food to the site of capsule formation. These findings are in agreement with those reported by Ashok Kumar *et al.*, (1996), Duraisamy *et al.*, (1999), Dutta *et al.*, (2000) and Sarkar *et al.*, (2010).

Irrigation treatments significantly influenced the GMR, NMR and B:C ratio. The highest

gross monetary return, net monetary return and B:C ratio was obtained with application of irrigation scheduling at 1.0 IW/CPE followed by 0.8 IW/CPE and 0.6 IW/CPE and lowest was found under irrigation at critical growth stages treatment.

Effect of Nitrogen application on yield attributes and economics were found to be significant. Application of nitrogen at 60 kg N ha^{-1} recorded maximum no. of capsules $plant^{-1}$, test wt., grain yield and stalk yield (qha^{-1}) over 30 and 0 kg N ha^{-1} . This is might be due to more accumulation of nitrogenous substances and better translocation of photosynthates to reproductive organs thereby efficient grain filling by application of nitrogen doses. Similar results were also reported by Ashok Kumar *et al.*, (1996), Subrahmaniyan and Arulmozhi (1999), Malik *et al.*, (2003), Abdal salam and Al-Shebani (2010) and Sarkar *et al.*, (2010).

Treatment 60 kg N ha⁻¹ recorded highest GMR and NMR followed by 30 kg N ha⁻¹ and 0 kg N ha⁻¹. But in case of B: C ration application of 30 kg Nha⁻¹ recorded highest B: C ratio (1.88) followed by 60 kg Nha⁻¹ (1.86) and 0 kg Nha⁻¹ (1.71).

Interaction Effect

The interaction effect between irrigation scheduling and nitrogen levels were found to be non significant in summer cultivation of sesame.

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