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# Effect of seed hardening, soil and foliar nutrition on yield, nutrient uptake, post-harvest soil fertility profile and economics of pearl millet under rainfed condition

**S Manibharathi, KP Senthilkumar and S Babu**


## Abstract
A field experiment entitled "Effect of seed hardening, soil and foliar nutrition on yield, nutrient uptake, post-harvest soil fertility profile and economics of pearl millet under rainfed condition". The experiment was executed in a farmer's field at Manathal village, Tharamangalam block of Salem district, Tamil Nadu, India during June-August, 2021. The treatments were imposed on a sandy loam soil. The experiment encompassed thirteen treatments with three replications and the experiment was laid out in a randomized block design. The results of the present investigation revealed that seed treatment with 2% KCl + soil application of vermicompost @ 5 t ha$^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_8$) recorded the higher grain yield, stover yield, nutrient uptake and post-harvest soil fertility profile of pearl millet. With regard to economics, Seed treatment with 2% KCl + soil application of humic acid @ 25 kg ha$^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_{10}$) recorded the highest net return and benefit cost ratio of pearl millet under rainfed condition.


**Keywords:** Yield, uptake, soil nutrient status, economics, pearl millet

## Introduction
Pearl millet (*Pennisetum glaucum* L.) is popularly known as bajra, which belong to the family of poaceae. It is a most important crop subsequent to rice, wheat, maize and sorghum. Pearl millet is a $C_4$ plant having high photosynthetic efficiency, more dry matter productivity and survival under adverse agro-climatic conditions with lesser inputs and more economic returns. It is critically important for food and nutritional security of human and animals in the arid and semi-arid regions due to its early maturity, drought tolerance, requiring minimal purchase inputs, mostly free from biotic and abiotic stress and its inherent ability to endure high temperature up to 42 °C during reproductive phase enables it for cultivation in adverse conditions, thus making it as climate resilient crop (Anon, 2021a) [4].

Pearl millet is actually a 'blessing in disguise and future crop for millions of poor households'. Hence, it called as "Poor man's food". Due to its excellent nutritional properties and resilience to climate change, pearl millet is designated as nutri-cereal for production, consumption, trade and was included in public distribution system (Anon, 2021b) [5].

To bring millets into mainstream and exploiting the nutritional rich properties and their cultivation, Govt. of India has declared year 2018 as the 'National Year of Millets' and the year 2023 is declared as 'International Year of Millets' by FAO Committee on Agriculture forum. Pearl millet is cultivated worldwide, over 30 million ha with the majority of crop grown in Africa (>18 million ha) and Asia (>10 million ha) (Raheem *et al.*, 2021) [22]. It is staple food for 90 million poor people and widely grown on 30 million hectare in the arid and semi-arid tropical regions of Asia and Africa accounting for half of the global millet production (Srivastava *et al.*, 2020) [32].

In India, pearl millet is the fourth most widely cultivated food crop after rice, wheat and maize. Most of pearl millet in India is grown in rainy (kharif) season. It is also cultivated during summer season in parts of Gujarat, Rajasthan and Uttar Pradesh and during the post rainy (rabi) season at a small scale in Maharashtra and Gujarat. In India, pearl millet occupies an area of 7.41 million hectare with an average production of 10.3 million tonnes and productivity of 1391 kg ha$^{-1}$ during 2019-2020 (Anon, 2021c) [4]. The major pearl millet growing states are Rajasthan, Uttar Pradesh, Haryana, Gujarat and Maharashtra contributing to 90 per cent of total production in the country. Rajasthan contributes nearly 4.283 million tonnes followed by Uttar Pradesh (1.302), Haryana (1.079), Gujarat (0.961), Maharashtra

(0.66) and Tamil Nadu (0.084). In Tamil Nadu, it occupies an area of 0.67 lakh hectare, with production of 1.85 lakh tonnes and productivity of 2743 kg $ha^{-1}$ during 2019-2020 (Ministry of Agriculture & Farmers welfare; Govt. of India, 2020) [19].

Pearl millet is a good source of carbohydrate, energy, fat (5-7%), ash (2.1%), crude protein (13.6%), quality protein (8-19%), starch (63.2%), α-amylase activity, vitamin A and B, antioxidants such as ferulic acid and coumaric acids with better fat digestibility (Goswami *et al*., 2020) [12]. It is called as the 'Powerhouse of Nutrition' as it consists of most of the important nutrients in good quantity and quality which is required for maintaining healthy and nutritious life.

Seed hardening with chemicals is one of the methods of pre sowing treatment to seeds. It is the practice of subjecting seeds to alternate wetting and drying along with seed hardening chemical like KCl mainly to induce drought tolerance, which results in modifying the physiological and biochemical nature of the seed so as to get the character that favours drought resistance. It induces early germination, better root and shoots growth, reduces seedling mortality, increase plant population and thereby enhances the yield of crops. Seed hardening is a common practice followed to enhance seed performance with respect to rate and uniformity of germination (De Lespinay *et al*., 2010) [8].

Seed treatment of panchakavya is an important technique of organic farming. It acts as a growth promoter and immunity booster and also restricts the incidence of common diseases (Vallimayil and Sekar, 2012) [34]. Panchakavya contains growth regulatory substances such as IAA, GA, cytokinin, essential plant nutrients, effective microorganisms like lactic acid bacterium, yeast and *Actinomycetes* (Somasundram *et al*., 2004) [30].

Vermicompost has been recognized as an eco-friendly technology for converting organic wastes into high value organic manure which is more in nitrates, available form of phosphorus, calcium, vitamins, natural phyto regulators and micro flora in balanced form which helps in reestablishment of the natural fertility of soil (Nohang and Yusuf, 2020) [20]. Use of vermicompost not only reduces the requirement of chemical fertilizers but also supplements all essential nutrients to increase crop yield besides improving the soil health (Sharma and Banik, 2014) [27].

Humic acid is one of the organic mineral fertilizers which contain major components of humic substances. Humic matter is formed through the chemical and biological humification of plant and animal matter and through the biological activities of microorganisms (Anon, 2010) [3]. Humic substances have a very strong influence on the growth of plant roots. Humic acids are applied on the soil, for the enhancement of root initiation and increased root growth (Pettit, 2004) [21].

The seaweed extract contains regulators, plant growth hormones, carbohydrates, auxin, gibberellins and vitamins which helps to maintain soil fertility and improve the nutrient status of soil. It is cost effective and eco-friendly for sustainable agriculture (Sasikala *et al*., 2016) [26]. Adding seaweed to the soil can improve plant macro and micronutrients (Gharakhani *et al*., 2016) [11].

Foliar application is a technique to supply macro and micro-nutrients through foliage, which avoids wastage or loss of nutrients, to enhance the nutrient use efficiency and reduces the cost of cultivation. In the sandy loam, foliar applied fertilizers are up to 20 times more effective when compared to soil applied fertilizers. Water soluble fertilizer of 19:19:19 (NPK) is totally water soluble in crystalline powder form.

The main reason for the low production in the pearl millet has been regarded as its the crop of marginal lands and crop of the poor farmers with little promotional efforts by farmers and government agencies. Therefore, there is a vast scope and need for increasing the yield of pearl millet. Increased use of inorganic fertilizers without organic manures has not only aggravated multi nutrient deficiencies in soil plant system but also detrimental to soil health. Hence, the present investigation was designed to study the effect of seed hardening, soil and foliar nutrition on yield, nutrient uptake, post-harvest soil fertility profile and economics of pearl millet under rainfed condition.

## Materials and Methods

A field investigation was executed in farmer's field at Manathal village, Tharamangalam block of Salem district, Tamil Nadu, India during June-August, 2021 to study the "Effect of seed hardening, soil and foliar nutrition on yield, nutrient uptake, post-harvest soil fertility profile and economics of pearl millet under rainfed condition". The experimental field was geographically located at $11^0 46'$ N latitude and $77^0 57'$ E longitude with an altitude of 225 m above the mean sea level in the North-Western Agro-climatic zone of Tamil Nadu. The CO (cu) 9 variety chosen for the study. The experiment was laid out in randomized block design with three replications and thirteen treatments *viz*., $T_1$ - Control (No seed hardening and nutrient application), $T_2$ - Seed treatment with 2% KCl + soil application of vermicompost @ 5t $ha^{-1}$, $T_3$-Seed treatment with 3% Panchakavya + soil application of vermicompost @ 5 t $ha^{-1}$, $T_4$-Seed treatment with 2% KCl + soil application of humic acid @ 25 kg $ha^{-1}$, $T_5$-Seed treatment with 3% panchakavya + soil application of humic acid @ 25 kg $ha^{-1}$, $T_6$-Seed treatment with 2% Kcl + soil application of seaweed extract @ 25 kg $ha^{-1}$, $T_7$-Seed treatment with 3% panchakavya + soil application of seaweed extract @ 25 kg $ha^{-1}$, $T_8$-$T_2$ + foliar application of 19:19:19 @ 25 DAS, $T_9$-$T_3$ + foliar application of 19:19:19 @ 25 DAS, $T_{10}$-$T_4$ + foliar application of 19:19:19 @ 25 DAS, $T_{11}$-$T_5$ + foliar application of 19:19:19 @ 25 DAS, $T_{12}$-$T_6$ + foliar application of 19:19:19 @ 25 DAS, $T_{13}$-$T_7$ + foliar application of 19:19:19 @ 25 DAS. The pearl millet CO (cu) 9 was sown with seed rate of 5 kg $ha^{-1}$ and with spacing of 45 x 15 cm. The experimental soil was sandy loam with a pH of 6.8. The soil was low in available nitrogen, medium in available phosphorus and high in available potassium.

## Results and Discussion

### Effect on yield

Grain yield and stover yield of pearl millet was significantly influenced by the seed hardening, soil and foliar nutrition treatments as presented in Table 1.

### Effect on grain yield

The appraisal of data presented in Table 1 revealed that the grain yield was significantly influenced by the seed hardening, soil and foliar nutrition of pearl millet. Among the different treatments experimented, seed treatment with 2% KCl + soil application of vermicompost @ 5 t $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_8$) recorded the highest grain yield of 2497 kg $ha^{-1}$. This was followed by seed treatment with 2% KCl + soil application of humic acid @ 25 kg $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_{10}$) recorded the grain yield of 2376 kg $ha^{-1}$. The treatments next in order were $T_{12}$, $T_9$, $T_{11}$, $T_{13}$, $T_2$, $T_4$, $T_6$, $T_3$, $T_5$ and $T_7$ registering the grain yield of 2253, 2131, 2086, 1964, 1841, 1799, 1677, 1552, 1428 and 1299 kg $ha^{-1}$ respectively. However, the treatments $T_9$ and $T_{11}$; $T_2$ and $T_4$ were not significantly different from each other. The treatment $T_1$ control (No seed hardening and nutrient application) registered the least grain yield of 907 kg $ha^{-1}$.

The increased grain yield was probably due to effective utilization of applied nutrients, increased sink capacity and nutrient uptake by the crop. The three major nutrients *viz.*, nitrogen, phosphorus and potassium are known to promote the growth and yield attributes by producing more dry matter and photosynthetic surface, well developed root system, sturdy stem and more number of grains ear $head^{-1}$ and heavier individual ear head due to ample cell turgidity and effective translocation of photosynthates from sources to sink as a consequence of liberal absorption of N, P and K. The yield potential of the crop is mainly governed by the growth and yield components. The significant improvement in leaf area index and dry matter production noticed at different stages, increased yield attributes and nutrient uptake would have resulted in enhanced ear head length, ear head girth, number of grains ear $head^{-1}$ and thus more grain yield. The findings are in line with the findings of Sunitha and Reddy (2012) [33].

Foliar application of 19:19:19 (NPK) fertilizers was found most beneficial in terms of better growth, increased yield and yield components like ear head length, ear head girth and number of grains ear $head^{-1}$ of crops. NPK absorbed by the plant is responsible for fixation of a carbon skeleton to amino acid synthesis which results in several proteins that have specific functions in plant metabolisms. In addition to this, during the grain filling period these carbon compounds previously fixed are broken down, transported and stored in form of proteins and amino acids. These are similar to the findings of Iqbal and Hidayat (2016) [14].

**Effect on Stover yield**

The perusal of data from table 1 revealed that the stover yield was significantly influenced by the seed hardening, soil and foliar nutrition of pearl millet. Among the different treatment combinations experimented, seed treatment with 2% KCl + soil application of vermicompost @ 5t $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_8$) recorded the highest stover yield of 4739.38 kg $ha^{-1}$. This was followed by seed treatment with 2% KCl + soil application of humic acid @ 25 kg $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_{10}$) recorded the stover yield of 4582.54 kg $ha^{-1}$. The treatments next in order were $T_{12}$, $T_9$, $T_{11}$, $T_{13}$, $T_2$, $T_4$, $T_6$, $T_3$, $T_5$ and $T_7$ registering the stover yield of 4415.98, 4267.70, 4186.35, 3998.62, 3827.44, 3751.23, 3602.16, 3447.39, 3255.30 and 3075.30 kg $ha^{-1}$ respectively. However, the treatments $T_9$ and $T_{11}$; $T_2$ and $T_4$ were not significantly different from each other. The least stover yield of 2180.70 kg $ha^{-1}$ was registered in $T_1$ (No seed hardening and nutrient application).

The elevated stover yield increased due to the synergetic effect of the concomitant supply of major nutrients increased the sink size coupled with higher levels of phytomass accumulation and efficient translocation of metabolites to the sink. Similar results have been obtained in the present investigation also corroborating the earlier findings of Keerthi *et al*. (2013) [18] confirming the outcome of the present study. The foliar application of 19:19:19 (NPK) delayed the phonological development while increasing the plant height, stem girth, number of leaves and increased biological yield in crops, confirming the findings of Amanullah *et al*. (2010a) [2].

**Effect on nutrient uptake**

The data pertaining to the nutrient uptake was presented in table 1. The nutrient uptake was significantly influenced by the seed hardening, soil and foliar nutrition of pearl millet. It is seen from the table that the maximum uptake of nitrogen, phosphorus and potassium was 77.56, 29.82 and 63.84 kg $ha^{-1}$ respectively was recorded in seed treatment with 2% KCl + soil application of vermicompost @ 5 t $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_8$). This was followed by $T_{10}$ (Seed treatment with 2% KCl + soil application of humic acid @ 25 kg $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS) recorded the nitrogen, phosphorus and potassium uptake of 74.87, 28.70 and 61.84 kg $ha^{-1}$ respectively. The treatments $T_9$ and $T_{11}$; $T_2$ and $T_4$ were comparable with each other. The $T_1$ control (No seed hardening and nutrient application) registered the least nitrogen, phosphorus and potassium uptake of 48.05, 15.31 and 32.08 kg $ha^{-1}$ respectively. This might be due to the role of vermicompost in releasing nitrogen and improving nitrogen availability in soil. Similar findings were reported earlier by Singh and Wasnik (2014) [29].

Further, an increase in nitrogen uptake was due to an efficient root system with improved permeability coupled with better absorption due to better availability of nutrients in the soil solution. Higher uptake of nutrients by crop could be attributed to the effect of organic matter present in vermicompost which could have increased the native microbial population and thereby increased dehydrogenase activity and sustained supply of nutrients. The organic manure increased its availability in the form of $NH_4$-N, $NO_3$-N, orthophosphates and potassium in the soil which led to better uptake of nutrients by the crop. The results were supported by Hussain *et al*. (2019) [13] and Jeevabharathi and Krishnaprabu (2019) [15].

The foliar applied nitrogen reduced nitrogen losses through denitrification and leaching compared with nitrogen fertilizer applications to the soil. The ability to provide nitrogen when root activity is impaired in dry conditions and uptake late in the season increases grain nitrogen concentration. This result may be due to the application of nitrogen fertilizer into the foliar resulting in much higher nitrogen content and dry matter production which increased the nitrogen uptake by plants. Fertilizer uptake by the plant and also foliar application significantly reduced the amount of $N_2$ fixed in the soil. The foliar applied phosphorus fertilizers increased phosphorus concentration and its uptake which suggests that phosphorus was absorbed poorly by the roots, but was well absorbed by the leaves also, the phosphorus use efficiency as applied to the soil is very low because more than 80 percent of the applied phosphorus becomes immobile and unusable by the plant because of adsorption, precipitation or conversion to organic form. The foliar application of potassium act as quality improvement and also enhanced drought stress, root growth and stem elongation. Similarly, potassium increased leaf water potential, osmotic potential and turgor potential under drought stress. Likewise, gas exchange parameters are improved by the application of potassium enhanced the photosynthetic rate and has a better effect on other attributes. These results are in line with the findings of Amanullah *et al.* (2010b) [1].

**Effect on post-harvest soil fertility profile**

The data on post-harvest soil fertility profile are presented in Table 1. The post-harvest soil fertility profile was significantly influenced by the seed hardening, soil and foliar nutrition of rainfed pearl millet. Among the different treatments tested, the treatment $T_8$ (Seed treatment with 2% KCl + soil application of vermicompost @ 5 t ha$^{-1}$ + foliar application of 19:19:19 @ 25 DAS) was recorded as the highest post-harvest soil available nitrogen, phosphorus and potassium of 211.45, 19.87 and 308.06 kg ha$^{-1}$ respectively and it was on par with the treatments $T_9$, $T_2$ and $T_3$. However, the treatments $T_{10}$, $T_{11}$, $T_4$ and $T_5$; $T_{12}$, $T_{13}$, $T_6$ and $T_7$ were not significantly different from each other. The treatment $T_1$ control (No seed hardening and nutrient application) registered the least post-harvest soil available nitrogen, phosphorus and potassium of 187.13, 10.27 and 277.04 kg ha$^{-1}$ respectively.

The increase in the availability of nitrogen in this treatment might be due to greater multiplication of soil microbes, act as a result of which organically bound nitrogen was converted into the inorganic form of nitrogen in the crop, therefore enriching the available pool of nitrogen. These findings corroborate the results of Sanjiv Kumar (2014) [25] and Sindhi *et al*. (2018) [28].

Incorporation of the cheapest and phosphorus rich source of vermicompost could have increased the availability of phosphorus in soil either directly by the process of decomposition and release of phosphorus from the biomass or by indirectly increasing the amount of soluble organic matter which is mainly release of organic acids that increased the rate of desorption of phosphate and thus improved the available phosphorus content in the soil. These findings were in line with the reports of Gautam *et al*. (2017) [10] and Verma *et al*. (2018) [35]. The available potassium was also increased in soil due to the beneficial effects of organic manures affecting clay organic interaction and direct $K_2O$ additions widening the available potassium pool of soil. Similar results were reported earlier in the case of vermicompost by Kasi Viswanath *et al*. (2019) [17] and Baradhan and Suresh Kumar (2018) [7].

Significant variation in available nitrogen, phosphorus and potassium in the soil was observed with each successive increase in fertility level. A considerable quantity of NPK left over in the soil, might have remained in the soil after meeting the maximum requirement of the crop at NPK application ultimately improving the soil fertility status. Similar results were also reported by Rao *et al.* (2010) [23], Spandana (2010) [31], Kalyani (2011) [16] and Ebrahimpour *et al*. (2011) [9].

**Table 1:** Effect of seed hardening, soil and foliar nutrition on grain yield, stover yield, nutrient uptake and post-harvest soil fertility profile of pearl millet under rainfed condition

| Treatments | Grain yield (kg ha$^{-1}$) | Stover yield (kg ha$^{-1}$) | Nutrient uptake (kg ha$^{-1}$) | | | Available nutrient status (kg ha$^{-1}$) | | |
|---|---|---|---|---|---|---|---|---|
| | | | N | P | K | N | P | K |
| $T_1$ | 907 | 2180.70 | 48.05 | 15.31 | 32.08 | 187.13 | 10.27 | 277.04 |
| $T_2$ | 1841 | 3827.44 | 62.80 | 23.35 | 49.85 | 208.64 | 19.43 | 304.62 |
| $T_3$ | 1552 | 3447.39 | 56.04 | 20.18 | 43.18 | 207.16 | 19.18 | 303.07 |
| $T_4$ | 1799 | 3751.23 | 61.36 | 22.56 | 48.68 | 200.13 | 18.03 | 294.43 |
| $T_5$ | 1428 | 3255.30 | 53.37 | 18.22 | 40.43 | 199.03 | 17.83 | 292.98 |
| $T_6$ | 1677 | 3602.16 | 58.69 | 21.34 | 45.97 | 192.41 | 16.50 | 284.45 |
| $T_7$ | 1299 | 3075.30 | 50.73 | 16.99 | 37.16 | 191.43 | 16.18 | 282.94 |
| $T_8$ | 2497 | 4739.38 | 77.56 | 29.82 | 63.84 | 211.45 | 19.87 | 308.06 |
| $T_9$ | 2131 | 4267.70 | 69.60 | 26.49 | 56.45 | 210.03 | 19.66 | 306.07 |
| $T_{10}$ | 2376 | 4582.54 | 74.87 | 28.70 | 61.84 | 202.86 | 18.43 | 297.17 |
| $T_{11}$ | 2086 | 4186.35 | 68.11 | 25.73 | 55.42 | 201.55 | 18.22 | 295.85 |
| $T_{12}$ | 2253 | 4415.98 | 72.24 | 27.59 | 58.64 | 194.83 | 17.03 | 287.08 |
| $T_{13}$ | 1964 | 3998.62 | 65.46 | 24.59 | 52.80 | 193.59 | 16.77 | 285.84 |
| SEm± | 40.03 | 48.48 | 0.85 | 0.36 | 0.68 | 1.42 | 0.21 | 1.77 |
| CD (p=0.05) | 117.54 | 142.34 | 2.51 | 1.08 | 2.00 | 4.17 | 0.64 | 5.20 |

**Effect on economics**

Concerning the economics of treatments imposed in this investigation was presented in Table 2. The trend is something differs from earlier parameters discussed. Seed treatment with 2% KCl + soil application of humic acid @ 25 kg ha$^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_{10}$) registered the higher net return (Rs. 68940.54 ha$^{-1}$) and benefit cost ratio (2.61) of pearl millet. This might be due to humic acid is a cost effective compared to other treatments. Though the highest gross return (Rs. 117104.38) was recorded in $T_8$ (Seed treatment with 2% KCl + soil application of vermicompost @ 5 t ha$^{-1}$ + foliar application of 19:19:19 @ 25 DAS) due to higher yield of crop. This was due to the prohibitive higher cost of vermicompost which has resulted in the higher cost of cultivation.

Hence, foliar nutrient fertigation through water dissolves NPK is a cost effective and agronomic nutrient management practice thus enhancing the more economic returns. These are similar to the findings of Rolston *et al*. (1979) [24]. The lowest gross return (Rs. 42995.70), net return (Rs. 3103.70) and benefit cost ratio (1.07) registered under control $T_1$ (No seed hardening and nutrient application). The reasons attributed to lowest economic values under the treatment $T_1$ might be due to poor yield recorded under the control treatment.

**Table 2:** Effect of seed hardening, soil and foliar nutrition on economics of pearl millet under rainfed condition

| Treatments | Gross Return in Rs. $ha^{-1}$ | Net Return in Rs. $ha^{-1}$ | BCR |
|---|---|---|---|
| $T_1$ | 42995.70 | 3103.70 | 1.07 |
| $T_2$ | 86672.44 | 21310.44 | 1.32 |
| $T_3$ | 73287.39 | 7915.39 | 1.12 |
| $T_4$ | 84706.23 | 43094.23 | 2.03 |
| $T_5$ | 67515.30 | 25893.30 | 1.62 |
| $T_6$ | 79067.16 | 37330.16 | 1.89 |
| $T_7$ | 61530.30 | 19783.30 | 1.47 |
| $T_8$ | 117104.38 | 50792.38 | 1.76 |
| $T_9$ | 100162.70 | 33840.70 | 1.51 |
| $T_{10}$ | 111502.54 | 68940.54 | 2.61 |
| $T_{11}$ | 98056.35 | 55484.35 | 2.30 |
| $T_{12}$ | 105800.98 | 63113.98 | 2.47 |
| $T_{13}$ | 92378.62 | 49681.62 | 2.16 |

## Conclusion

Based on the trend of yield, it was noticed that among the different treatments experimented, seed treatment with 2% KCl + soil application of vermicompost @ 5 t $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_8$) was superior with respect to concerning yield, nutrient uptake and post-harvest soil fertility profile of pearl millet. Concerning profit, seed treatment with 2% KCl + soil application of humic acid @ 25 kg $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS ($T_{10}$) recorded the highest net return and benefit cost ratio.

In the light of the above said facts, it can be concluded that seed treatment with 2% KCl + soil application of humic acid @ 25 kg $ha^{-1}$ + foliar application of 19:19:19 @ 25 DAS is an economically viable technology for enhancing the profitability of pearl millet in the rainfed area.

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