The Pharma Innovation Journal 2022; 11(3): 1825-1828

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(3): 1825-1828

www.thepharmajournal.com
Received: 03-12-2021
Accepted: 08-02-2022

Shivam Yadav
M.Sc. Scholar, Department of Agronomy, Faculty of Agriculture, Naini Agriculture Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Dr. Joy Dawson
Professor and Head, Department of Agronomy, Faculty of Agriculture, Naini Agriculture Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Lalit Kumar Sanodiya
Ph.D., Scholar, Department of Agronomy, Faculty of Agriculture, Naini Agriculture Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Shivam Yadav
M.Sc. Scholar, Department of Agronomy, Faculty of Agriculture, Naini Agriculture Institute, SHUATS, Prayagraj, Uttar Pradesh, India

Influence of bio-fertilizer and zinc levels on growth and green yield of fodder pearl millet (*Pennisetum glaucum* L.)

Shivam Yadav, Dr. Joy Dawson and Lalit Kumar Sanodiya

Abstract
Field experiment was conducted on fodder pearl millet during *Zaid* season of 2021, at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P). The treatments consist of Levels of bio-fertilizer *viz*.- Control, *Pseudomonas fluorescens* at 15 g, *Azotobacter chroococum* at 15 g and *Trichoderma viride* at 5g and three zinc levels *viz.* 5, 15 and 25 kg ZnSO4 per ha. The experiment was laid out in randomized block design with three replications. The results showed that maximum plant height (96.92 cm), dry matter (38.49 g/plant), Number of tillers per plant (5.86) and green fodder yield (41.19 kg/plot) and fodder yield (45.76 t/ha) of fodder pearl millet at first cut, respectively; and economics *viz*. gross return (114400 INR/ha) net return (71536 INR/ha) and B:C ratio (.67) were recorded with *Azotobacter chroococum* at 15g/kg seed + Zinc at 25kg /ha) ratio than rest of the levels of zinc.

Keywords: Plant height, dry matter yield, green fodder yield, bio-fertilizer, zinc levels

Introduction

Pearl millet (*Pennisetum americanum* L.) is one of the most important crops which grows in the arid and semi-arid areas in the world for both food and forage production (Arya *et al.*, 2013) [2]. It is nutritious and palatable and can be feed as green, dry or as conserved fodder in the form of silage or hay. In India, animal husbandry is closely associated with crop production as a complementary enterprise, possessing the largest livestock population of 529.7 million heads. But their performance is deplorably low due to the poor nourishment which is primarily ascribed to the fluctuating and inconsistent supply of quality green fodder. Against the projected need of 1025 million tonnes of green fodder in the country, the present availability is 390 million tonnes only (www.icar.org), with a huge deficit of 61.95 per cent.

Pearlmillet (*Pennisetum glaucum* L.) is an important crop grown for food and fodder to meet the needs of both human and livestock population. It is one of the most important component crops of agriculture and animal husbandry and dominating the rural economy in dryland areas of India. It is a fast growing, short duration, drought tolerant crop having high biomass production potential, tillering and ratooning ability with high protein content of 10-12 per cent, free from anti-nutrient thus making it as an outstanding fodder crop for the rainfed situations and serves as an ideal crop under regions of low rainfall conditions (Patel *et al*., 2008) [13]. The green fodder of bajra is leafy, palatable and very nutritious feed stock for cattle ensuring good milk yield. Pearlmillet can be grazed or cut and fed at any growth stage, as it has no HCN content like sorghum (Tiwana and Puri 2005) [18] opined that fodder pearlmillet is excellent for making silage, particularly in regions where long dry spells during the rainy season and it produces higher silage yields with higher protein content than sorghum.

Numbers of different bacteria promote plant growth, including Azotobacter sp., Azospirillum sp., Pseudomones sp., Bacillus sp. Acetobacter sp. (Turan *et al*., 2006) [19]. Some common examples of PGPR genera exhibiting plant growth promoting activity are Pseudomonas, Azospirillum, Azotobacter, Bacillus, Burkholdaria, Rhizobium, Erwinia, Mycobacterium Flavobacterium, etc. Bacteria include species of Azotobacter and Azospirillum, both of which provide direct and indirect effects on plant growth and pest resistance (Nelson, 2004) [12]. More recently, a new species of nitrogen fixing bacterium, Acetobacter sp. was isolated from sugarcane in the different parts of the world (Sharma, 2012) [16]. In pearlmillet crop inoculation of nitrogen fixing and phosphate solubilizing microorganisms alone or in combination increased plant height, number of tillers and ultimately the yield (Saxena, 1997) [6].

Trichoderma sp. are also reported as growth promoting fungi by enhancing the availability of nutrients and minerals (N, P, Fe) for plants, producing plant growth hormones and decomposing organic material (Kaewchai *et al*., 2009) [8].

In plants, zinc plays a key role as a structural constituent or regulatory co-factor of a wide range of different enzymes in many important biochemical pathways. Zinc deficiency in the plant retards development and maturation of the panicles of grain crops (Alloway, 2004) [1]. As in soils and plants, Zn deficiency is also a common nutritional problem in humans, predominantly in developing countries where diets are rich in cereal-based foods and poor in animal products.

Materials and Methods

The current study was carried out in the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the *Zaid* season of 2021. (U.P.). The experimental field is located approximately 9 kilometers from Prayagraj city, near the Yamuna River, on the left side of the Allahabad-Rewa Road.

Prayagraj is located in the subtropical zone of Uttar Pradesh, with hot summers and pleasant winters. The area's average temperature is 46 °C to 48 °C, with temperatures seldom dropping below 3 °C or 4 °C. The relative humidity levels range from 20% to 94 percent. In this location, the average annual rainfall is 1013.4 mm.

The soil chemistry analysis revealed a sandy loam texture with a ph of 7.4, low amounts of organic carbon (0.32 percent) and potassium (78 kg/ha), and a low quantity of accessible phosphorus (34.5 kg/ha). The soil was electrically conductive and had a electrical conductivity of 0.27 dS/m.

For each of the ten treatment combinations, three replications were employed. The therapy details and treatment combinations are shown in Tables 1 and 2, respectively. Pearlmillet variety Kamadgiri (7575) was physically seeded on April 4th, 2021. Bio-fertilizer and zinc levels were maintained according to the treatment combinations. Plant height (cm) at harvest, dry weight at harvest, Number of tillers per plant, and green fodder yield (t/ha) were all successfully measured, and an economic analysis of each treatment was completed to determine the best treatment combination for Pearlmillet cultivation.

Statistical analysis

The experimental data analysed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments was also worked out (Gomez and Gomez, 1984) [4].

Chemical analysis of soil

Composite soil samples are collected randomly before the layout of experiment was laid so as to determine the soil properties initially. The soil samples are collected from 0-15 cm depth and were dried under shade, then powdered with the help of a wooden pestle and mortar then sieved through a 2 mm sieve and was then subjected to further analysis. The physical properties of soil were evaluated by using the Bouyoucos hydrometer method outlined by Bouyoucos (1927) and for organic carbon by rapid titration method by Nelson (1975). Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asia (1956), available phosphorus by Olsen's method as outlined by Jackson (1967), available potassium was determined by use of flame photo 9 meter normal ammonium acetate solution and estimating by using the flame photometer (ELICO Model) as outlined by Jackson (1973).

Table 1: Treatment Details

Biofertilizer: 3 (Three) levels	***Pseudomonas fluorescens* at 15g**
	Azotobacter chroococum at 15g
	Trichoderma viride at 5g
Zinc: 3 (Three) levels	5 kg/ha
	15 kg/ha
	25 kg/ha
	Control

Table 2: Treatment Combinations

Treatments No.	Treatments combinations
T1	Control NPK (60:40:40 kg /ha)
T2	*Pseudomonas fluorescens* at 15g/kg seed + Zinc at 5kg/ ha)
T3	*Pseudomonas fluorescens* at 15g/kg seed + Zinc at 15kg/ ha)
T4	*Pseudomonas fluorescens* at 15g/kg seed + Zinc at 25kg /ha)
T5	*Azotobacter chroococum* at 15g/kg seed + Zinc at 5kg /ha)
T6	*Azotobacter chroococum* at 15g/kg seed + Zinc at 15kg/ ha)
T7	*Azotobacter chroococum* at 15g/kg seed + Zinc at 25kg /ha)
T8	*Trichoderma viride* at 5g/kg seed + Zinc at 5kg /ha)
T9	*Trichoderma viride* at 5g/kg seed + Zinc at 15kg/ ha)
T10	*Trichoderma viride* at 5g/kg seed + Zinc at 25kg /ha)

Results and Discussion Growth parameters

Data pertaining to growth parameters which are plant height (cm), dry weight (g/plant) and Number of tillers per plant were recorded and tabulated in Table 3. The significantly maximum plant height was recorded with application of *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ ha) which was significantly superior over all the treatments and statically at par with treatment of *Azotobacter chroococum* at 15 g/kg seed + Zinc at 5 kg /ha) (90.24 cm) and *Azotobacter chroococum* at 15 g/kg seed + Zinc at 15 kg/ ha) (92.10 cm) this might be due to as zinc is directly or in directly involved in the production of chlorophyll and foliar application is known to be very responsive as the availability of growth parameters by its foliar application is not affected by soil pH in tandem which ensures higher yield, while in case of data related to plant dry weight treatment with *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ ha)was recorded maximum dry weight (38.49 g) which is significantly superior all over the treatments and treatment with *Azotobacter chroococum* at 15 g/kg seed + Zinc at 15 kg/ ha), is statically at par. During 45 DAS there was no significant difference among the treatment and maximum number of tillers per plant of was observed (6.27) *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg /ha) and lowest number of tillers per plant (3.98) was obtained with Control NPK (60:40:40 kg/ ha). However, T6 *Azotobacter chroococum* at 15g/kg seed + Zinc at 15kg /ha) are found statistically at par to T7 *Azotobacter chroococum* at 15g/kg seed + Zinc at 25kg /ha). Zinc nutrition is known to increase tillering in pearl millet which may perhaps cause a significant increase in dry matter accumulation. Similar result was reported by Jain *et al.*, (2001) [6] and Jakhar *et al.*, (2006) [7], Prasad *et al.*, (2014) [14].

Dry matter accumulation of plants is the final outcome of photosynthetic activities. A significant increase in plant dry matter at different stages of growth due to increase in nitrogen levels might be attributed to the effect of nitrogen in increasing the amount and efficiency of chlorophyll which influence the photosynthetic efficiency and formation of other nitrogen compounds. Similar result also reported by Heringer and Moojen (2002) [5] and Singh *et al.*, (2000) [3]. Increase in number of tillers due to application of nitrogen has also been reported by Yakardi and Reddy (2009) [21], Mesquita and Pinto (2000) [10] and Prasad *et al.*, (2014) [6].

Table 3: Effect of bio-fertilizer and zinc levels on growth of fodder pearl millet

Treatments combinations		Growth Parameters		
		Plant height (cm)	Dry weight of plant (g/ plant)	Number of tillers per plant
1	Control NPK(60:40:40 kg/ha)	73.15	1.23	3.11
2	*Pseudomonas fluorescens* at 15 g/kg seed + Zinc at 5 kg/ha)	84.84	32.42	4.35
3	*Pseudomonas fluorescens* at 15g/kg seed + Zinc at 15 kg/ha)	86.11	33.92	5.05
4	*Pseudomonas fluorescens* at 15g/kg seed + Zinc at 25 kg/ha)	86.71	35.40	5.29
5	*Azotobacter chroococum* at 15 g/kg seed + Zinc at 5 kg/ha)	90.24	35.52	5.52
6	*Azotobacter chroococum* at 15 g/kg seed + Zinc at 15 kg/ha)	92.10	36.16	5.72
7	*Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ha)	96.92	38.49	5.86
8	*Trichoderma viride* at 5 g/kg seed + Zinc at 5 kg/ha)	73.75	29.98	4.67
9	*Trichoderma viride* at 5 g/kg seed + Zinc at 15 kg/ha)	75.19	27.84	4.73
10	*Trichoderma viride* at 5 g/kg seed + Zinc at 25 kg/ha)	80.40	26.51	4.86
F Fest		S	S	S
S.Ed. (+)		2.740	0.796	0.076
CD (p=0.5)		5.756	1.673	0.159

Yield parameters

Green Fodder Yield (kg/plot and t/ha)

Data pertaining fodder yield (kg/plot and t/ha) of Fodder pearl millet there was a significant influence in the fodder yield (kg/plot and t/ha) Table 4 was observed from 15 DAS to 60 DAS showing some significant impact on effect of levels of Bio-fertilizer and Application of Zinc on growth and yield of Fodder pearl millet.

During At harvest significantly superior fodder yield (41.19 kg/plot) T7 *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ha). The minimum fodder yield (30.90 kg/plot) was found in treatment T1 Control NPK (60:40:40 kg/ha). However, T5 *Azotobacter chroococum* at 15g/kg seed + Zinc at 5kg /ha) and T4 *Pseudomonas fluorescens* at 15g/kg seed + Zinc at 25 kg/ha) are found statistically at par to T7 *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ha). During At harvest significantly superior fodder yield (45.76 t/ha) T7 *Azotobacter chroococum* at 15g/kg seed + Zinc at 25 kg/ha). The minimum fodder yield (34.34 t/ha) was found in treatment T1 Control NPK (60:40:40 kg/ha). However, T6 *Azotobacter chroococum* at 15 g/kg seed + Zinc at 15 kg/ha) and T5 *Azotobacter chroococum* at 15 g/kg seed + Zinc at 5kg/ha) are found statistically at par to T7 *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ha). These finding was collaborated by Latake *et al*. (2009) [9] whose results obtained proved the efficacy of nitrogen fixing and phosphate solubilizing microorganisms to enhance growth and yield of pearlmillet crop when inoculated to the seed and have possibility of substituting a part of demand of chemical fertilizers of the crop. Muraleedharan *et al*. (2010) [11] has reported that bio-fertilizers promote growth by increasing the availability of primary nutrients. Bhagchand and Gautam (2000) [3] also reported that the use of bio-fertilizers lead to higher availability of nitrogen and phosphorus that promoted growth and development and ultimately resulting in higher yields. Similar results in cereal crops have been reported by National Centre for Organic farming (2012). So these can substitute a part of chemical fertilizers and farmers can get better returns.

Table 4: Effect of bio-fertilizer and zinc levels on fodder yield (kg/plot and t/ha) of fodder pearl millet

Treatments combinations		Yield attributes	
		Fodder yield (kg/plot)	Fodder yield (t/ha)
1	Control NPK(60:40:40 kg /ha)	30.90	4.34
2	*Pseudomonas fluorescens* at 15 g/kg seed + Zinc at 5 kg/ ha)	37.06	41.18
3	*Pseudomonas fluorescens* at 15 g/kg seed + Zinc at 15 kg/ ha)	37.88	42.09
4	*Pseudomonas fluorescens* at 15 g/kg seed + Zinc at 25 kg /ha)	39.08	43.42
5	*Azotobacter chroococum* at 15 g/kg seed + Zinc at 5 kg /ha)	39.90	44.34
6	*Azotobacter chroococum* at 15 g/kg seed + Zinc at 15 kg/ ha)	40.40	44.89
7	*Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ ha)	41.19	45.76
8	*Trichoderma viride* at 5 g/kg seed + Zinc at 5 kg /ha)	35.71	39.68
9	*Trichoderma viride* at 5 g/kg seed + Zinc at 15 kg/ ha)	35.31	39.24
10	*Trichoderma viride* at 5 g/kg seed + Zinc at 25 kg /ha)	34.38	38.20

F Fest	S	S
S.Ed. (+)	0.656	0.729
CD (p=0.5)	1.378	1.531

Conclusion
Findings of present study well demonstrated the positive effects of bio-fertilizer particularly zinc levels treatment on various growth and yield parameters of pearlmillet plant. The application *Azotobacter chroococum* at 15 g/kg seed + Zinc at 25 kg/ha) obtaining higher yield attributes and yield of pearlmillet useful for eastern Uttar Pradesh condition.

Acknowledgement
The authors are thankful to Advisor Dr. Joy Dowson for constant support and guidance. I am indebted for the support to all faculty members and seniors Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj – 211007, Uttar Pradesh, India for providing us necessary facilities to undertake the studies.

Conclusion
On the basis of results obtained in present investigation, it is concluded that the profitable production of pearlmillet can be secured by bio-fertilizer and zinc levels. These practices may be passed on to the farmers for obtaining higher returns in this agro-climatic zone.

References
1. Alloway BJ. Zinc in soils and crop nutrition. International Zinc Association (IZA), 168 Avenue de Tervueren, 1150 Brussels, Belgium, 2004, 123.
2. Arya RK, Kumar S, Yadav AK, Kumar A. Grain quality improvement in pearlmillet –a review. Forage Res. 2013;38:189-201.
3. Baghchand, Gautam RC. Effect of organic manure, biofertilizer and inorganic fertilizer on growth, yield and quality of rainfed pearl millet. Annals of Agriculture Research. 2000;21:459-464.
4. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research, edn. Johns & Sons, New York. 1984;2:591.
5. Heringer I, Moojen EL. Productive potential, structure changes and quality of pearl millet under different nitrogen levels. Revista Brasileira de Zootecnia. 2002;31(2):875-882.
6. Jain NK, Poonia BL, Singh RP. Response of pearl millet (*Pennisetum glaucum*) to zinc fertilization in flood-prone eastern plains zone of Rajasthan. Indian J Agril. Sci. 2001;71(5):339-340.
7. Jakhar SR, Singh M, Balai CM. Effect of farmyard manure, phosphorus and zinc levels on growth, yield, quality and economics of pearl millet (*Pennisetum glaucum*). Indian J Agril. Sci. 2006;76(1):58-61.
8. Kaewchai S, Soytong K, Hyde KD. Mycofungicides and fungal biofertilizers. Fungal diversity. 2009;38:25-50.
9. Latake SB, Shinde DB, Bhosale DM. Effect of inoculation of beneficial microorganisms on growth and yield of pearlmillet. Indian Journal of Agriculture Research. 2009;43:61-64.
10. Mesquita EE, Pinto JC. Nitrogen levels and sowing methods on forage yield produced after harvesting of millet seed (*Pennisetum glaucum* (L.) R. Br.). Revista Brasileira de Zootecnia. 2000;29(4):971-977.
11. Muraleedharan H, Seshadri S, Perumal K. Biofertiliser (Phosphobacteria), Shri AMM Murugappa Chettiar Research Centre, Taramani, Chennai, 2010 December.
12. Nelson LM. Plant growth promoting rhizobacteria (PGPR): Prospects for new inoculants, Crop Management, 2004, 301-305.
13. Patel MR, Sadhu AC, Patel RM, Parmar HP, Kher. Cutting management in different genotypes of forage bajra during summer season. Research on Crops. 2008;9(2):325-327.
14. 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.
15. Sexsena A. Response of pearlmillet to inoculation with biofertilizers in the Indian arid zone. Proc. Symposium-Recent Advances in Arid Ecosystem, 1997, 283-286.
16. Sharma KA. A Handbook of organic farming, Agrobios (India), 2012, 269.
17. Singh D, Singh VAS, Joshi YP. Effect of nitrogen fertilization and cutting intervals on yield and quality of Napier Bajra hybrid. Range Management & Agroforest. 2000;21(2):128-134.
18. Tiwana US, Puri KP. Effect of nitrogen levels on the fodder yield and quality of pearlmillet varieties under rainfed conditions. Forage Research. 2005;31(2):142-143.
19. Turan M, Ataoglu N, Sahin F. Evaluation of the capacity of phosphate solubilizing bacteria and fungi on different forms of phosphorus in liquid culture. Sustainable Agricultural. 2006;28:99-108.
20. Yakadri M, Reddy APK. Productivity of pearl millet (*Pennisetum glaucum* (L.) R. Br.) as influenced by planting pattern and nitrogen levels during summer. J Res. ANGRAU. 2009;37(1/2):34-37.