



## Study of Productivity and Economics of Pearl Millet (*Pennisetum glaucum* L.) Variety ABV -04 in Relation to Nitrogen and Phosphorus

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### Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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### ABSTRACT

**Background:** Pearl millet can thrive in a wide range of local conditions. In areas where sorghum cannot thrive, pearl millet is a viable alternative. Sorghum and maize can't compete with pearl millet when it comes to soil moisture utilisation and heat tolerance.

**Objectives:** Effects of nitrogen and phosphorus on yield and economics of pearl millet

**Methods:** With the goal of studying the effect of nitrogen and phosphorus on yield and economics of Pearl millet (*Pennisetum glaucum* L.) Var. ABV - 04 under a Randomized block design with 9 treatments (T1-T9). The experimental results revealed that 120 kg N/ha + 60 kg P/ha produced ear head length (20.77 cm), number of grains/ear head (1972.0), grain yield (2.68 t/ha), harvest index (41.49 percent). T9 120 kg N/ha + 60 kg P/ha produced greater net returns (95,132.00 INR/ha), gross returns (1,36,544.00 INR/ha), and benefit-to-cost ratios (2.30).

**Conclusion:** 120 kg N/ha + 60 kg P/ha yielded the highest net return (95,132.00 INR /ha), gross return (1,36,544.00 INR /ha), and benefit: cost ratio than any other combination of nutrition source (2.30).

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**Keywords:** Pearl millet; nitrogen; phosphorus; economics yield.

## 1. INTRODUCTION

The scientific name for the millet most commonly seen in India is *Pennisetum glaucum*. *Cumbu* is also known as bulrush, cattail, or spiked millet in English, bajra in Hindi, *dukhn* in Arabic, mil à chandelles or petit millet in French, and *mhunga* or *mahango* in regions of southern Africa, among other names. Despite the fact that this plant is native to Africa, millet is a staple food for many Indians from lower socioeconomic backgrounds. The bajra crop is used by some rural populations for thatching rooftops and as a feed grain for their cows. Bajra is mostly grown in arid and dry areas. Bajra is planted on more than 260,000 square kilometers around the world, and it produces half of the world's millet. The optimal temperature range for this crop is between 25 and 31 degrees Celsius, and it grows best in drier sections of the country. It requires 40-50 cm of rainfall per year to thrive. India is largest producer of pearl millets covering about 8.75 million ha of marginal and sub marginal lands primarily in the states of Rajasthan, Gujarat, Haryana, Uttar Pradesh and Maharashtra and ranking 3<sup>rd</sup> after rice and wheat in acreage [1] India is the largest producer of pearl millet in the world which occupies an area of 95.96 lakh ha and production of 77.02 lakh tones with productivity of 803 kg ha [2]. Gujarat has an area of 0.150 lakh hectares under pearl millet cultivation and production of 0.252 lakh tones with productivity of 1680 kg/ha [3].

Nitrogen is an essential macronutrient for plant growth and is a component of amino acids, the building blocks of plant proteins and enzymes. Proteins are the structural ingredients of all living things, and enzymes let plants perform a wide range of biochemical activities. Nitrogen is also a problem for the chlorophyll molecule, which allows the plant to capture sunlight energy through photosynthesis, boosting plant growth and output. Nitrogen is important in the plant because it ensures that electricity is available when and where the plant needs it to maximizes yield. Proteins and enzymes help change water and nutrient uptake in the roots, thus they're a good source of this important nutrient. Now that we've established the position and realized how important nitrogen is to a crop, we need to figure out how to protect and utilize this vital nutrient during the nitrogen cycle. Unfortunately, the nitrogen cycle is a leaky system, which means it frequently strives for excessive nitrogen

utilization efficiency. However, several studies have shown that nitrogen application can boost millet production efficiency [4]. Ali also noticed an increase in yield associated with an increase in nitrogen levels [5].

Phosphorus is a component of flowers complex nucleic acid structure that governs protein production. As a result, phosphorus is essential in the cellular department and the production of new tissue. Phosphorus is also linked to a variety of internal plant strength disparities. Phosphorus is frequently recommended as a row-carried out beginning fertilizer for early boom growth. Early increase response to phosphorus was confirmed in fewer than 40% of the test fields in university of Nebraska starter fertilizer research carried out in the 1980s (Penas, 1989). Even while phosphorus does not boost grain output, starter packets may also boom early. Manufacturers must carefully weight the aesthetic effects of fertilizer application against increased revenue from increased production.

## 2. MATERIALS AND METHODS

During the kharif season of 2021, a field experiment was conducted out at the C.R.F of the wing of Agronomy in Shaits Prayagraj, which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude, and 98 m altitude over the mean sea degree (MSL). to see how phosphorus and nitrogen affect the growth and output of Pearl millet (*Pennisetum glaucum* L.). The trial was set up in a Randomized Block design with nine treatments that were reproduced three times. The length of each online plot for each therapy is 3m 3m. When given in combination, the treatment is classified as having a recommended dose of Potash via Muriate of Potash, as well as Nitrogen via Urea and Phosphorus via DAP. (T1) 80 kg N/ha + 20 kg P (T2) a 100 kg N/ha + 20 kg P/ha, (T3) 120 kg N/ha + 20 kg P/ha, (T4) 80 kg N/ha + 40 kg P/ha, (T5) 100 kg N/ha + 40 kg P/ha, (T6) 120 kg N/ha + 40 kg P/ha, (T7) 80 kg N/ha + 60 kg P/ha, (T8) 100 kg N/ha + 60 At harvesting maturity, the pearl millet crop was harvested smartly. Plant height (cm) and dry rely accumulation g plant were manually recorded on five randomly selected consultant plants from each plot of each replication one at a time, and seeds were isolated from each internet plot and dried under solar for three days after harvesting. Later, the seeds were winnowed, washed, and the seed yield per hectare was calculated and expressed in tonnes per hectare. After 10 days of

thorough drying in the sun, the Stover production from each online plot was measured and expressed in tonnes per hectare. The statistics were calculated and analysed using the Gomez and Gomez statistical approach [6]. The benefit: cost ratio was reworked after the fee value of seed was replaced with straw and the general value of crop cultivation was protected.

### 3. RESULTS AND DISCUSSION

#### 3.1 Yield and Yield Attributes

##### 3.1.1 Ear Head Length (CM)

The statistical analysis of ear head length revealed the enormous impact of ear head period. The treatment of 120 kg N/ha + 60 kg P/ha resulted in a significant and maximal ear head length (20.77). However, with 120 kg N/ha + 60 kg P/ha, no other treatment achieved statistical parity. Nitrogen utilisation increases the cytonins' activity in plants, resulting in increased cellular division and elongation. Because nitrogen is a component of chloroplast porphyrins, increased nitrogen fertilisation increased crop ear head length due to increased photosynthates synthesis. Phosphorus treatment will be attributed to a general improvement in plant growth as measured by increased dry count number accumulation, which could be due to quicker phosphorus and other nutrient delivery to plants. improved food availability to plants at the flower primordial intiation stage, which may have aided in the production of more robust tillers and, as a result, increased ear head length These findings are also consistent with those of Azad [7], Sharma et al. [8].

#### 3.2 Number of Grains/ear Head

The statistical analysis of the amount of grains per ear head revealed a significant influence. Significant and the largest number of grains per ear head were recorded in the treatment of 120 kg N/ha + 60 kg P/ha (1972). The statistical parity between 100 kg N/ha + 60 kg P/ha and 120 kg N/ha + 60 kg P/ha was achieved, however. Cell division and elongation are boosted as a result of the increased activity of cytokinin in plants, which are activated by nitrogen. For this reason, enhanced nitrogen fertilisation boosted grain and ear head production via increasing photosynthate production, because porphyrins in chloroplasts contain nitrogen. Munirathnam and Gautam, [9], and Reddy et al., [10], have also found that the quantity of grains per ear head might vary

depending on the amount of nutrients in the soil. As a result of increased phosphorus and other nutrient supplies to plants, the overall improvement in plant development can be linked to phosphorus application. Plants may have benefited from an earlier supply of nutrients during the floral primordial initiation stage, resulting in a greater number of functional tillers and ultimately more grains/ear heads. Azad [7], Sharma et al. [8], and others have found similar results (2012).

#### 3.3 Grain Yield

Different combinations of Nitrogen and Phosphorus with Potassium have a substantial impact on grain production. The treatment 120 kg N/ha + 60 kg P/ha (2.68 ta/ha) produced the maximum grain production, but 100 kg N/ha + 60 kg P/ha was shown to be statistically equivalent to 120 kg N/ha + 60 kg P/ha. The grain production of pearl millet grew dramatically as the amount of nitrogen and phosphorus applied increased. This is due to nitrogen application, which can be attributed to increased photosynthesis, which results in enhanced plant growth and dry matter production. As a result, an increase in nitrogen supply might have boosted all of the growth metrics and yield-attributing features, resulting in higher yields. Munirathnam and Gautam, [9], Guggari and Kalaghatagi, [11], and Singh et al., [12] all showed increased grain output as a result of altering nutrient levels. Increased vegetative growth could be linked to phosphorus fertilisation, presumably as a result of effective uptake and utilisation of other nutrients received through the plant's large root system. Grain yield is a function of biological yield. As a result, the higher grain yield features may be attributed to a considerable increase in biological yield with the application of phosphorus. These findings are also consistent with those of Azad [7], Sharma et al. [8].

#### 3.4 Stover Yield

The administration of nitrogen and phosphorus had a considerable impact on the pearl millet crop's Stover yield. Although 120 kg N/ha + 60 kg P/ha produced the highest Stover production (3.77 ta/ha), 100 kg N/ha + 60 kg P/ha was determined to be statistically equivalent to 120 kg N/ha + 60 kg P/ha. The yield of pearl millet stover increased dramatically as the amount of nitrogen and phosphorus applied increased. This is due to nitrogen application, which can be attributed to increased photosynthesis, which results in



**Table 1. Effect of Nitrogen and Phosphorus on yield and yield attributing characters of pearl millet var. 'ABV - 04'**

T. No	Treatments	Ear head length (cm)	No. of grains/ear head	Grain Yield (t/ ha)	Stover Yield (t/ha)
T <sub>1</sub>	80 kg N/ha + 20 kg P/ha	16.13	1671.00	2.21	3.26
T <sub>2</sub>	100 kg N/ha + 20 kg P/ha	16.87	1699.00	2.28	3.36
T <sub>3</sub>	120 kg N/ha + 20 kg P/ha	17.50	1784.67	2.42	3.50
T <sub>4</sub>	80 kg N/ha + 40 kg P/ha	17.20	1747.33	2.36	3.44
T <sub>5</sub>	100 kg N/ha + 40 kg P/ha	18.70	1861.33	2.51	3.59
T <sub>6</sub>	120 kg N/ha + 40 kg P/ha	19.37	1885.00	2.55	3.64
T <sub>7</sub>	80 kg N/ha + 60 kg P/ha	18.33	1833.33	2.47	3.56
T <sub>8</sub>	100 kg N/ha + 60 kg P/ha	20.20	1942.67	2.63	3.74
T <sub>9</sub>	120 kg N/ha + 60 kg P/ha	20.77	1972.00	2.68	3.77
	SEm (±)	0.18	14.56	0.03	0.24
	CD (P 0.05)	0.53	43.27	0.07	0.07

**Table 2. Effect of Nitrogen and Phosphorus on economics of pearl millet var. 'ABV - 04'**

T. No.	Treatments	Cost of cultivation (INR/ ha)	Gross return (INR/ ha)	Net return (INR/ha)	Benefit: Cost ratio
T <sub>1</sub>	80 kg N/ha + 20 kg P/ha	38,924.00	1,12,574.00	73,650.00	1.89
T <sub>2</sub>	100 kg N/ha + 20 kg P/ha	39,185.00	1,16,433.00	77,248.00	1.97
T <sub>3</sub>	120 kg N/ha + 20 kg P/ha	39,445.00	1,23,369.00	83,924.00	2.13
T <sub>4</sub>	80 kg N/ha + 40 kg P/ha	39,908.00	1,20,258.00	80,350.00	2.01
T <sub>5</sub>	100 kg N/ha + 40 kg P/ha	40,168.00	1,28,061.00	87,893.00	2.19
T <sub>6</sub>	120 kg N/ha + 40 kg P/ha	40,429.00	1,30,186.00	89,757.00	2.22
T <sub>7</sub>	80 kg N/ha + 60 kg P/ha	40,891.00	1,26,208.00	85,317.00	2.09
T <sub>8</sub>	100 kg N/ha + 60 kg P/ha	41,151.00	1,34,419.00	93,268.00	2.27
T <sub>9</sub>	120 kg N/ha + 60 kg P/ha	41,412.00	1,36,544.00	95,132.00	2.30

#Data not subjected to statistical analysis.



#### 4. CONCLUSION

Treatment 120 kg N/ha + 60 kg P/ha produced the highest grain yield (2.68 ta/ha), gross return (1,36544.00 INR/ha), net return (95,132.00 INR/ha), and benefit: cost ratio (2.30), which may be more preferable for farmers because it is more economically profitable and thus can be recommended to farmers.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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