

**Effect of Integrated nutrient management on yield, uptake and soil properties of pearl millet (*Pennisetum glaucum* L.) in alluvial soil of Gird region of Madhya Pradesh.**

---

## **ABSTRACT**

**Aims:** Effect of Integrated nutrient management on yield, uptake and soil properties of pearl millet (*Pennisetum glaucum* L.) in alluvial soil of Gird region of Madhya Pradesh.

**Study design:** Randomized block design.

**Place and Duration of Study:** Department of Soil Science and Agricultural Chemistry, R.V.S.K.V.V., CoA, Gwalior, Districts of Madhya Pradesh during *kharif*, 2022

**Methodology:** There were 12 treatments T<sub>1</sub> – Control, T<sub>2</sub> -50% NPK, T<sub>3</sub>-75% NPK, T<sub>4</sub>-100% NPK, T<sub>5</sub>- 150% NPK, T<sub>6</sub>-100% NPK-S, T<sub>7</sub>-100% NPK ZnSO<sub>4</sub>, T<sub>8</sub> -100% NPK + FeSO<sub>4</sub>, T<sub>9</sub>-50% NPK + FYM, T<sub>10</sub> -75% NPK + FYM, T<sub>11</sub> -100% NPK + FYM and T<sub>12</sub>-100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)} and were replicated thrice under RBD and were statistically analyzed by the Fisher's analysis of variance technique was adopted as suggested by Panse and Sukhatme (1984) for Randomized Block Design. The pH, EC, OC, N, P, K and S content before creation of treatments were 7.72, 0.23 dSm<sup>-1</sup>, 0.39 %, 170 kg ha<sup>-1</sup>, 12.04 kg ha<sup>-1</sup> and 180 kg ha<sup>-1</sup> respectively.

**Results:** The results indicated that yield, uptake of nutrients and soil properties pH, EC, OC, Available Nitrogen, Phosphorus, Potassium and Sulphur were found highest in the treatment T<sub>12</sub>-100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)} and was found lowest in the treatment T<sub>1</sub> – Control.

**Conclusion:** Based on experimental findings it can be concluded that application of 100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)} is beneficial in terms of yield, uptake of nutrients and Soil chemical properties pearl millet.

**Keywords:** Integrated nutrient, yield, uptake, soil properties and alluvial soil.

## **1. INTRODUCTION**

### **Introduction:**

The dramatic increase in worldwide agricultural production per unit area significantly reduced starvation rates in the developing world and enhanced the global food supply (Lal, 2009). During recent intensive farming systems, chemical fertilizers (consisting of N, P and K) are applied excessively to provide the nutrients for plants for increasing agricultural productivity. However, injudicious use of these fertilizers has caused pollution problems leading to public health hazards. Moreover, use of chemical fertilizers alone was not efficient in improving the nutrient status of soil (Kang *et al.*, 2005) and integrated nutrient management system was found more appropriate to enhance soil fertility and plant growth. During last decades in India, it has been widely acknowledged that system oriented production research is needed to be strengthened as it is essential for maximizing land production per unit area, by harnessing synergies generated through microbial interactions in soil-crop-weather systems.

Pearl millet [*Pennisetum glaucum* (L.)] is one of the vital cropping systems of our country, which is spread over arid and semi-arid regions. During the last five decades, consumption of chemical fertilizers (NPK) has increased phenomenally from 0.07 mt in 1950-51 to 25.95 mt in 2021-22 (Anonymous, 2021). With the application of recommended doses of fertilizers, the yield potential of cereal-cereal cropping system has reached to a

plateau. Moreover, application of excessive fertilizers has deteriorated soil health and especially organic matter has depleted.

For obtaining optimum crop production fertility of soil is very important but the absence of organic matter from soil results in unproductive soil. To supply essential plant nutrients in adequate amounts, huge quantity of organic material is needed. Slow release of plant nutrients after decomposition from organic material has been reported to promote crop growth (Goutamiet *al.*, 2018). Organic sources when applied to preceding crop, leaves the residual effect and this benefit is harvested by the succeeding crop and system becomes sustainable through integrated use of crop residues, chemical fertilizers, green manure and FYM (farm yard manure) as a source of nutrients.

## 2. MATERIAL AND METHODS

The field experiment was conducted during *kharif*, 2022-23 at the research farm of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, R.V.S. K.V.V., Gwalior. There were 12 treatments  $T_1$  – Control,  $T_2$  -50% NPK,  $T_3$ -75% NPK,  $T_4$  -100% NPK,  $T_5$  - 150% NPK,  $T_6$  -100% NPK-S,  $T_7$  -100% NPK ZnSO<sub>4</sub>,  $T_8$  -100% NPK + FeSO<sub>4</sub>,  $T_9$  -50% NPK + Farm Yard Manure,  $T_{10}$  -75% NPK + FYM,  $T_{11}$  -100% NPK + FYM and  $T_{12}$ -100% NPK + FYM + {PSB+ *Azotobacter* were applied through Seed treatment)) and were replicated thrice under Randomized Block Design. There recommended fertilizer dose for pearl millet as per the treatments were applied (80:40:20 N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O gha<sup>-1</sup>, respectively) through urea, di-ammonium phosphate, SSP and muriate of potash. In all, 50 per cent of nitrogen and entire dose of P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O was applied at the time of sowing and remaining 50 per cent of nitrogen was top dressed in the form of urea for pearl millet at 30 days after sowing. In treatment 100 % NPK, phosphorus was added through SSP. Only  $T_6$ -100% NPK-S phosphorus source was DAP to make it sulphur free treatment. As per treatment FYM was added @10 tonnes ha<sup>-1</sup> yr<sup>-1</sup> before sowing of crop. *Azotobacter* and PSB were added in soil by seed treatment at the time of sowing. The investigation entitled study the “Effect of Integrated nutrient management on yield, uptake and soil properties of pearl millet (*Pennisetum glaucum* L.) in alluvial soil of Gird region of Madhya Pradesh. The pH, EC, OC, N, P, and K content in soil before creation of treatments were 7.72, 0.23 dSm<sup>-1</sup>, 0.39 %, 170 kg ha<sup>-1</sup>, 12.04 kg ha<sup>-1</sup> and 180 kg ha<sup>-1</sup> respectively. The observations were recorded during course of study including the yield at harvesting, uptake of nutrients after harvest of sample, pH, EC, OC, available N, P, K and S after harvesting of crop samples were collected from soil. The collected data for various parameters were statistically analyzed using Fisher’s analysis of variance (ANOVA) technique and the treatments were compared at 5 per cent level of significance.

## 3. RESULTS AND DISCUSSION

The data presented investigation revealed that the highest grain yield 2353.33 kgha<sup>-1</sup> was obtained under the application of  $T_{12}$  (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)) which was found highly significant over other treatment. The treatment recorded 37.08 and 37.96 % increased in the grain yield over control. The significantly higher grain yield of 2349.0 kgha<sup>-1</sup> was recorded with application of (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)) which was 37.52 % and 65.34 % higher than  $T_1$  (Control) and  $T_4$  (100% NPK) respectively. Application of various combination of treatment significantly increased straw yield over  $T_1$  (Control). The maximum straw yield 5724.67 kgha<sup>-1</sup> was obtained with treatment  $T_{12}$  (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)) which was found to be significantly higher over rest of the other treatment. The treatment recorded 35.89 % increased in the straw yield over control. The application of the organic and inorganic nutrient sources including 100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)) provided balanced nutrients to the pearl millet which resulted into significantly

enhance in grain and straw yield. The outcomes showed conformity with Karforma *et al.* (2012), Husain *et al.* (2013), Jat *et al.* (2014) and Verma (2016).

**Table-1 Effect of integrated nutrient management on grain and straw yield.**

| S.No.            | Treatment                                            | Grain yield (Kg $ha^{-1}$ ) | Straw yield (kg $ha^{-1}$ ) |
|------------------|------------------------------------------------------|-----------------------------|-----------------------------|
| 1                | Control                                              | 893.33                      | 2054.67                     |
| 2                | 50% NPK                                              | 1116.67                     | 2568.33                     |
| 3                | 75% NPK                                              | 1326.67                     | 3051.33                     |
| 4                | 100% NPK                                             | 1520.00                     | 3496.00                     |
| 5                | 150% NPK                                             | 1640.00                     | 4100.00                     |
| 6                | 100% NPK –S                                          | 1523.33                     | 3604.00                     |
| 7                | 100% NPK + ZnSO <sub>4</sub>                         | 1546.67                     | 3662.00                     |
| 8                | 100% NPK + FeSO <sub>4</sub>                         | 1521.00                     | 3702.40                     |
| 9                | 50% NPK + FYM                                        | 1632.67                     | 3918.40                     |
| 10               | 75% NPK + FYM                                        | 1853.33                     | 4633.33                     |
| 11               | 100% NPK+ FYM                                        | 2196.67                     | 5272.00                     |
| 12               | 100% NPK + FYM + {PSB+ Azotobacter (Seed treatment)} | 2353.33                     | 5724.67                     |
| <b>S.Em.(±)</b>  |                                                      | <b>30.84</b>                | <b>88.11</b>                |
| <b>CD(0.05%)</b> |                                                      | <b>90.44</b>                | <b>258.41</b>               |

It is evident from the table 2 that the application of T<sub>12</sub> (100% NPK + FYM + {PSB+ Azotobacter (Seed treatment)}) obtained highest uptake of Nutrients by pearl millet grain and straw which was significant than the remaining treatments. However, addition of FYM enhanced significantly the Nutrients uptake by the crop. More uptake of Nutrients with FYM addition are more likely the outcomes of favourable effect of FYM on Nutrients by pearl millet crop might be due to attribution of more availability of Nutrients from addition of FYM. More uptake of Nutrient under the treatments with FYM resultant in mineralized Nutrients from FYM could meet the need of nutrients of crop. The outcomes are tuned with findings by Dahiya *et al.* (1987) and Singh *et al.* (1994). Mishustin and Petrova (1958) recorded that the raised uptake of Nutrients with Azotobacter inoculation.

**Table-2 Effect of integrated nutrient management on nutrient uptake N, P, K and S.**

| S. No. | Treatment                    | N uptake |       | P uptake |       | K uptake |       | S uptake |       |
|--------|------------------------------|----------|-------|----------|-------|----------|-------|----------|-------|
|        |                              | Seed     | Straw | Seed     | Straw | Seed     | Straw | Seed     | Straw |
| 1      | Control                      | 44.61    | 8.66  | 2.17     | 2.30  | 5.22     | 25.19 | 2.48     | 1.83  |
| 2      | 50% NPK                      | 50.04    | 12.59 | 3.59     | 3.31  | 6.97     | 34.02 | 3.73     | 2.79  |
| 3      | 75% NPK                      | 52.17    | 15.59 | 4.99     | 4.21  | 9.67     | 43.49 | 4.94     | 3.66  |
| 4      | 100% NPK                     | 55.47    | 23.53 | 6.50     | 4.54  | 11.42    | 50.54 | 6.58     | 4.28  |
| 5      | 150% NPK                     | 56.50    | 23.36 | 7.27     | 5.81  | 12.70    | 59.49 | 7.47     | 5.33  |
| 6      | 100% NPK – S                 | 55.64    | 20.98 | 6.48     | 4.64  | 11.86    | 52.13 | 4.32     | 4.04  |
| 7      | 100% NPK + ZnSO <sub>4</sub> | 56.46    | 24.14 | 6.66     | 5.02  | 11.23    | 53.34 | 7.46     | 4.66  |

|                  |                                                                     |              |              |              |              |             |             |             |             |
|------------------|---------------------------------------------------------------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|
| 8                | 100% NPK +<br>FeSO <sub>4</sub>                                     | 55.48        | 25.36        | 6.35         | 4.91         | 11.23       | 53.90       | 7.39        | 4.76        |
| 9                | 50% NPK +<br>FYM                                                    | 55.00        | 28.12        | 6.95         | 5.39         | 11.99       | 57.72       | 7.22        | 4.89        |
| 10               | 75% NPK +<br>FYM                                                    | 63.24        | 36.65        | 8.05         | 6.49         | 13.64       | 70.49       | 8.62        | 5.96        |
| 11               | 100% NPK+<br>FYM                                                    | 65.48        | 43.35        | 10.10        | 8.52         | 16.51       | 85.72       | 11.11       | 7.11        |
| 12               | 100% NPK +<br>FYM +<br>{PSB+<br>Azotobacter<br>(Seed<br>treatment)} | 75.27        | 50.11        | 11.30        | 9.69         | 20.10       | 94.11       | 12.21       | 8.30        |
| <b>S.Em.(±)</b>  |                                                                     | <b>1.380</b> | <b>0.611</b> | <b>0.179</b> | <b>0.140</b> | <b>0.31</b> | <b>1.33</b> | <b>0.16</b> | <b>0.11</b> |
| <b>CD(0.05%)</b> |                                                                     | <b>4.047</b> | <b>1.791</b> | <b>0.525</b> | <b>0.411</b> | <b>0.91</b> | <b>3.89</b> | <b>0.46</b> | <b>0.33</b> |

From the data presented in the table 3 it can be revealed that the maximum in organic carbon content of soil was indicated in the treatment T<sub>12</sub> (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)}) 0.407 % which was found non significant than T<sub>11</sub> (100% NPK+ FYM) 0.405%. It might be due to consistent increase in yields leads by the application of this treatment. The application of FYM and seed inoculation with *Azotobacter* and PSB were the reason of increasing the organic carbon content in comparison with the application of NPK alone. Similar results were reported by kumar (2002),Prakash *et al.* (2002), Bhattacharya *et al.* (2004).

The available N values of different soil layers as impacted by continuous application of various treatments are represented in table 3. On further study of data, the maximum value of available N was recorded in the treatment T<sub>12</sub> (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)}) 184.11 kg ha<sup>-1</sup> which was found significant over other treatment although found at par with the treatment T<sub>11</sub> (100% NPK + FYM), 179.93. The results showed with the findings of Singh *et al.* (2001). Application of the treatment T<sub>12</sub> (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)}) in comparison with the treatment NPK applied alone.

Maximum available P was noticed in T<sub>12</sub> (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)}) 15.19 kg ha<sup>-1</sup> which was found significant than other treatments. It was also recorded that significant increases had occurred with the increases in level of fertilizer application in soil. Results are lined with the finding of Shinde and Solanki (1991), Swarup and Yaduvanshi (2000).

The available K content of soil as influenced by application of various treatments. In general the available K was found maximum in the treatment T<sub>12</sub> (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)}) 196.57 kg ha<sup>-1</sup> which was followed by the treatment T<sub>11</sub> (100% NPK + FYM) 186.53 kg ha<sup>-1</sup>. Kauraw, (1982) and Sahu (2004) summarized that the typical behavior of K distribution within the soil profile from the applied pool, Luxury consumption of K by the growing crops as per its availability and prevailing moisture situations of the profiles.

The available S content of soil as influenced by application of various treatments. In general the available S was found maximum in the treatment T<sub>12</sub> (100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)}) 18.63 kg ha<sup>-1</sup> which was followed by the treatment T<sub>11</sub> (100% NPK + FYM) 17.87 kg ha<sup>-1</sup>. Similar findings have been reported by Singh *et al.* (1998 b) and Rsikesh thakur (2010).

**Table-3 Effect of integrated nutrient management on pH, EC, OC(%) Available N, P, K and S.**

| S.No.            | Treatment                                                     | pH           | EC           | OC(%)        | N<br>(Kgha <sup>-1</sup> ) | P<br>(Kgha <sup>-1</sup> ) | K<br>(Kgha <sup>-1</sup> ) | S<br>(Kgha <sup>-1</sup> ) |
|------------------|---------------------------------------------------------------|--------------|--------------|--------------|----------------------------|----------------------------|----------------------------|----------------------------|
| 1                | Control                                                       | 7.516        | 0.119        | 0.363        | 158.77                     | 9.61                       | 160.27                     | 6.41                       |
| 2                | 50% NPK                                                       | 7.480        | 0.119        | 0.376        | 162.36                     | 9.83                       | 164.20                     | 7.67                       |
| 3                | 75% NPK                                                       | 7.633        | 0.130        | 0.379        | 165.58                     | 10.97                      | 163.40                     | 10.53                      |
| 4                | 100% NPK                                                      | 7.680        | 0.116        | 0.391        | 171.32                     | 11.07                      | 176.47                     | 12.04                      |
| 5                | 150% NPK                                                      | 7.780        | 0.125        | 0.392        | 177.30                     | 12.07                      | 177.17                     | 12.78                      |
| 6                | 100% NPK –S                                                   | 7.660        | 0.132        | 0.391        | 171.71                     | 11.29                      | 174.40                     | 9.13                       |
| 7                | 100% NPK +<br>ZnSO <sub>4</sub>                               | 7.633        | 0.125        | 0.390        | 172.91                     | 11.28                      | 173.53                     | 12.81                      |
| 8                | 100% NPK +<br>FeSO <sub>4</sub>                               | 7.630        | 0.126        | 0.391        | 171.57                     | 11.38                      | 173.90                     | 12.66                      |
| 9                | 50% NPK + FYM                                                 | 7.643        | 0.125        | 0.383        | 172.23                     | 11.98                      | 172.87                     | 14.48                      |
| 10               | 75% NPK + FYM                                                 | 7.553        | 0.127        | 0.393        | 177.27                     | 13.57                      | 177.57                     | 17.67                      |
| 11               | 100% NPK+ FYM                                                 | 7.650        | 0.126        | 0.405        | 178.93                     | 14.21                      | 186.53                     | 17.87                      |
| 12               | 100% NPK +<br>FYM + {PSB+<br>Azotobacter<br>(Seed treatment)} | 7.540        | 0.125        | 0.407        | 183.11                     | 15.19                      | 196.57                     | 18.63                      |
| <b>S.Em.(±)</b>  |                                                               | <b>0.054</b> | <b>0.004</b> | <b>0.009</b> | <b>3.574</b>               | <b>0.691</b>               | <b>2.205</b>               | <b>0.127</b>               |
| <b>CD(0.05%)</b> |                                                               | <b>NS</b>    | <b>NS</b>    | <b>0.027</b> | <b>10.483</b>              | <b>2.027</b>               | <b>6.468</b>               | <b>0.372</b>               |

#### 4. CONCLUSION

Based on experimental findings it can be concluded that application of 100% NPK + FYM + {PSB+ *Azotobacter* (Seed treatment)} is beneficial in terms of yield, uptake of nutrients and Soil chemical properties pearl millet.

#### REFERENCES

##### Reference to a journal:

- [1] Lal R. Soils and Food Sufficiency. A review. *Agronomy Sustainable Development* 2009;29(3):113-133
- [2] Kang GS, Beri V, Rupela OP, Sidhu BS. A new index to assess soil quality and sustainability of wheat based cropping systems. *Biological Fertility Soils* 2005;41:389-398.
- [3] Goutami N, Sujani Rao Ch, Sireesha A, Pulla, Rao Ch. Vijaya Gopal A. Effect of long-term use of inorganic fertilizers, organic manures and their combination on soil properties and enzyme activity in rice-rice cropping system. *International Journal Current Microbiology Applied Science* 2018;7(09):469-486.
- [4] Karforma, J.; Ghosh, M.; Ghosh, D.C. and Mandal, S. Effect of integrated nutrient management on growth, productivity, quality and economics of fodder maize in rainfed upland of tarai region of West Bengal. *International Journal of Agriculture Environment Biotechnology*. 2012;5(4):419-427.

- [5] Hussain; Iqbal; Muhammad, Asghar and Hafiz, Naeem. (2013). Impact of phosphate solubilising bacteria on growth and yield of maize. *Soil and Environmental Science of Pakistan*. 2013;32(1):71-78.
- [6] Jat, P.C.; Rathore, S.S. and Sharma, R.K. Effect of integrated nutrient management and intercropping systems on yield attributes and yield of maize. 2014;27(1):52-56.
- [7] Verma, Chanchal; Thanki J.D.; Singh, Deshraj and Chaudhari, S.N. Effect of nitrogen, biofertilizer and farm yard manure on yield and nutrient uptake in oat (*Avena sativa* L.). *The Bioscan. An International Quarterly Journal of Life Sciences*. 2016;11(1):499-501.
- [8] Dahiya, S. S.; Goyal, S.; Antil, R.S. and Karwasra, S. P. S. Effect of farm yard manure and cadmium on dry matter yield and nutrient uptake by maize. *J. Ind. Soc. Soil. Sci.*, 1987; 35:460-464.
- [9] Singh, Vinay; Kumar, R. and Ram Lakhan .Effect of applied farmyard manure and molybdenum on yield and nutrient uptake by Egyptian clover. *Ind. J. Agron.*, 1994; 39 (3): 307-309.
- [10] Mishustin, E. N. and Petrova, A. N. Producing and user of bacterial fertilizer *Kiewlzn. Anukr. SSR*; 1958.
- [11] Kumar, V. Integrated use of fertilizer and FYM in maize- wheat and pearl millet – wheat cropping system. *Annals of Plant and Soil. Res.* 2002;4(1): 189-190.
- [12] Prakash, Y.S., Bhadoria, P.B.S. and Rakhit, A. Comparative efficacy of organic manures on the changes in soil properties and nutrient availability in Alfisols. *Journal of the Indian Society of Soil Science*, 2002;50: 219-221.
- [13] Bhattacharya, R, Prakash, V, Kundu, S, Srivasta, A.K. and Gupta, H.S. Effect of long-term manuring on soil organic carbon, bulk density and water retention characteristics under soybean-wheat cropping sequence in North Western Himalayas. *Journal of the Indian Society of Soil Science*, 200; 52: 238- 242.
- [14] Singh, Muneshwar, Singh, V. P. and Summi Reddy, K. Effect of integrated use of fertilizers nitrogen and farm yard manure on transformation of N, K, and S and productivity of rice-wheat system on a Vertisols. *J. Ind. Soc. Soil Sci.* 2001;49(3): 430-435.
- [15] Shinde , D. A. and Solanki, A. S. Release of Olsen P in absence and presence of added FYM in Swell – Shrink Soils. *J. Ind. Soc. Soil Sci.* 1991;39 (4): 795-804.
- [16] Swamp, A. and Yaduvanshi, N.P.S. Effect of Integrated Nutrient Management on soil properties and yield of rice in alkali soil. *Journal of the Indian Society of Soil Science*. 2000;48, 279 - 282
- [17] Kauraw, Dravlal. In situ hydraulic properties of a Vertisol and water uptake by plant roots. *Ph.D. Thesis*, 1982; JNKVV, Jabalpur (MP).
- [18] Sahu, R.K. Impact of integrated resource management on soil health and productivity of ricechickpea cropping sequence. *M.Sc. Thesis*, 2004; JNKW, Jabalpur (MP).
- [19] Singh, D., Rana, D.S. and Pandey, R.N. Crop yields and changes in soil fertility status of a Typic Ustochrept under intensive cultivation and longterm use of fertilizers. *Proc. National workshop, long-term fertility management through Integrated Nutrient supply system IISS*, Bhopal, 1998b; 183 - 193.
- [20] Thakur Risikesh, Sawarkar, S.D., Kauraw, D.L. and Singh, Muneshwar. Effect of inorganic and organic sources on nutrients availability in a Vertisol. *Agropedology*, 2010; 20(1) 53-59.