Original Research Article

Effectof Potassium and Zincon growthandyieldofPearl millet (*Pennisetumglaucum* L.)

ABSTRACT

The field experiment was conducted in Crop Research Farm (CRF) in Department of Agronomy during*Zaid* season 2023-24 on Pearl millet crop**.** The treatment consisted of Potassium(30, 40 and 50 Kg/ha) and Zinc (15,20 and 25 kg/ha) and a control. The experiment was laid outwith a Randomize Block Design (RBD) with ten treatments which are replicated thrice as T_1Potassium 30kg/ha+Zinc 15 kg/ha, T_2Potassium 30kg/ha+Zinc 20 kg/ha, T_3Potassium 30kg/ha+Zinc 25 kg/ha T_4Potassium 40kg/ha+Zinc 15 kg/ha, T_5Potassium 40kg/ha+Zinc 20 kg/ha, T_6Potassium 40kg/ha+Zinc 25 kg/ha,T_7Potassium 50kg/ha+Zinc 15 kg/ha, T_8Potassium 50kg/ha+Zinc 20 kg/ha, T_9Potassium 50kg/ha+Zinc 25 kg/ha and a T_{10} Control. The soil ofexperiment plot was sandy loamy in texture, nearly neutral in soil reaction (pH 6.8), low inorganic carbon (0.46 %), available N (225.42 kg/ha), available P (38.2 kg/ha) and available K(240.7 kg/ha). Application of Potassium 50kg/ha+Zinc 25 kg/ha was recorded with the results which revealed that significantly highest growth attributes of Pearl millet at 80 DAS viz., Plant height (203.24 cm), dry weight (144.17 g),Ear head length (30.23 cm), grains/head (1848.78) and yield attributes such as Grain yield (4530.43 kg/ha), Stover yield (7246.59 kg/ha).

Keywords:,*Nitrogen, Pearl millet,Phosphorus, Potassium, Zinc.*

1. INTRODUCTION

Pearl millet is commonly known in India as Bajra or Bajri also known as ‘cattail’ and 'bullrush millet'. It is originated from tropical western Africa. It belongs to the family Gramineae (Poaceae). The cultivated species are *Pennisetum glaucum* L. (2n=14) used for grain and Pennisetum purpureum (2n=28) used for green and dry fodder. Pearl millet is the fifth most important cereal crop globally after rice, wheat, maize, and sorghum. It is used as a staple food for human consumption and fodder for livestock sector. It is a good source of energy (360 calories) and carbohydrates (67 g) and consist of 12 g protein, 5 g fat and 2 g minerals in 100 gm of bajra seeds (Directorate of Millets Development, 2021-22; Project Coordinator Review, 2022). It is considered as poor man’s food. It is critically important for food and nutritional security as it possess several advantages such as early maturing, drought tolerance, require minimal purchase of inputs and is mostly free from biotic and abiotic stresses. . Pearl millet (*Pennisetum glaucum* L.) is most widely grown as staple food by small and marginal farmers in Asia and Africa. It is a C4 plant having high photosynthetic efficiency, more dry matter productivity and survives under adverse agro-climatic conditions with lesser inputs and more economic returns. The crop is critically important for food and nutritional security of humans and animals in arid and semi-arid regions as Pearl millet is early maturing, drought tolerant, and has inherent ability to endure high temperatures up to 42°C during reproductive phase enabling it for cultivation in adverse conditions, thus making it a climate resilient crop. Due to its excellent nutritional properties, pearl millet is designated as nutri-cereal (Gazette of India, No.133 dtd 13th April, 2018) for production, consumption, trade and was included in Public Distribution System (PDS).

Potassium is one of the primary nutrients required for the growth and development of plants. It improves both yield and quality of agricultural produce and enhances the plant resistance to various biotic and abiotic stresses. It majorly functions in the photosynthesis, metabolism of carbohydrate and physiological processes such as root development, water use efficiency, synthesis of protein and amino acids, enzyme activation (Choudhary *et al*. 2014).

Micronutrients are important for maintaining soil health and also increasing productivity of crops. These are needed in very small amounts. Zinc is especially for regular healthy growth and reproduction of plants (Marschner, 1995). In plants, zinc plays a key role as a structural constitute or regulatory co-factor of a wide range of different enzymes in many important biochemical pathways.

2. MATERIALS AND METHOD

This experiment was laid out during the *Zaid* season of 2023-24 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The crop research farm is situated at 25^0 39” 42” N latitude, 81^0 67” 56” E longitude and at an altitude of 98 m above mean sea level. The experiment was layout in Randomized Block Design (RBD) with ten treatment and three replicated. The treatment details are as follows T_1Potassium 30kg/ha+Zinc 15 kg/ha, T_2Potassium 30kg/ha+Zinc 20 kg/ha, T_3Potassium 30kg/ha+Zinc 25 kg/ha

T_4Potassium40kg/ha+Zinc 15 kg/ha, T_5Potassium 40kg/ha+Zinc 20 kg/ha, T_6Potassium 40kg/ha+Zinc 25 kg/ha,T_7Potassium 50kg/ha+Zinc 15 kg/ha, T_8Potassium 50kg/ha+Zinc 20 kg/ha, T_9Potassium 50kg/ha+Zinc 25 kg/ha and a T_{10} Control. The observations were recorded for plant height (cm), plant dry weight (g),Crop growth rate (g/m^2/day), Relativegrowthrate(g/g/day), Ear head length (cm), Number of grains/heads, Test weight (g), grain yield (kg/ha), Stover yield (kg/ha).

3. RESULT AND DISCUSSION

3.1 Growth Parameter

3.1.1 Plant height (cm)

At 80 DAS maximum plant height of (203.24 cm) was recorded with treatment 9 (Potassium 50kg/haalong withZinc25 kg/ha), whereas treatment 7 and 8 (Potassium 50kg/ha along withZinc 15kg/ha and Potassium 50kg/ha along withZinc 20kg/ha) were statisticallyatparwithtreatment 9 (Potassium 50kg/haalong withZinc25 kg/ha).

The plant height of Pearl millet increased significantly due to application of different levels of Potassium and Zinc. Potassiumis an essential element of all the amino acids in plant structures; theseare the building blocks of plant proteins and are important to the development of plant tissuessuch as the cells, membranes, and chlorophyll. Similar results were reported by Iqbal *etal.*,(2013) &Manwar and Mankar (2015). The increase in plant height may be attributed to role of Zinc as a catalyst or stimulant in most of physiological and metabolic process and it alsoimportant in synthesis of tryptophan, a component of some protein and a compound neededfor production of growth hormones (auxins) like Indole Acetic Acid (IAA). Similar results were alsoreportedbyReddy*etal.*, (2021).

3.1.2 Plant dry weight (g/plant)

At 80 DAS highest plant dry weight (144.17 g) was found in treatment 9 (Potassium 50kg/haalong withZinc25 kg/ha). However, treatment 5, 6, 7 and 8(Potassium 40kg/haalong with Zinc20kg/ha , Potassium 40kg/ha along withZinc 25kg/ha,Potassium 50kg/ha along withZinc 15kg/ha and Potassium 50kg/ha along withZinc 20kg/ha) were statistically at par with the treatment 9 (Potassium 50kg/haalong withZinc25 kg/ha).

The dry weight of Pearl millet increased significantly due to application of Potassium. AsPotassium might have provided congenial nutritional environment to the plants, which helpsin attributing to its pivotal role in several physiological and biochemical processes which are ofvital importance for growth and development of plant in terms of dry weight. The increase in dry weightmay be attributed to role of Zinc as a catalyst or stimulant in most of the physiologicalandmetabolicprocessesandmetalactivatororenzymesresultinginincreasedgrowthanddevelopment of plant.SimilarresultswerealsoreportedbyReddy*etal.*,(2021)andVinodKumar*etal.*,(2018)

3.1.3 Cropgrowthrate(g/m^2/day)

Although,thestatisticalanalysisofCGRduring60 - 80DASsignificant highest CGRvalue (43.07/m^2/day)wasobserved in treatment 3 (Potassium 30kg/ha along withZinc 25kg/ha). and accept treatment 9 and 10 (Potassium 50kg/ha along withZinc 25kg/ha and Control) which was not found statisticallyatparwith treatment 3(Potassium 30kg/ha along withZinc 25kg/ha).

3.1.4 Relativegrowthrate(g/g/day)

Duringthegrowthintervalof 60 - 80DASinterval highestRGRvalue(0.028 g/g/day)wasrecordedwithtreatment 1,2 and 3 (Potassium 30kg/haalong with Zinc15kg/ha, Potassium 30kg/haalong with Zinc20kg/ha, and Potassium 30kg/haalong with Zinc25kg/ha).

3.2 Yield attributes and Yield Parameter

3.2.1 Earhead length (cm)

Asignificantimpactwasexperientialbythestatisticalanalysisofearheadlength.Treatment with Potassium 50kg/ha along Zinc25 kg/ha was recorded highest ear head length(30.23). However, treatment 7 and 8 (Potassium 50kg/ha along withZinc 15kg/ha and Potassium 50kg/ha along withZinc 20kg/ha) were found statisticallyatparwithtreatment 9 (Potassium 50kg/haalong withZinc25 kg/ha).NPK application can be attributed to a general development in plant growth as replicated byincreased dry matter accumulation, which may be due to an 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 metabolicprocesses rely on Zinc, as well as tryptophan synthesis. Zinc is a vital component of severalproteinsthatproducegrowth hormones(auxins)suchasIAA.Intwoseparatestudies,Sharma*etal*. (2012)and Sharma*etal*. (2008) cametothesameresult.

3.2.2 Numberof grains/earhead

Significant effect was observed by the statistical analysis of number of grains/ear head.Treatment 9 (Potassium 50kg/ha along with Zinc25 kg/ha) recorded significant and highest number ofgrains/ear head (1848.75). However, treatment 5, 6, 7 and 8(Potassium 40kg/haalong with Zinc20kg/ha, Potassium 40kg/ha along withZinc 25kg/ha, Potassium 50kg/ha along withZinc 15kg/ha and Potassium 50kg/ha along withZinc 20kg/ha) were statistically at par with the treatment 9 (Potassium 50kg/haalong withZinc25 kg/ha. Potassium could be attributed to overallimprovement in plant growth and increased availability of nutrients to plants at the flowerprimordial initiation stage which might have helped in greater effective tillers formation andultimately increased number of grains/ear head and ear head lengthmay be attributed to the role of Zinc as a catalyst orstimulant in most of physiological and metabolic process a component of some protein and a compound needed for production of growthhormones (auxins) like Indole Acetic Acid.Similar results were also reported by Reddy *et al.*,(2021),VinodKumar*etal.*,(2018) andChouhan *etal.*, (2015).

3.2.3 Testweight (g)

The statistical analysis on test weight was found to be non-significant. However, highest testweight (8.22 g) was recorded with treatment 9 (Potassium 50kg/ha+Zinc25 kg/ha) and lowesttestweight(5.71 g)was recorded in control.

3.2.4 Grain yield(kg/ha)

Increased grain yield was obtained due to PotassiumandZinc and RDFtreatmentcombinations. The highestgrain yield (4530.43 kg/ha) was obtained in treatment 9 (Potassium 50 kg/ha along withZinc 25 kg/ha) whereas, treatment 8 (Potassium 50kg/ha along withZinc 20kg/ha) were statisticallyatparwithtreatment 9

(Potassium 50kg/haalong withZinc25 kg/ha). Applying potassium might be appliedtoimprove vegetativedevelopment,probablyuptakeandutilizationofotherelementsfascinated by its wide root system developed by NPK imitation. Zinc's roleas a "catalyst" in the synthesis of tryptophan, as well as the growth and development of theplant,may beascribedtotheincreaseingrainyield.SimilarfindingswerepreviouslypublishedbySharma*etal*., (2012)andSingh*etal*.,(2016).

3.2.5 Stoveryield(kg/ha)

Application of Potassium and Zinc has significantly impact on stover production of the Pearlmillet.AtPotassium 50kg/ha+Zinc25kg/ha,thehighest stoveryield(7246.59 kg/ha)wasobtained whereas,treatments 6, 7 and 8 (Potassium 40kg/ha +Zinc 25kg/ha, Potassium 50kg/ha +Zinc 15kg/ha and Potassium 50kg/ha +Zinc 20kg/ha) were obtained statistically at par with the treatment 9 (Potassium 50kg/ha+Zinc25 kg/ha). Applying Potassium might be ascribed to improve vegetative development,probablyuptakeandutilizationsofotherelementsfascinatedbyitswiderootsystemde veloped under Potassium. The biological yield is a function of the stover yield. Zinc is criticalto the growth and development of tryptophan, a necessary amino acid for plant growth anddevelopment. Both Sharma *et al.*, (2012) and Singh*et al.*, (2016) found the same results in theirresearch.

CONCLUSION

From the results, it is concluded that application of Potassium 50 kg/ha along with Zinc 25kg/ha (Treatment 9) in Pearl millet has recorded highest plant height, dry weight, grain yield and stover yield.

Table1Influence ofPotassium andZincon growth of Pearlmillet.

S.No.

S.No.	Treatments	Plant height (cm) 80DAS	Dry weight (g) 80DAS	CGR ($g/m^2/day$) 60-80DAS	RGR (g/g/day) 60-80DAS
1.	Potassium 30kg/ha+ Zinc15kg/ha	176.70	131.93	42.57	0.028
2.	Potassium 30kg/ha+ Zinc20kg/ha	177.83	133.17	42.29	0.028
3.	Potassium 30kg/ha+ Zinc25kg/ha	181.80	135.87	43.07	0.028
4.	Potassium 40kg/ha+ Zinc15kg/ha	185.11	136.74	42.26	0.027
5.	Potassium 40kg/ha+ Zinc20kg/ha	187.17	137.93	41.76	0.026
6.	Potassium 40kg/ha +Zinc 25kg/ha	191.67	139.82	42.32	0.026
7.	Potassium 50kg/ha +Zinc 15kg/ha	195.68	141.90	42.34	0.026
8.	Potassium 50kg/ha +Zinc 20kg/ha	198.92	143.10	41.41	0.025
9.	Potassium 50kg/ha+Zinc25 kg/ha	203.24	144.17	39.47	0.022
10.	Control(RDF:- 80:40:40NPK kg/ha)	168.85	118.62	33.42	0.024
	F	S	S	S	NS
	testS	3.70	2.17	1.74	0.0010
	Em± CD (P=0.05)	11.01	6.45	5.18	-

		Earhead length (cm)	No.ofgrains/earhead	Testweight (g)	Seedyield(Kg/ha)	Stoveryield (Kg/ha)
1.	Potassium 30kg/ha+ Zinc15kg/ha	22.77	1279.65	5.80	3359.37	6391.84
2.	Potassium 30kg/ha+ Zinc20kg/ha	23.21	1308.55	5.93	3490.14	6473.69
3.	Potassium 30kg/ha+ Zinc25kg/ha	23.63	1339.06	6.31	3573.38	6585.61
4.	Potassium 40kg/ha+ Zinc15kg/ha	24.87	1409.91	6.76	3718.26	6660.26
5.	Potassium 40kg/ha+ Zinc20kg/ha	25.28	1516.07	6.94	3854.11	6751.13
6.	Potassium 40kg/ha +Zinc 25kg/ha	26.04	1610.44	7.55	3964.08	6958.59
7.	Potassium 50kg/ha +Zinc 15kg/ha	28.82	1629.51	7.66	4171.65	7085.82
8.	Potassium 50kg/ha +Zinc 20kg/ha	29.04	1715.03	7.92	4340.04	7176.40
9.	Potassium 50kg/ha+Zinc25 kg/ha	30.23	1848.75	8.22	4530.43	7246.59
10.	Control(RDF:- 80:40:40NPK kg/ha)	21.43	1215.07	5.71	3076.06	5689.70
	F	S	S	NS	S	S
	testS	1.17	80.20	0.40	113.02	165.13
	Em±	3.48		1.197		
	CD (P=0.05)		338.30		335.81	490.63

Table2Influence ofPotassium andZincon yield and yield attributes of Pearlmillet.

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