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Effect of phosphorus and zinc on growth and yield of pearl millet (*Pennisetum glaucum* L.)

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Abstract
At SHUATS, Prayagraj, in the rainy season of 2021, pearl millet (*Pennisetum glaucum* L.) var. "ABV-04" was subjected to a nine-treatment field trial to determine the impact on the crop of the phosphorus and zinc levels (phosphorus at 30 kg/ha, 40 kg/ha, and 50 kg/ha, respectively) (U.P). The treatments comprised T_1 – 30 kg Phosphorus/ha + 5 kg Zinc/ha, T_2 – 30 kg Phosphorus/ha + 15 kg Zinc /ha, T_3 – 30 kg Phosphorus/ha + 25 kg Zinc/ha, T_4 – 40 kg Phosphorus/ha + 5 kg Zinc /ha, T_5 – 40 kg Phosphorus/ha + 15 kg Zinc/ha, T_6 – 40 kg Phosphorus/ha + 25 kg Zinc/ha, T_7 – 50 kg Phosphorus/ha + 5 kg Zinc/ha, T_8- 50 kg Phosphorus/ha + 15 kg Zinc/ha, T_9 – 50 kg Phosphorus/ha + 25 kg Zinc/ha. Application of 50 kg Phosphorus/ha + 25 kg Zinc /ha noted highest plant height (212.43 cm), plant dry weight (47.54 g/plant), ear head length (18.90 cm) no. of grains/ear head (1958) and grain yield (2.66 t/ha), stover yield (3.90 t/ha).

Keywords: Growth, phosphorus, pearl millet, yield, zinc

Introduction

The food grain demand of India will increase to about 291m ton by 2025 and to 377 m ton by 2050 (Amarasinghe *et al.*, 2010) [1]. Since, there is limited scope to increase the net cultivated area (142 million ha), the improved per unit area productivity could trigger overall increase in food grain production. Pearl millet (*Pennisetum glaucum* L.) is maximum generally grown as staple food by small and marginal farmers in Asia and Africa. "Bajra is a C4 plant having high photosynthetic efficiency, more dry weight production and survive under different agro-climatic conditions with less inputs and more economic returns". The crop is critically important for food and nutritious security of humans and animals in arid and semiarid regions as pearl millet is early maturing, drought tolerant, requiring minimal use of inputs, mostly free from biotic stress and abiotic stress and its characteristic ability to tolerate high temperatures up to 42 °C during reproductive stage enable the crop cultivation in hostile conditions. Pearl millet is well adapted to grow under most adverse agro-climatic conditions considered by drought, low soil fertility & high temperatures. Pearl millet covers an estimated 31 m ha worldwide and is grown in higher than 30 countries in arid & semi-arid tropical and subtropical areas of Africa, Asia & Latin America. (ICRISAT; http://exploreit.icrisat.org, 2021) [6].

The major manufacture factor to boost up the yield of pearl millet is enricher management, which has contributed to the extent of 27 percent. Nitrogen, phosphorus and potassium are major essentials required to development the crop production. Phosphorus is second vital major plant nutrient for crop production. It has been called as the "Bottlneck of world hunger". "Phosphorus plays key roles in many plant processes such as energy metabolism, the synthesis of nucleic acids and membranes, photosynthesis, respiration, nitrogen fixation and enzyme regulation Raghothama, (1999) [16]". "Phosphorus is a limiting factor to plant growth and productivity on 40% of the world's arable soil. Satisfactory P nutrition improves several characteristics of plant development change including flowering, fruiting, root growth & yield mechanisms of many crops. Phosphorus acceptance in plants is regularly controlled by the very low solubility of phosphorus in the soil Vance, (2001) [23]". A lack of phosphorus as a nutrient causes phosphorus-poor soils in agricultural systems, thus harvesting crops lose their P value.

Micronutrient In order for plants to develop and progress, Zn requires a stable supply of nutrients from all of the necessary fertilisers in order to achieve optimal growth and output.

In order to function properly, many proteins, such as transcription factors and metallic enzymes, need zinc as a structural component (Singh and Kumar, 2009). As well as maintaining plant nutrition, micronutrients have been shown to increase production and quality (Jakhar *et al*., 2006) [9]. After nitrates and phosphorus, zinc is often regarded the third most essential nutrient for plants in India.

Materials and Methods

Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, India's agricultural research farm is situated at 25° 24' 42" N latitude, 81° 50' 56" E longitude, and 98 metres above sea level. To see how phosphorus and zinc affect Pearl millet's growth and output. (*Pennisetum glaucum* L.). Using a Randomized Block Design (RBD), nine different treatments were evaluated in triplicate. Each plot size of treatment has 3m × 3m. A mixture of (RDF)recommended doses of urea and MOP, together with phosphorus and zinc, are used in the treatments, which are characterised as follows: (T1) 30 kg/ha phosphorus + 5 kg/ha zinc, (T2) 30 kg/ha phosphorus + 15 kg/ha zinc, (T3) 30 kg/ha phosphorus + 25 kg/ha zinc, (T4) 40 kg/ha phosphorus + 5 kg/ha zinc, (T5) 40 kg/ha phosphorus + 15 kg/ha zinc, (T6) 40 kg/ha phosphorus + 25 kg/ha zinc, (T7) 50 kg/ha phosphorus + 5 kg/ha zinc, (T8) 50 kg/ha phosphorus + 15 kg/ha zinc, (T9) 50 kg/ha phosphorus + 25 kg/ha zinc. During the harvesting stage, treatment-wise, the pearl millet crop was collected. On five randomly chosen plants from each replication, dry matter accumulation (g/plant) and the number of seeds collected from each plot were recorded. Winnowed and gutted crops were used to determine and express the seeds per hectare produced in tonnage per hectare. Stover must be dried for seven days in the sun to obtain the yield per hectare for each plot. "Gomez & Gomez (1984)'s statistical approach was used to calculate and analyse the data".

Results and Discussion

Effect on growth parameters

Plant height

Table 1 shows the plant height measurements improved as per crop growth progressed. At 80DAS, treatment T_9 treated with (50 kg Phosphorus/ha + 25 kg Zinc/ha) recorded highest height (212.43 cm) and treatments T_8, T_6 were found to be statistically at par with T_9. The maximum plant height was attained by the regular supply of plant nutrients during all growth stages, through a supply of phosphorus & zinc, along with nitrogen and potassium. Increasing P level up to 50 kg/ha significantly developed plant height throughout the crop growth period. "Phosphorus is an important element in all biological systems, participating in most metabolic pathways and as a structural component of nucleic acids, coenzymes, phosphoproteins, and phospholipids". Plant height has been shown to increase due to the role of zinc as a "catalyst" in most physiological, metabolic, and tryptophane synthesis processes. Certain protein elements are required to produce growth hormones (auxins) including IAA. There were similar findings described in Mehta *et al*. (2008), Sharma *et al*. (2012).

Table 1: Impact of Phosphorus and Zinc on growth parameters of pearl millet var. 'ABV - 04'

S. No	Treatment combinations	Plant height (cm)	Dn matter accumulation (g/plant)
1.	30 kg Phosphorus/ha + 5 kg Zinc/ha	181.20	37.07
2.	30 kg Phosphorus/ha + 15 kg Zinc/ha	187.33	38.65
3.	30 kg Phosphorus/ha + 25 kg Zinc/ha	186.47	39.69
4.	40 kg Phosphorus/ha + 5 kg Zinc/ha	192.10	39.03
5.	40 kg Phosphorus/ha + 15 kg Zinc/ha	201.00	41.45
6.	40 kg Phosphorus/ha + 25 kg Zinc/ha	204.40	43.81
7.	50 kg Phosphorus/ha + 5 kg Zinc/ha	197.73	40.99
8.	50 kg Phosphorus/ha + 15 kg Zinc/ha	206.70	45.07
9.	50 kg Phosphorus/ha + 25 kg Zinc/ha	212.43	47.54
	S.Em(+)	3.72	1.17
	CD (P 0.05)	11.05	3.46

Table 2: Impact of Phosphorus and Zinc on yield parameters characters of pearl millet var. 'ABV - 04'

S. No	Treatments	Ear head length (cm)	No. of grains/ear head	Grain Yield (t/ha)	Stover Yield (t/ha)
1.	30 kg Phosphorus/ha + 5 kg Zinc/ha	15.80	1849.33	2.29	3.72
2.	30 kg Phosphorus/ha + 15 kg Zinc/ha	16.63	1862.67	2.33	3.75
3.	30 kg Phosphorus/ha + 25 kg Zinc/ha	17.47	1882.67	2.42	3.82
4.	40 kg Phosphorus/ha + 5 kg Zinc/ha	16.97	1870.67	2.37	3.74
5.	40 kg Phosphorus/ha + 15 kg Zinc/ha	17.90	1910.33	2.50	3.75
6.	40 kg Phosphorus/ha + 25 kg Zinc/ha	18.20	1918.00	2.54	3.79
7.	50 kg Phosphorus/ha + 5 kg Zinc/ha	17.60	1893.00	2.45	3.77
8.	50 kg Phosphorus/ha + 15 kg Zinc/ha	18.53	1931.67	2.60	3.55
9.	50 kg Phosphorus/ha + 25 kg Zinc/ha	18.90	1958.00	2.66	3.90
	S.Em(+)	0.31	14.40	0.03	0.03
	CD (P 0.05)	0.91	42.77	0.07	0.10

Dry matter accumulation

The treatment T_9 treated with (50 kg Phosphorus/ha + 25 kg Zinc/ha) recorded a highest dry matter accumulation of 47.54 g at 80DAS, T_8 treatment is statistically at par with T_9. It is more important because all other vegetative characters contain it. Dry weight of pearl millet increased due to the application of P. Phosphorus may have provided a favourable nutritional environment for the plants, which contributes to their essential role in several physical and chemical processes that remain critical for plant development and advance in terms of dry weight. The improved in dry weight may be attributed to zinc's role in most physiological, metabolic processes, and the synthesis of tryptophane. Growth hormones (auxins) like IAA are created by the metabolism of protein. Similar results were stated by Sammauria and Yadav (2010) [18], Singh *et al.* (2016) [20].

Yield and yield attributes

Ear head length

A significant impact was experiential by the statistical analysis of ear head length. Treatment with 50 kg Phosphorus/ha + 25 kg Zinc/ha, the highest ear head length (18.90) was recorded. However, statistical parity was obtained with 50 kg Phosphorus/ha + 15 kg Zinc/ha and 40 kg/ha + 25 kg Zinc/ha. Phosphorus application can be attributed to a general development in plant growth as replicated by increased dry matter accumulation, which may be due to an increased supply of phosphorus and other nutrients to plants. Increased availability of nutrients to plants at the flowering stage, which might take greater effective tiller formation and ultimately increased ear head length. The increase in ear head length (cm) may be attributed to Physiological and metabolic processes rely on zinc, as well as tryptophan synthesis. Zinc is a vital component of several proteins that produce growth hormones (auxins) such as IAA. In two separate studies, Sharma *et al*. (2012) and Sharma *et al*. (2008) [21] came to the same result.

Number of grains/ear head

A significant impact was observed by the analysis variance in the statistics of the no. of grains per ear head. With a total of 50 kg Phosphorus/ha + 25 kg Zinc/ha (1958), the maximum number of grains per ear head was 9. 50 kg Phosphorus/ha + 25 kg Zinc/ha and 40 kg Phosphorus/ha + 25 kg Zinc/ha were statistically equivalent. Phosphorus application can be ascribed to an overall enhancement in plant development as reflected by increased dry weight, which may be due to an increased supply of phosphorus and other nutrients to plants. Increased nutrient availability to plants during the flower primordial intiation stage, which may have resulted in more effective tiller formation and, ultimately, increased the no. of grains/ear head. The growth in the no. of grains/ear head may be attributed zinc plays a crucial role in a myriad of physiological and metabolic processes such as the synthesis of tryptophane. It is also used to produce growth hormones (auxins) such as IAA. Researchers Sharma *et al.* (2012) and Sharma *et al.* (2008) [21] observed similar outcomes.

Grain yield

Increasing grain yields required phosphorus, zinc, nitrogen, and potassium treatment combinations. The highest grain yield was obtained with treatment treated with 50 kg Phosphorus/ha + 25 kg Zinc/ha (2657 Kg); however, 50 kg Phosphorus/ha + 15 kg Zinc/ha is statistically on par with 50 kg Phosphorus/ha + 25 kg Zinc/ha. Applying phosphorus might be ascribed to improved vegetative development, probably uptake and utilisation of other elements fascinated by its wide root system developed by phosphorus imitation. Phosphorus can be credited with a significant rise in natural yield because of the increase in grain production. Zinc's role as a "catalyst" in the synthesis of tryptophan, as well as the growth and development of the plant, may be ascribed to the increase in grain yield. Similar findings were previously published by Sharma *et al*. (2012) and Singh *et al*. (2016) [20].

Stover yield

Application of phosphorus & zinc has significantly impact on stover production of the pearl millet. At 50 kg Phosphorus/ha + 25 kg Zinc/ha, the maximum stover yield (3.90 t/ha) was obtained. 50 kg phosphorus/ha + 15 kg zinc/ha and 30 kg phosphorus/ha + 25 kg zinc/ha are both statistically equivalent to 50 kg phosphorus/ha + 25 kg zinc. Applying phosphorus might be ascribed to improved vegetative development, probably uptake and utilisation of other elements fascinated by its wide root system developed under phosphorus. The biological yield is a function of the stover yield. Zinc is critical to the growth and development of tryptophane, a necessary amino acid for plant growth and development. Both Sharma *et al.* (2012) and Singh *et al.* (2016) [20] found the same results in their research.

Conclusion

Due to its high grain output (2.66 t/ha) and accomplishment of all growth and yield goals, 50 kg P/ha + 25 kg Zn/ha would bring farmers benefits. This combination may be suggested to farmers in the future if more trials are conducted.

References

1. Amarasinghe UA, Shah T, Singh OP. Changing consumption patterns: Implications on food and water demand in India, International Water Management Institute, Colombo, Sri Lanka. IWMI Research Report. 2010;119:43.
2. Arshewar SP, Karanjikar PN, Tskankhar VG, Waghmare YM. Effect of Nitrogen and Zinc on growth, yield and Economics of Pearl Millet (*Pennisetum glaucum* L.). International Journal of Current Microbiology Applied. Sciences. 2018;6:2246-2253.
3. Dadhich LK, Gupta AK. Growth and yield of fodder pearl millet as influenced by sulphur, zinc and intercropping with cowpea. Fertiliser News. 2005;50(3):55-57.
4. Dwivedi MS, Malaiva DD, Mathukia RK, Khanpara. Effect of Sulphur and zinc on yield and nutrient content in maize. Ann Pl. Soil Res. 2005;3:155-57.
5. Gautam Singh DK, Vimal Kumar, Shankar Ramand Ajay Babu. Effect of nitrogen and phosphorous levels on growth, yield and nutrient uptake of pearl millet. (*Pennisetum glaucum* L.) International Archive of Applied Sciences and technology. 2020;11(1):101-105.
6. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), 2021. URL: http://exploreit.icrisat.org/profile/Pearl%20Millet/178.Accessed on 12.06.2021
7. Jain NK, Dhama AK. Residual effect of phosphorus and zinc on yield, nutrient content and uptake and economics of pearl millet (*Pennisetum glaucum*)-wheat (*Triticum aestivum*) cropping system. Indian Journal of Agricultural Sciences. 2005;75(5):281-284.
8. Jain NK, Dahama AK. Direct and residual effects of phosphorus and zinc fertilization on productivity of wheat (*Triticum asstium*. L) pearl millet cropping system. Indian J Agron. 2006;51(3):165-169.
9. Jakhar SR, Singh M, Balai CM. Effect of farmyard manure, phosphorus and zinc levels on growth, yield, quality and economics of pearl millet. Indian Journal of Agricultural Sciences. 2006;76(1):58-61.

10. Kadam S, Pawar S, Jakkawad S. Impact of Integrated Nutrient Management on Growth, Yield of Summer Pearl Millet. Trends in Biosciences, 2019, 12(4).
11. Kaushik SK, Gautam RC. Effect of nitrogen and phosphorus on the production potential of pearl millet-cowpea or green gram intercropping systems under rainfed conditions. Journal of Agricultural Science Cambridge. 2009;108:361-364.
12. Khinchi V, Kumawat SM, Arif M. Forage growth and quality of pearl millet (*Pennisetum americanum* L.) as influenced by nitrogen and zinc levels in hyper arid region of Rajasthan. Range Manog. Agroforestry. 2018;39(2):237-242.
13. Kumar P, Kumar R, Singh SK, Kumar A. Effect of fertility on growth, yield and yield attributes of pearl millet (*Pennisetum glaucum* L.) under rainfed condition. Int. J Tropi. Agri. 2014;32:3-4.
14. Oseni TO. Growth and Zinc uptake of Sorghum and Cowpea in response to Phosphorus and Zinc Fertilization. World Journal of Agricultural Sciences. 2009;5(6):670-674.
15. Prasad SK, Singh MK, Renu Singh. Effect of Nitrogen and Zinc on growth, yield and uptake of pearl millet (*Pennisetum glaucum* L.). An Inter. Quarterly J Life Sci. 2014;9(1):163-166.
16. Raghothama KG. Phosphate acquisition. Ann. Rev. Plant Physiol. Plant Mol. Bio. 1999;50:665-693.
17. Raskar SC. Effect of nutrient management for sustainable productivity in pearl millet (*Pennisetum galucum*)-wheat (*Triticum aestivum*) system. Advances in Plant Sciences. 1999;19(2):491-495.
18. Sammauria R, Yadav RS. Response of pearl millet (Pennisetum glaucum) to residual fertility under rainfed conditions of arid region of Rajasthan. Indian Journal Dryland Agricultural Research & Dev. 2010;25(1):53-60.
19. Satybham Singh, Virendra Singh, Datt Shukla, Brajesh Yadav. Effect of planting geometry and phosphorus levels on pearl millet (*Pennisetum glaucum*) An International Journal. 2019;14(1):18-22.
20. Singh G, Choudhary P, Ratore VK, Rawat RS, Jat BL. Performance of nitrogen and zinc levels on growth, yield, quality and economics of fodder pearl millet under dry land conditons. Int. J of Dev. Rese. 2016;06(10):9627-9643.
21. Sharma A, Namdeo Ajay G, Mahadik KR. Molecular markers; new prospects in plant, genome analysis. Pharmacohnosy Reviews. 2008;2:23-34.
22. Trivedi SL, Takkar PN, Randhawa NS. Effect of Phosphatic fertilization on zinc adsorption in some vertisols and inceptisols. Journal of Indian Society of Soil Science. 1996;40:251-255.
23. Vance CP. Symbiotic nitrogen fixation and phosphorus acquisition. Plant nutrition in a world of declining renewable resources. Plant Physiology. 2001;127:390-397.
24. Wang H, Yum JJ, Zhou W. Effect of zinc application on the growth and zinc uptake by maize under soil moisture stress. Plant. Nutrition and Fertilizer Science. 2003;9(1):1-7.
25. Yadav J. Increasing levels of phosphorus pearl millet. Journal of the Indian Society of Soil Science. 1990;45(1):112-119.