Effect of nutrient management and PPFM application on growth and productivity of barnyard millet under rain-fed ecosystem

G Arun Balaji, Dr. S Sakthivel, Dr. C Chinnusamy and Dr. S Muthuramu

Abstract
An experiment was conducted during Rabi 2018 at Agricultural Research station, Paramakudi in Ramanathapuram (Dt). The objective of experiment was to find out the suitable fertilizer level along with drought mitigation measures to increase the yield of Barnyard millet under rain-fed condition. Growth character of Barnyard millet is expressed in terms of plant height and the yield characters are expressed in terms of number of productive tillers, length of panicle, test weight, grain and straw yield. Split application of 150 % of RDF 99:49.5:30 NPK kg ha⁻¹ (NK: 25% Basal, 75% in equal split at tillering & flowering) along with PPFM application synergistically increased the grain and straw yield of barnyard millet under rain-fed ecosystem. Application of PPFM is helpful in mitigating drought stress during crop growth period.

Keywords: Nutrient management, split application, PPFM, rain-fed ecosystem, barnyard millet

Introduction
Millets are predominant dry land crops. Barnyard millet is usually cultivated in an area were climatic and edaphic condition are unsuitable for rice cultivation (Sood et al., 2015) [1]. Among all the millets barnyard millet is hardy and vigorous growing nature, which can be grown in drought and waterlogging condition. Millets are quick growing and short duration cereals can withstand adverse condition (Raundal et al., 2017) [2]. Barnyard millet is highly nutritious. Good whiteness retention after milling and also has high milling percentage (70 %). Besides their nutritional value it has its own disadvantage of lower productivity (683 kg ha⁻¹), contribution of millets in total food production of India reduced from 22.17% to 6.94% over the last six decades (Malathi et al., 2015) [3]. Hence there is a scope to increase the productivity of barnyard millet under rain-fed condition with proper nutrient management and drought mitigation measures.

Materials and methods
The field experiment was conducted at Agricultural Research Station, Paramakudi during Rabi 2018. The beds were formed with a dimension of 5.0 m x 4.0 m and the plots were properly levelled to have uniform surface area. The field experiment was laid out in a Randomized block design with 12 treatment combination, replicated thrice and with net plot size of 4 m × 3.6 m. Pre- monsoon line sowing was taken on 05-09-2018 with the spacing of 25x10 cm. First soaking rain of 29 mm received on 15-09-2018. The recommended nutrients were applied through Urea, SSP and MOP. Phosphorous is applied as basal for all the treatments, N & K were applied to the crop as per the treatment schedule. Total amount of rainfall received during the cropping period was 374 mm received in 17 rainy days. PPFM application (1% spray solution) was given using high volume sprayer on 30 and at 50 days after receipt of soaking rain.

In each treatment, five plants were selected randomly for biometric observation. The observations on growth parameters, yield parameters and yield were recorded on 20 and 40 days after receipt of soaking rain and at harvest. The crop was harvested at 05-12-2018.

Treatment Details
T1- RDF (66:33:20 NPK kg ha⁻¹) as basal
T2- RDF (NK: 25% Basal, 25% Tillering & 50% Flowering)
T3- RDF (NK: 25% Basal, 75% in equal split at Tillering & Flowering)
T4- 150% RDF (99:49.5:30 NPK kg ha⁻¹) as basal
T5- 150% RDF (NK: 25% Basal, 25% Tillering & 50% Flowering)
T6- 150% RDF (NK: 25% Basal, 75% in equal split at Tillering & Flowering)
T7- RDF as basal + 1% PPFM**
T8- RDF (NK: 25% Basal, 25% Tillering & 50% Flowering) + 1% PPFM**
T9- RDF (NK: 25% Basal, 75% in equal split at Tillering & Flowering) + 1% PPFM**
T10- 150% RDF as basal + 1% PPFM**
T11- 150% RDF (NK: 25% Basal, 25% Tillering & 50% Flowering) + 1% PPFM**
T12- 150% RDF (NK: 25% Basal, 75% in equal split at Tillering & Flowering) + 1% PPFM**

**Entire dose of phosphorous applied as basal**

**PPFM application at 30 and 50 days after receipt of soaking rain**

Results and discussion

**Growth parameters**

Plant height was recorded at harvest, the highest plant height (143.2 cm) was recorded with T12 treatment compared to other treatment, which may be due to adequate availability of nutrient throughout the crop period as well as sufficient nutrient availability to the plants may lead to anatomical changes in plants such as increase in size of cells, intercellular spaces and thinner cell walls that leads to increased plant height, same result was noted by Raundal et al., (2017) in rain-fed little millet. Triveni et al., (2018) [4] and Sandhya Rani et al., (2017) [5] in finger millet.

**Yield parameters**

At harvest 150 % RDF NK; 25% Basal, 75% in equal split at tillering & flowering with 1% PPFM (T12) increased the number of tillers plant\(^{-1}\). Basal application of RDF (T1) recorded least number of tiller plant\(^{-1}\). Same trend was observed with regard to panicle weight. Application of 150% of RDF NK: 25% Basal, 75% in equal split at tillering & flowering with 1% PPFM (T12) recorded highest panicle weight (18.5 g panicle\(^{-1}\)) followed by the same treatment without PPFM application (T6) This may be due to increased vegetative growth and capacity to produce more number of tillers under higher nitrogen levels. This result corroborates with the findings of Sathya et al., (2009) [6]. Increased panicle length was observed with 150% of RDF NK: 25% Basal, 75% in equal split at tillering & flowering with 1% PPFM (T12). Optimum quantity of N and K available at flowering stage of crop, may increase the photosynthetic assimilates as well as tolerance to pest and diseases and uniform availability of nutrient to the crop increases the panicle length of barnyard millet. This result was confirmed with the findings of Raundal et al., (2017) in little millet. Treatment with increased fertilizer application at critical stage of crop recorded increased test weight (T12). Split application of nutrient to the plant makes the efficient use of available resource in rain-fed condition and also improves the source to sink relationship which ultimately shows the effect on test weight of crop. This result witnessed the result of Raundal et al., (2017) in rain-fed little millet.

**Grain and straw yield**

Highest grain and straw yield was recorded with treatment (T12) 1,568 kg ha\(^{-1}\) and 7,743 kg ha\(^{-1}\) followed by (T6) 1526 kg ha\(^{-1}\) of grain yield and 6319 kg ha\(^{-1}\) of straw yield. Number of productive tillers, panicle length, panicle weight and test weight exerted a very strong positive correlation with grain yield of plant Rinkey Arya et al., (2017) [7].

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Tillers plant(^{-1})</th>
<th>Panicle length (cm)</th>
<th>Test weight (g)</th>
<th>Panicle weight (g panicle(^{-1}))</th>
<th>Grain yield kg ha(^{-1})</th>
<th>Straw yield kg ha(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1: RDF</td>
<td>123.8</td>
<td>1.5</td>
<td>15.99</td>
<td>3.5</td>
<td>7.2</td>
<td>918</td>
<td>3611</td>
</tr>
<tr>
<td>T2: RDF (25% Basal, 25% Tillering &amp; 50% Flowering)</td>
<td>127.3</td>
<td>2.0</td>
<td>16.81</td>
<td>3.6</td>
<td>13.5</td>
<td>929</td>
<td>5277</td>
</tr>
<tr>
<td>T3: RDF (25% Basal, NK in equal split at Tillering &amp; Flowering)</td>
<td>128.4</td>
<td>2.2</td>
<td>17.21</td>
<td>3.7</td>
<td>11.1</td>
<td>944</td>
<td>3958</td>
</tr>
<tr>
<td>T4: 150% RDF</td>
<td>132.8</td>
<td>2.2</td>
<td>17.8</td>
<td>3.8</td>
<td>14.4</td>
<td>1031</td>
<td>5625</td>
</tr>
<tr>
<td>T5: 150% RDF (25% Basal, 25% Tillering &amp; 50% Flowering)</td>
<td>136.1</td>
<td>2.8</td>
<td>18.58</td>
<td>4.0</td>
<td>14.6</td>
<td>1104</td>
<td>4201</td>
</tr>
<tr>
<td>T6: 150% RDF (25% Basal, NK in equal split at Tillering &amp; Flowering)</td>
<td>141.0</td>
<td>3.4</td>
<td>19.64</td>
<td>4.1</td>
<td>16.0</td>
<td>1526</td>
<td>6319</td>
</tr>
<tr>
<td>T7: RDF + 1% PPFM</td>
<td>125.7</td>
<td>2.0</td>
<td>16.27</td>
<td>3.5</td>
<td>9.3</td>
<td>926</td>
<td>4757</td>
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<tr>
<td>T8: RDF (25% Basal, 25% Tillering &amp; 50% Flowering) + 1% PPFM</td>
<td>127.6</td>
<td>2.0</td>
<td>16.86</td>
<td>3.7</td>
<td>10.5</td>
<td>933</td>
<td>6631</td>
</tr>
<tr>
<td>T9: RDF (25% Basal, NK in equal split at Tillering &amp; Flowering) + 1% PPFM</td>
<td>128.8</td>
<td>2.2</td>
<td>17.32</td>
<td>3.8</td>
<td>11.5</td>
<td>995</td>
<td>5069</td>
</tr>
<tr>
<td>T10: 150% RDF + 1% PPFM</td>
<td>135.1</td>
<td>2.6</td>
<td>17.93</td>
<td>4.0</td>
<td>12.1</td>
<td>1083</td>
<td>5173</td>
</tr>
<tr>
<td>T11: 150% RDF (25% Basal, 25% Tillering &amp; 50% Flowering) + 1% PPFM</td>
<td>139.8</td>
<td>3.0</td>
<td>19.07</td>
<td>3.9</td>
<td>15.6</td>
<td>1250</td>
<td>6875</td>
</tr>
<tr>
<td>T12: 150% RDF (25% Basal, NK in equal split at Tillering &amp; Flowering) + 1% PPFM</td>
<td>143.2</td>
<td>4.0</td>
<td>20.2</td>
<td>4.1</td>
<td>18.5</td>
<td>1568</td>
<td>7743</td>
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<tr>
<td>Skd</td>
<td>6.07</td>
<td>0.16</td>
<td>0.89</td>
<td>0.15</td>
<td>1.51</td>
<td>57.0</td>
<td>237.7</td>
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<tr>
<td>CD (0.05%)</td>
<td>12.603</td>
<td>0.343</td>
<td>1.860</td>
<td>0.328</td>
<td>3.138</td>
<td>118.30</td>
<td>493.12</td>
</tr>
</tbody>
</table>

**Conclusion**

Split Application of 150% of RDF (99:49.5:33) (NK: 25% Basal, 75% in equal split at tillering & flowering) + 1% PPFM application on 30 and at 50 days of the crop period increased the grain yield and straw yield of Barnyard millet under rain-fed ecosystem. Thus in turn resulted in higher return to the rain-fed farmer.

**References**

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