Yield Improvement and Nutrient Uptake of Little Millet (*Panicum sumatrense*) for Agronomic Interventions

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

ABSTRACT

Field experiments were conducted during *kharif*, 2019 and *kharif* 2020 at S.V. Agricultural College Farm, Tirupati with three different times of sowing of little millet (second fortnight of June, first fortnight of July and second fortnight of July) in combination with three methods of establishment (Broadcasting, Sowing at 30 cm × 10 cm and transplanting 20 days old seedlings) and three nitrogen levels (20 kg N ha\(^{-1}\); 30 kg N ha\(^{-1}\) and 40 kg N ha\(^{-1}\)). The results of the experiment revealed that among the three times of sowing, second fortnight of June sowings recorded higher grain yield, straw yield and nutrient uptake of little millet while lower values of these were obtained with July second fortnight sown crop during both the years of study. Transplanted little millet resulted in superior grain yield, straw yield and nutrient uptake compared to broadcasting and sowing at 30 cm × 10 cm. Maximum values of grain yield, straw yield and nutrient uptake were observed with application of 40 kg N ha\(^{-1}\) while minimum values of these parameters were obtained with application of 20 kg N ha\(^{-1}\). Transplanting little millet during second fortnight of June along with the application of 40 kg N ha\(^{-1}\) achieved higher grain and straw yield besides nutrient uptake by grain.
Keywords: Little millet; time of sowing; methods of establishment; nitrogen; yield; nutrient uptake.

1. INTRODUCTION

Small millets have gained their attention owing to their inherent capacity of early maturity, higher yield due to C₄ plant type, capacity to yield even in poor soil under low rainfall and poor management conditions; hence they are popularly known as “climate resilient” crops in Indian agriculture. Considering health consciousness and importance of nature’s nutraceutical value, demand for these group of crops are ever increasing. To harness the ethical value of the people and to meet the demand, scientific advancements and technologies are essential and need of the hour. Little millet is one among the six small millets grown in most of the regions of scanty and erratic rainfall on poor and marginal soils. Cultivation of this crop is mostly confined to hilly tract of poor tribal community of the country. The demand for little millet is increasing now-a-days due to its high nutritional profile with low glycemic index particularly by the people suffering from diabetes.

The choice of sowing time was identified as important management option to optimize yield of crop. Appropriate sowing method is the important non-monetary input in crop production, which affects the crop growth, yield and quality to a greater extent. Method of establishment play important role to fully exploit all available resources for growth as it provides optimum growing condition.

Because of its wider adaptability under moisture stress condition and flexibility with sowing time, this crop become promising and popular among the farmers of dry zone. But yield of crop is limited due to its cultivation on marginal and sub-marginal lands with imbalanced nutrition and negligence in cultivation practices. Nitrogen is the primary nutrient that determines the growth and yield of the crop as it is integral part of chlorophyll which ultimately manifests photosynthetic rate. Especially the technical interventions which improve the yield of little millet have been lacking. In this context, an experiment is planned for developing the agronomic tools that enhance the production potential of little millet crop in Southern agroclimatic zone of Andhra Pradesh.

2. MATERIALS AND METHODS

Field experiments were carried out during kharif, 2019 and kharif, 2020 at S.V. Agricultural College Farm, Tirupati, geographically situated at 13.5o N latitude and 79.5o E longitude at an altitude of 182.9 meters above mean sea level, categorised as the Southern Agro-climatic Zone of Andhra Pradesh. The experimental soil was sandy loam in texture, neutral in reaction (pH 6.9), low in organic carbon (0.37 per cent) and low in available nitrogen (177 kg ha⁻¹), medium in available phosphorus (28 kg ha⁻¹) and medium in potassium (216 kg ha⁻¹). The experiment was laid out in split-split-plot design with twenty seven treatment combinations and replicated thrice. The treatments comprised of three different times of sowing of little millet in main plots (T₁: second fortnight of June, T₂: first fortnight of July and T₃: second fortnight of July) in combination with three methods of establishment in sub-plots (M₁: Broadcasting, M₂: Sowing at 30 cm × 10 cm and M₃: Transplanting 20 days old seedlings) and three nitrogen levels in sub sub plots (N₁: 20 kg N ha⁻¹, N₂: 30 kg N ha⁻¹ and N₃: 40 kg N ha⁻¹). Little millet was established in the experiment field according to the treatments i.e., broadcasted @ 12 kg ha⁻¹, sown in lines with 30 cm × 10 cm spacing and transplanted 20 day old seedlings at 30 cm × 10 cm which were raised in nursery. The scheduled nitrogen was applied in two equal splits viz., first half at the time of sowing as basal and remaining half as top dressing at 50 DAS. Five plants were selected at random from net plot area and labelled with tags for recording growth and yield attributes during the crop growing period. The data recorded on various parameters of crop during the course of investigation was statistically analyzed following the analysis of variance procedure as suggested by Panse and Sukhatme [1]. Statistical significance was tested with ‘F’ test at 5 per cent level of probability and compared the treatment means with critical difference.

3. RESULTS AND DISCUSSION

3.1 Productivity

Grain yield of little millet was significantly influenced by the time of sowing, establishment methods and nitrogen levels during both the years of experimentation (Tables 1 & 2). Among the three different times of sowing, grain yield was significantly higher with June II fortnight sowing of little millet during kharif, 2019 while grain yield recorded with June II fortnight sowing was on par with the grain yield of July I fortnight sown little millet during Kharif, 2020. Significantly
higher straw yield was obtained with little millet sown during I fortnight of June during both the years of study. Significantly lower grain yield and straw yield of little millet were observed with the II fortnight of July sowing during both the years of field trials. Favorable weather conditions prevailed during II fortnight of June resulted in maximum uptake of nutrients by the crop due to which higher values of yield attributes were obtained and reflected in superior grain yield and straw yield of little millet sown during II fortnight of June. These results were in conformity with the findings of Rao et. al. [2], Jadhav et. al. [3] and Ramachandrappa et. al.[4].

Highest grain yield and straw yield of little millet was recorded with transplanting 20 days old seedlings during both the years of experimentation (Tables 1 & 2). Transplanting method of establishment resulted in significantly higher grain yield and straw yield compared with sowing at 30 cm × 10 cm, which is in turn significantly superior to broadcasting of little millet. During both the years of study, significantly lower grain yield and straw yield were recorded with broadcasting. Higher grain yield and straw yield of little millet in transplanting may be attributed due to more space between plants that resulted in higher number of tillers, panicle number and more grains from the wider spacing in transplanting compared to the closer spacing and scattered stands in broadcasting establishment method. Results of the experiment are in line with the findings of Upadhyay et al., [5], Patil et al., [6] and Chavan et al., [7].

Application of 40 kg N ha⁻¹ recorded highest grain yield and straw yield of little millet during both the years of experimentation, which were significantly comparable with that of 30 kg N ha⁻¹, which is significantly superior to 20 kg ha⁻¹ N application (Tables 1 & 2). The improvement in yield with enhanced nitrogen application might be attributed to better availability and uptake of nutrients which in turn lead to efficient metabolism. Sarala et al., [8], Shashidhara et al., [9] and Jyothi et al., [10] have reported similar findings.

The interaction effect between methods of establishment and nitrogen levels was significant during both the years of study. Maximum grain yield and straw yield were achieved with the transplanting method of establishment in combination with the application of 40 kg N ha⁻¹.

3.2 Nutrient Uptake

Uptake of nitrogen by grain and straw of little millet was highest with June II fortnight sown crop while lowest nitrogen uptake by grain and straw was observed with crop sown during II fortnight of July during both the years of field experiment (Tables 3 & 4). Little millet sown during II fortnight of June resulted in significantly superior nitrogen uptake by grain to the grain nitrogen uptake of I fortnight of July sown crop, which was statistically comparable with that of crop sown during II fortnight of July during kharif 2019. However, during kharif 2020, grain nitrogen uptake by little millet sown during II fortnight of June was statistically on par with that of the crop sown during I fortnight of July and was significantly higher than the July II fortnight sown crop. Crop sown during II fortnight of June and I fortnight of July were in parity with each other in terms of nitrogen uptake by straw and were statistically superior to the crop sown during II fortnight of July during both years of study. While phosphorous and potassium uptake by little millet were maximum with June II fortnight sown crop and statistically comparable with that of July I fortnight sown crop, which were in turn significantly higher than the crop sown during II fortnight of July during both the years of field experimentation. Higher nutrient uptake with early sown crop was due to longer vegetative lag phase of the crop for efficient use of growth resources leading to higher dry matter accumulation. Similar results were obtained by Deshmukh et al., [11] and Mubeena et al. [12].

Transplanting of 20 days old little millet seedlings recorded highest nitrogen, phosphorous and potassium uptake whereas lowest uptake of these nutrients was found with broadcasting method of establishment during both the years of study (Tables 3 & 4). Transplanting has attained highest nitrogen phosphorous and potassium uptake, which was in significant disparity with that of owing at 30 cm × 10 cm, which was significantly superior to broadcasting during both the years of experimentation. Wider spacing and lesser competition at each hill resulted in profuse rooting and tillering in transplanted little millet increased nutrient availability which correspondingly attributed to maximum nutrient uptake. These results are in line with the findings of Nitin et al. [13], Kanthi et al. [14] and Singh et al. [15].
Table 1. Grain yield (kg ha⁻¹) of little millet as influenced by time of sowing, methods of establishment and nitrogen levels

|          | 2019       | 2020       | Pooled |
|----------|------------|------------|--------|
|          | T₁, T₂, T₃ | Mean of M  | Mean of N |
| M₁ N₁    | 940, 804, 612 | 859, 947 | 965, 882, 669 | 923, 1018, N₁ N₂ | 952, 843, 640 | 891, 982 |
| N₂       | 1028, 878, 679 | 1111, 940, 737 | 1163, 1038, 813 | 1249, 1213, N₂ N₃ | 1152, 1042, 889 | 1197, 1161 |
| M₃ N₂    | 1141, 989, 844 | 1144, 1110, M₂ N₁ | 1163, 1095, 935 | 1242, 1363, M₂ N₃ | 1240, 1165, 917 | 1361, 1305 |
| N₃       | 1311, 1178, 1013 | 1433, 1292, 1098 | 1537, 1443, 1228 | 1354, 1245, 1071 | 1485, 1367, 1163 |
| M₄ N₃    | 1220, 1103, 869 | 1300, 1247, M₃ N₁ | 1260, 1226, 964 | 1422, 1363, M₃ N₃ | 1240, 1165, 917 | 1361, 1305 |
| N₄       | 1536, 1308, 1056 | 1795, 1509, 1305 | 1954, 1659, 1432 | 1597, 1384, 1117 | 1875, 1584, 1368 |
| Mean of T| 1279, 1111, 913 | Mean of T | Mean of T | Mean of T | 1352, 1232, 1011 | 1316, 1171, 962 |

Interaction between methods of establishment and nitrogen levels

|          | 2019       | 2020       | Pooled |
|----------|------------|------------|--------|
|          | M₁, M₂, M₃ | Mean of N  | Mean of N |
| N₁       | 785, 991, 1064 | 839, 1064 | 1150, 1018 | N₁, 812, 1028, 1107 | 982 |
| N₂       | 862, 1167, 1300 | 927, 1280 | 1432, 1313 | N₂, 894, 1223, 1366 | 1161 |
| N₃       | 930, 1274, 1536 | 1005, 1403 | 1682, 1363 | N₃, 967, 1338, 1609 | 1305 |
| Mean of M| 859, 1144, 1300 | Mean of M | Mean of M | Mean of M | 923, 1249, 1422 | 891, 1197, 1361 |

|          | 2019 | 2020 | Pooled |
|----------|------|------|--------|
|          | SEm ± | CD (P = 0.05) | SEm ± | CD (P = 0.05) | SEm ± | CD (P = 0.05) |
| T        | 18.8 | 115  | 20.3  | 123  | 19.5 | 118 |
| M        | 27.2 | 84   | 31.4  | 97   | 29.2 | 90 |
| N        | 27.5 | 79   | 30.6  | 88   | 29.0 | 83 |
| T×M      | 42.9 | NS   | 48.8  | NS   | 45.7 | NS |
| T×N      | 43.3 | NS   | 47.8  | NS   | 45.4 | NS |
| M×N      | 47.5 | 140  | 53.5  | 157  | 50.4 | 148 |
| T×M×N    | 11.1 | NS   | 12.6  | NS   | 11.8 | NS |
Table 2. Straw yield (kg ha\(^{-1}\)) of little millet as influenced by time of sowing, methods of establishment and nitrogen levels

|                  | 2019 | 2020 | Pooled |
|------------------|------|------|--------|
|                  | T\(_1\) | T\(_2\) | T\(_3\) | Mean of M | Mean of N | T\(_1\) | T\(_2\) | T\(_3\) | Mean of M | Mean of N | T\(_1\) | T\(_2\) | T\(_3\) | Mean of M | Mean of N |
| M\(_1\) N\(_1\)  | 1455  | 1265 | 1018  | 1350 | 1474 | 1751 | M\(_1\) N\(_1\) | 1475 | 1351 | 1115 | 1447 | 1573 | M\(_1\) N\(_1\) | 1465 | 1308 | 1067 | 1399 | 1524 |
| N\(_2\)          | 1579  | 1369 | 1114  | 1696 | 1456 | 1198 | N\(_2\)          | 1621 | 1474 | 1227 | 1580 | 1779 | N\(_2\)          | 1600 | 1421 | 1170 |       |       |
| N\(_3\)          | 1737  | 1525 | 1349  | 1753 | 1704 | 1561 | N\(_3\)          | 1761 | 1660 | 1501 | 1911 | 1855 | N\(_3\)          | 1749 | 1592 | 1425 | 1832 | 1779 |
| N\(_2\)          | 1975  | 1789 | 1592  | 2146 | 1948 | 1713 | N\(_2\)          | 2099 | 1974 | 1783 |       |       | N\(_2\)          | 2037 | 1881 | 1688 |       |       |
| N\(_3\)          | 2291  | 2092 | 1893  | 2653 | 2235 | 2009 | N\(_3\)          | 2474 | 2191 | 1855 |       |       | N\(_3\)          | 2382 | 2081 | 1754 |       |       |
| Mean of T        | 1931  | 1695 | 1448  |       |       |       | Mean of T        | 1352 | 1232 | 1011 |       |       | Mean of T        | 1982 | 1779 | 1535 |       |       |

Interaction between methods of establishment and nitrogen levels

|                  | 2019 | 2020 | Pooled |
|------------------|------|------|--------|
|                  | M\(_1\) | M\(_2\) | M\(_3\) | Mean of N | M\(_1\) | M\(_2\) | M\(_3\) | Mean of N | M\(_1\) | M\(_2\) | M\(_3\) | Mean of N |
| N\(_1\)          | 1246  | 1537 | 1639  | 1474 | N\(_1\) | 1314 | 1641 | 1765 | 1573 | N\(_1\) | 1280 | 1589 | 1702 | 1524 |
| N\(_2\)          | 1354  | 1785 | 1972  | 1704 | N\(_2\) | 1441 | 1952 | 2173 | 1855 | N\(_2\) | 1397 | 1869 | 2072 | 1779 |
| N\(_3\)          | 1450  | 1936 | 2305  | 1897 | N\(_3\) | 1587 | 2141 | 2535 | 2088 | N\(_3\) | 1519 | 2038 | 2420 | 1992 |
| Mean of M        | 1350  | 1753 | 1972  |       |       |       | Mean of M        | 1447 | 1911 | 2157 |       |       | Mean of M        | 1399 | 1832 | 2065 |       |       |

SEm ± CD (P = 0.05)

|                  | 2019 | 2020 | Pooled |
|------------------|------|------|--------|
|                  | T    | M    | N     | T×M   | T×N   | M×N   | T×M×N  |
| SEm ±            |       |      |       |       |       |       |       |
| T                | 26.4 | 161  | 27.3  | 166   | 26.7  | 163   |        |
| M                | 38.5 | 119  | 46.8  | 144   | 42.4  | 131   |        |
| N                | 38.8 | 111  | 42.7  | 122   | 40.6  | 116   |        |
| T×M              | 60.5 | NS   | 71.5  | NS    | 65.7  | NS    |        |
| T×N              | 60.9 | NS   | 66.3  | NS    | 63.3  | NS    |        |
| M×N              | 67.0 | 197  | 76.4  | 225   | 71.4  | 210   |        |
| T×M×N            | 15.7 | NS   | 18.0  | NS    | 16.8  | NS    |        |
### Table 3. Nitrogen uptake (kg ha\(^{-1}\)) by little millet at harvest as influenced by time of sowing, methods of establishment and nitrogen levels

| TREATMENTS                        | Straw 2019 | Straw 2020 | Straw Pooled | Grain 2019 | Grain 2020 | Grain Pooled | Total uptake 2019 | Total uptake 2020 | Total uptake Pooled |
|-----------------------------------|------------|------------|--------------|------------|------------|--------------|------------------|------------------|-------------------|
| **Times of sowing**               |            |            |              |            |            |              |                  |                  |                   |
| \(T_1\): II Fortnight of June     | 26.86      | 27.58      | 27.22        | 21.97      | 22.20      | 22.09        | 48.84            | 49.78            | 49.31             |
| \(T_2\): I Fortnight of July     | 25.27      | 26.32      | 25.79        | 19.70      | 21.05      | 20.37        | 44.96            | 47.37            | 46.17             |
| \(T_3\): II Fortnight of July    | 20.24      | 21.14      | 20.69        | 17.51      | 18.71      | 18.11        | 37.75            | 39.85            | 38.80             |
| **SEm ±**                         | 0.424      | 0.569      | 0.486        | 0.355      | 0.490      | 0.422        | 0.506            | 0.522            | 0.510             |
| CD (P = 0.05)                     | 2.58       | 3.47       | 2.96         | 2.16       | 2.98       | 3.08         | 3.18             | 3.10             |                   |
| **Methods of establishment**      |            |            |              |            |            |              |                  |                  |                   |
| \(M_1\): Broadcasting            | 21.40      | 22.31      | 21.86        | 17.08      | 17.53      | 17.31        | 38.48            | 39.84            | 39.16             |
| \(M_2\): Sowing at 30 cm x 10 cm | 24.45      | 25.28      | 24.86        | 20.01      | 21.04      | 20.53        | 44.45            | 46.32            | 45.39             |
| \(M_3\): Transplanting 20 day old seedlings (30 cm x 10 cm) | 26.52 | 27.46 | 26.99 | 22.09 | 23.39 | 22.74 | 48.61 | 50.85 | 49.73 |
| **SEm ±**                         | 0.392      | 0.357      | 0.364        | 0.336      | 0.417      | 0.375        | 0.600            | 0.687            | 0.633             |
| CD (P = 0.05)                     | 1.21       | 1.10       | 1.12         | 1.03       | 1.28       | 1.16         | 1.85             | 2.12             | 1.95              |
| **Nitrogen levels**               |            |            |              |            |            |              |                  |                  |                   |
| \(N_1\): 20 kg N ha\(^{-1}\)     | 20.58      | 21.69      | 21.14        | 16.86      | 17.14      | 17.00        | 37.44            | 38.83            | 38.13             |
| \(N_2\): 30 kg N ha\(^{-1}\)     | 24.65      | 25.85      | 25.25        | 20.13      | 21.40      | 20.76        | 44.78            | 47.24            | 46.01             |
| \(N_3\): 40 kg N ha\(^{-1}\)     | 27.14      | 27.51      | 27.32        | 22.19      | 23.42      | 22.81        | 49.33            | 50.93            | 50.13             |
| **SEm ±**                         | 0.409      | 0.409      | 0.396        | 0.369      | 0.439      | 0.403        | 0.612            | 0.661            | 0.627             |
| CD (P = 0.05)                     | 1.17       | 1.17       | 1.14         | 1.06       | 1.26       | 1.15         | 1.75             | 1.90             | 1.80              |
| **INTERACTION**                   |            |            |              |            |            |              |                  |                  |                   |
| TxM                               |            |            |              |            |            |              |                  |                  |                   |
| **SEm ±**                         | 0.699      | 0.761      | 0.708        | 0.593      | 0.766      | 0.678        | 0.988            | 1.103            | 1.030             |
| CD (P = 0.05)                     | NS         | NS         | NS           | NS         | NS         | NS           | NS               | NS               | NS                |
| TxN                               |            |            |              |            |            |              |                  |                  |                   |
| **SEm ±**                         | 0.718      | 0.812      | 0.741        | 0.631      | 0.766      | 0.709        | 1.002            | 1.071            | 1.022             |
| CD (P = 0.05)                     | NS         | NS         | NS           | NS         | NS         | NS           | NS               | NS               | NS                |
| MxN                               |            |            |              |            |            |              |                  |                  |                   |
| **SEm ±**                         | 0.700      | 0.680      | 0.668        | 0.621      | 0.748      | 0.682        | 1.053            | 1.161            | 1.089             |
| CD (P = 0.05)                     | NS         | NS         | NS           | NS         | NS         | NS           | NS               | NS               | NS                |
| TxMxN                             |            |            |              |            |            |              |                  |                  |                   |
| **SEm ±**                         | 0.175      | 0.184      | 0.174        | 0.152      | 0.190      | 0.170        | 0.253            | 0.278            | 0.262             |
| CD (P = 0.05)                     | NS         | NS         | NS           | NS         | NS         | NS           | NS               | NS               | NS                |
Table 4. Phosphorous and Potassium uptake by little millet at harvest as influenced by time of sowing, methods of establishment and nitrogen levels

| TREATMENTS                                                 | Phosphorous uptake (kg ha\(^{-1}\)) | Potassium uptake (kg ha\(^{-1}\)) |
|------------------------------------------------------------|-------------------------------------|-----------------------------------|
|                                                            | 2019      | 2020      | Pooled  | 2019      | 2020      | Pooled  |
| Times of sowing                                            |           |           |         |           |           |         |
| T\(_1\): II Fortnight of June                              | 11.17     | 11.61     | 11.39   | 22.33     | 23.45     | 22.89   |
| T\(_2\): I Fortnight of July                               | 8.89      | 10.24     | 9.57    | 19.93     | 20.92     | 20.42   |
| T\(_3\): II Fortnight of July                              | 7.37      | 8.43      | 7.90    | 17.64     | 18.60     | 18.12   |
| SEm ±                                                      | 0.187     | 0.231     | 0.161   | 0.190     | 0.224     | 0.204   |
| CD (P = 0.05)                                              | 1.14      | 1.41      | 0.98    | 1.15      | 1.36      | 1.24    |
| Methods of establishment                                   |           |           |         |           |           |         |
| M\(_1\): Broadcasting                                     | 7.43      | 8.59      | 8.01    | 18.12     | 19.14     | 18.63   |
| M\(_2\): Sowing at 30 cm x 10 cm                           | 9.00      | 10.04     | 9.52    | 19.87     | 20.87     | 20.37   |
| M\(_3\): Transplanting 20 day old seedlings (30 cm x 10 cm)| 11.00     | 11.66     | 11.33   | 21.90     | 22.96     | 22.43   |
| SEm ±                                                      | 0.311     | 0.188     | 0.201   | 0.424     | 0.461     | 0.442   |
| CD (P = 0.05)                                              | 0.96      | 0.58      | 0.62    | 1.31      | 1.42      | 1.36    |
| Nitrogen levels                                            |           |           |         |           |           |         |
| N\(_1\): 20 kg N ha\(^{-1}\)                              | 7.60      | 7.93      | 7.76    | 17.68     | 18.68     | 18.18   |
| N\(_2\): 30 kg N ha\(^{-1}\)                              | 9.14      | 10.62     | 9.88    | 20.12     | 21.13     | 20.62   |
| N\(_3\): 40 kg N ha\(^{-1}\)                              | 10.69     | 11.74     | 11.21   | 22.09     | 23.16     | 22.63   |
| SEm ±                                                      | 0.288     | 0.212     | 0.218   | 0.408     | 0.437     | 0.421   |
| CD (P = 0.05)                                              | 0.83      | 0.61      | 0.63    | 1.17      | 1.25      | 1.21    |
| INTERACTION                                                |           |           |         |           |           |         |
| T\(_x\)M                                                   |           |           |         |           |           |         |
| SEm ±                                                      | 0.478     | 0.352     | 0.327   | 0.629     | 0.690     | 0.657   |
| CD (P = 0.05)                                              | NS        | NS        | NS      | NS        | NS        | NS      |
| T\(_x\)N                                                   |           |           |         |           |           |         |
| SEm ±                                                      | 0.448     | 0.378     | 0.348   | 0.607     | 0.657     | 0.629   |
| CD (P = 0.05)                                              | NS        | NS        | NS      | NS        | NS        | NS      |
| M\(_x\)N                                                   |           |           |         |           |           |         |
| SEm ±                                                      | 0.512     | 0.353     | 0.368   | 0.716     | 0.771     | 0.741   |
| CD (P = 0.05)                                              | NS        | NS        | NS      | NS        | NS        | NS      |
| T\(_x\)M\(_x\)N                                             |           |           |         |           |           |         |
| SEm ±                                                      | 0.121     | 0.089     | 0.086   | 0.164     | 0.178     | 0.171   |
| CD (P = 0.05)                                              | NS        | NS        | NS      | NS        | NS        | NS      |
Application of 40 kg N ha\(^{-1}\) resulted in highest nitrogen, phosphorous and potassium uptake by little millet while lowest uptake of these was observed with 20 kg ha\(^{-1}\) N application during both the years (Table 3 & 4). Significantly superior nutrient uptake was found with 40 kg N ha\(^{-1}\), which was statistically comparable with that of 30 kg N ha\(^{-1}\), which in turn was significantly higher than application of 20 kg N ha\(^{-1}\). Application of 40 kg N ha\(^{-1}\) improved the microbial activity through enhanced root exudates and increased translocation of nutrients which might have contributed to higher nitrogen, phosphorus and potassium contents respectively in the plant tissue. These results are in accordance with the findings of Jyothi et al. [10] and Gautam et al., [16].

4. CONCLUSION

Transplanting 20 days old little millet seedlings along with application of 40 kg N ha\(^{-1}\) during second fortnight of June resulted in highest grain yield, straw yield and nutrient uptake by the crop. Lower grain and straw yield as well as nutrient uptake was found with broadcasting little millet along with 20 kg N ha\(^{-1}\) during second fortnight of July in the southern agroclimatic zone of Andhra Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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