Original Research Article

Potassium & Plant Growth Regulators' Effects on Growth Parameters and Yield of Pearl Millet (*Pennisetum glaucum* L.) Var NBH-5658 ~~Pearl Millet (Pennisetum glaucum L.) Var NBH-5658 as Influenced by Potassium & Plant growth regulators Effects on Growth Parameters and Yield~~

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ABSTRACT;

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Background : Pearl millet can grow in variety of ~~Nature~~nature~~,~~ . Pearl millet a viable alternative to sorghum in area where it cannot thrive~~,~~ . When it comes to soil moisture utilisation and heat tolerance, sorghum and maize cannot compete with pearl millet.

Objectives: Effects of potassium and plant growth regulators on growth parameters and yield of pearl millet

Methods: With the goal of study~~ing~~ the effect of potassium and plant growth regulators on growth and yield of Pearl millet (*Pennisetum glaucum* L.) Var. NBH-5658 under a Randomized block design with 10 treatments (T1-T10) The experimental results revealed that 60 kg K/ha + NAA 100 ppm+ Triacontanol 500 ppm produced maximum plant height (221.20), plant dry weight (49.42) and yield parameters ear head length (20.50cm), number of grains/ear head (1970), Test weight (9.38g), grain yield (2.72 t/ha), and stover yield (3.78). Harvest Index (41.84)

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Conclusion: The combination of 60 kg potassium/ha and NAA 100 ppm and Triacontanol 500 ppm proved to be the most advantageous to farmers, resulting in 221.20-cm plant height, 49.42-gm plant dry weight, 1972 grains per ear head, 9.38g test weight and 2.68 ta grain yield and 3.26 ta stover yields, 41.84 % Harvest Index respectively.

Keywords: Growth; ~~pearl~~ Pearl millet; Potassium' Plant growth regulators, Yield.

1. INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R.BR.] is the most important cereal crop subsequent to rice, wheat, maize and sorghum. It is staple food of 90 million poor people and widely grown on 30 million ha in the arid and semi-arid tropical region of ~~asia~~Asia and Africa accounting for half of global millet production. In India fourth most cultivated crop after rice, wheat and maize. 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 kilometres 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 3rd after rice and wheat in acreage~~-~~. Pearl millet production in India is the largest in the world, with an area of 95.96 million hectares and a total output of 77.02 million tonnes. Pearl millet productivity per hectare is 803 kilograms. Pearl millet is grown on 0.150 million hectares in Gujarat and produces 0.252 million tonnes, with a yield of 1680 kg per hectare.

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Potassium is an essential major plant nutrient with numerous functions.~~-~~ Potassium increases water use efficiency and transforms sugar into starch in the grain filling process It plays a major role in activating enzymes, regulating stomatal function,. Thus several depletion of potash in soils under long term continuous cropping without supplemental potash, leads to minimal exchangeable potassium. Millet is one of the high potassium demanding crops, and it requires a large amount of potassium to complete its life cycle. In the absence of external potassium application, soil K weathering is the major source for meeting the K requirement. (Ch, Srinivasarao et al, 2013)

The plant growth regulators (PGRs) have potential for increasing crop productivity under environmental stress. Growth regulators are chemical substances which can alter the growth and developmental processes leading to increased yield, improved grain quality or facilitated harvesting (Espindula et al., 2009). Nutrient levels and plant growth regulators application had significant influence on growth parameters of Pearl millet. The exogenous applications of NAA to improve growth and yield under various stress conditions including drought, salinity, extreme temperatures, and heavy metal toxicity. They are also involved in developmental processes such as seed germination, leaf angle, flowering time, and seed yield, which are of great agronomic importance

2. MATERIALS & 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 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 Ten treatments that were reproduced three times. The length of each 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) 40 kg K/ha + NAA 100 ppm (T2) a 40 kg K/ha +Triacontanol 500 ppm, (T3) 40 kg K/ha + NAA 100 ppm + Triacontanol 500 ppm, (T4) 50 kg K/ha + NAA 100 ppm, (T5) 50 kg K/ha + Triacontanol 500 ppm, (T6) 50 kg K/ha + NAA 100 ppm + Triacontanol 500 ppm, (T7) 60 kg K/ha + NAA 100 ppm, (T8) 60 kg K/ha + Triacontanol 500 ppm, Treatment (T9) 60 kg K/ha + NAA 100 ppm + Triacontanol 500 ppm (T10) N;P;KK/ha 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, 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 & DISSCUSIONS

3.1 Effect on Growth Parameters

3.1.1 Plant height

Impact of potassium and plant growth regulators on plant height of pearl millet ~~Data~~ data presented in Table 1, tabulated with parameter plant height (cm) of pearl millet and there was increasing in crop age plant height was progressively increased with the advancement of the experimentation. The plant height was significantly higher in all different growth intervals with the levels of potassium (K) and Plant growth regulators (PGR) harvest, maximum plant height (221.20 cm) was recorded with the application of potassium (K) 60 kg ha-1 + NAA 100ppm +Triacontanol 500 ppm which was significantly superior over all other treatments. The probable reason for increases plant height might due to the potassium in that application plays crucial role in meristematic growth through its effects on the synthesis of Phytohormones, among various plant hormones, cytokinin plays an important role in growth of the plant. Similar, results observed by Yadav et al., (2012) and Chauhan et al., (2017). Growth regulators are chemical substances which can alter the growth and developmental processes leading to increased yield, improved grain quality or facilitated harvesting (Espindula et al., 2009).

Figure 1: Field sampling

3.1.2 Dry matter of plant

Data pertaining to dry weight (g/plant) in the Table 1 and there was dry weight had consecutively increased from 20 DAS to at harvest. at harvest, maximum dry weight (49.42 g/plant) was recorded with the application of potassium (K) 60 kg ha-1 +NAA 100 ppm+ Traicontonol 500 ppm . At harvest, Potassium 60 kg/ha + Triacontanol 500 ppm -1 which were statistically at per to the application of of potassium (K) 60 kg ha-1 +NAA 100 ppm+ Traicontonol 500 ppm. The probable reason for increase in dry weight might due to the potassium in that application plays a crucial role in meristematic growth through its effect on the synthesis of phytoharmones. Similar results reported by Chauhan et al., (2017). attributed improvement in dry matter accumulation by PGRs due to reduction in photorespiration, further, it is well established fact that the dry matter accumulation is the balance between photosynthesis and respiration process in the plant system. An increase in plant growth might be due to higher quantity of chlorophyll synthesis in the leaf tissue and delayed senescence of plant leaves. It is also probable that photosynthetic efficiency might have sustained for longer duration following the foliar application of growth regulators partly due to higher rate of Co2 fixation by treated plants and partly due to greater translocation of photosynthates from source of various sinks as reported by ~~king~~ King et al., (1967).

3.2 Yield and Yield Attributes

3.2.1 Ear head length

The statistical analysis of ear head length revealed the enormous impact of ear head period. The treatment of Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm resulted in a significant and maximal ear head length (20.50 cm). However, with Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm, no other treatment achieved statistical parity. Potassium utilisation increases the cytokines' activity in plants, resulting in increased cellular division and elongation. Because potassium is a component of chloroplast porphyrins, increased potassium fertilisation increased crop ear head length due to increased photosynthates synthesis. Plant growth regulators 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 and other nutrient delivery to plants. improved food availability to plants at the flower primordial initiation 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 [8], Sharma et al. [7].

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3.2.2 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 Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm (1972). The statistical parity between Potassium 60 kg/ha + Triacontanol 500 ppm and Potassium 60 kg/ha + NAA 100 ppm + 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 nitrogen. For this reason, enhanced Potassium fertilisation boosted grain and ear head production via increasing photosynthate production, because porphyrins in chloroplasts contain potasium. 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 plant growth regulators and other nutrient supplies to plants, the overall

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improvement in plant development can be linked to Plant growth regulators 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. Gurrala et al. and others have found similar results (2018)

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Table 1. Effect of potassium and plant growth regulators on growth parameters of pearl millet

T NO	Treatments	Plant Height(cm)	Dry weight (g)
1	Potassium 40 kg/ha + NAA 100 ppm	198.07	33.56
2	Potassium 40 kg/ha + Triacontanol 500 ppm	212.00	35.24
3	Potassium 40 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	214.27	37.37
4	Potassium 50 kg/ha + NAA 100 ppm	215.73	39.73
5	Potassium 50 kg/ha + Triacontanol 500 ppm	216.80	41.75
6	Potassium 50 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	217.13	42.69
7	Potassium 60 kg/ha + NAA 100 ppm	217.20	44.85
8	Potassium 60 kg/ha + Triacontanol 500 ppm	220.07	47.09
9	Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	221.20	49.42
10	Control 80:40:40 N:P:K	192.80	32.57
	F test	S	S
	SEm±	0.47	0.47
	CD (P = 0.05)	1.26	0.35

Table 2. Nitrogen & Phosphorus influence on Cumbu Yield and Characteristics

T NO	Treatments	Ear head Length(cm)	No. of grains/ear head	Grain Yield (ta/ha)	Stover Yield (ta/ha)
1	Potassium 40 kg/ha + NAA 100 ppm	16.15	1621.00	2.33	3.25
2	Potassium 40 kg/ha + Triacontanol 500 ppm	16.75	1681.00	2.18	3.44
3	Potassium 40 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	17.53	1759.00	2.24	3.37
4	Potassium 50 kg/ha + NAA 100 ppm	17.07	1783.00	2.40	3.58
5	Potassium 50 kg/ha + Triacontanol 500 ppm	18.30	1856.00	2.56	3.67
6	Potassium 50 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	19.50	1868.00	2.42	3.64

7	Potassium 60 kg/ha + NAA 100 ppm	18.20	1945.00	2.67	3.72
8	Potassium 60 kg/ha + Triacontanol 500 ppm	20.40	1964.00	2.69	3.74
9	Potassium 60 kg/ha + NAA 100 ppm + Triacontanol 500 ppm	20.50	1970.00	2.72	3.78
10	Control 80:40:40 N:P:K	15.91	1521. .00	2.20	3.15
	F test	S	S	S	S
	SEm±	0.06	5.16	8.35	6.81
	CD (P = 0.05)	0.19	15.34	0.02	0.11

3.2.3 Grain yield

Different combinations of Nitrogen, Phosphorus & Potassium and PGR can have a significant effect on grain production. A grain yield of 20.50 ta/ha was obtained with a treatment of (Potassium 60 kg/ha + NAA 100 ppm +Triacontanol 500 ppm) however, Potassium 60 kg/ha + Triacontanol 500 ppm yielded results statistically equivalent to those of (Potassium 60 kg/ha + NAA 100 ppm +Triacontanol 500 ppm). Increasing the amount of Potasium and Plant growth regulators applied greatly boosted pearl millet grain yields. This suggests that rising the nitrogen supply may have enhanced all growth indices, yield-related features Biological yield affects grain yield. A significant improvement in biological yield can therefore be attributed to the better grain production characteristics. These findings are also consistent with those of Heidari et al,..date??

Figure 2: Biological yield

3.2.4 Stover yield

The stover yield output of the pearl millet crop had also been greatly altered by the treatment of Potassium & Plant growth regulators. In terms of stover yield (3.78 ta/ha), the highest was observed at (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 Pottasium and Plant growth regulators, pearl millet yielded substantially more stover yield than it did without them. Growth of plant & dry matter production may have increased as a result 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. As a result, enhanced straw yield qualities might be blamed for a large rise in biological yields following the addition of phosphorus. A higher nitrogen supply could have resulted in a higher stover yield as a result 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.,date??

Figure 3: Stover yield

4. CONCLUSION

Potassium 60 kg/ha + NAA 100 ppm +Triacontanol 500 ppm was determined to be the most beneficial to farmers, resulting in 221.20-cm plant height, 49.42-gm plant dry weight, 1970 grains per ear head, and 2.72 ta grain yield and 3.15 ta stover yields, respectively.

REFERENCES

Singh RK, Chakraborty D, Garg RN, Sharma PK, Sharma UC. Effect of different water regimes and nitrogen application on growth, yield, water use and nitrogen uptake by pearl millet (Pennisetum glaucum). Indian Journal of Agricultural Sciences. 2010;80(3):213-216

Munirathnam P, Gautam RC. Response of promising pearl millet (Pennisetum glaucum) cultivars to levels and time of nitrogen application under rainfed conditions. Indian Journal of Agronomy. 2002;47(1):77-80

Guggari AK, Kalaghatagi SB. Effect of fertilizer and biofertilizer on pearl millet (Pennisetum glacum) and pigeon pea (Cajanus cajan) intercropping system under rainfed conditions. Indian Journal of Agronomy. 2005;50(1):24-26

Srinivasarao Ch, Sumanta Kundu, B.k. Ramachandrappa, Sharanbhoopal Reddy, Rattan Lal, B. Venkateswarlu, K.L. Sahrawat, R. Prakash Naik (2013) Potassium release characteristics, potassium balanceand fingermillet yield sustainability in a 27 – year long experiment on an *(Pennisetumglaucum)* - Alfisol in the semi-arid tropical India

Espindula MC, Rocha VS, Grossi JAS, Souza MA, Souza LT, Favarato LF. Use of growth retardants in wheat. *Planta Daninha* 2009; **27**:379-387

Gomez KA, Gomez AA. Statistical procedures for agricultural research. 2nd edn. John Wiley and Sons, Inc. London, UK; 1984

Yadav, S.S., Tikko, A. and Singh, J.P. (2012). Effect of potassium on pearl millet-wheat cropping system in coarse textured soils of Southern Haryana. Journal of the Indian Society of Soil Science, 60(6): 145-14

Chauhan, T.M., Lakhan, R. and Singh, V. (2017). Effect of potassium and sulphur on yield and nutrient uptake by pearl millet (Pennisetum glaucum L.) in alluvial soil. Annals of Plant and Soil Research 19(2): 141-145

King, R.W., Wardlow, I.F. and Evans, L.T. 1967. Effect of assimilate utilization photosynthesis in wheat. Planta. 77: 261-276.

Sharma PK, Kumar Sudesh, Chaudhary, GR. Effect of organic manure and nutrient management on productivity and soil fertility status in Pearl millet (Pennisetum glaucum). Research on Crops. 2012;13: 503-506..

Azad VB, Bali BS, Saha AAS. Effect of phosphorus levels and biofertilizers on yield, P-uptake and economics of wheat (Triticum aestivum). Environment and Ecology. 2010;28:534–537

Reddy BPS, Madhuri KV, Venkaiah K, Prathima T. Effect of nitrogen and potassium on yield and quality of pearl millet (Pennisetum glaucum L.). International Journal of Agricultural Innovations and Research. 2016;4(4):2319-1473.

Gurrala, S., Guru, G. and Lokanadan, Subbalakshmi, 2018. Effect of nutrient levels and plant growth regulators on growth parameters of pearlmillet. International Journal Pure and Applied Bioscience. 6(1): 1520-1525

Heidari, M. and Jamshid, P. (2010). Interaction between salinity and potassium on grain yield, carbohydrate content and nutrient uptake inpearl millet. ARPN Journal of Agricultural and Biological Science, 5(6): 39-46

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