www.ThePharmaJournal.com

The Pharma Innovation

Influence of crop geometry and nitrogen levels on growth and yield of chia seed (*Salvia hispanica* L.)

Shubham Dubey, Lalit Kumar Sanodiya, Ravin Singh, Ravendra Kumar, Vipin Patel and Anoj Singh

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(9): 1235-1238

www.thepharmajournal.com
Received: 24-06-2023
Accepted: 27-07-2023

Shubham Dubey
M.Sc. Scholar, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh, India

Lalit Kumar Sanodiya
Assistant Professor, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh, India

Ravin Singh
M.Sc. Scholar, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh, India

Ravendra Kumar
M.Sc. Scholar, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh, India

Vipin Patel
M.Sc. Scholar, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh, India

Anoj Singh
Ph.D. Scholar, SHUATS, Naini, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Lalit Kumar Sanodiya
Assistant Professor, Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh, India

Abstract
The field experiment took place during the *Rabi* season of 2022–2023 at the United University's Agronomy Research Farm in Jhalwa Prayagraj, Uttar Pradesh. "Influence of crop geometry and nitrogen levels on growth and yield of chia seed (*Salvia hispanica* L.)". The experiment consisted of three, doses of nitrogen (80, 100, 120 kg/ha) and three spacing (40 × 15 cm, 50 × 15 cm, 60 × 15 cm). Three replications of the Randomised Block Design (RBD) statistical design were used to carry out the experiment. Variety used was "Chia Ampion W-83". The results of the study show that, among the treatments, the use of 120 kg N/ha at 60 × 15 cm spacing produced significantly higher plant height (131.75 cm), number of leaves/Plant (275.86), fresh plant weight (961.23 g), dry weight (136.67 g/plant), root length (15.72 cm), number of branches (13.40), fresh root weight (9.25 g/plant), dry root weight (3.02 g), number of effective branch/plant (27.29), number of grains per spike (278.03), length of spike (18.75 cm), number of panicles (26.83) and test weight (2.03 g). Highest yield was found to be ttreatment combination receiving 120 kg N/ha at 60 × 15 cm spacing fetched highest grain yield (11.60 q/ha), stover yield (57.03 q/ha) and harvest index (28.20 %). The maximum economic gross return (177700 ₹/ha), net return (122843.28 ₹/ha) and benefit cost ratio (2.24) obtained with application of 120 kg N/ha at 60 × 15 cm brought about more return than control.

Keywords: Chia, spacing, nitrogen, growth, yield and economics

Introduction

Chia seed (*Salvia hispanica* L.) is still not widely cultivated in India, and there is a dearth of knowledge about the plant's development, phenology, nutritional needs, and management tactics for making the most of each region's edaphoclimatic features. Taking into account the knowledge on agronomic management and the significance of nitrogen fertilisation of crops in soils of Prayagraj condition in (U.P.) India, as well as the rising global demand for chia. This served as motivation for this endeavour. To assess how nitrogen fertilisation and planting geometry affect the chia plant's growth, development, and productivity. (Mohanty *et al.*, 2021) [7]. Now a day's malnutrition is a worldwide concern for scholars and health experts. There are currently 795 million undernourished people in the globe, with the percentage in emerging nations hovering around 12.9% and alarmingly rising daily. Therefore, as public health awareness grows around the world, there is a rising demand for functional foods that offer a variety of health benefits. Additionally, because of its adaptability to various pedoclimatic situations, chia is viewed as a substitute crop in terms of food security and climate change by (Kirruti *et al.*, 2021) [5]. In terms of nutrition, chia seeds are high in alpha-linolenic acid (ALA), an omega-3 fatty acid derived from plants. The oil in the seed ranges from 25 to 40 percent, with 60 percent of it being omega-3 alpha-linolenic acid and 20 percent being omega-6 linoleic acid. Both of these essential fatty acids are absolutely necessary for human health and cannot be produced synthetically. Additionally, they include a lot of dietary fibre, protein, calcium, iron, magnesium, and zinc (Herman *et al.*, 2016) [2].

It is possible to characterise plant growth as the unstoppable expansion of some of its physical dimensions, followed by cell division and division. One of the fundamental methods for figuring out how much a crop will produce is to analyse its growth. Growth indices describe how the assimilatory system of plants produces and distributes organic matter to the various plant organs (leaves, stems, roots, and inflorescences), all of which depend on photosynthesis, respiration, and the transfer of photoassimilates. Chia is a plant with a low water demand that thrives in arid and semi-arid climates. *Salvia hispanica* L. has demonstrated excellent promise as a crop plant for its seed oil. Chia oil is currently one of the most expensive oils available.

Compared to other oils, such as soybean oil (Glycine max), sunflower oil (*Helianthus annuus* L.), rapeseed oil (*Brassica napus* L.), and olive oil (*Olea europaea* L.), chia oil is of higher quality. The flour, a by-product of oil extraction, is suitable for both human and animal consumption. It is high in fibre and contains ingredients with antioxidant activity, giving it an emulsifying character and enhancing the feeling of fullness after consuming the grain. India's cultivation of this plant is still not very advanced, and there is a dearth of knowledge surrounding the development, phenology, growing season, nutritional needs, and management techniques for making the most of each region's edaphon-climatic characteristics. Studies on the agronomic management of the chia crop have been condensed because it is a recently proposed crop to Odisha and to India as a whole. (Freitas *et al*., 2016) [1]

Since amino acids, nucleic acids, enzymes, proteins, chlorophyll, and cell walls are all structural components of nitrogen, it participates in a variety of physiological and biochemical plant activities. The primary issue is the central inflorescence's uneven ripening in comparison to the lateral shoots, which continue to be green. Waiting until every seed is ready increases the chance of seed loss because of issues with breaking, bird damage, and abiotic factors like rain and wind. Chia is an intriguing choice because it has been demonstrated to be drought-tolerant while sustaining strong growth when there is less water available. In contrast, recent crops in Mexico are already using nitrogen in amounts greater than 100 kg per hectare (68 kg per acre). The Lamiaceae family includes the chia plant (*Salvia hispanica* L.), which is indigenous to Mexico and Guatemala. Pre-Columbian communities raised this crop, which was the third-most significant economic source after maize (*Zea mays* L.) and beans (*Phaseolus vulgaris* L.). Food, medicine, and oil were all prized uses for chia seeds. But after the Spanish arrived and began to colonise, the species' cultivation sharply declined. (Ixtaina *et al*., 2010) [4].

Materials and Methods

At the United University's Agricultural Research Farm in Rawatpur, Jhalwa, Prayagraj (U.P.), India, which is located at 25.390 N latitude, 81.750 E longitude and has an elevation of 113 metres above mean sea level, a field experiment was carried out in the *Rabi* season of 2022. To research how chia seed (*Salvia hispanica* L.) production, yield, and economics are affected by integrated nutrition management. The experiment was set up in a randomised block design with three replications to examine the effects of crop geometry and nitrogen levels on the growth and yield of chia seed. The experiment was comprised of eleven treatments *viz*., T_1 40 x 15 cm + Nitrogen 80 kg/ha, T_2 40 x 15 cm + Nitrogen 100 kg/ha, T_3 40 x 15 cm + Nitrogen 120 kg/ha, T_4 50x 15 cm + Nitrogen 80 kg/ha, T_5 50 x 15 cm + Nitrogen 100 kg/ha, T_6 50 x 15 cm + Nitrogen 120 kg/ha, $T_{7,}$ 60x 15 cm + Nitrogen 80 kg/ha, T_8 60 x 15 cm + Nitrogen 100 kg/ha, T_9 60 x 15 cm + Nitrogen 120 kg/ha, T_{10} Control. Chai seed variety "chia Ampion W 83" was sown after pre-sowing irrigation using 1 kg ha^{-1} seed rate. A basal dose of 120 kg N, 50 kg P_2O_5, 50 kg k. was administered per hectare as per the fertiliser dosage recommendation. Before sowing, FYM was administered to the field according to the treatment instructions and blended with the soil. As a result, seeds were vaccinated. The data collected for each character was subjected to statistical analysis using the "analysis of variance" technique. Overall differences were evaluated using the "F" test of significance at the recommended 5 percent level of significance. For comparing treatments, critical differences at a 5% level of probability were determined.

Results and Discussion

Effect on growth parameters

At harvest, significantly the treatments T_9 (60 x 15 cm + Nitrogen 120 kg/ha) was recorded highest plant height (131.75 cm), fresh plant weight (961.23 g), dry weight (136.67 g/plant), root length (15.72 cm), number of branches (13.40), fresh root weight (9.25 g/plant) and dry root weight (3.02 g). However, the T_8 (60 x 15 cm + Nitrogen 100 kg/ha) and T_7 (60 x 15 cm + Nitrogen 80 kg/ha), which was statically at par with treatment T_9 as compared to all the treatments.

This is because more nitrogen was applied, increasing the nitrogen content of the cell sap as protein, amides, and aminoacids, which in turn caused the cells to elongate and multiply, increasing the growth. As plant population density grew, the internodal lengths also increased. This outcome was consistent with the information captured by (Inamullah *et al*., 2012) [3]. Because there was more competition for light in a region with dense plant growth, lateral growth was suppressed and apical dominance grew. These outcomes are consistent with those of (Mary *et al*., 2018) [8]. The lengthening of stems and an increase in the number of nodes per plant as a result of mutual shadowing are likely the causes of the growth acceleration at greater plant densities. The information showed that the application of nitrogen had a considerable impact on plant growth. At all phases of growth, there was a considerable rise with every increase in nitrogen application rate. (Mohanty *et al.,* 2021) [7].

Effect on yield attributes and yield

Significantly higher number of effective branches (27.29), number of grains per spike (278.03), length of spike (18.75), number of panicles (26.83), test weight (2.03 g), grain yield (11.60 q/ha), straw yield (57.03 q/ha) and harvest index (28.20%). over all the other treatments. However, the treatments T_9 (60 x 15 cm + Nitrogen 120 kg/ha) was recorded maximum which is significantly superior all over the T_8 (60 x 15 cm + Nitrogen 100 kg/ha) and T_7 (60 x 15 cm + Nitrogen 80 kg/ha) was statically at par with treatment T_9.

Table 1: Influence of crop geometry and nitrogen levels of chia seed.

T. No.	Treatment combination	At harvest			
		Plant height (cm)	Fresh plant weight (g)	Plant dry weight (g)	Root length (cm)
T_1	40 x 15 cm + Nitrogen 80 kg/ha	122.97	842.53	129.43	15.72
T_2	40 x 15 cm + Nitrogen 100 kg/ha	123.26	878.20	132.30	13.99
T_3	40 x 15 cm + Nitrogen 120 kg/ha	123.20	895.47	131.37	14.66
T_4	50 x 15 cm + Nitrogen 80 kg/ha	123.37	898.23	132.13	13.55
T_5	50 x 15 cm + Nitrogen 100 kg/ha	124.21	903.73	132.70	13.85
T_6	50 x 15 cm + Nitrogen 120 kg/ha	124.72	920.20	133.93	13.65
T_7	60 x 15 cm + Nitrogen 80 kg/ha	125.72	940.90	132.77	13.82
T_8	60 x 15 cm + Nitrogen 100 kg/ha	131.01	956.03	136.67	14.49
T_9	60 x 15 cm + Nitrogen 120 kg/ha	131.75	961.23	133.83	13.54
T_{10}	Control	91.52	824.53	113.69	14.34
F-test		S	S	S	S
SEm (±)		6.86	27.04	3.99	0.42
CD (p=0.05)		20.39	80.33	11.85	1.24

Table 2: Influence of crop geometry and nitrogen levels of chia seed.

T. No.	Treatment combination	At harvest			
		No. of branch	No. of leaves	Fresh root weight (g)	Dry root wright (g)
T_1	40 x 15 cm + Nitrogen 80 kg/ha	12.63	257.91	9.25	2.05
T_2	40 x 15 cm + Nitrogen 100 kg/ha	12.86	263.20	7.81	2.00
T_3	40 x 15 cm + Nitrogen 120 kg/ha	12.73	272.51	7.45	1.88
T_4	50 x 15 cm + Nitrogen 80 kg/ha	13.10	260.55	7.07	2.15
T_5	50 x 15 cm + Nitrogen 100 kg/ha	13.13	267.53	7.75	3.02
T_6	50 x 15 cm + Nitrogen 120 kg/ha	13.03	264.40	7.06	1.76
T_7	60 x 15 cm + Nitrogen 80 kg/ha	12.86	270.48	7.56	2.04
T_8	60 x 15 cm + Nitrogen 100 kg/ha	13.15	270.19	8.04	2.09
T_9	60 x 15 cm + Nitrogen 120 kg/ha	13.40	275.86	8.01	2.00
T_{10}	Control	13.21	225.20	4.18	2.65
F-test		S	S	S	S
SEm (±)		0.12	7.98	0.66	0.24
CD (p=0.05)		0.37	23.71	1.97	0.71

Table 3: Influence of crop geometry and nitrogen levels to yield of chia seed.

T. No.	Treatment combination	Yield attribute			Yield		
		No. of effective tillers/m^2	Number of grains per spike	Test weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
T_1	40 x 15 cm + Nitrogen 80 kg/ha	25.17	264.90	1.61	8.53	49.87	23.56
T_2	40 x 15 cm + Nitrogen 100 kg/ha	23.19	258.57	2.03	8.77	50.27	24.23
T_3	40 x 15 cm + Nitrogen 120 kg/ha	23.54	273.97	1.23	9.67	51.73	22.02
T_4	50 x 15 cm + Nitrogen 80 kg/ha	27.07	268.47	1.21	9.87	52.47	27.10
T_5	50 x 15 cm + Nitrogen 100 kg/ha	23.55	263.23	1.24	10.23	53.97	25.28
T_6	50 x 15 cm + Nitrogen 120 kg/ha	27.19	267.97	1.17	10.30	54.40	27.50
T_7	60 x 15 cm + Nitrogen 80 kg/ha	25.35	248.30	1.30	10.47	56.93	25.63
T_8	60 x 15 cm + Nitrogen 100 kg/ha	25.90	278.03	1.19	10.67	57.00	26.42
T_9	60 x 15 cm + Nitrogen 120 kg/ha	27.29	270.90	1.37	11.60	57.03	28.20
T_{10}	Control	25.63	235.17	1.25	8.37	46.13	26.12
F-test		S	S	S	S	S	NS
SEm (±)		0.98	8.08	0.15	0.62	2.29	1.23
CD (p=0.05)		2.91	24.01	0.44	1.86	6.80	-

Fig 1: Harvesting of respective research trial

Fig 2: Field view in flowering stage

Fig 3: Field visit with respective advisor on research trial

Acknowledgement

I express thankfulness to my respected advisor Dr. Lalit Kumar Sanodiya (Agronomy) and all the faculty members of Faculty of Agriculture & Allied Sciences, United University, Rawatpur, Jhalwa, Prayagraj, Uttar Pradesh – 211012. For providing essential facility to undertake the studies.

Conclusion

The findings of present study showed that application of 60 x 15 cm + Nitrogen 120 kg/ha (T_9) performed better of growth and yield attributes which was found to be more productive and economically viable. Since the finding are based on the research done in one season. Further trials are needed to confirm more precise results.

References

1. Freitas JHES, de Santana KV, do Nascimento ACC, de Paiva SC, de Moura MC, Coelho LCBB, *et al*. Evaluation of using aluminum sulfate and water-soluble Moringa oleifera seed lectin to reduce turbidity and toxicity of polluted stream water. Chemosphere. 2016;163:133-141.
2. Herman JP, McKlveen JM, Ghosal S, Kopp B, Wulsin A, Makinson R, *et al*. Regulation of the hypothalamic-pituitary-adrenocortical stress response. Comprehensive physiology. 2016;6(2):603.
3. Inamullah SI, Ayub M, Khan AA, Anwar S, Khan SA. Response of common buckwheat to nitrogen and phosphorus fertilization. Sarhad J Agric. 2012;28(2):172-178.
4. Ixtaina VY, Vega A, Nolasco SM, Tomás MC, Gimeno M, Barzana E, *et al*. Supercritical carbon dioxide extraction of oil from Mexican chia seed (*Salvia hispanica* L.): Characterization and process optimization. The Journal of Supercritical Fluids. 2010;55(1):192-199.
5. Kirruti JS, Mburu MW, Njoroge DM. The Effect of Drying Processes on the Nutritional and Phytochemical Levels of Chia Leaves (*Salvia hispanica* L.) at Different Stages of Growth. European Journal of Agriculture and Food Sciences. 2021;3(6):68-75.
6. Maruti Hulihalli UK, Arvind KBN. Production potential of buckwheat (*Fagopyrum esculentum*) as influenced by genotypes and fertilizer levels in Northern transition zone of Karnataka, India. International journal of current Microbiology and Applied Sciences. 2018;7(9):537-545.
7. Mohanty P, Umesha C, Sarangi DR, Sanodiya LK. Impact of Spacing and Nitrogen Levels on growth and Yield of Chia (*Salvia hispanica* L.). In Biological Forum: An International Journal. 2021;13(1):148-153.
8. Andrae R, Fouesneau M, Creevey O, Ordenovic C, Mary N, Burlacu A, *et al*. Gaia data release 2-first stellar parameters from apsis. Astronomy & Astrophysics. 2018 Aug 1;616:A8.