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# INFLUENCE OF IRON AND ZINC FORTIFICATION AND FARMYARD MANURE ON GROWTH, YIELD ATTRIBUTES AND YIELD OF PEARL MILLET (*Pennisetum glaucum* L. R. Br. emend stuntz)

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**ABSTRACT**

A field experiment on pearl millet was conducted during *Kharif* 2023, 2024 at the Instructional Farm, SKNCOA, SKNAU, Jobner (Rajasthan) revealed that FYM @ 12.0 t $ha^{-1}$ ($M_3$) significantly improved plant height at 60 DAS (160.60, 161.98 and 161.29 cm) and at harvest (179.10, 179.71 and 179.40 cm), length of ear head (25.97, 26.39 and 26.18 cm), grain weight per ear head (10.38, 10.75 and 10.56 g) and grain yield (2650, 2655 and 2653 kg $ha^{-1}$), while among micronutrient treatments, soil application of $FeSO_4$ and $ZnSO_4$ @ 25 kg $ha^{-1}$ each followed by foliar spray ($F_3$) recorded higher plant height at 60 DAS (155.25, 155.50 and 155.38 cm) and at harvest (173.48, 173.82 and 173.65 cm), length of ear head (25.60, 25.43 and 25.51 cm), grain weight per ear head (9.99, 10.28 and 10.13 g) and grain yield (2544, 2548 and 2546 kg $ha^{-1}$) during 2023, 2024 and pooled analysis, respectively, under semi-arid conditions of Rajasthan.

***Keywords*** **:** Pearl millet, Farmyard manure (FYM), Iron and Zinc sulphate ($FeSO_4$, $ZnSO_4$), Grain yield, Growth parameters.

## Introduction

Pearl millet (*Pennisetum glaucum* (L.) R. Br. emend Stuntz) is an important warm-season cereal crop widely cultivated in arid and semi-arid regions due to its remarkable tolerance to drought, high temperature and poor soil fertility. It ranks sixth among major cereals globally and holds a significant position in India as the fourth most important cereal after rice, wheat and sorghum (Jain *et al.*, 2018; Prasad *et al.*, 2015; Singh *et al.*, 2017). Its adaptability to marginal lands and rainfed conditions makes it a key crop for ensuring food and nutritional security in resource-constrained regions. Pearl millet is also nutritionally rich, containing appreciable amounts of protein, dietary fiber and essential micronutrients such as iron (Fe) and zinc (Zn), along with a balanced amino acid profile (Manga and Kumar, 2011). Due to these advantages, it has been recognized as a “Nutri-cereal” and promoted through national and global initiatives, including the International Year of Millets (Chaudhary *et al.*, 2024). Despite its importance, the productivity of pearl millet remains below its potential, particularly in rainfed areas where erratic rainfall and poor soil fertility limit crop performance. Among the major constraints, micronutrient deficiencies especially of zinc and iron play a critical role in reducing yield and grain quality. Zinc is essential for enzyme activation, protein synthesis and growth regulation, while iron is vital for chlorophyll formation and metabolic processes (Solanki *et al.*, 2016; Kumar *et al.*, 2019). Deficiency of these nutrients not only affects plant growth but also contributes to micronutrient malnutrition in humans, as cereal-based diets dominate in many developing regions. Integrated nutrient management, involving the combined use of organic and inorganic sources, offers a sustainable strategy to improve soil fertility and crop productivity. Farmyard manure (FYM) enhances soil physical, chemical and biological properties, improves water-holding capacity and supports microbial activity, while soil and foliar application of micronutrients improves nutrient use efficiency and crop performance (Jhansi *et al.*, 2023). Furthermore, beneficial soil microorganisms such as plant growth-promoting rhizobacteria enhance nutrient availability; zinc-solubilizing bacteria increase zinc availability and siderophore-producing microbes facilitate iron uptake. Therefore, integrating micronutrient fertilization with organic amendments and microbial interventions is essential for improving the productivity and nutritional quality of pearl millet under semi-arid conditions.

## Material and Methods

The present investigation was conducted at the Instructional Agronomy Farm of SKN College of Agriculture, SKN Agriculture University (SKNAU), Jobner (Rajasthan) during the kharif seasons of 2023, 2024 and pooled analysis. The soil of the experimental field was loamy sand in texture, slightly alkaline in reaction (pH 8.08), low in organic carbon (0.21 g $kg^{-1}$) and available nitrogen (127.45 kg $ha^{-1}$), medium in available phosphorus (21.00 kg $ha^{-1}$) and potassium (144.88 kg $ha^{-1}$) and deficient in micronutrients like zinc (0.59 mg $kg^{-1}$) and iron (3.74 mg $kg^{-1}$). The experiment was laid out in a split plot design with three replications, comprising 24 treatment combinations (4 × 6) with a total of 72 plots. The main plot treatments included four levels of farmyard manure (FYM) viz., control ($M_0$), FYM @ 4.0 t $ha^{-1}$ ($M_1$), FYM @ 8.0 t $ha^{-1}$ ($M_2$) and FYM @ 12.0 t $ha^{-1}$ ($M_3$), while sub plot treatments consisted of six methods of Fe and Zn application viz., control ($F_0$), soil application of $FeSO_4$ @ 25 kg/ha and $ZnSO_4$ @ 25 kg/ha ($F_1$), foliar spray of FeSO4 @ 0.5% + ZnSO4 @ 0.5% at 25 and 40 DAS ($F_2$), soil application of $FeSO_4$ @ 25.0 kg/ha and $ZnSO_4$ @ 25.0 kg/ha followed by foliar spray of $FeSO_4$ @ 0.5% + $ZnSO_4$ @ 0.5% at 25 and 40 DAS ($F_3$), soil application of $FeSO_4$ @ 25.0 kg/ha and $ZnSO_4$ @ 25.0 kg/ha + Fe and Zn solubilizing microbes each @ 500 g/ha ($F_4$) and soil application of $FeSO_4$ @ 25.0 kg/ha and $ZnSo_4$ @ 25.0 kg/ha + Fe and Zn solubilizing microbes each @ 500 g/ha followed by foliar spray of $FeSO_4$ @ 0.5% + $ZnSO_4$ @ 0.5% at 25 and 40 DAS ($F_5$). The gross plot size was 3.6 m × 4.0 m (14.4 $m^2$) and net plot size was 2.7 m × 3.0 m (8.1 $m^2$). Pearl millet variety RHB-223 was sown at a seed rate of 4.0 kg $ha^{-1}$ with crop geometry of 45 cm × 10 cm spacing. A recommended dose of fertilizers (60:30:20 kg N:P:K $ha^{-1}$) was applied uniformly to all plots, with half nitrogen and full phosphorus and potassium applied as basal and the remaining nitrogen top dressed at 25–30 DAS. FYM was incorporated 21 days before sowing, while Fe and Zn were applied through soil and foliar methods as per treatments. The crop was grown under rainfed conditions following standard agronomic practices. Observations on plant height were recorded from five randomly selected and tagged plants at 30 DAS, 60 DAS and at harvest, while yield attributes such as length of ear head and grain weight per ear head were recorded from five samples per plot at harvest. Grain yield was recorded from net plot produce after threshing, cleaning and drying and expressed in kg $ha^{-1}$. The data were analyzed using analysis of variance (ANOVA).

## Results and Discussion

### Effect of FYM levels on growth, yield attributes and yield parameters of pearl millet

#### Plant height (cm)

Plant height at 30 DAS did not differ significantly due to varying FYM levels during both years. However, a marked and statistically significant increase in plant height was observed at 60 DAS and at harvest with increasing levels of FYM. The application of FYM @ 12.0 t $ha^{-1}$ ($M_3$) recorded the maximum plant height at 60 DAS (160.60, 161.98 and 161.29 cm) and at harvest (179.10, 179.71 and 179.40 cm) during 2023, 2024 and pooled analysis, respectively, which was significantly superior to FYM @ 8.0 t $ha^{-1}$ ($M_2$), FYM @ 4.0 t $ha^{-1}$ ($M_1$) and control ($M_0$). Further, the highest level of FYM ($M_3$) resulted in an increase in plant height of 30.95, 31.36 and 31.15 per cent at 60 DAS and 32.55, 31.41 and 31.97 per cent at harvest over control during 2023, 2024 and pooled analysis, respectively. The significant increase in plant height with higher levels of FYM during both 2023, 2024 and pooled analysis may be attributed to improvement in soil physical, chemical and biological properties. Application of FYM enhances soil structure, aeration and water holding capacity, which facilitates better root growth and nutrient absorption. FYM also acts as a source of both macro and micronutrients and ensures their gradual release through microbial decomposition. This continuous nutrient supply might have improved cell division and elongation, resulting in increased plant height. Similar findings were reported by Jain *et al.* (2018), Thakur *et al.* (2011), Brar *et al.* (2015) and Kumar *et al.* (2024).

#### Length of ear head (cm)

Different levels of FYM significantly influenced the length of ear head of pearl millet during 2023, 2024 and pooled analysis. The maximum length of ear head was recorded with the application of FYM @ 12.0 t $ha^{-1}$ ($M_3$), registering values of 25.97 cm, 26.39 cm and 26.18 cm during 2023 and 2024, respectively. This treatment was found significantly superior to all other FYM levels as well as control. The increase in length of ear head under $M_3$ was to the extent of 25.88, 25.97 and 25.93 per cent over control during 2023, 2024 and pooled analysis, respectively. The increase in length of ear head under higher FYM levels due to improved nutrient availability and efficient translocation of assimilates towards reproductive organs. FYM enhances microbial activity and nutrient mineralization, which supports better growth and development of ear heads. The improved physiological condition of plants under adequate nutrient supply might have promoted reproductive growth, resulting in longer ear heads. These findings are in accordance with earlier reports of Thakur *et al.* (2011), Brar *et al.* (2015), Kumar *et al.* (2024) and Singh *et al.* (2024).

**Grain weight per ear head (g)**

Application of different levels of FYM significantly enhanced the grain weight per ear head of pearl millet during both the years of study. The highest grain weight per ear head was recorded with FYM @ 12.0 t $ha^{-1}$ ($M_3$), registering values of 10.38 g, 10.75 g and 10.56 g during 2023, 2024 and pooled analysis, respectively, which was significantly superior to FYM @ 8.0 t $ha^{-1}$ ($M_2$), FYM @ 4.0 t $ha^{-1}$ ($M_1$) and control ($M_0$). The increase in grain weight per ear head under $M_3$ was found to be 28.15, 29.83 and 28.94 per cent over control during 2023, 2024 and pooled, respectively. Higher grain weight per ear head observed with FYM may be attributed to better grain filling due to improved availability of nutrients throughout the crop growth period. FYM facilitates balanced nutrition and enhances metabolic activities, leading to increased synthesis and translocation of photosynthates towards developing grains. The improved soil environment and nutrient uptake might have resulted in efficient grain development and higher grain weight. Similar results were also reported by Jain *et al.* (2018), Kumar *et al.* (2024) and Singh *et al.* (2024).

**Grain yield (kg $ha^{-1}$)**

Different levels of FYM significantly influenced the grain yield of pearl millet during both years of study. The highest grain yield was recorded with the application of FYM @ 12.0 t $ha^{-1}$ ($M_3$), registering 2650, 2655 and 2653 kg $ha^{-1}$ during 2023, 2024 and pooled analysis, respectively, which was significantly superior to FYM @ 8.0 t $ha^{-1}$ ($M_2$) (2425, 2431 and 2428 kg $ha^{-1}$), FYM @ 4.0 t $ha^{-1}$ ($M_1$) (2204, 2209 and 2207 kg $ha^{-1}$) and control ($M_0$) (1982, 1984 and 1983 kg $ha^{-1}$). The increase in grain yield under $M_3$ was found to be 33.70, 33.82 and 33.79 per cent higher over control during 2023, 2024 and pooled analysis, respectively. The significant increase in grain yield with higher levels of FYM attributed to the combined effect of improved growth parameters and yield attributes. FYM improves soil fertility by increasing organic carbon content, enhancing microbial activity and improving nutrient availability. The continuous release of nutrients during decomposition ensures better plant growth, higher biomass production and improved source-sink relationship. Enhanced vegetative growth under FYM application might have increased photosynthetic activity and carbohydrate accumulation, leading to higher grain yield. Moreover, improved soil moisture retention and nutrient use efficiency might have further contributed to yield enhancement. These findings are in agreement with the reports of Jain *et al.* (2018), Thakur *et al.* (2011), Brar *et al.* (2015), Kumar *et al.* (2024) and Singh *et al.* (2024) and Seema *et al*. (2025).

**Effect of methods of application and levels of Fe and Zn on growth, yield attributes and yield of pearl millet**

**Plant height (cm)**

Different methods of application and levels of Fe and Zn did not exert a significant effect on plant height at 30 DAS during both years of experimentation. However, a significant increase in plant height was observed at 60 DAS and at harvest. The maximum plant height at 60 DAS (155.25, 155.50 and 155.38 cm) and at harvest (173.48, 173.82 and 173.65 cm) during 2023, 2024 and pooled analysis, respectively, was recorded with soil application of $FeSO_4$ @ 25 kg $ha^{-1}$ and $ZnSO_4$ @ 25 kg $ha^{-1}$ followed by foliar spray of $FeSO_4$ 0.5% + $ZnSO_4$ 0.5% at 25 and 40 DAS ($F_3$), which remained at par with $F_5$ and was significantly superior to $F_4$, $F_2$, $F_1$ and control ($F_0$). The treatment $F_3$ resulted in an increase in plant height of 27.54, 26.60 and 27.07 per cent at 60 DAS and 28.91, 28.72 and 28.82 per cent at harvest over control during 2023, 2024 and pooled analysis, respectively. Zinc plays an important role in auxin synthesis and enzyme activation, thereby promoting cell division and elongation, while iron is involved in chlorophyll synthesis and electron transport system. The improved physiological processes and enhanced photosynthetic efficiency under adequate supply of Fe and Zn might have resulted in increased vegetative growth and plant height. Similar findings were reported by Arabhanvi and Hulihalli (2017), Borase *et al.* (2018), Ram *et al.*

(2021), Reddy *et al.* (2023), Reema *et al.* (2023) and Yadav *et al* (2025).

**Length of ear head (cm)**

Different methods of application and levels of Fe and Zn significantly influenced the length of ear head of pearl millet during both years of study. The maximum the length of ear head was recorded with soil application of $FeSO_4$ @ 25 kg $ha^{-1}$ and $ZnSO_4$ @ 25 kg $ha^{-1}$ followed by foliar spray of $FeSO_4$ 0.5% + $ZnSO_4$ 0.5% at 25 and 40 DAS ($F_3$), registering values of 25.60 cm, 25.43 cm and 25.51 cm during 2023, 2024 and pooled analysis, respectively. This treatment was found to be at par with $F_5$ (soil application along with Fe and Zn solubilizing microbes followed by foliar spray) and significantly superior to the remaining treatments. The increase in the length of ear head under $F_3$ was observed to be 27.43, 24.29 and 25.85 per cent over control during 2023, 2024 and pooled analysis, respectively. Zinc is known to play a vital role in reproductive development and synthesis of growth hormones, while iron enhances metabolic activities and energy transfer processes. The combined application of Fe and Zn might have improved the development of reproductive organs, resulting in longer ear heads. The synergistic effect of these micronutrients likely enhanced assimilate partitioning towards sink organs, thereby improving ear head development. These results are in agreement with the findings of Arabhanvi and Hulihalli (2017), Borase *et al.* (2018), Girish *et al.* (2023), Reema *et al.* (2023) and Yadav *et al* (2025).

**Grain weight per ear head (g)**

Maximum grain weight per ear head of pearl millet was recorded with soil application of $FeSO_4$ @ 25 kg $ha^{-1}$ and $ZnSO_4$ @ 25 kg $ha^{-1}$ followed by foliar spray of $FeSO_4$ 0.5% + $ZnSO_4$ 0.5% at 25 and 40 DAS ($F_3$), registering values of 9.99 g, 10.28 g and 10.13 g during 2023, 2024 and pooled analysis, respectively. This treatment remained statistically at par with $F_5$, but was found significantly superior to the remaining treatments including $F_4$, $F_2$, $F_1$ and control ($F_0$). The improvement in grain weight per ear head under $F_3$ may be attributed to the combined effect of soil and foliar application of micronutrients, which ensured better availability and uptake of Fe and Zn during critical growth stages, thereby enhancing grain development and filling. Consequently, the increase in grain weight per ear head under $F_3$ was observed to be 26.14, 25.52 and 25.84 per cent higher over control during 2023, 2024 and pooled analysis, respectively. Increase in grain weight per ear head under the application of $FeSO_4$ and $ZnSO_4$ could be attributed to better grain filling resulting from improved availability and uptake of Fe and Zn during critical growth stages. Zinc plays a crucial role in enzyme activation and carbohydrate metabolism, while iron is involved in photosynthesis and respiration. The combined application of these nutrients might have enhanced assimilate production and its translocation towards developing grains, resulting in higher grain weight. Moreover, improved metabolic activity and nutrient utilization might have contributed to efficient grain development. Similar observations were reported by Borase *et al.* (2018) and Kuldeep *et al*. (2018), Girish *et al.* (2023), Reema *et al.* (2023) and Yadav *et al* (2025).

**Grain yield (kg $ha^{-1}$)**

Grain yield of pearl millet was significantly influenced by different methods of application and levels of Fe and Zn during both years of study. The maximum grain yield was recorded with soil application of $FeSO_4$ @ 25 kg $ha^{-1}$ and $ZnSO_4$ @ 25 kg $ha^{-1}$ followed by foliar spray of $FeSO_4$ 0.5% + $ZnSO_4$ 0.5% at 25 and 40 DAS ($F_3$), registering values of 2544, 2548 and 2546 kg $ha^{-1}$ during 2023, 2024 and pooled analysis, respectively. This treatment remained statistically at par with $F_5$ (soil application of Fe and Zn along with Fe and Zn solubilizing microbes followed by foliar spray), but was found significantly superior to $F_4$, $F_2$, $F_1$ and control ($F_0$). The increase in grain yield under $F_3$ may be attributed to improved nutrient availability and uptake, resulting in enhanced growth and better grain formation. Consequently, grain yield under $F_3$ increased by 29.93, 29.87 and 29.90 per cent over control during 2023, 2024 and pooled analysis, respectively. The combined soil and foliar application of Fe and Zn ensured a steady and readily available supply of nutrients, which enhanced physiological and biochemical processes such as photosynthesis, enzyme activity and nutrient uptake. Zinc contributes to auxin synthesis and regulation of growth processes, while iron plays a key role in chlorophyll formation and energy transfer. The improved source-sink relationship and efficient translocation of assimilates might have resulted in higher grain yield. These findings are supported by earlier reports of Veeranagappa *et al*. (2010), Paramesh *et al*. (2014), Paramesh *et al*. (2020), Anwar *et al.* (2022), Swaroop and Debbarma (2023), Girish *et al.* (2023), Reema *et al.* (2023) and Yadav *et al* (2025).

**Table 1:** Effect of farm yard manure and methods of application and levels of Fe and Zn on plant height of pearl millet

| Treatment | Plant height (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 DAS | | | 60 DAS | | | At harvest | | |
| | 2023 | 2024 | Pooled | 2023 | 2024 | Pooled | 2023 | 2024 | Pooled |
| **Main Plot (FYM)** | | | | | | | | | |
| $M_0$ | 36.50 | 36.71 | 36.61 | 122.64 | 123.31 | 122.98 | 135.12 | 136.75 | 135.94 |
| $M_1$ | 37.51 | 37.61 | 37.56 | 135.77 | 136.11 | 135.94 | 150.78 | 150.98 | 150.88 |
| $M_2$ | 37.80 | 38.10 | 37.95 | 148.27 | 149.02 | 148.64 | 165.00 | 165.18 | 165.09 |
| $M_3$ | 38.50 | 38.90 | 38.70 | 160.60 | 161.98 | 161.29 | 179.10 | 179.71 | 179.40 |
| SEm± | 0.99 | 1.04 | 0.72 | 3.56 | 3.69 | 2.56 | 4.04 | 4.04 | 2.86 |
| CD (P=0.05) | NS | NS | NS | 12.32 | 12.76 | 7.90 | 13.99 | 13.97 | 8.80 |
| CV % | 11.12 | 11.64 | 10.09 | 10.65 | 10.97 | 9.81 | 10.89 | 10.83 | 9.81 |
| **B. Sub plot (Methods of application and levels of Fe and Zn)** | | | | | | | | | |
| $F_0$ | 36.30 | 36.63 | 36.47 | 121.73 | 122.83 | 122.28 | 134.57 | 135.04 | 134.80 |
| $F_1$ | 37.39 | 37.61 | 37.50 | 140.13 | 141.13 | 140.63 | 155.69 | 156.44 | 156.06 |
| $F_2$ | 36.64 | 37.19 | 36.92 | 130.79 | 131.93 | 131.36 | 145.35 | 145.50 | 145.42 |
| $F_3$ | 38.38 | 38.39 | 38.39 | 155.25 | 155.50 | 155.38 | 173.48 | 173.82 | 173.65 |
| $F_4$ | 37.78 | 38.10 | 37.94 | 141.99 | 142.10 | 142.04 | 156.55 | 157.30 | 156.92 |
| $F_5$ | 38.98 | 39.04 | 39.01 | 161.06 | 162.11 | 161.58 | 179.38 | 180.83 | 180.11 |
| SEm± | 1.15 | 1.19 | 0.89 | 3.12 | 3.15 | 2.53 | 3.50 | 3.51 | 2.82 |
| CD (P=0.05) | NS | NS | NS | 8.93 | 9.00 | 7.12 | 10.00 | 10.04 | 7.95 |
| CV % | 10.56 | 10.92 | 9.61 | 7.63 | 7.65 | 7.01 | 7.69 | 7.69 | 7.16 |

NS = Non-significant

**Table 2:** Effect of farm yard manure and methods of application and levels of Fe and Zn on effective tillers, length of ear head and grain yield of pearl millet

| Treatment | Length of ear head (cm) | | | Grain weight/ear head (g) | | | Grain yield (kg/ha) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2023 | 2023 | Pooled | 2023 | 2024 | Pooled | 2023 | 2024 | Pooled |
| **Main Plot (FYM)** | | | | | | | | | |
| $M_0$ | 20.63 | 20.63 | 20.79 | 8.10 | 8.28 | 8.19 | 1982 | 1984 | 1983 |
| $M_1$ | 22.42 | 22.42 | 22.59 | 8.87 | 9.12 | 8.99 | 2204 | 2209 | 2207 |
| $M_2$ | 24.23 | 24.23 | 24.40 | 9.63 | 9.95 | 9.79 | 2425 | 2431 | 2428 |
| $M_3$ | 25.97 | 25.97 | 26.18 | 10.38 | 10.75 | 10.56 | 2650 | 2655 | 2653 |
| SEm± | 0.50 | 0.50 | 0.36 | 0.21 | 0.22 | 0.15 | 55 | 59 | 41 |
| CD (P=0.05) | 1.72 | 1.72 | 1.10 | 0.72 | 0.76 | 0.46 | 191 | 205 | 125 |
| CV % | 9.05 | 9.05 | 9.00 | 9.53 | 9.73 | 8.63 | 10.12 | 10.85 | 10.49 |
| **B. Sub plot (Methods of application and levels of Fe and Zn)** | | | | | | | | | |
| $F_0$ | 20.09 | 20.09 | 20.27 | 7.92 | 8.19 | 8.05 | 1958 | 1962 | 1960 |
| $F_1$ | 23.15 | 23.15 | 23.47 | 9.22 | 9.52 | 9.37 | 2266 | 2271 | 2268 |
| $F_2$ | 21.69 | 21.69 | 21.90 | 8.57 | 8.85 | 8.71 | 2105 | 2110 | 2108 |
| $F_3$ | 25.60 | 25.60 | 25.51 | 9.99 | 10.28 | 10.13 | 2544 | 2548 | 2546 |
| $F_4$ | 23.24 | 23.24 | 23.54 | 9.37 | 9.54 | 9.45 | 2360 | 2364 | 2362 |
| $F_5$ | 26.11 | 26.11 | 26.25 | 10.41 | 10.77 | 10.59 | 2659 | 2663 | 2661 |
| SEm± | 0.48 | 0.48 | 0.38 | 0.21 | 0.22 | 0.17 | 52 | 53 | 37 |
| CD (P=0.05) | 1.37 | 1.37 | 1.07 | 0.59 | 0.62 | 0.47 | 147 | 151 | 104 |
| CV % | 7.13 | 7.13 | 7.04 | 7.74 | 7.90 | 7.67 | 7.71 | 7.19 | 7.36 |

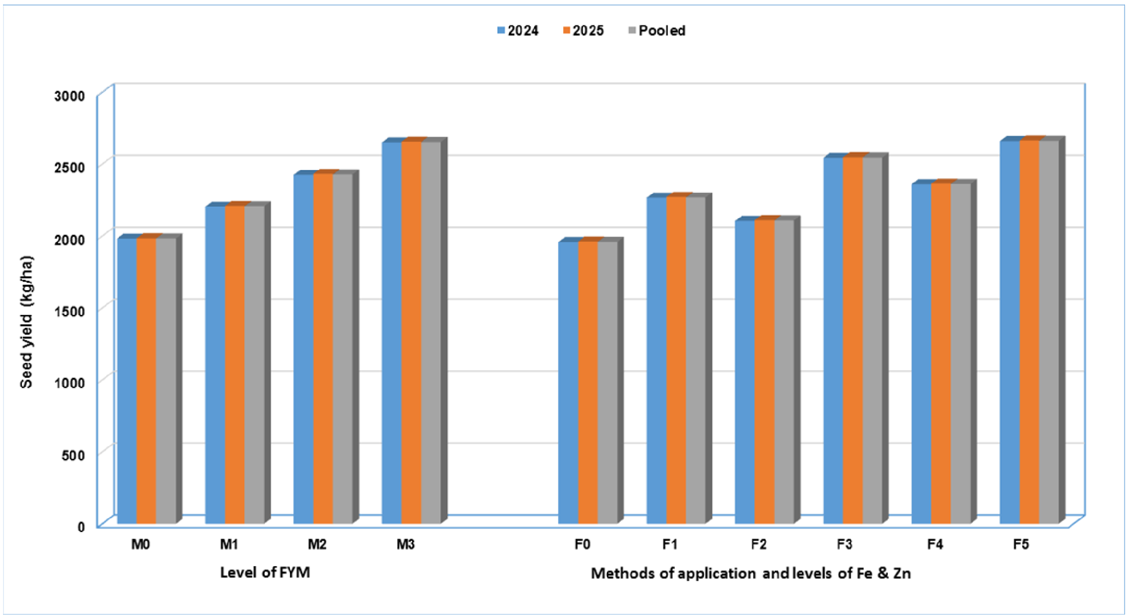


**Fig. 1:** Effect of farm yard manure and methods of application and levels of Fe and Zn on grain yield of pearl millet

## Conclusion

The study revealed that application of FYM @ 12.0 t ha$^{-1}$ ($M_3$) and soil application of $FeSO_4$ @ 25 kg ha$^{-1}$ and $ZnSO_4$ @ 25 kg ha$^{-1}$ followed by foliar spray of $FeSO_4$ 0.5% + $ZnSO_4$ 0.5% at 25 and 40 DAS ($F_3$), significantly improved growth, yield attributes and grain yield of pearl millet during 2023, 2024 and pooled analysis. The enhanced performance may be attributed to improved nutrient availability, better physiological activity and efficient assimilate translocation. Hence, combined use of FYM and micronutrients can be recommended for higher productivity and soil health under semi-arid conditions.

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