Study of Productivity and Economics of pearl millet (Pennisetum glaucum L.) Variety NBH-5658 in Relation to Potassium and Plant growth regulators

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Authors' contributions

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

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 Potassium and plant growth regulators on yield and economics of pearl millet.

Methods: With the goal of studying the effect of Potassium and plant growth regulators on yield and economics of Pearl millet (Pennisetum glaucum L.) Var. NBH - 5658 under a Randomized block design with 9 treatments (T1-T The experimental results revealed that Potassium 60 kg/ha + NAA-100ppm,+Traicontonol-500ppm, produced ear head length (20.50 cm), Number of grains/ear head (1970.0), grain yield (2.72 t/ha), Stover yield (3.78 t/ha) harvest index (41.84 %).T9 Potassium 60 kg/ha + NAA-100ppm,+Traicontonol-500ppm produced greater gross returns (1,36,000.00 INR/ha), net returns (92,840.00 INR/ha), , and benefit-to-cost ratios (2.14).

Key words: Pearl millet**,** Potassium, Plant growth regulators, NAA, Triacontanol, yield, economics , attributes, net return, B:C ratio.

1. INTRODUCTION

"Pearl millet [*Pennisetum glaucum* (L.)] is a cereal crop, after rice, wheat, maize, and sorghum, that is essential. On 30 million acres of land in the tropical dry and semi-arid region of Asia and Africa, it is a staple meal for 90 million poor people and accounts for half of the world's millet output. After rice, wheat, and maize, teh fourth most grown crop in India. Several rural communities utilise the bajra crop as a feed grain for their cows and for thatching rooftops. Most bajra is grown in dry, arid regions" [1]. A cereal crop, after rice, wheat, maize, and sorghum, that is essential. On 30 million acres of land in the tropical dry and semi-arid region of Asia and Africa, it is a staple meal for 90 million poor people and accounts for half of the world's millet output. After rice, wheat, and maize, teh fourth most grown crop in India. Several rural communities utilise the bajra crop as a feed grain for their cows and for thatching rooftops. Most bajra is grown in dry, arid regions [2].

Protein (11.6%), iron in particular (8.8%), fat (5%) and carbs (67%) are all abundant in its grains. Most of the world's pearl millet is cultivated in North West India, which also produces 24% of the world's coarse grains and covers 42% of the total area under pearl millet cultivation [2]. Concerns regarding agriculture's capacity to meet the demands of a population that is expanding at an exponential rate have increased due to a lack of new land available for food cultivation and deteriorating soil fertility. When compared to solitary cropping, intercropping increases overall production per unit area per unit time by making efficient use of resources. Planting short-lived crops like pearl millet alongside cluster beans and green gramme crops may increase economic returns per unit of land since there will be less rivalry due to their temporally varying peak resource demand (Bishan Rawat et al, 2018).

A vital main nutrient for plants, potassium serves a variety of purposes. During the grain filling process, potassium turns sugar into starch and improves water usage efficiency. As a result of its crucial role in controlling stomatal function and the activation of enzymes, potash is frequently depleted in soils when long-term continuous cropping is practised without the addition of additional potash, leaving little exchangeable potassium. In order to complete its life cycle, millet, one of the crops with a high potassium need, needs a significant amount of potassium. The main source for supplying soil with K in the absence of external potassium administration is weathering of the soil [3].

Under environmental stress, plant growth regulators (PGRs) have the potential to boost crop yield. Chemicals known as "growth regulators" can change how organisms grow and develop, which might enhance output, improve grain quality, or make harvesting easier [4]. The amount of nutrients and the use of plant growth regulators had a big impact on Pearl millet's growth metrics. the exogenous use of NAA to boost yield and growth in the face of diverse stresses as salt, drought, extremely high or low temperatures, and heavy metal toxicity. Also, they participate in very significant agronomic developmental processes such seed germination, leaf angle, blooming duration, and seed yield.

2. MATERIALS AND METHODS

During the Zaid season of 2022, a field experiment was conducted out at the C.R.F of the wing of Agronomy in Shaits Prayagraj, which is located at 25o 24' 42" N latitude, 81o 50' 56" E longitude, and 98 m altitude over the mean sea degree (MSL) to see How Pearl millet's growth and productivity are affected by potassium and plant growth regulators (*Pennisetum glaucum* L.). Ten treatments, each replicated three times, were used in the experiment, which was set up using a randomised block design. The size of each plot is 3 metres. The suggested doses for the medication include potassium through, nitrogen via urea, and phosphorus via DAP. Potassium via Muriate of Potash. (T1) Potassium 40 kg /ha + NAA 100 ppm (T2) Potassium 40 kg /ha +Triacontanol 500 ppm, (T3) Potassium 40 kg /ha + NAA 100 ppm + Triacontanol 500 ppm, (T4) Potassium 50 kg /ha + NAA 100 ppm, (T5) Potassium 50 kg /ha + Triacontanol 500 ppm, (T6) Potassium 50 kg/ha + NAA 100 ppm + Triacontanol 500 ppm, (T7) Potassium 60 kg/ha + NAA 100 ppm, (T8) Potassium 60 kg/ha + Triacontanol 500 ppm, Treatment (T9) Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm (T10) N-P-K (RDF 80;40;40) /ha. “The Stover production from each online plot was measured and expressed in tonnes per hectare after 10 days of full drying in the sun. Using, the statistics were computed and examined. The Gomez and Gomez [5] statistical approach”.

3. RESULTS AND DISSCUSION

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 60 kg K/ha+100 PPM NAA + 500 PPM Triacontanol /ha. resulted in a significant and maximal ear head length (20.50 cm). However, with 60 kg K/ha+100 PPM NAA + 500 PPM Triacontanol /ha., no other treatment achieved statistical parity. “Potassium is one of the chief plant nutrients for the growth and development of plants in pearl millets potassium plays vital role in enzyme activates water and energy metabolism translocation of assimilation, photo synthesis protein and starch synthesis” (Sudhanshu et al., (2018). “The application of triacontanol and NAA was attribute to an increased rate of photo synthetic activity accelerated transport and efficiency of utilization photosynthetic products thus result resulting cell elongation and rapid cell growing portion the plant".(Suresh et al., (2020)

3.2 Number of grains in the ear

"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 60 kg K/ha+100 PPM NAA + 500 PPM. The statistical parity between Potassium 60 kg/ha + Triacontanol 500 ppm and 60 kg K/ha+100 PPM NAA + Triacontanol 500 PPM was achieved, however. Cell division and elongation are boosted as a result of the increased activity of cytokinin in plants, which are activated by potassium"(Buduri et al., (2020). For this reason, enhanced potassium fertilisation boosted grain and ear head production via increasing photosynthate production, because porphyrins in chloroplasts contain potassium. Munirathnam and Gautam,, and Reddy et al., 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 PGR and other nutrient supplies to plants, the overall improvement in plant development can be linked to 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. Sagar et al. , Sharma et al., and others have found similar results (2012).

3.3 Grain yield

"Different combinations of Potassium & PGR can have a significant effect on grain production. A grain yield of 2.72 ta/ha was obtained with a treatment of Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm however, Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm yielded results statistically equivalent to those of (Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm). Increasing the amount of potassium and plant growth regulators applied greatly boosted pearl millet grain yields. This suggests that rising the potassium supply may have enhanced all growth indices, yield-related features biological yield affects grain yield" Chauhan et al.,(2017). A significant improvement in biological yield can therefore be attributed to the better grain production characteristics. These findings are also consistent with those of Azad, Sivakumar et al.,(2002).

3.4 Stover yield

"The stover yield output of the pearl millet crop had also been greatly altered by the treatment of Nitrogen & Phosphorus. In terms of stover yield (3.78 ta/ha), the highest was observed, Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm. however, (Potassium 60 kg/ha + Triacontanol 500 ppm) was shown to be statistically equivalent to , Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm) With the addition of potassium and PGR , pearl millet yielded substantially more stover yield than it did without them. Growth of plant & dry matter production may have increased because of greater photosynthesis. In this way, rise of potassium supply may have boosted all growth metrics and yield features, which finally contributed to rise of stover production. Straw production affects biological yield" (Kunduru et al.,(2021). As a result, enhanced straw yield qualities might be blamed for a large rise in biological yields following the addition ofPlant growth regulaors. A higher potassium supply could have resulted in a higher stover yield because of increased growth parameters and yield related features. Stover yield was increased by adjusting nutrient levels in Munirathnam and Gautam, Guggari and Kalaghatagi, , and Singh et al.,

3.5 Economics

Among the different combination of nutrient source Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm recorded higher gross return (1,36,000.00 INR/ha) net return (92,840.00 INR /ha), and benefit: cost ratio (2.14).

Fig 1:Field experiment

Table 1: Effect of potassium and plant growth regulators on Ear head length (cm), No of Grains/ear head (g) and Stover Yield(t/ha) and harvest index(%) of pearl millet.

S.No	Treatments	Ear head length (cm)	No of Grains/ear head	Grain yield (t/ha)	Stover yield (t/ha)	Harvest Index (%)
1	Potassium 40 kg/ha + NAA 100 ppm	16.15	1621.00	2.33	3.25	41.75
2	Potassium 40 kg/ha + Triacontanol 500 ppm	16.75	1681.00	2.18	3.44	38.79
3	Potassium 40 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	17.53	1759.00	2.24	3.37	39.75

4	Potassium 50 kg/ha + NAA 100 ppm	17.07	1783.00	2.40	3.58	40.14
5	Potassium 50 kg/ha + Triacontanol 500 ppm	18.30	1856.00	2.56	3.67	41.09
6	Potassium 50 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	19.50	1868.00	2.42	3.64	39.93
7	Potassium 60 kg/ha + NAA 100 ppm	18.20	1945.00	2.67	3.72	41.78
8	Potassium 60 kg/ha + Triacontanol 500 ppm	20.40	1964.00	2.69	3.74	41.80
9	Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	**20.50**	**1970.00**	**2.72**	**3.78**	**41.84**
10	Control 80:40:40 N:P:K	15.91	1521. .00	2.20	3.15	41.12
	F test	S	S	S	S	S
	SEm±	0.06	5.16	8.35	6.81	0.47
	CD (P = 0.05)	0.19	15.34	0.02	0.11	0.74

Table 2. Effect of potassium and plant growth regulators on economics of pearl millet.

S.No	Treatments	Cost of Cultivation (INR/ha)	Gross return (INR)	Net return (INR/ha)	B:C ratio
1	Potassium 40 kg/ha + NAA 100 ppm	42,790.00	1,16,500.00	73,710.00	1.72
2	Potassium 40 kg/ha + Triacontanol 500 ppm	42,840.00	1,09,000.00	66,160.00	1.54
3	Potassium 40 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	42,940.00	1,12,000.00	69,060.00	1.60
4	Potassium 50 kg/ha + NAA 100 ppm	42,950.00	1,20,000.00	77,050.00	1.79
5	Potassium 50 kg/ha + Triacontanol 500 ppm	43,000.00	1,28,000.00	85,000.00	1.97

6	Potassium 50 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	43,100.00	1,21,000.00	77,900.00	1.80
7	Potassium 60 kg/ha + NAA 100 ppm	42,950.00	1,33,500.00	90,400.00	2.10
8	Potassium 60 kg/ha + Triacontanol 500 ppm	43,160.00	1,34,500.00	91,550.00	2.12
9	Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	43,260.00	**1,36,000.00**	**92,840.00**	**2.14**
10	Control 80:40:40 N:P:K	**42,050.00**	1,10,000.00	67,950.00	1.61

4. CONCLUSION

Treatment Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm. produced the highest grain yield (2.72 ta/ha), gross return (1,36,000.00 INR/ha), net return (92,840.00 INR/ha), and benefit: cost ratio (2.14), 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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