Biological Forum – An International Journal **14(2a): 435-439(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Physiological Growth Parameters of linseed (*Linum usitatissimum* L.) as Influenced by different Irrigation Scheduling and Fertility Levels

Anamika Jain Badkul[1*], P.B. Sharma[2], Amrita Badkul[4], Lalita Bhayal[1] and R.P. Sahu[3]
[1]Ph.D. Scholar, Department of Agronomy, COA, JNKVV, Jabalpur (Madhya Pradesh), India.
[2]Head of the Department and Chief Agronomist, Department of Agronomy, COA. JNKVV, Jabalpur (Madhya Pradesh), India.
[3]Scientist, Department of Agronomy, COA, JNKVV, Jabalpur (Madhya Pradesh), India.
[4]Ph.D. Scholar, Department of Plant Breeding and Genetics, MGCGV, Satna (Madhya Pradesh), India.

(Corresponding author: Anamika Jain Badkul)*
(Received 30 April 2022, Accepted 18 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: A field experiment was conducted during *Rabi* season of 2020-21 and 2021-22 at Research farm, College of Agriculture, JNKVV, Jabalpur to assess response of linseed to different various irrigation schedules and fertility levels on sandy loam soil. The treatments comprised of three irrigation levels i.e. no irrigation (I_0), 0.6 IW/CPE ratio (I_1) and 0.8 IW/CPE ratio (I_2) and four fertility levels *i.e.* N: P: K: S @ 30:20:10:00 (N_1), 30:20:10:20 (N_2), 60: 40: 20: 00 (N_3) and 60: 40: 20: 20 (N_4) kg ha^{-1} tested in split plot design with three replications. The Leaf Area Index, Leaf Area Duration, Crop Growth Rate and Relative Growth Rate were recorded highest under the irrigation schedule with 0.8 IW/CPE ratio which was at par with the value under 0.6 IW/CPE ratio over the no irrigation (I_0). As regards to fertility levels, LAI was recorded significantly higher with NPKS@ 60:40:20:20 kg ha^{-1} as compared to other fertility levels. However, all the physiological indicators *i.e.* LAI, LAD, CGR, RGR was found highest in I_2 and N_4 treatment.

Keywords: Linseed, leaf area index, leaf area duration, crop growth rate, relative growth rate.

INTRODUCTION

India is one of the leading oilseeds growing country in the world and fourth largest vegetable oil economy next to USA, China and Brazil. Linseed (*Linum usitatissimum* L.) is India's most important oilseed crop, ranking second after to rapeseed-mustard in terms of acreage and production. It is important industrial, edible oil, and fibre crop on account of the oil derived from its seed and the stem fibre. It is high in oil (41%), protein (20%), and dietary fibre (28%), (Morris, 2005).

Linseed is an important *Rabi* crop chiefly grown under rainfed (63%), utera (25%) and irrigated (12%) conditions (Dash *et al.*, 2017). Among the different agronomic practices, irrigation and essential plant nutrients play a vital role in achieving higher levels of yield of linseed. Seed yield of linseed is directly affected by Nitrogen availability especially when grown under irrigated condition (Patel *et al*., 2017). Beside nitrogen, sulphur is very crucial for good oilseed yield (Aravind *et al.,* 2009). Research evidences show that linseed yield is determined by the ability of plants to accumulate dry matter during the vegetative period (Aufhammer *et al.,* 2000; Hassan and Leitch 2000). The dynamics of dry matter distribution to various plant organs, their yielding and productivity in Linseed may be characterized by using various indices of growth analysis *i.e.* LAI, LAD, CGR, and RGR (Aufhammer *et al.,* 2000). Thus the study was carried out to study the physiological growth parameters of linseed as influenced by different irrigation scheduling and fertility levels.

METHODOLOGY

The experiment was conducted at instructional research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during R*abi* season of 2020-21 and 2021-22. The climate of this region is sub-tropical with cool winter and hot summers and mean annual rainfall of Jabalpur is 1350 mm. Jabalpur belongs to "Kymore plateau and Satpura Hills" agro-climatic zone as per norms of National Agricultural Research Programme. The experiment comprised of three irrigation levels *i.e.* no irrigation (I_0), 0.6 IW/CPE ratio (I_1) and 0.8 IW/CPE ratio (I_2) and four fertility levels *i.e* N: P: K: S @ 30:20:10:00 (N_1), 30:20:10:20 (N_2), 60: 40: 20: 00 (N_3) and 60: 40: 20: 20 (N_4) kg ha^{-1} tested in split plot design

with three replications. The physiological parameter was recorded at different time intervals as detailed below:

Leaf area index (LAI). LAI is the ratio of leaf area (A) over a certain ground area (P). It was worked out at 3 stages i.e.30, 60 and 90 DAS. It was calculated by using the formula given by Watson (1952).

$$LAI = \frac{\text{Leaf area (A)}}{\text{Ground area (P)}}$$

Leaf area duration (LAD): LAD was estimated according to the formula:

$$LAD\ (days) = \frac{(LAI_1 + LAI_2)}{2} \times (T_2 - T_1)$$

Where, LAI_1 and LAI_2 were the leaf area indices at time T_1 and T_2, respectively. Cumulative LAD was calculated by adding all the LAD values attained at different stages (30-60, 60-90 DAS).

Crop growth rate (CGR): The crop growth rate was computed by using the following formula:

$$CGR\ (g\ day^{-1}\ m^{-2}) = \frac{(W_2 - W_1)}{t_2 - t_1\ (P)}$$

Where, P = Ground area, W_1 = Dry weight of plant m^{-2} recorded at time t_1, W_2 = Dry weight of plant m^{-2} recorded at time.

Relative growth rate (RGR): RGR given by Watson (1952) Where,

$$RGR\ (g\ g^{-1}\ day^{-1}) = \frac{(InW_2 - InW_1)}{(t_2 - t_1)}$$

W_1 = Dry weight of plant m^{-2} at time T_1, W_2 = Dry weight of plant m^{-2} at time T_2, ln = Natural log

The data recorded on these aspects were subjected to 'F' test of variances and results are interpreted on the basis of mean values.

RESULTS AND DISCUSSION

Leaf area index (LAI): The data on mean LAI as influenced by different treatments revealed that **(**Table 1 and Fig. 1) irrigation at 0.8 IW/CPE ratio gave significantly higher values as compared to 0.6 IW/CPE ratio and no irrigation condition at 60 and 90 DAS. Linseed crop is responsive to irrigation (Rana *et al*., 2000). Irrigation at 0.8 IW/CPE ratio could be able to supply sufficient moisture for the optimum growth of linseed which in turn resulted in increased leaf size, area and ultimately leaf area index.

Among different fertility levels LAI was recorded significantly highest in NPKS @ 60:40:20:20 kg ha^{-1} as compared to all the treatments. At the level of nutrients, particularly the nitrogen in combination with sulphur give birth to more number of leaves with increase in size and resulted in vigorous plant growth. NPK @ 30:20:10 kg ha^{-1} recorded lowest LAI at all the stage. The reason for lowered number of leaves and reduced leaf size at other fertility levels might be due to lower dose of nutrients Tanwar *et al*. (2011).

Leaf area duration (LAD): The data depicted that **(**Table 1 and Fig. 2) the increase in leaf area duration was more pronounced in 30-60 and 60-90 DAS. However, LAD was observed significantly higher in 0.8 IW/CPE ratio than 0.6 IW/CPE and no irrigation. However, No irrigation was observed to be significantly lower leaf area duration at all growth stages.

Table 1: Response of irrigation levels and fertility levels on LAI and LAD of linseed (Pooled mean data of 2 years).

Treatments	leaf area index (LAI)			leaf area Duration (days)	
Irrigation Schedules	**30 DAS**	**60 DAS**	**90 DAS**	**30-60 DAS**	**60-90 DAS**
I_0- No irrigation	0.24	1.41	1.19	24.74	38.95
I_1- 0.6 IW/CPE ratio	0.31	2.23	1.82	38.09	60.83
I_2- 0.8 IW/CPE ratio	0.30	2.74	1.97	45.56	70.54
SEm±	0.01	0.09	0.03	1.44	1.54
CD at 5%	0.04	0.36	0.10	5.81	6.21
Fertility Levels (kg ha^{-1})					
N_1- NPK @30:20:10	0.25	1.70	1.22	29.13	43.74
N_2- NPKS @30:20:10:20	0.26	1.99	1.42	33.88	51.27
N_3- NPK @ 60:40:20	0.28	2.29	1.92	38.47	63.14
N_4- NPKS @60:40:20:20	0.34	2.53	2.07	43.03	68.94
SEm±	0.01	0.07	0.04	1.08	1.17
CD at 5%	0.02	0.21	0.11	3.25	3.52

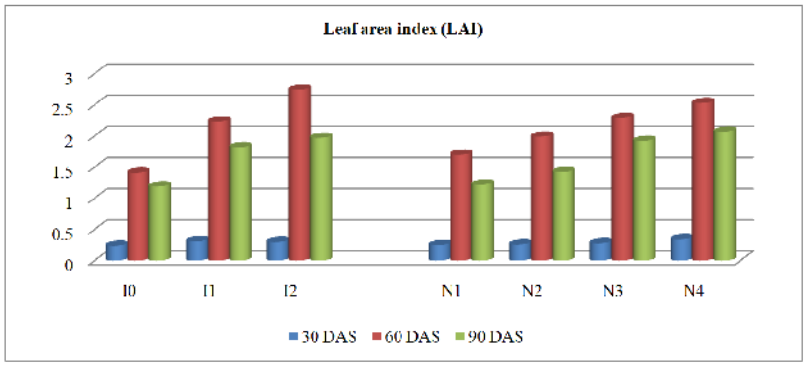

Fig. 1. Response of irrigation levels and fertility levels on LAI of linseed (Pooled mean data of 2 years).

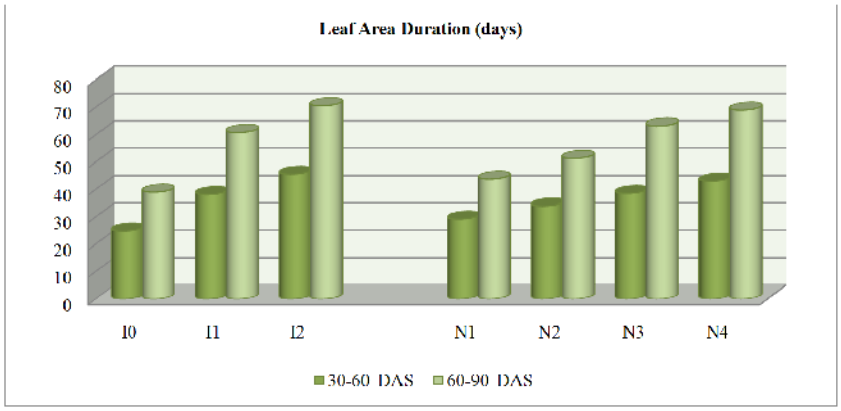

Fig. 2. Response of irrigation levels and fertility levels on LAD of linseed (Pooled mean data of 2 years).

The crop sown in treatment NPKS @ 60:40:20:20 kg ha^{-1} reported a remarkable increase particularly during both stages. It might be due to more number of leaves produced per unit area. The lowest leaf area duration was recorded under NPK @ 30:20:10 kg ha^{-1}.

Crop growth rate (CGR): The data on mean crop growth rate (g day^{-1} m^{-2}) are presented in Table 2 and Fig. 3. The increased rate of per day dry matter production resulted in higher CGR in 0.8 IW/CPE ratio which was at par with 0.6 IW/CPE ratio but lower in treatment no irrigation. Irrigation was a dire necessity especially at the time of critical stages.

Table 2: Response of irrigation levels and fertility levels on CGR and RGR of linseed (Pooled mean data of 2 years).

Treatments	Crop Growth Rate ($gm^{-2}day^{-1}$)		Relative Growth Rate (gg^{-1} day^{-1})	
Irrigation Schedules	**30-60 DAS**	**60-90 DAS**	**30-60 DAS**	**60-90 DAS**
I_0- No irrigation	1.42	6.23	0.025	0.019
I_1- 0.6 IW/CPE ratio	2.29	8.74	0.028	0.021
I_2- 0.8 IW/CPE ratio	2.68	8.84	0.030	0.022
SEm±	0.12	0.34	0.001	0.001
CD at 5%	0.48	1.37	0.004	0.002
Fertility Levels (kg ha^{-1})				
N_1- NPK @30:20:10	1.58	5.23	0.025	0.018
N_2- NPKS @30:20:10:20	1.87	5.71	0.027	0.019
N_3- NPK @ 60:40:20	2.33	9.92	0.028	0.023
N_4- NPKS @60:40:20:20	2.75	10.89	0.029	0.023
SEm±	0.12	0.61	0.001	0.001
CD at 5%	0.35	1.83	NS	0.003

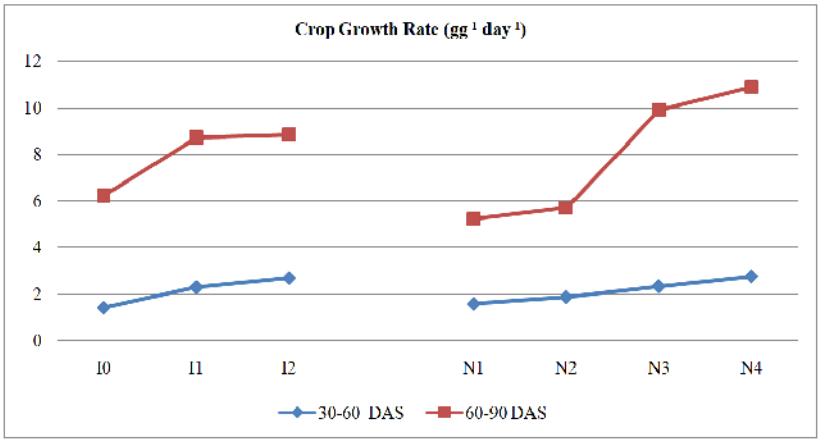

Fig. 3. Response of irrigation levels and fertility levels on CGR of linseed (Pooled mean data of 2 years).

Crop growth rate significantly affected at stages through all fertility levels. Among all numerically superior CGR recorded under NPKS @ 60:40:20:20 kg ha^{-1} followed by NPK @ 60:40:20 kg ha^{-1}. CGR increased might be due to active contribution of leaves in photosynthesis at this period. Similar result was also given by Ramesh and Ram Prasad (2013). Minimum crop growth rate recorded under both NPK @30:20:10 kg ha^{-1} and NPKS @ 30:20:10:20 kg ha^{-1} which was statistically at par each other. The significant increase in dry matter might be due to availability of nutrient with sulphur to the crop at appropriate vegetative stage, resulted in increase in plant growth and it also might have improvement in photosynthetic area of plant that cumulatively contributed to higher dry matter accumulation which directly influenced crop growth rate. These results are in accordance with (Kumari *et al.*, 2021) in linseed.

Relative growth rate (RGR): The data (Table 2 and Fig. 4) clearly showed that during 30-60 and 60-90 DAS, 0.8 IW/CPE ratio reported the highest RGR (0.030 and 0.022 $gg^{-1}day^{-1}$ respectively) closely followed by 0.6 IW/CPE ratio (0.028 and 0.021 g g^{-1} day^{-1}) whereas, significantly superior over No irrigation (I_0). This was mainly because these irrigated condition showed vigorous growth ability and attained relatively higher biomass accumulation than rainfed condition (Awasthi *et al*., 2011).

The mean relative growth rate was not affected significantly by fertility levels at 30-60 DAS. An increase in relative growth rate in NPKS @60:40:20:20 kg ha^{-1} at 60-90 DAS may be due to sulphur application (Saha and Mandal 2000). NPK @ 60:40:20 kg ha^{-1} treatment recorded similar result with NPKS @ 60:40:20:20 kg ha^{-1} at 60-90 DAS.

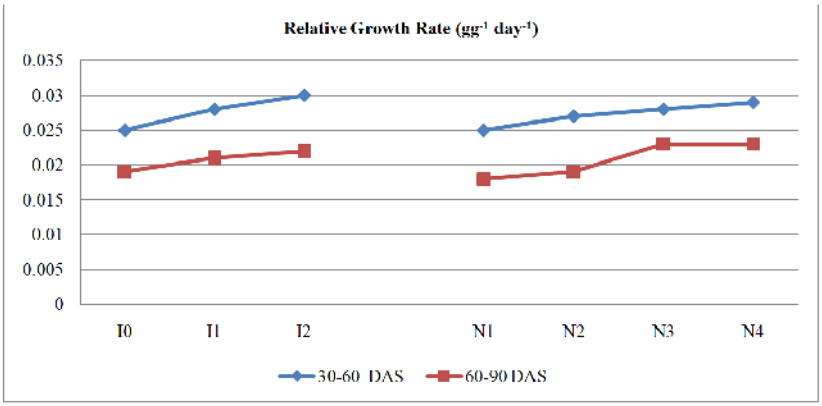

Fig. 4. Response of irrigation levels and fertility levels on RGR of linseed (Pooled mean data of 2 years).

CONCLUSION

The irrigation schedule at 0.8 IW/CPE ratio proved to be superior in terms of higher physiological parameters followed by 0.6 IW/CPE ratio and no irrigation condition. Among all physiological stages sowing of linseed under the treatment NPKS @ 60:40:20:20 kg ha^{-1} was found advantageous in recording more LAI, LAD, CGR and RGR. However, these results are of two year mean. Hence, further experimentation is required to get the standard irrigation scheduling and recommended dose of nutrients for linseed for a particular locality.

Acknowledgement. Author is very thankful to Department of Agronomy, Collage of Agriculture, JNKVV, Jabalpur (M.P.), for research work support.
Conflict of Interest. None.

REFERENCES

Aufhammer, W., Wägner, W., Kaul, H. P. and Kübler, E. (2000). Radiation use by oil seed crops – a comparison of winter rape, linseed and sunflower. *J. Agron. & Crop Sci., 184*: 277–286.

Awasthi, U. D., Dubey, S. D. and Shripal (2011). Effect of nitrogen and moisture conservation practices on yield, uptake, water-use efficiency and quality of linseed (*Linum usitatissimum* L.). *Indian Journal of Agricultural Sciences*, *81*(4): 383-385.

Dash, J., Sen, N. B. and Mohapatra, U. B. (2017). Linseed: A Valuable Crop Plant. *International Journal of Advance Research*, *5*(3), 1428-1442.

Hassan F. U., Leitch M. H. (2000). Influence of seeding on contents and up take of N, P and K in linseed (*Linum usitatissimum* L.). *J. Agron. & Crop Sci*., *185*, 193-199.

Kumar, A., Sharma P., Thomas L., Agnihotri A. and Banga, S. S. (2009). Canola cultivation in India: scenario and future strategy. *16th Australian Research Assembly on Brassicas*, Ballarat Victoria, Australia.

Kumari, S., Kumari, R. and Kumar, S. (2021). Evaluation of the Performance of Micronutrients on Growth and Quality Parameters of Linseed (*Linum usitatissimum* L.). *Biological Forum – An International Journal*, *13*(3): 450-453.

Patel, R. K., Tomar G.S. and Dwivedi, S. K. (2017). Effect of irrigation scheduling and nitrogen levels on growth, yield and water productivity of linseed (*Linum usitatissimum* L.) under Vertisols. *Journal of Applied and Natural Science*, *9*(2): 698-705.

Ramesh, R., and Ramprasad E. (2013). Effect of plant growth regulators on morphological, physiological and biochemical parameters of soybean (*Glycine max* L. Merrill). *Helix*, (6): 441-447.

Rana, D. S., Saran G. and Pachauri, D. K. (2000). Effect of level and time of irrigation and nitrogen on the yield attributes, seed yield and water use of linseed (*Linum usitatissimum* L.), *Annals of Agricultural Research*, *21*(1): 37-41.

Saha, A. and Mandal, B. K. (2000). Growth and yield of yellow sarson and mustard in relation to sulphur nitrogen in lowland entisol under rainfed condition. *J. Oilseeds Res., 17*(2): 307-314.

Tanwar, S. P., Rokadia P. and Singh, A. K. (2011). Effect of row ratio and fertility levels on chickpea (*Cicer arientinum*) and linseed (*Linum usitatissimum* L.) intercropping system. *Indian Journal of Agronomy*, *56*(3): 217-222.

Watson, D. J. (1952). Physiological basis of varieties in yield. *Advances in Agronomy*, (4): 101-145.

How to cite this article: Anamika Jain Badkul, P.B. Sharma, Amrita Badkul, Lalita bhayal and R.P. Sahu (2022). Physiological Growth Parameters of linseed (*Linum usitatissimum* L.) as Influenced by different Irrigation Scheduling and Fertility Levels. *Biological Forum – An International Journal*, *14*(2a): 435-439.