e ISSN-2230-9411

International Journal of Forestry and Crop Improvement

Volume **6** | Issue 1 | June, 2015 | 21-26 | ■ Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE

DOI: 10.15740/HAS/IJFCI/6.1/21-26

Summer sesame response to moisture and thermal regimes

K.N. SONDARVA, H.D. RANK AND P.S. JAYSWAL

ABSTRACT : A field experiment was conducted at instructional farm of soil and water engg., CAET, JAU, Junagadh during summer season (Feb.-May), 2012 to study the summer sesame response to moisture and thermal regimes with three Factorial Strip Plot Design. The crop was exposed to different thermal regimes by four dates of sowing *i.e.*, 1st Feb., 14th Feb., 1st March and 14th March with moisture regimes by varying the irrigation interval (3, 4 and 5 days irrigation interval). Results revealed that the seasonal depth of irrigation decreased with delay in sowing from 1st February and the growing days requirement decreased with delaying sowing after 1st February. The more number of growing days were required to mature the crop with less total thermal heat unit. The sesame yield is significantly influenced by the thermal regimes. The highest and lowest sesame grain yield of 1131.59 kg/ha and 555.20 kg/ha was observed for the dates of sowing of 16th February and 1st February, respectively. The grain yield increased rapidly by delaying the sowing from 1st Feb. to 21st Feb., then after it decreased slowly and continously. The vegetative stage was found the most sensitive stage to thermal regimes followed by establishment stage, flowering stage, ripening stage and reproductive stage. The highest grain yield of 991.27 kg/ha was found under drip irrigation at 3-days interval which was higher by the tune of 10.33 per cent, 17.32 per cent and 20.86 per cent as compared to that of under 4, 5 days under drip and 7-days under surface irrigation, respectively.

KEY WORDS : Summer, Sesame, Moisture, Thermal regimes

HOW TO CITE THIS ARTICLE : Sondarva, K.N., Rank, H.D. and Jayswal, P.S. (2015). Summer sesame response to moisture and thermal regimes. *Internat. J. Forestry & Crop Improv.*, **6** (1) : 21-26.

ARTICLE CHRONICAL : Received : *12.11.2014;* Revised : *08.04.2015;* Accepted : *11.05.2015*

INTRODUCTION

Water resources of a country constitute one of its vital assets. India occupies only 329 M-ha geographical area, which forms 2.4 per cent of the world's land area; it supports over 15 per cent of the world's population. The population of India as on 31 March, 2011 stood at 1,210,193,422 persons. Thus, India supports more than 1/6th of world population with 1/50th of world's land and 1/25th of world's water resources. Drip irrigation is one of the best and latest methods for efficient utilization of irrigation water. It is an efficient method of application of water in which, the water is applied at low rate over long period of time at frequent intervals with low-pressure delivery system, in order to avoid water stress to the plant. Drip irrigation provides high water use efficiency, higher crop yield, less labour requirement and relatively

MEMBERS OF RESEARCH FORUM

Address of the Correspondence : **K.N. SONDARVA,** Agricultural School (JA.U.), HALVAD (GUJARAT) INDIA

Address of the Coopted Authors : H.D. RANK AND P.S. JAYSWAL, Department of Soil and Water Engineering, College of Agricultural Engineering and Technology, Junagadh Agricultural University, JUNAGADH (GUJARAT) INDIA

low operating cost, less weed growth, less insect and pest attacks, shorter growing season and earlier harvest of the crop. The soil moisture in the upper root zone is evacuated mainly due to soil evaporation and the water stored in the lower portion can be utilized efficiently by plant. To conserve water for a longer period and to reduce evaporation mulching is used. Mulching is the application of any plant residues or other materials to cover the top soil surface.

Temperature is an important weather parameter that affects plant growth, development and yield. Photosynthesis produces the sources of assimilates which plants use for growth and development. Temperature and radiation influence the rate of photosynthesis. However, plants also have an obligatory development in time, which must be met if the photosynthetic assimilates are to be converted into economically useful yields of satisfactory quantity and quality. Temperature (and day-length in case of photosensitive crops) influences the developmental sequence of crop growth in relation to crop phonology. Evolutionary changes that have occurred in the biochemical and physical characteristics of photosynthesis have resulted in a large variation between crops in both their optimum temperature requirements and the responses of photosynthesis to changes in temperature, radiation, and composition of the atmosphere. The present investigation was undertaken to study summer sesame response to moisture and thermal regimes the objectives, to assess the effect of thermal regimes during different growth stages of sesame crop on yield, to assess the effect of irrigation interval on crop yield.

EXPERIMENTAL METHODS

A field experiment was conducted at instructional farm of soil and water engineering, CAET, JAU, Junagadh during summer season (Feb.-May), 2012 to study the summer sesame response to moisture and thermal regimes with three Factorial Strip Plot Design. The experiment comprising of 24 treatment combinations were laid out in strip plot design with four replications. The treatment combination of four levels of thermal regime (four dates of sowing 1st February, 16th February, 1st March and 16th March, 2012) and three levels of irrigation interval *viz.*, 3 days, 4 days, 5 days with drip irrigation with mulch and without mulch and 7 days with surface irrigation without mulch as common to all treatments. Wheat straw mulch applied manually over treatments with mulch at the rate of 5 tonn/ha.

EXPERIMENTAL RESULTS AND ANALYSIS

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

Water applications (depth) :

The seasonal depth of irrigation was found varying from lowest of 225 mm to highest of 432 mm, respectively under irrigation interval of 5 days under date of sowing 16th March and 3 days irrigation interval under date of sowing 16th February. The seasonal depth of irrigation applied under surface irrigation (7 days irrigation interval) was found varied from 488.8 mm to 320 mm under thermal windows of 16th March and 1st February, respectively. The seasonal depth of irrigation was found decreased with delayed in sowing from 1st February because number of required growing days decreased. The reason behind the decreased in the growing days requirement was higher thermal heat units availabilities per day with delayed sowing. In fact, the estimated water requirement per day was increased with delayed sowing due to higher thermal regimes. Seasonal irrigation depth for Irrigation interval is as shown in Table 1. Crop yield response to seasonal depth of irrigation under different thermal window with mulch and no mulch given in Table

Table 1 : Seasonal depth of irrigation under different treatments

Thermal window	Seasonal irrigation depth for Irrigation interval (days)						
	3		4		5		7
	M (mm)	NM (mm)	M (mm)	NM (mm)	M (mm)	NM (mm)	NM (mm)
01-Feb.	405	405	396	396	346	346	488.8
16-Feb.	432	432	330	330	303	303	454.8
01-Mar.	376	376	309	309	280	280	390.4
16-Mar.	300	300	237	237	225	225	320

M= Wheat straw mulch@5t/ha, NM = No mulch application

4 and represented in the Fig. 6. A linear relationship was found between grain yield and seasonal depth of irrigation for all the thermal windows. The yield decreased with decrease in seasonal depth of irrigation and water applied was lower than the optimal water requirements and yet there is a scope for increasing the yield by increased water application. The similar results obtained by Ucan *et al.* (2007) reported that the amount of irrigation water applied significantly affected the seed yield of sesame. Significant higher grain yield was recorded with higher water quantities treatments. This also supports the results of Foroud *et al.* (1993); Balasubramaniyan and Dharmalingam (1996), they found that increase in yield was directly related to increased number of irrigations.

Effects of thermal window on growing days and seasonal heat units requirements (growing degree days) :

The highest growing days requirements was observed as 109 days for date of sowing -W_1 (1st February) with highest inputs of seasonal thermal heat unit 2152°C days as shown in Table 2 and also depicted in Fig. 1. The lowest growing day's requirement was observed as 74 days for the sesame sown at 16th March (W_4) with lowest thermal heat units of 1722°C days. The estimated crop water requirements increased with delayed sowing from 1st February to 16th February and then afterward decreased as it can be seen in Fig. 2. The reason behind the increase in crop water requirement up to thermal window of 16th February was due to

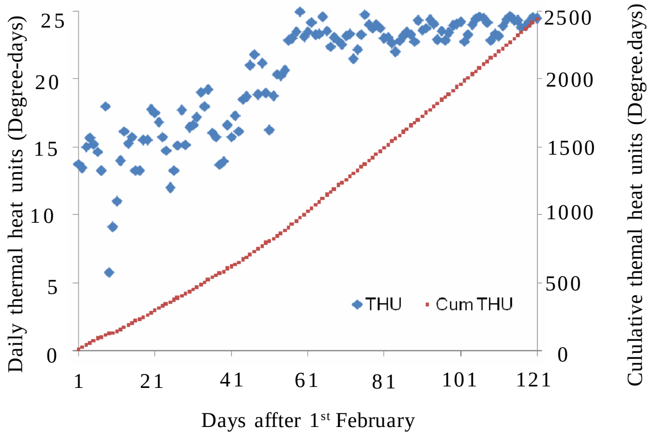

Fig. 1 : Daily and cumlative thermal heat units availability from 1st February

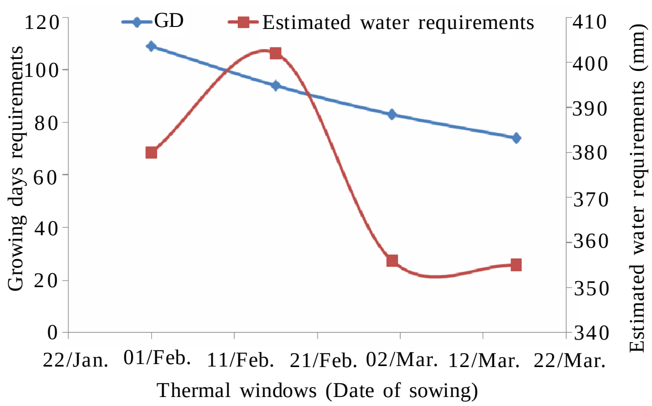

Fig. 2 : Effects of thermal windows on growing days and water requirements

Table 2 : Growing days, thermal heat unit inputs and average grain yield of sesame for different thermal windows

Thermal window	Growing days	Seasonal thermal heat unit (degree-days)	Estimated water requirements as per climatic approach (mm)
01-Feb.	109	2152	380
16-Feb.	94	1946	402
01-Mar.	83	1803	356
16-Mar.	74	1722	355

Table 3 : Statistical analysis results for the effect of thermal window on grain yield of sesame

Treatments	Grain yield (kg/ha)
Thermal window	
W_1=1st Feb.	555.20
W_2=16th Feb.	1131.59
W_3= 1st Mar.	1084.72
W_4=16th Mar.	828.09
S.E. ±	33.36
C.D. (P=0.05)	106.75
C.V. (%)	18.16

increase in mean daily temperature while decrease in it after that was because of deceased in growing days requirements to mature the crop.

The effects of seasonal thermal heat units' availabilities on the sesame grain yield as shown in Table 3 and thermal heat use efficiency were computed as presented in Fig. 3. It shows that the highest and lowest sesame grain yield of 1131.59 kg/ha and 555.20 kg/ha was observed for the thermal windows of 16th February and 1st February, respectively. The crop yield deceased for the thermal windows later than 16th Feb. The pod yield of 828.10 kg/ha was found under thermal windows of 16th March as the crop matured earlier due to higher rate of thermal heat unit availability per day. The highest grain yield recorded under thermal windows of 16th Feb. shows that the crop production can be optimum if the daily thermal heat units availability are around 15, 18, 23 and 24 degree-days/day during the establishment, vegetative, flowering-reproductive and ripening stages, respectively.

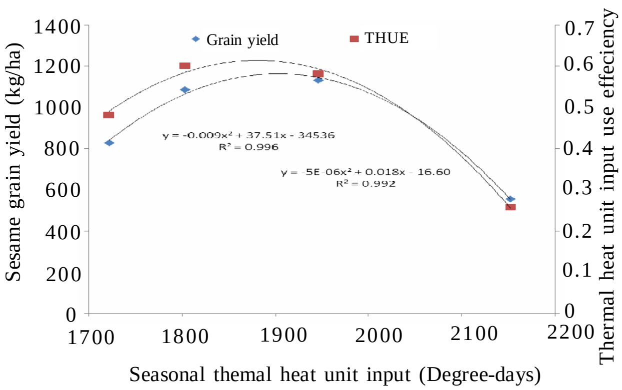

Fig. 3 : Effects of seasonal thermal heat units on sesame grain yield and thermal heat use efficiency

The crop yield response to thermal heat unit availability during growth stages are presented separately in Fig. 4 and 5 for different irrigation intervals with and

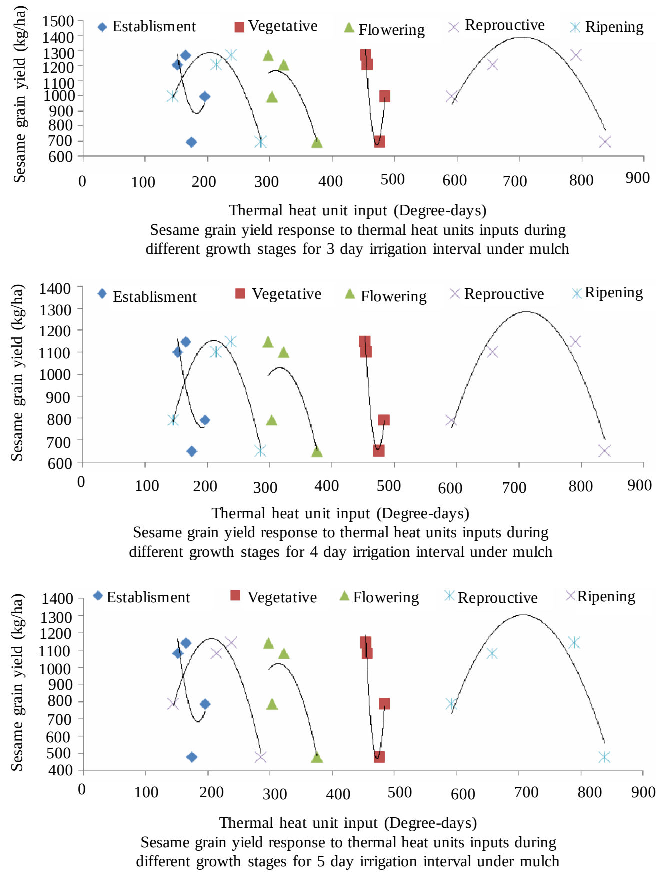

Fig. 4 : Sesame grain yield response to thermal heat units inputs during different growth stages for 3 day, 4 day and 5 day irrigation interval with mulch

without mulch. It could be seen that the quadratic relationship was found between grain yield and thermal heat unit for all the stages. It was found that the increase in thermal heat unit was due to increase in growing days requirement because of lower rate of thermal heat unit availability per day, which had slow down the physiological growth. The vegetative stage was found most sensitive followed by establishment stage, flowering stage, ripening stage and reproductive stage.

Table 4 : Effect of irrigation interval on grain yield of sesame

Irrigation interval	Grain yield (kg/ha)
I_1=3 days	991.27
I_2=4 days	888.86
I_3=5 days	819.56
Control=surface at 7 days	784.46
S.E. ±	31.92
C.D. (P=0.05)	110.47
C.V. (%)	20.06

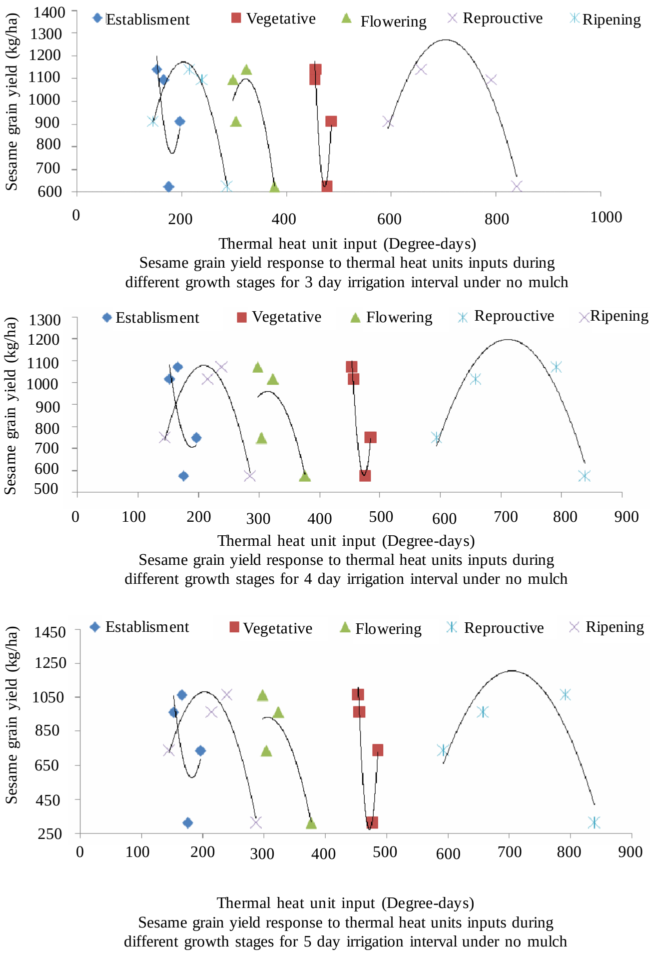

Fig. 5 : Sesame grain yield response to thermal heat units inputs during different growth stages for 3 day, 4 day and 5 day irrigation interval under no mulch

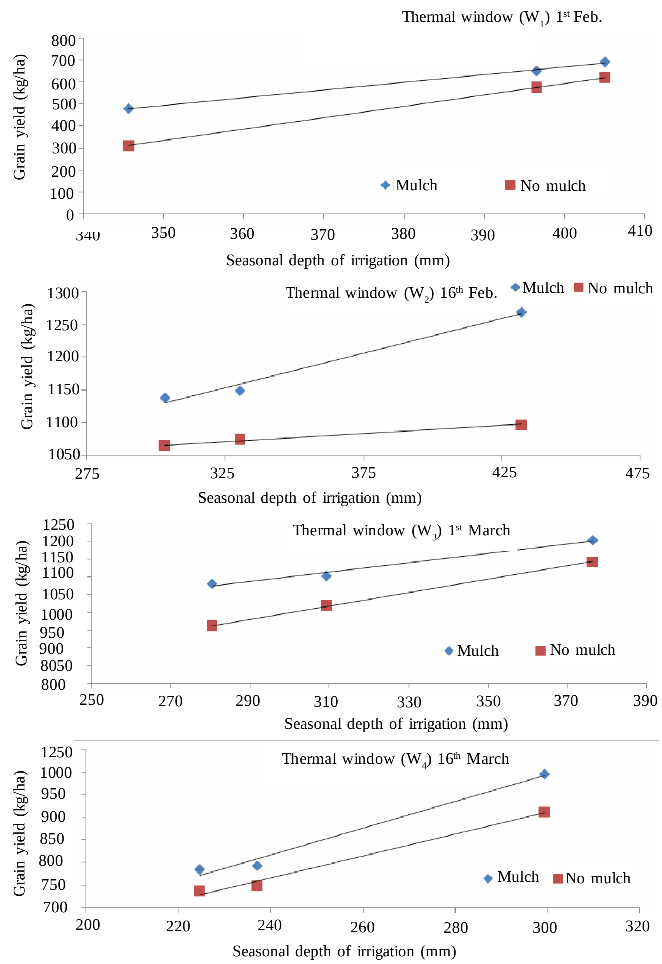

Fig. 6 : Sesame grain yield response to thermal heat units inputs during different growth stages for 3 day, 4 day and 5 day irrigation interval with mulch

Effect of thermal regime :

It was found that the daily thermal heat units availability was lower than 20 degree-days up to 45 days *i.e.* 15th March, 2012. During 45 to 75 days after 1st February, it varied from 20 to 23 while it was around 24 then after. The highest daily thermal heat unit availability was 24.95 at 59th day after 1st February. The cumulative thermal heat unit of 2440 degree-days was observed after 121 days after 1st February. The highest growing days requirements was observed as 109 days for 1st February (W_1) with highest seasonal thermal heat unit for 109 days of 2152 degree-days while the lowest growing days requirements was observed as 76 days for the sesame sown at 16th March (W_4) as 76 days with lowest thermal heat units of 1722 degree-days. It was revealed that if the daily thermal heat unit availability is lower, the more number of growing days are required to mature the crop with less total thermal heat unit requirements. The highest and lowest sesame grain yield of 1131.59 kg/ha and 555.20 kg/ha was observed for the thermal windows of 16th February and 1st February, respectively it shows that the crop production can be optimum if the daily thermal heat units availability are around 15, 18, 23 and 24 degree-days/day during the establishment, vegetative, pod development and pod maturity stages, respectively.

Effect of moisture regime :

The grain yield decreased with increase in irrigation interval. The reason is quite common that higher the irrigation interval, the crop plant has to face higher stress due to infrequent irrigations. The highest grain yield of

991.27 kg/ha was found under irrigation by drip at 3-days interval which was higher by the tune of 10.33 per cent, 17.32 per cent and 20.86 per cent as compared to that of under 4, 5 days under drip and 7-days under surface irrigation, respectively. Similar results related to the present investigation by Ghosh and Mohiuddin (2000); Garai and Datta (2001) and Garai and Datta (1999).

Conclusion :

Based on the data observations, analysis and its results, the following conclusions could be drawn from the present investigation.

REFERENCES

Balasubramaniyan, P. and Dharmalingam, V. (1996). Influence of irrigation and N levels on summer sesame. *Sesame & Safflower Newsletter*, **11**:45- 49.

Foroud, N., Mundel, H.H., Saindon, G. and Entz, T. (1993). Effect of level and timing of moisture stress on soya beans yield, protein and oil response. *Field Crop Res.*, **33** (3): 195- 205.

Garai, A.K.and Datta, J.K.(1999). Influence of plant growth regulators on growth, morphophysiological characters and yield of summer sesame (*Sesamum indicum* L.) under moisture stress. *Acta Physiologia Plantrum*, **21** (3): 277-281.

Garai, A.K. and Datta, J.K. (2001). Studies on physiological parameters and seed yield of sesame under moisture stress and growth regulators. *J. Maharashtra Agric. Univ.*, **26** (3): 280-283.

Ghosh, D.C. and Mohiuddin, Md. (2000). Response of summer sesame (*Sesamum indicum*) to biofertilizer and growth regulator. *Agric. Sci. Digest*, **20** (2): 90-92.

Ucan, K., Killi, F., Gencoglan, C.and Merdun, H. (2007). Effect of irrigation frequency and amount on water use efficiency and yield of sesame (*Sesamum indicum* L.) under field conditions. *Field Crops Res.*, **101** (3) : 249-258.

6th Year
★★★★★ of Excellence ★★★★★