



International Journal of Research in Agronomy

E-ISSN: 2618-0618

P-ISSN: 2618-060X

© Agronomy

www.agronomyjournals.com

2024; 7(10): 266-270

Received: 02-08-2024

Accepted: 05-09-2024

Santosh Choudhary

Research Scholar, Department of
Agronomy, Rajasthan Agricultural
Research Institute, Durgapura,
SKNAU, Jobner, Rajasthan, India

Seema Sharma

Professor, Department of
Agronomy, Rajasthan Agricultural
Research Institute, Durgapura,
SKNAU, Jobner, Rajasthan, India

Seema Yadav

Research Scholar, Department of
Agronomy, Sri Karan Narendra
Agriculture University, Jobner,
Jaipur, Rajasthan, India

Bahnu Pratap Ghail

Research Scholar, Department of
Agronomy, Rajasthan Agricultural
Research Institute, Durgapura,
SKNAU, Jobner, Rajasthan, India

Pinky Yadav

Research Scholar, Department of
Agronomy, MPUAT, Udupur,
Rajasthan, India

Corresponding Author:

Santosh Choudhary

Research Scholar, Department of
Agronomy, Rajasthan Agricultural
Research Institute, Durgapura,
SKNAU, Jobner, Rajasthan, India

Nitrogen and drought management in pearl millet for sustainable productivity and profitability under rain-fed condition of Rajasthan

Santosh Choudhary, Seema Sharma, Seema Yadav, Bahnu Pratap Ghail and Pinky Yadav

DOI: <https://doi.org/10.33545/2618060X.2024.v7.i10d.1760>

Abstract

A field experiment was taken on Pearl millet for two consecutive years during *Kharif* 2022 to *kharif*-2023 at Agronomy Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan to study the “Nitrogen and Drought management in Pearl millet for Sustainable Productivity and Profitability under Rain-fed condition of Rajasthan”. All the treatments including poultry manure + bio-mix and vermicompost + Bio-mix had significant effect on growth, growth indices & yield parameters and yield of pearl millet. On pooled basis, results showed that bio-organics recorded significantly higher all the growth and growth indices viz., Dry matter accumulation, leaf area, leaf area index, crop growth, relative growth rate and leaf area duration and no. total of tillers per meter row length and Yield attributes and yield: viz., no. of effective tillers/meter row length, length of earhead, girth of earhead, no. of grains/earhead, grain (2484 g/plot) and stover (5627 g/plot) yields and net returns (63.6 Rs/plot) of pearl millet and found at par with treatments poultry manure + Bio-mix followed by Vermicompost + Bio-mix and FYM+ Bio-mix over control. With respect to seed priming with abscisic acid @ 150 ppm recorded highest growth and growth indices, yield attributes and yield of pearl over rest of seed priming treatment during both the years and in pooled data.

Keywords: Poultry manure, vermicompost, FYM, bio-mix, growth and yield

Introduction

Pearl millet (*Pennisetum glaucum*), the fourth most important cereal crop, is a popular crop in India as it is tolerant to heat and drought and can grow well on soil with low fertility. Pearl millet is a staple food in many parts of India and among people living in other countries with desert land and little rainfall. It is an excellent source of energy and vitamins & minerals are important for nutritional security. The world's hardest warm-season cereal crop is pearl millet. (Reddy *et al.*, 2012) ^[12]. In India, pearl millet is grown over an area of 7.55 Mha with an annual production of 9.22 Mt and productivity of 1221 kg ha. (Anonymous 2022-23a) ^[13]. The major pearl millet growing states are Rajasthan, Maharashtra, Uttar Pradesh, Gujarat and Haryana contributing to 90% of total production in the country. About 45% of the total comes from Rajasthan, which is followed by Tamil Nadu (2%), Maharashtra (6%) Haryana (9%), Uttar Pradesh (19%), and Gujarat (9%). The crop covered around 45.54 lakh hectares in Rajasthan and produced 58.90 lakh tonnes with a productivity of 1296 kg/ha. (Anonymous 2023) ^[14]. India grows most pearl millet during the rainy (kharif) season, which runs from June/July to September/October. In some areas of Gujarat, Rajasthan, and Uttar Pradesh, pearl millet is also grown in the summer (February–May); in Maharashtra and Gujarat, it is grown on a modest scale in the post-rainy (rabi) season (November–February). Indiscriminate use of high analysis chemical fertilizers results in the deficiency of secondary and micronutrient in soil also make it hard and compact thus reduces water holding capacity of soil too. At this critical juncture, there is an urgent need to optimize nutrient demand to sustain crop production without affecting soil health with protection environment. It has been observed that the prolonged application of FYM makes nutrients available gradually and synchronize with the need of crops.

FYM plays a critical role in availability of various essential nutrients to plants by enhancing the microbial population and their activities in the soil. (Tomar *et al.*, 2023) ^[13]. Bio-mix are commonly called microbial consortia which are capable of mobilizing important nutritional elements in the soil from non-usable to usable form by the crop plants through their biological processes. Drought induced losses in crop yield probably exceed losses from all other causes, since both the severity and duration of the stress are critical. Various management strategies have been proposed to cope up with drought stress. Using various chemicals to pre-sowing seed priming enhances seed viability, vigor, root length, root-shoot ratio, and yield. Chemicals like ABA, SA and KNO₃ at variable concentrations promote germination of seeds, improve seedling growth, activity of various hydrolases, solubilisation and mobilization of nitrogen from cotyledons to growing embryo, rate of water uptake, resulting in improvement of nitrate content and enhanced yield in various crops ((Hayat *et al.*, 2010 and Anju *et al.*, 2019) ^[6, 1].

Materials & Methods

A field experiment was conducted during rainy (*khari*) seasons of 2022 and 2023 at Agronomy Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan to study the “Nitrogen and Drought management in Pearl millet for Sustainable Productivity and Profitability under Rainfed condition of Rajasthan”. The experimental site was located at 26°51'2" N latitude and 75°47'2" E longitude and at an altitude of 390 m above mean sea level. The mean maximum temperature was 34.9 °C, 34.7 °C and minimum temperature was 21.6 °C, 18.7 °C and total rainfall was 725.2 mm and 604.7 mm during the crop period in the year 2022 and 2023, respectively. Well-drained loamy sand and coarse in texture soil was found at the experimental site. It was low in organic carbon (0.323%) and available nitrogen (140.0 kg/ha), medium in available phosphorus (29.7 kg/ha) and available potash (267.0 kg/ha) with pH 8.05 and EC 0.09 dS m⁻¹. DTPA extractable Zn and Fe was 0.54 and 2.98 ppm. The experiment was laid out in split plot design with 3 replications and 16 treatment combinations. First factor, 4 treatments of bio-organics, viz. F₀: Control, F₁: FYM + bio-mix, F₂: vermicompost + bio-mix and F₃: poultry manure + bio-mix and second factor, 4 treatments of seed priming, viz. P₀: control (water), P₁: potassium nitrate @ 0.5%, P₂: salicylic acid @ 200 ppm and P₃: abscisic acid 150 ppm. Bio-mix are microbial bio-fertilizer consortia (consisting of *Azotobacter*, *Azospirillum* and phosphate solubilizing bacteria) commercially branded as Bio-mix, convert nutrients present in the soil and in the manure to a form which can easily be absorbed by plants. The experiment was taken on the fixed site continuously for the two years. Certified seeds of pearl millet variety RHB -234 were used for sowing. The seeds were sown manually 2-3 cm deep after seed priming in previously opened furrows as per the treatments with a recommended seed rate of 4.0 kg /ha. In organic plots whole RDF was applied through FYM, Vermicompost and poultry manure after calculating the concentration of nutrients present in them. For applying 100% RDN per hectare through FYM, 12.5 tons of well decomposed FYM., having 0.48, 0.23, 0.49% NPK was applied in the plots before sowing and mixed well, 3 tons of vermicompost having 2.0, 1.4, 0.90% NPK was applied for 100%, in the plots Likewise, 2 tons of poultry manure having 3.0, 2.60, 1.4% NPK was applied for 100%, in the plots before sowing. In both the year crop was sown in second week of July and harvested in first week of October. For working out the economics, prevailing market prices for grain and stover and other inputs were

considered. The data were statistically analyzed and both years results are presented.

Result and Discussion

Growth and Growth indices: All the growth and growth indices viz., Dry matter accumulation, leaf area, leaf area index, crop growth, relative growth rate and leaf area duration and no. total of tillers per meter row length were significantly influenced by bio-organics and seed priming (Table 1 & 2 and Fig. 1 & 2). Results revealed that significantly higher dry matter accumulation/plants, leaf area/plant, leaf area index and no. of total tillers/meter row length were found under treatment F₃: poultry manure + Biomix which was being at par with vermicompost + bio-mix. Likewise, CGR, RGR and LAD were significantly higher under treatment F₃ and it remained at par with F₂. Organic manures along with bio- mix had significant favourable effects on soil physical, chemical and biological properties which directly or indirectly influence the plant growth and growth indices characters by increasing the water holding capacity of soil, increasing organic carbon, enhancing microbial activity in the soil which is resulted into more availability of nutrients by solubilizing or mobilizing the fixed pool of nutrients in the soil. Results were also in close conformity with those found by Ankit *et al.* (2019) ^[2] and Kumar *et al.* (2022) ^[7]. The seed priming with P₃: abscisic acid @150 ppm was obtained significantly maximum dry matter accumulation/plants, leaf area/plant, leaf area index and no. of total tillers/ meter row length and being similar with P₂: salicylic acid @ 200 ppm where is CGR, RGR and LAD were significantly higher under treatment P₃ and it remained at par with P₂. The photosynthetic rate may have increased as a result, which in turn may have increased the plants' supply of carbohydrates. This, in turn, may have enhanced the plants' vertical and lateral growth, improving their leaf area and dry matter accumulation, which in turn produced an increase in the leaf area index and other growth indices. These results also corroborate with the findings of Niranjana Raj *et al.* (2007) ^[10] and Balaji *et al.* (2019) ^[5]. Yield attributes and yield: viz., no. of effective tillers/ meter row length, length of ear head, girth of ear head, no. of grains/ear head, grain, stover and biological yield/ plot of pearl millet were also significantly influenced by the different bio-organic treatments and seed priming (Table 2 & 3 and Fig. 3). Among the different treatments tried, application of poultry manure+ bio-mix and Vermicompost + bio-mix (F₃ and F₂) recorded highest no. of effective tillers (29 and 27 /meter row length in pooled data), length of ear head (32.73 & 31. 14 cm in 2022 and 28.83 & 27. 43 cm in 2023), girth of ear head (28.85 and 30.15 mm in pooled data), no. of grains/earhead (2227 & 2158 in 2022 and 1985 & 1899 in 2023), grain (2403 & 2331 g in pooled data), stover (5627 & 5383 g in pooled data) and biological yield (8112 & 7714 g/ plot in pooled data) over rest of the treatments. The increased translocation of photosynthates towards sink development may have been caused by the beneficial effects of organic manures, which are essential for root development, energy translocation, and plant metabolic processes. The fact that proper decomposition and mineralization of organic manures due to increased microbial activity resulted in an increased supply of available P and N with other essential plant nutrients directly to the plant as well as solubility effects on fixed form of P could be the cause of the beneficial effect of combined use of organic manures (poultry manure or vermicompost) and Biomix on grain and stover yields. (Patel *et al.* (2014) ^[11]. These findings are in close agreement with those reported by Meena *et al.* (2017) ^[8] and Yadav *et al.* (2023) ^[14].

Various seed priming treatments, seed priming with abscisic acid @ 150 ppm was showed significantly maximum no. of effective tillers (25 / meter row length in pooled data) length of ear head (30.65 & 27.50 & 26.80 cm in 2022, 2023), girth of ear head (28.85 mm in pooled data), no. of grains/ear head (2198 & 2150 in 2022 and 1965 & 1934 in 2023), grain (2290 & 2229 g/ plot in pooled data), stover (5356 & 5318 g/ plot in pooled data) and biological yield (7707 & 7617 g/ plot in pooled data) over control and was statistically at par with salicylic acid @ 200 ppm during both the years. It was also found that with sufficient moisture in the plant and soil, plant nutrients particularly N, P and K were more available and might have translocated to produce more dry matter. Secondly, higher yield with no moisture stress might be due to its key role in root

development by reducing mechanical resistance of soil, higher transpiration, greater nutrient uptake and more photosynthesis due to metabolic activities in the plant. The results are also in cognizance with those of (Menaka *et al.* 2008) [9].

Conclusion

Based on the results of present investigation, it is concluded that long term application of poultry manure @ t/ha with Bio-mix @ 2l/ha and seed priming with abscisic acid @ 150 ppm or salicylic acid @ 200 pmm treatments can be prevent nitrogen deficiency and drought management and produce economically higher grain (2484 g/plot) and stover (5627 g/plot), biological (8412 g /plot) yield and with highest net returns (63.6 Rs/plot).

Table 1: Effect of bio-organics and seed priming on leaf area index and CGR (g/m²/day) of pearl millet

Treatments	Leaf area index						CGR (g/m ² /day)			
	30 DAS		60 DAS		At harvest		30-60 DAS	60 DAS	At harvest	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
Bio-organics										
F ₀ : Control	2.14	2.08	3.68	3.47	2.32	2.24	26.61	23.56	7.21	8.41
F ₁ : FYM + Bio-mix	2.35	2.31	4.12	4.04	2.51	2.45	30.16	28.15	19.16	20.08
F ₂ : Vermi-compost + Bio-mix	2.39	2.35	4.45	4.29	2.65	2.59	34.39	34.69	23.84	20.00
F ₃ : Poultry manure + Bio-mix	2.45	2.38	4.54	4.35	2.81	2.71	34.70	34.92	28.67	23.80
SEm±	0.06	0.05	0.09	0.09	0.09	0.09	0.76	0.63	0.44	0.25
CD (P=0.05)	0.20	0.17	0.30	0.27	0.32	0.30	2.64	2.19	1.52	0.86
Seed priming										
P ₀ : Control (water)	2.23	2.15	3.98	3.88	2.40	2.22	25.36	22.82	11.88	11.67
P ₁ : Potassium nitrate (0.5%)	2.34	2.30	4.11	3.94	2.54	2.47	32.66	32.24	20.69	18.76
P ₂ : Salicylic acid (200 ppm)	2.36	2.32	4.31	4.14	2.62	2.63	33.67	32.87	23.40	20.81
P ₃ : Absciscic acid (150 ppm)	2.39	2.35	4.38	4.19	2.72	2.68	34.18	33.38	22.92	21.05
SEm±	0.03	0.03	0.03	0.04	0.05	0.04	0.73	0.60	0.30	0.22
CD (P=0.05)	0.09	0.09	0.10	0.10	0.15	0.12	2.12	1.76	0.86	0.63

Table 2: Effect of bio-organics and seed priming on RGR (mg/g/day), LAD (days), length of ear head (cm) and no. of grain/ ear head of pearl millet

Treatments	RGR (mg/g/day)		LAD (days)		Length of ear head (cm)		No. of grain / ear head	
	30- 60 DAS		60 DAS- At harvest		60 DAS - At harvest		At harvest	
	2022	2023	2022	2023	2022	2023	2022	2023
Bio-organics								
F ₀ : Control	15.58	15.85	1.51	2.02	57.29	54.14	26.85	25.89
F ₁ : FYM + Bio-mix	16.08	16.35	3.26	3.69	64.08	62.85	29.24	28.50
F ₂ : Vermi-compost + Bio-mix	16.47	17.45	3.52	3.06	69.11	66.66	30.93	30.23
F ₃ : Poultry manure + Bio-mix	16.18	17.30	4.08	3.54	70.60	67.69	32.64	31.48
SEm±	0.35	0.35	0.07	0.06	1.55	1.48	0.95	0.90
CD (P=0.05)	NS	1.22	0.23	0.22	5.37	5.13	3.28	3.12
Seed priming								
P ₀ : Control (water)	16.01	15.36	2.48	2.72	61.95	60.37	28.01	26.05
P ₁ : Potassium nitrate (0.5%)	16.08	17.28	3.16	3.05	64.01	61.36	29.47	28.63
P ₂ : Salicylic acid (200 ppm)	15.98	17.21	3.42	3.29	66.97	64.36	30.56	30.44
P ₃ : Absciscic acid (150 ppm)	16.03	17.11	3.31	3.26	68.15	65.26	31.63	30.98
SEm±	0.24	0.24	0.06	0.06	0.96	0.89	0.76	0.72
CD (P=0.05)	NS	0.71	0.17	0.17	2.79	2.61	2.20	2.10

Table 3: Effect of bio-organics and seed priming on grain (g/plot), stover (g/plot) and biological yield (g/plot) and net returns (₹/plot) of pearl millet

Treatments	Grain yield			Stover yield			Biological yield			Net returns (₹)	
	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled	2022	2023
Bio-organics											
F ₀ : Control	1536	1458	1498	3874	3570	3722	5510	5128	5319	33.0	35.7
F ₁ : FYM + Bio-mix	1986	1838	1912	4693	4458	4576	6774	6326	6550	45.6	46.6
F ₂ : Vermi-compost + Bio-mix	2413	2248	2331	5578	5188	5383	7991	7436	7714	56.1	58.7
F ₃ : Poultry manure + Bio-mix	2565	2403	2484	5762	5493	5627	8327	7896	8112	60.0	63.6
SEm±	59.73	82.45	67.97	122.5	182.21	109.79	179.79	262.13	158.9	1.72	2.68

CD (P=0.05)	206.7	285.33	246.47	424.0	630.52	338.30	622.15	907.10	789.7	5.96	9.29
Seed priming											
P ₀ : Control (water)	1607	1492	1550	3952	3628	3790	5659	5171	5415	34.8	35.5
P ₁ : Potassium nitrate (0.5%)	2002	1880	1914	5042	4645	4843	7251	6660	6955	49.7	50.9
P ₂ : Salicylic acid (200 ppm)	2368	2229	2299	5434	5202	5318	7802	7432	7617	54.6	58.3
P ₃ : Absciscic acid (150 ppm)	2412	2290	2351	5479	5237	5356	7891	7524	7707	55.7	59.9
SEm _±	43.02	49.99	44.02	92.91	97.64	67.39	131.29	144.63	97.96	1.23	1.56
CD (P=0.05)	125.56	145.91	133.5	271.20	285.0	191.62	383.22	422.14	277.71	3.60	4.56

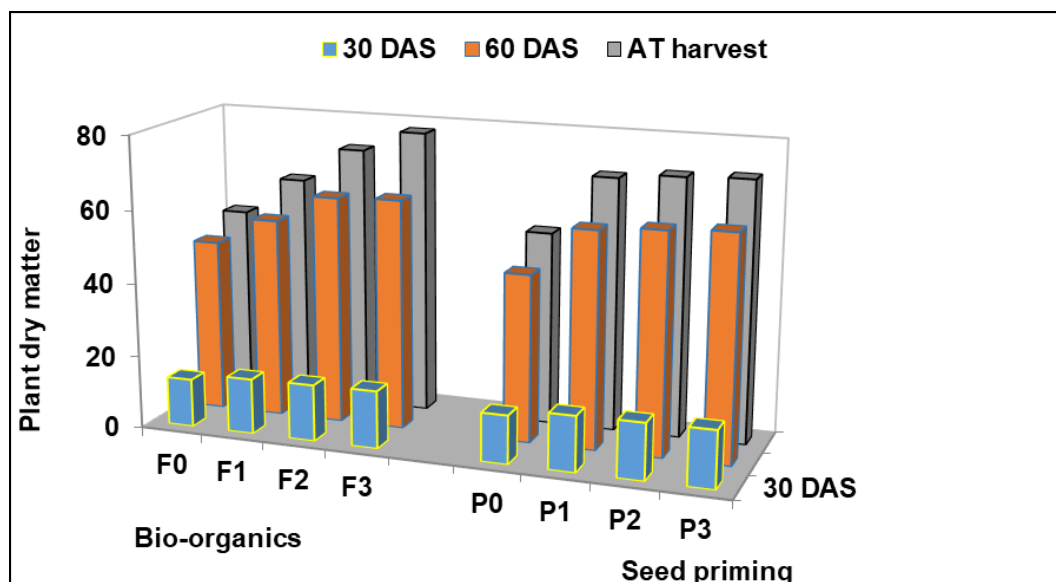


Fig 1: Effect of bio-organics and seed priming on dry matter accumulation of pearl millet

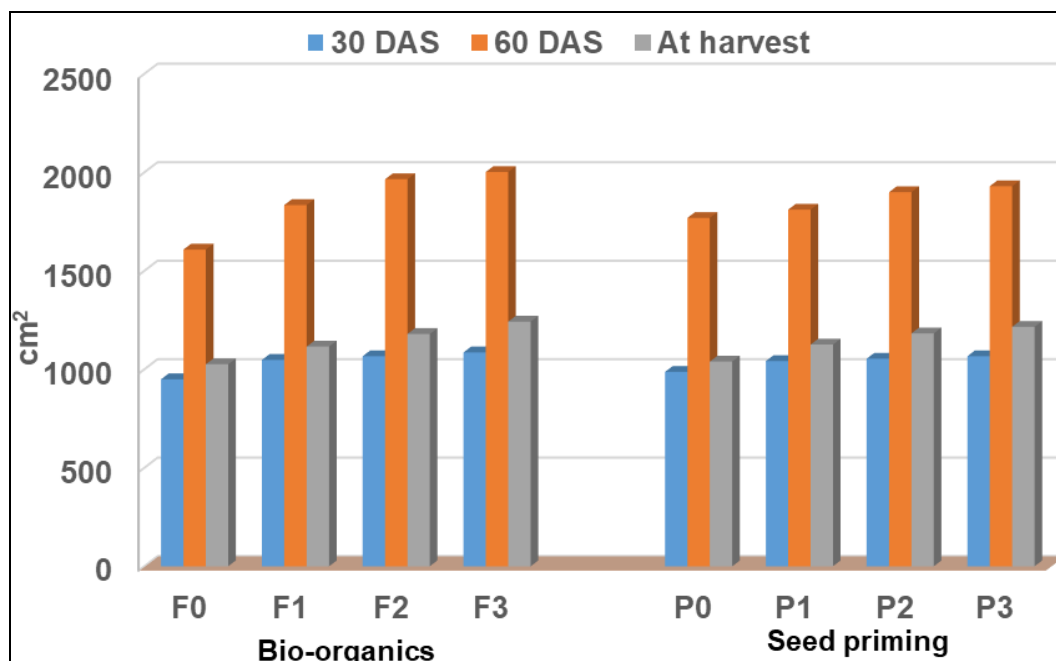


Fig 2: Effect of bio-organics and seed priming on leaf area of pearl millet

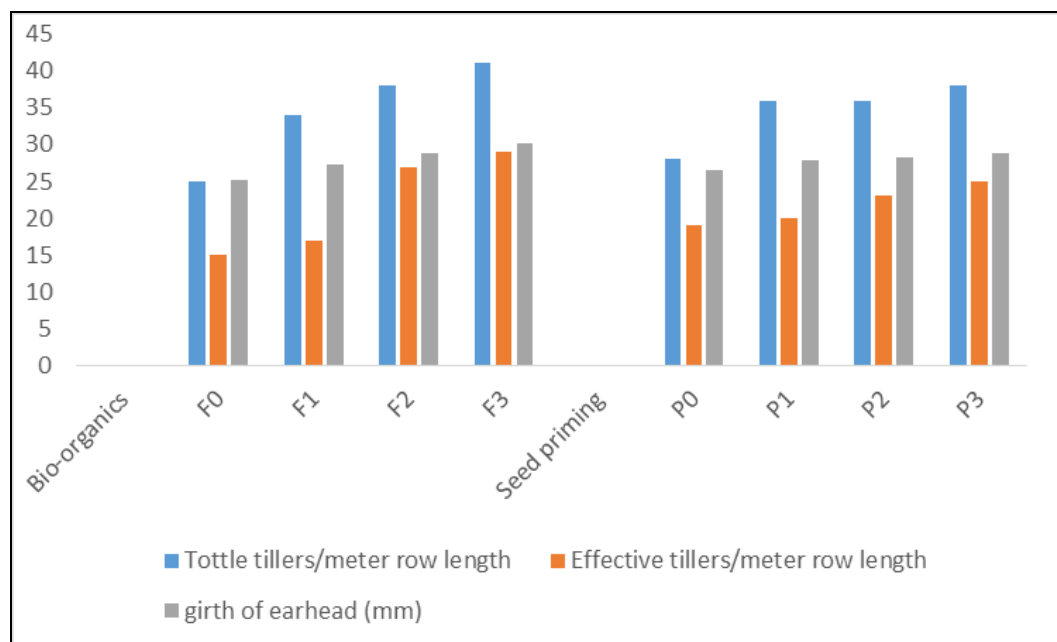


Fig 3: Effect of bio-organics and seed priming on total no. of tillers/meter row length, no. of effective tillers /meter row length and girth of earhead (mm) of pearl millet

Reference

- Anju UL, Doddagoudar SR, Pattanashetti SK, Gowda B, Vijaykumar K. Influence of seed priming on seed germination, seedling growth, peroxidase activity, proline and total soluble sugar content of pearl millet (*Pennisetum glaucum* L.) under salinity stress. *Int J Chem Stud*. 2019;7(5):508-514.
- Ankit, Singh K, Kaur J, Gandhi N. Effect of azotobacter, FYM (Farmyard manure) and PSB (Phosphorus solubilizing bacteria) on the yield and yield attributing characters on pearl millet (*Pennisetum glaucum*). *J Pharmacogn Phytochem*. 2019;8(1):505-507.
- Anonymous. Final estimation of Directorate of Economic and Statistics Government of India. 2022-2023a.
- Anonymous. Board of Revenue, Rajasthan. 2023.
- Balaji DS, Narayana GS. Effect of various bio priming seed enhancement treatment on seed quality in certain minor millets. *Plant Arch*. 2019;19(1):1727-1732.
- Hayat Q, Hayat S, Irfan M, Ahmad A. Effect of exogenous salicylic acid under changing environment: A review. *Environ Exp Bot*. 2010;68:14-25.
- Kumar P, Kumar S, Singh R, Singh GP, Singh AK. Effect of nutrient management and moisture conservation practice on roots and yield attributes of Pearl millet (*Pennisetum glaucum* L.) under light textured soil. *The Pharma Innovation J*. 2022;11(5):385-388.
- Meena R, Maurya SK, Meena RK. Effect of mulching and organic sources on growth parameters and yield of pearl millet (*Pennisetum glaucum* L.) crop under rainfed area of vindhyan region, India. *J Pure Appl Microbiol*. 2017;9(2):351-355.
- Menaka C, Vanangamudi K, Renganayaki PR, Lakshmi S. Seed hardening and pelleting to increase the productivity of pearl millet under rain fed condition. *Res Crops*. 2008;9(3):704-706.
- Niranjana Raj S, Shetty NP, Shetty HS. Seed bio-priming with *Pseudomonas fluorescens* isolates enhances growth of pearl millet plants and induces resistance against downy mildew. *Int J Pest Manag*. 2007;50(1):41-48.
- Patel PR, Patel BJ, Vyas KG, Yadav BG. Effect of integrated nitrogen management and bio-fertilizer in kharif pearl millet (*Pennisetum glaucum* L.). *Adv Res J Crop Improv*. 2014;5(2):122-125.
- Reddy AA, Malik D, Singh IP, Ardeshta NJ, Kundu KK, Rao P, et al. Demand and supply for pearl millet grain and fodder by 2020 in Western India. *ASI*; 2012. 635 p.
- Tomar A, Trivedi SK, Sharma SK, Singh S. Effect of integrated nutrient management on plant growth parameters and yield of pearl millet (*Pennisetum glaucum* L.) in alluvial soil of Gird region of Madhya Pradesh. *Biol Forum - An Int J*. 2023;15(7):253-255.
- Yadav SL, Sharma GK, Yadav SS, Trivedi SK, Khambalkar PA, Jat R. Long-term effect of organic and chemical sources of nutrients on yield and economics of pearl millet in inceptisols of gird region of Madhya Pradesh. *Biol Forum - An Int J*. 2023;15(2):267-270.