



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
www.agronomyjournals.com
2024; 7(9): 367-370
Received: 30-06-2024
Accepted: 04-08-2024

Kusum Saini
M.Sc. Scholar,
Department of Agriculture,
Vivekananda Global University,
Jaipur, Rajasthan, India

Arjun Lal Prajapat
Assistant Professor
Vivekananda Global University
Rajasthan, Jaipur, Rajasthan,
India

Corresponding Author:
Kusum Saini
M.Sc. Scholar,
Department of Agriculture,
Vivekananda Global University,
Jaipur, Rajasthan, India

Effect of nitrogen and iron on growth and yield in pearl millet (*Pennisetum glaucum* L.)

Kusum Saini and Arjun Lal Prajapat

DOI: <https://doi.org/10.33545/2618060X.2024.v7.i9e.1536>

Abstract

In Kharif season 2023, a field experiment on loamy sand soil was carried out at the research farm of Vivekananda Global University in Jaipur. Nine treatments of nitrogen and iron are included in the experiment: (Control, 25% RDN (15 Kg/ha) + 0.5% FeSO₄ as foliar spray, 50% RDN (30 Kg/ha) + 0.5% FeSO₄ as foliar spray, 75% RDN (45 Kg/ha) + 0.5% FeSO₄ as foliar spray, 100% RDN (60 Kg/ha) + 0.5% FeSO₄ as foliar spray, 25% RDN (15 Kg/ha) + 1.0% FeSO₄ as foliar spray, 50% RDN (30 Kg/ha) + 1.0% FeSO₄ as foliar spray, 75% RDN (45 Kg/ha) + 1.0% FeSO₄ as foliar spray, 100% RDN (60 Kg/ha) + 1.0% FeSO₄ as foliar spray). The experiment was set up in a randomized block design and was replicated three times. The outcomes showed that among the treatments obtained with (100% RDN (60 Kg/ha) + 1.0% FeSO₄ as foliar spray) resulted significantly higher growth and yield of pearl millet.

Keywords: RDN, FeSO₄, pearl millet, growth, yield

1. Introduction

Pearl millet, scientifically known as [*Pennisetum glaucum* (L.)]. It is one of early domesticated millet, cereal grain and a staple food crop. It is also referred as “Bajra” in India. It is cultivated in arid and semi-arid regions of Africa and South Asia. It is native of tropical western Africa some 4000 years ago. It has ability to withstand in harsh weather condition, adapted to extreme temperature and drought, that making it adapted crop for arid reasons than other cereal crops. It is utilized as fodder & feed for livestock. India account 50% of global millet production in the country. In terms of cultivation its ranks 6th globally & 4th in country among cereal crops. Its grain contains about 11.6% protein, 5% fat, 67% carbohydrate, 2.7% minerals and about 12.4% moisture. It also contains higher amount of carotene, riboflavin (Vit B₂) and niacin (Vit B₄). Traditionally, Bajra chapatti known as Sogra/Hogra is the part of daily diet in the western Rajasthan. Besides it, “Khichadi” and “churma” are the delicious dishes prepared from pearl millet flour.

One essential nutrient that is closely linked to a plant's vegetative growth and development is nitrogen. It is a necessary nutrient for the structural element of the cell wall and is involved in the metabolic processes of the plant. This is a key component of the synthesis of amino acids, proteins, and chlorophyll, all of which are necessary for plant growth. When present in sufficient quantities, it promotes the growth of individual plant parts as well as the increase of plant output and quality. At a particular concentration, nitrogen increases the availability of potassium (K) and phosphorus (P), three essential nutrients for plants. Indian soil lacks nitrogen, and plants react to it according to its availability. A crop that requires a lot of nitrogen, pearl millet reacts differently to nitrogen fertilizers. Nevertheless, the effects of N treatment on the growth and yield of pearl millet (Bajra) can vary.

Since iron is involved in the metabolic processes of respiration, photosynthesis, and DNA synthesis, it is a necessary micronutrient for almost all living things. Fe is essential for the synthesis of proteins, the production of starch, the synthesis of chlorophyll, the maintenance of enzymatic activity, and the synthesis of chloroplasts in pearl millet. In many plant physiological and metabolic pathways, it is essential. Due to the plant's requirement for iron and the consumption of less soluble iron in the soil, an iron deficit results in interveinal chlorosis. Even yet, most well-aerated soils have an adequate amount of it. Because it creates an overwhelming amount of insoluble ferric compounds at neutral pH values, it has little biological activity. Due to its inclusion in numerous active enzymes, including the cytochromes of the electron transport chain, it is necessary for a broad variety of biological processes.

2. Materials and Methods

2.1 field experimental conditions

The experiment was directed at Research farm, Vivekananda Global University, Jaipur during *Kharif* season 2023. The details of the materials used and procedures accepted for crop raising and the standards adopted for assessment of treatments throughout the course of examine are illustrate in this chapter. The experiment was directed at Research farm, Vivekananda Global University, Jaipur. Topographically the study area is located at 075°88'99'' E longitude, 26°81'17'' N latitude and his region comes under Agro-climatic zone IIIA (Semi-arid Eastern Plain Zone) of Rajasthan. The climate of this zone is semi-arid characterized by extremes of temperature both in summer and winters. Throughout summers, temperature may go as high as (45.5 °C), while, in winter, it may lower down upto (1°C). The rainfall of this tract varies from (500-700 mm), most of which is received by south-west monsoon between the months of July-September. For the *Kharif* (2023) crop season represented mean weekly data of 29th-41th week in (table 3.1), the mean maximum temperature was lies between (30.5-36.0 °C) and mean minimum temperature was lies between (16.7-25.2 °C), mean maximum relative humidity varies from (72.7-90.8%) while mean minimum relative humidity varies from (45.1-72.8%), and total rainfall in this season was (283.70 mm) recorded during the cropping season.

2.2 Statistical analysis

Experimental data recorded in various observations were statistically analyzed with the help of Fishers's analysis of variance technique. The critical differences for the treatment comparisons were worked out wherever the (F' test) was found significant @ 5% level of significance.

3. Results and Discussion

3.1 Growth Parameters

Growth attributes of pearl millet presenting in table 4.2 to 4.3 viz., plant height and dry matter accumulation production were significantly increased with increase in N and Fe levels in the experiment. Among the all treatments, T₉ (100% RDN (60 Kg/ha) +1.0% FeSO₄ as foliar spray) attained the maximum plant height (41.90, 155.57 and 208.33 cm) and dry matter production (11.51, 64.52 and 85.78 g per plant) at 30, 60 DAS and at harvest respectively which was on equivalent to T₅, T₈, T₄ and T₇. Highest growth parameters that were observed with T₉ which feasible due to higher level of nutrients, it might made possible better uptake and accumulation of nutrients for better growth of plant height and dry matter accumulation. Further, beneficial effect of Fe attributed towards photosynthesis and chlorophyll synthesis enhanced gave dry matter accumulation. Significantly the length of the ear head (39.56 cm) a considerable improvement over the control was assessed with the utilization of T₉ (100% RDN (60 Kg/ha) +1.0% FeSO₄ as

foliar spray). The length of the ear head was gradually increased along with the nitrogen levels these calculations was suggested by Joshi *et al.* (2018) [7]. It could be due to iron which plays a very important role in DNA synthesis, photosynthesis, respiration and transfer of energy in the metabolic reactions of living cells. The maximum no of tillers were obtained by increase in the nitrogen fertilizer stated by Babar *et al.* (2021) [3] and Arshewar *et al.* (2018) [2]. The no of effective tillers per plant significantly was resulted with the utilization of T₉ (100% RDN (60 Kg/ha) +1.0% FeSO₄ as foliar spray) over the control. The increase in the nitrogen the effective tillers are increased significantly has been stated by Gautam *et al.* (2019) [5] and Gowde *et al.* (2023) [6].

3.2 Yield attributes and yield

The effect of N and Fe play crucial role on no. of effective tillers per plant, test weight, grain yield, straw yield and protein content of pearl millet. In general, the utilization of 100% RDN (60 Kg/ha) + 1.0% FeSO₄ as foliar spray) increased effective tillers per meter row length in the tune of (39.56). Higher rate of nitrogen utilization of results in cell division, photosynthesis, cytokinin synthesis and many more. This result is closely corroborated with the findings of Ravi *et al.* (2023) [10] in pearl millet crop. The more no of tillers are obtain by increase in the iron fertilizer has stated by Ravi *et al.* (2023) [10]. The overall improvement in crop growth due to the effect of nitrogen and iron resulted in growth and development, these results similar with the findings of Maharana *et al.* (2023) [12] and Ravi *et al.* (2023) [10].

Significantly maximum test weight resulted (7.95 g) with the utilization of T₉ (100% RDN (60 Kg/ha) +1.0% FeSO₄ as foliar spray) but it was statistically equivalent to the utilization of T₅, T₈, T₄ and T₇. Test weight increased by the application of high level of nitrogen feasible attributed to the better filling of grains resulting into bigger size grains and as a result maximum test weight. This is closely similar with the findings of Arshewar *et al.* (2018) [2] and Pal *et al.* (2017) [8] in pearl millet crop.

The grain yield and straw yield was significantly determined due to increase of nitrogen. However the grain yield (1542 Kg/ha) and straw yield (3855 Kg/ha) was obtained in T₉ (100% RDN (60 Kg/ha) +1.0% FeSO₄ as foliar spray) which were loftier over the all other treatments and control. The results are also in agreement with the findings of Babar *et al.* (2021) [3], Arshewar *et al.* (2018) [2]. The significant increase in grain and straw yield of pearl millet was largely a function of improved growth and the consequent increase in different yield attributes as mentioned above. This favorable effect feasible owing to the fact that Fe play important function in development and energy transformation in various metabolic processes of the plant. The results revealed that different nitrogen and iron treatments had no significant effect on harvest index of pearl millet. These results are similar to findings of Saini *et al.* (2018) [11].

Table 1: Effect of nitrogen and Iron on plant stand per meter row length at 20 DAS and at harvest of Pearl millet

Treatments	Plant Stand/m row length	
	20DAS	At Harvest
T ₁ -Control	8.17	7.83
T ₂ -25% RDN (15Kg/ha) + 0.5% FeSO ₄ as foliar spray	8.19	7.85
T ₃ -50% RDN (30Kg/ha) + 0.5% FeSO ₄ as foliar spray	8.32	7.96
T ₄ -75% RDN (45Kg/ha) + 0.5% FeSO ₄ as foliar spray	8.88	8.55
T ₅ -100% RDN (60Kg/ha) + 0.5% FeSO ₄ as foliar spray	9.17	8.83
T ₆ -25% RDN (15Kg/ha) + 1.0% FeSO ₄ as foliar spray	8.22	7.89
T ₇ -50% RDN (30Kg/ha) + 1.0% FeSO ₄ as foliar spray	8.63	8.30
T ₈ -75% RDN (45Kg/ha) + 1.0% FeSO ₄ as foliar spray	8.97	8.63
T ₉ -100% RDN (60Kg/ha) +1.0% FeSO ₄ as foliar spray	9.78	9.44
S.Em±	0.36	0.47
C.D (P=0.05)	NS	NS

Table 2: Effect of nitrogen and Iron on plant height at 30, 60 DAS and at harvest of Pearl millet

Treatments	Plant Height (cm)		
	30 DAS	60 DAS	At Harvest
T ₁ -Control	31.63	118.90	142.28
T ₂ -25% RDN (15Kg/ha) + 0.5% FeSO ₄ as foliar spray	35.67	132.75	160.67
T ₃ -50% RDN (30Kg/ha) + 0.5% FeSO ₄ as foliar spray	36.97	135.88	196.33
T ₄ -75% RDN (45Kg/ha) + 0.5% FeSO ₄ as foliar spray	39.43	144.78	203.00
T ₅ -100% RDN (60Kg/ha) + 0.5% FeSO ₄ as foliar spray	40.50	151.25	206.67
T ₆ -25% RDN (15Kg/ha) + 1.0% FeSO ₄ as foliar spray	37.07	134.77	167.33
T ₇ -50% RDN (30Kg/ha) + 1.0% FeSO ₄ as foliar spray	38.57	141.18	201.67
T ₈ -75% RDN (45Kg/ha) + 1.0% FeSO ₄ as foliar spray	39.70	145.00	202.21
T ₉ -100% RDN (60Kg/ha) +1.0% FeSO ₄ as foliar spray	41.90	155.57	208.33
S.Em±	1.60	6.48	9.09
C.D (P=0.05)	4.81	19.43	27.24

Table 3: Effect of nitrogen and Iron on dry matter accumulation at 30, 60 DAS and at harvest of pearl millet

Treatments	Dry Matter Accumulation (g/plant)		
	30 DAS	60 DAS	At Harvest
T ₁ -Control	8.41	48.80	64.35
T ₂ -25% RDN (15Kg/ha) + 0.5% FeSO ₄ as foliar spray	8.82	52.20	76.95
T ₃ -50% RDN (30Kg/ha) + 0.5% FeSO ₄ as foliar spray	9.84	57.33	81.05
T ₄ -75% RDN (45Kg/ha) + 0.5% FeSO ₄ as foliar spray	11.16	61.95	84.10
T ₅ -100% RDN (60Kg/ha) + 0.5% FeSO ₄ as foliar spray	11.42	63.23	85.48
T ₆ -25% RDN (15Kg/ha) + 1.0% FeSO ₄ as foliar spray	9.95	54.73	79.60
T ₇ -50% RDN (30Kg/ha) + 1.0% FeSO ₄ as foliar spray	10.30	60.52	82.95
T ₈ -75% RDN (45Kg/ha) + 1.0% FeSO ₄ as foliar spray	11.32	62.28	84.55
T ₉ -100% RDN (60Kg/ha) +1.0% FeSO ₄ as foliar spray	11.51	64.52	85.78
S.Em±	0.38	2.32	3.34
C.D (P=0.05)	1.14	6.97	10.02

Table 4: Effect of nitrogen and Iron on ear head length, number of effective tiller and test weight of Pearl millet

Treatments	Ear Head Length (cm)	Number of effective tillers	Test Weight (g)
T ₁ -Control	24.63	19.63	6.17
T ₂ -25% RDN (15Kg/ha) + 0.5% FeSO ₄ as foliar spray	31.83	25.27	7.73
T ₃ -50% RDN (30Kg/ha) + 0.5% FeSO ₄ as foliar spray	28.96	24.20	6.92
T ₄ -75% RDN (45Kg/ha) + 0.5% FeSO ₄ as foliar spray	35.33	26.26	7.82
T ₅ -100% RDN (60Kg/ha) + 0.5% FeSO ₄ as foliar spray	37.97	26.94	7.90
T ₆ -25% RDN (15Kg/ha) + 1.0% FeSO ₄ as foliar spray	29.27	24.96	6.93
T ₇ -50% RDN (30Kg/ha) + 1.0% FeSO ₄ as foliar spray	32.23	25.33	7.80
T ₈ -75% RDN (45Kg/ha) + 1.0% FeSO ₄ as foliar spray	35.67	26.28	7.85
T ₉ -100% RDN (60Kg/ha) +1.0% FeSO ₄ as foliar spray	39.56	27.63	7.95
S.Em±	1.69	1.26	0.35
C.D (P=0.05)	5.07	3.77	1.05

Table 5: Effect of nitrogen and Iron on grain, straw, biological yield and harvest index of Pearl millet

Treatments	Yield			
	Grain yield (Kg/ha)	Straw yield (Kg/ha)	Biological yield (Kg/ha)	Harvest Index (%)
T ₁ -Control	1066	2669	3735	28.76
T ₂ -25% RDN (15Kg/ha) + 0.5% FeSO ₄ as foliar spray	1295	3237	4531	28.58
T ₃ -50% RDN (30Kg/ha) + 0.5% FeSO ₄ as foliar spray	1374	3436	4810	28.57
T ₄ -75% RDN (45Kg/ha) + 0.5% FeSO ₄ as foliar spray	1473	3684	5157	28.57
T ₅ -100% RDN (60Kg/ha) + 0.5% FeSO ₄ as foliar spray	1522	3806	5329	28.70
T ₆ -25% RDN (15Kg/ha) + 1.0% FeSO ₄ as foliar spray	1342	3354	4696	28.58
T ₇ -50% RDN (30Kg/ha) + 1.0% FeSO ₄ as foliar spray	1400	3499	4899	28.57
T ₈ -75% RDN (45Kg/ha) + 1.0% FeSO ₄ as foliar spray	1493	3600	5093	29.33
T ₉ -100% RDN (60Kg/ha) +1.0% FeSO ₄ as foliar spray	1542	3855	5396	28.75
S.Em±	61.90	211.08	260.31	0.84
C.D (P=0.05)	185.57	632.83	780.42	NS

4. Conclusion

Considering the results obtained from the present investigation, it may be conclude that – the application of nitrogen at (100% RDN (60 Kg/ha) + 1.0% FeSO₄ as foliar spray) proved to be the most suitable dose as it gave significantly higher plant height, dry matter accumulation, length of ear head, No. of effective

tillers, test weight, grain (1542Kg/ha) and straw (3855 Kg/ha) yield.

Above conclusions are based on a one season study and needs further confirmation by repeating the trial for at least one more season.

5. References

1. Association of Official Agricultural Chemists (AOAC). Official methods of analysis. 8th ed. Washington, D.C.: AOAC; c1960.
2. Arshewar SP, Prashant N, Karanjikar V, Takankhar VG, Waghmare YM. Effect of nitrogen and zinc on growth, yield, and economics of pearl millet (*Pennisetum glaucum* L.). Int J Curr Microbiol App Sci. 2018;6:2246-2253.
3. Babar SR, Athoni BK, Basamma K. Influence of nutrient levels on pearl millet (*Pennisetum glaucum* L.) growth, yield, and economics under dryland condition of Northern Karnataka. J Pharmacogn Phytochem. 2021;10(1):333-336.
4. Fisher RA, Yates F. Statistical tables. Edinburgh: Oliver and Boyd; c1963.
5. Gautam SA, Singh DK, Kumar V, Ramand S, Babu A. Effect of nitrogen and phosphorus levels on growth, yield, and nutrient uptake of pearl millet (*Pennisetum glaucum* L.). Int Arch Appl Sci Technol. 2020;11(1):101-105.
6. Gowde KAK, Kumar S, Sharma J, Kumar SL, Mallikarjun. Effect of nitrogen and phosphorus levels on growth and yield of pearl millet (*Pennisetum glaucum* L.). The Pharma Innovation J. 2023;12(9):1971-1973.
7. Joshi MP, Pankhaniya RM, Mohammadi NK. Response of pearl millet (*Pennisetum glaucum* L.) to levels and scheduling of nitrogen under south Gujarat condition. Int J Chem Stud. 2018;6(1):32-35.
8. Pal BD, Vora VD, Vekaria PD, Sutaria GS, Akbari KN, Verma HP. Effect of nitrogen and phosphorus on yield and yield attributes of maize in South Saurashtra, India. Int J Curr Microbiol App Sci. 2017;6(3):212-218.
9. Palli SG, Dawson J, Buriga T, Swaroop, Kobagapu MR. Effect of nitrogen and iron on growth and yield of foxtail millet (*Setaria italica* L.). IJECC. 2023;13(6):180-185. Article no. IJECC.98510. ISSN: 2581-8627.
10. Ravi KN, Jadhav RL, Bhat SN, Kamble AS. Effect of graded levels of nitrogen with iron and zinc nutrition on growth, yield, and quality of pearl millet (*Pennisetum glaucum* L.). The Pharma Innovation J. 2023;13(9):2425-2433.
11. Saini AK, Patel AM, Saini LH, Patel KM, Patel GM. Influence of irrigation, fertility, and hydrogel levels on yield and yield attributes of summer pearl millet (*Pennisetum glaucum* L.) in Gujarat. J Pharmacogn Phytochem. 2018;7(2):2910-2913.
12. Maharana S, Singh S. Effect of iron and zinc on growth and yield of pearl millet (*Pennisetum glaucum* L.). The Pharma Innovation J. 2021;10(10):546-550.