*Original Research Article*

Effect of PROM and nano urea on growth and yield of pearlmillet

ABSTRACT

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| A field experiment was conducted during *kharif-rabi*, 2022-23 and 2023-24 at the Agronomy Instruction Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India. The study comprised fifteen treatment combinations involving five levels PROM and three treatments of nano urea, tested in a randomized block design with factorial concept in three replications. The pooled results indicated that application of 200% RDP through PROM recorded significantly higher growth, yield attributes and yield parameters *viz*., plant height at 45 DAS and at harvest, effective tillers per plant, earhead length, grain and straw yields of pearlmillet;  |

*Keywords: PROM, Nano urea, Neem coated urea, Pearlmillet*

1. INTRODUCTION

Phosphorus (P) is the major plant nutrient and considered as one of the primary factor limiting crop yield (Zaidi *et al.,* 2009). In India 60% soil are low to medium status in soil available P content (Motsara, 2002) and based on nutrient index value, the soils of Banaskantha district are marginal in available phosphorus (Panchal *et al.,* 2018). Therefore, application of phosphatic fertilizers is essentially required to maximize crop yields. The nutrient availability from chemical fertilizers is not more than 20% and has forced the poor farmers to add two times more than the optimum application rate of P-fertilizers. PROM is the alternate source of the phosphatic fertilizers. It is well documented that during composting process of organic waste a variety of organic acids are released. The interaction of organic acids released during composting results in P solubilization from RP for plant uptake. The use of organic fertilizers made up of various composted materials, is now established as a key strategy not only for improving soil organic matter contents and nutrients supply to plants but also for reducing the input cost of mineral fertilizers and promoting healthier environments (Ahmad *et al*., 2006).

 The use of nano fertilizers is the most important application of nanotechnology in agriculture so far (Agrawal and Rathore, 2014; Naderi *et al.,* 2011). Nano urea may be a sustainable option for farmers towards smart agriculture and combat climate change. Nano urea may fulfil the plant nutrient requirement as a fertilizer since it is bio available to plants because of the size of one nano urea liquid particle is 30 nanometre and it has about 10,000 times more surface area as compared to the conventional granular urea. Hence, nano urea increases its availability to crop by more than 80% resulting in higher nutrient use efficiency (Lakshman *et al.,* 2022). In addition to this, nano urea helps in minimizing the environmental footprint by reducing the loss of nutrients from agriculture fields in the form of leaching and gaseous emissions which used to cause environmental pollution and climate change.

Pearl millet is the sixth most important cereal in the world and it is the fourth most widely grown food crop in India after rice, wheat and corn. As traditional arid and semi-arid crop, it is an important component of dry land agriculture. In India it is grown under 75.72 lakh ha with the production of 114.31 lakh tonne and productivity 1510 kg/ha(DA and FW, 2022-23). The productivity of pearlmillet, which is much lesser than its production potential, vary greatly with rainfall quantity, intensity and its distribution. Hence, the research effort should be diverted to overcome the constraints that are responsible for its productivity. To bring millets into mainstream for exploiting the nutritional rich properties and promoting their cultivation, Govt. of India has declared Year 2018 as the “Year of Millets” and the Year 2021 was declared as “International Year of Millets” by Food and Agriculture Organization Committee on Agriculture (COAG) forum.

2. materials and methods

 The field experiment was laid out at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Banaskantha (Gujarat). Geographically, Sardarkrushinagar is situated at 24º19ʹ North latitude and 72º19ʹ East longitude with an elevation of 154.42 m above the mean sea level. It is situated in the North Gujarat Agro-climatic Zone - IV. The soil of the experimental plot was loamy sand in texture, low in organic carbon and available N, medium in available P2O5, K2O, S and DTPA-extractable Zn. The experiment consisted of 15 treatment combination which comprises of five levels of phosphorous sources *i.e.,* P1 (100% RDP through DAP), P2 (50% RDP through PROM), P3 (100% RDP through PROM), P4 (150% RDP through PROM) and P5 (200% RDP through PROM) and three treatments of nano urea N1 (100% RDN through NCU), N2 (75% RDN through NCU + foliar spray of nano-urea @ 0.4% at 35 and 50 DAS) and N3 (50% RDN through NCU + foliar spray of nano-urea @ 0.4% at 35 and 50 DAS) which were laid out in a factorial randomized block design (FRBD) and replicated thrice. Recommended dose of fertilizer (RDF) for *kharif* pearlmillet was 80-40-00 kg N-P2O5-K2O/ha. 50% RDN of pearlmillet was applied as basal and remaining amount of RDN was applied at 30 DAS. Seed treatment of pearlmillet was made with *Azospirillum* and PSB each @ 5ml/kg seed. Common application of zinc sulphate (21% Zn) @10 kg/ha was applied as basal and FYM @ 5 t/ha was applied 10 days before the sowing of pearlmillet. The plot size was maintained at 7.2 m × 5.0 m. The variety GHB 1129 @ 3.75 kg/ha was used in the study. Seed rate of pearlmillet was 3.75 kg/ha. Plant spacing was maintained at 45 cm (row to row). PROM was applied at the time of sowing in granular form which contains 10.4% P2O5. Foliar spray of nano-urea as per treatment was carried out at 35 and 50 DAS**.** For the preparation of 0.4% nano urea solution 4 ml nano urea was used per one litre of water.

2.1 STATISTICAL ANALYSIS

The pooled analysis of the kharif pearlmillet crop were analyzed for two years was worked out as per the method described by Panse and Sukhatme (1985). Bartlett’s test was applied to examine the homogeneity of variance due to error. The variance obtained due to season x treatment components were tested against joint estimate of error variance with an objective to find out whether season x treatment interaction exist or otherwise.

3. results and discussion

3.1 growth parameters

The data on different plant growth parameters like plant height at 45 DAS and at harvest, number of effective tillers per plant and earhead length of pearlmillet as influenced by PROM and nano urea levels are presented in table 1 and 2.

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| Table 1: Effect of PROM and nano urea on plant height of pearlmillet |
| **Treatments** | **Plant height (cm)** |
| **At 45 DAS** | **At harvest** |
| **2022** | **2023** | **Pooled** | **2022** | **2023** | **Pooled** |
| **A: Levels of PROM (P)**  |  |
| P1: 100% RDP through DAP | 105.2 | 121.7 | 113.5 | 182.8 | 204.3 | 193.5 |
| P2: 50% RDP through PROM  | 91.6 | 106.6 | 99.1 | 175.5 | 190.7 | 183.1 |
| P3: 100% RDP through PROM | 101.7 | 118.9 | 110.3 | 180.6 | 200.2 | 190.4 |
| P4: 150% RDP through PROM  | 107.3 | 124.1 | 115.7 | 184.1 | 206.2 | 195.2 |
| P5: 200% RDP through PROM  | 112.7 | 129.7 | 121.2 | 188.6 | 213.5 | 201.1 |
| S.Em.± | 2.93 | 3.04 | 2.11 | 2.73 | 3.25 | 2.12 |
| CD @ 5% | 8.48 | 8.80 | 9.43 | 7.91 | 9.43 | 9.50 |
| **B: Nano urea spray (N)** |
| N1: 100% RDN through NCU | 109.8 | 126.1 | 117.9 | 189.4 | 209.1 | 199.2 |
| N2: 75% RDN through NCU + foliar spray of nano urea @ 0.4% at 35 and 50 DAS | 103.3 | 124.1 | 113.7 | 181.5 | 200.2 | 190.9 |
| N3:50% RDN through NCU + foliar spray of nano urea @ 0.4% at 35 and 50 DAS | 98.1 | 110.4 | 104.2 | 176.1 | 199.7 | 187.9 |
| S.Em.± | 2.27 | 2.35 | 1.63 | 2.11 | 2.52 | 1.65 |
| CD @ 5% | 6.57 | 6.82 | 7.31 | 6.13 | 7.30 | 7.36 |
| Interactions(P×N) (Y×P) (Y×N) (Y×P×N) | NS | NS | NS | NS | NS | NS |
| CV% | 8.47 | 7.58 | 7.99 | 4.49 | 4.81 | 4.68 |

**Table:- 2 Effect of PROM and nano urea on number of effective tillers per plant and**

 **earhead length of pearlmillet.**

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| --- | --- | --- |
| **Treatments** | **Number of effective tillers per plant** | **Earhead length (cm)** |
|  | **2022** | **2023** | **Pooled** | **2022** | **2023** | **Pooled** |
| **A: Levels of PROM (P)**  |
| P1: 100% RDP through DAP | 2.75 | 2.93 | 2.84 | 21.15 | 24.74 | 22.95 |
| P2: 50% RDP through PROM  | 2.56 | 2.58 | 2.57 | 17.53 | 20.57 | 19.05 |
| P3: 100% RDP through PROM | 2.68 | 2.74 | 2.71 | 20.09 | 23.78 | 21.94 |
| P4: 150% RDP through PROM  | 2.71 | 3.15 | 2.93 | 21.71 | 25.28 | 23.50 |
| P5: 200% RDP through PROM  | 2.91 | 3.23 | 3.07 | 23.21 | 26.92 | 25.07 |
| S.Em.± | 0.07 | 0.12 | 0.07 | 0.89 | 0.95 | 0.65 |
| CD @ 5% | 0.20 | 0.35 | 0.31 | 2.56 | 2.75 | 2.90 |
| **B: Nano urea spray (N)**  |
| N1: 100% RDN through NCU | 2.79 | 3.07 | 2.93 | 22.78 | 26.09 | 24.44 |
| N2: 75% RDN through NCU + foliar  spray of nano urea @ 0.4% at  35 and 50 DAS | 2.73 | 2.99 | 2.86 | 20.74 | 23.77 | 22.26 |
| N3:50% RDN through NCU + foliar  spray of nano urea @ 0.4% at  35 and 50 DAS | 2.64 | 2.71 | 2.67 | 18.70 | 22.91 | 20.81 |
| S.Em.± | 0.05 | 0.09 | 0.05 | 0.69 | 0.74 | 0.50 |
| CD @ 5% | NS | 0.27 | 0.24 | 1.99 | 2.13 | 2.25 |
| Interactions(P×N) (Y×P) (Y×N) (Y×P×N) | NS | NS | NS | NS | NS | NS |
| CV% | 7.58 | 12.53 | 10.54 | 12.81 | 11.75 | 12.25 |

The result shows that significantly higher plant height at at 45 DAS and at harvest, number of effective tillers per plant and earhead length of pearlmillet were obtained due to the application of 200% RDP through PROM (P5). The increased in growth parameter could be attributable to continuous optimum supply of phosphorous through the whole plant growth period at higher levels of PROM. The similar results were also reported by Singh *et al*. (2015).

Nano urea spray did not exert any significantly on plant height, number of effective tillers per plant and earhead length of peralmillet, but the application of 100% RDN through neem coated urea (N1) gave significantly the highest plant height at 45 and at harvest and earhead length of pearlmillet. The treatment N1 increased the effective tillers per plant by 2.33 and 10.00% over N2 and N3 respectively. It might be due to fact that an application of 100% RDN through NCU provide optimum nitrogen which improve the plant growth The similar results were also reported by Mehta and Bharat (2019).

The interaction effect of PROM and nano urea did not exert any significant effect on plant height at 45 DAS and at harvest, number of effective tillers per plant and earhead length of pearlmillet.

**3.2 GRAIN AND STRAW YILED**

A perusal of data presented in Table 3 revealed that at higher doses of PROM (200% RDP) significantly improved grain yield (2275 kg/ha) of pearlmillet over rest of treatments but it remained at par with treatment P4 (150% RDP through PROM) and P1 (100% RDP through DAP) during both the individual year as well as in pooled results. On a pooled basis, the application of 200% RDP through PROM (P5) increased grain yield by 10.75, 24.95, 14.47 and 8.36% over P1, P2, P3 and P4 treatments, respectively. The straw yield (5448, 5689 and 5569 kg/ha) of pearlmillet influenced significantly under the treatment of P5 (200% RDP through PROM). But it remained at par with P1, P3 and P4 in pooled analysis. An increase in grain and straw yield might be due to the fact that at higher dose of PROM provide optimum P to plant resulted improvement in root development which provide strength to the plant and also increase area for more absorption of nutrients. These results are in close agreement with those described by Raut *et al.* (2018), Chaudhari (2019), Jagadeesha *et al*. (2019), Aechra *et al.* (2021) and Ranjha *et al*. (2023).

It is explicated from the data presented in Table 4 revealed that application of 100% RDN through NCU gave the highest grain yield i.e 2101, 2383 and 2242 kg/ha during 2022, 2023 and in pooled results, respectively over the rest of treatments. The application of 100% RDN through NCU (N1) gave the highest straw yield 5319, 5572 and 5446 kg/ha over rest of the treatment but in pooled result it was remained at par with treatment N2. Significantly the higher grain yield was recorded at 100% RDN due to fact that the optimum application of nitrogen increases the growth of plant part and metabolic process such as photosynthesis leads to higher photosynthates accumulation and their translocation towards the economic parts of plant. moreover, it directly involved in energy transformation, activation of enzyme in carbohydrate metabolism and consequently greater translocation of photosynthates towards vegetative and reproductive parts led to overall improvement in growth and yield attributes (earhead length and effective tillers per plant) which ultimately reflects on grain yield. The results are close conforming with the results of Chavan et al. (2023) and Dokhe et al. (2024).

The interaction effect between PROM and nano failed to show its significant effect on grain and straw yield during both the individual years as well as in pooled analysis.

**3.3 TEST WEIGHT**

The data regarding the test weight of pearlmillet as influenced by PROM and nano urea are given in Table 4. It indicated that the different level of PROM and nano urea did not exert any significant effect on test weight of pearlmillet during both the individual years and in pooled results.

**Table 3: Effect of PROM and nano urea on grain and straw yield of pearlmillet**

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| **Treatments** | **Grain yield (kg/ha)** | **Straw yield (kg/ha)** |
|  | **2022** | **2023** | **Pooled** | **2022** | **2023** | **Pooled** |
| **A: Levels of PROM (P)**  |
| P1: 100% RDP through DAP | 1950 | 2158 | 2054 | 5033 | 5204 | 5119 |
| P2: 50% RDP through PROM  | 1726 | 1915 | 1821 | 4619 | 4854 | 4737 |
| P3: 100% RDP through PROM | 1895 | 2080 | 1987 | 4880 | 5109 | 4995 |
| P4: 150% RDP through PROM  | 2009 | 2190 | 2099 | 5157 | 5369 | 5263 |
| P5: 200% RDP through PROM  | 2154 | 2396 | 2275 | 5448 | 5689 | 5569 |
| S.Em.± | 73.3 | 88.7 | 57.5 | 174.6 | 188.2 | 128.3 |
| CD @ 5% | 212 | 257 | 257 | 506 | 545 | 574 |
| **B: Nano urea spray (N)**  |
| N1: 100% RDN through NCU | 2101 | 2383 | 2242 | 5319 | 5572 | 5446 |
| N2: 75% RDN through NCU + foliar spray of nano urea @ 0.4% at 35 and 50 DAS | 1932 | 2147 | 2039 | 4900 | 5125 | 5012 |
| N3:50% RDN through NCU + foliar spray of nano urea @ 0.4% at 35 and 50 DAS | 1807 | 1914 | 1861 | 4864 | 5038 | 4951 |
| S.Em.± | 56.8 | 68.7 | 44.6 | 135.2 | 145.8 | 99.4 |
| CD @ 5% | 164 | 199 | 199 | 392 | 422 | 445 |
| Interactions (P×N) (Y×P) (Y×N) (Y×P×N) | NS | NS | NS | NS | NS | NS |
| CV% | 11.29 | 12.39 | 11.92 | 10.42 | 10.76 | 10.60 |

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| Table 4: Effect of PROM and nano urea on test weight of pearlmillet  |
| **Treatments** | **Test weight (g)** |
|  | **2022** | **2023** | **Pooled** |
| **A: Levels of PROM (P)**  |
| P1: 100% RDP through DAP | 8.53 | 8.62 | 8.58 |
| P2: 50% RDP through PROM  | 8.11 | 8.30 | 8.16 |
| P3: 100% RDP through PROM | 8.24 | 8.50 | 8.37 |
| P4: 150% RDP through PROM  | 8.66 | 8.74 | 8.70 |
| P5: 200% RDP through PROM  | 8.70 | 8.80 | 8.75 |
| S.Em.± | 8.35 | 8.08 | 9.32 |
| CD @ 5% | NS | NS | NS |
| **B: Nano urea spray (N)**  |
| N1: 100% RDN through NCU | 8.73 | 8.76 | 8.74 |
| N2: 75% RDN through NCU + foliar spray of nano urea @ 0.4% at 35 and 50 DAS | 8.35 | 8.64 | 8.50 |
| N3: 50% RDN through NCU + foliar spray of nano urea @ 0.4% at 35 and 50 DAS | 8.20 | 8.39 | 8.29 |
| S.Em.± | 0.15 | 0.12 | 0.10 |
| CD @ 5% | NS | NS | NS |
| Interactions(P×N) (Y×P) (Y×N) (Y×P×N) | NS | NS | NS |
| CV% | 7.00 | 5.23 | 6.16 |

**4. CONCLUSION**

On the basis of two years experimental findings, it is concluded that application of 200% RDP through PROM and 100% RDN through neem coated urea recorded higher values and found beneficial in terms of growth, grain and straw yield of pearlmillet.

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