Economics of different nitrogen sources (organic and inorganic) in kharif pearl millet (Pennisetum glaucum L.)

Shobha Kumari and Sonam Mahawar

Abstract
Among the response of different source of nitrogen, treatment T1 (25% RDN through VC + 75 % N through Urea + Azotobactor) recorded maximum plant height (277.17 cm), plant dry weight (98.83 g), number of tillers (3.40), crop growth rate (2.74 g m⁻² day⁻¹), relative growth rate (0.04 g g⁻¹ day⁻¹), ear plant⁻¹ (3.57), length of ear (31.85), no. of grains ear⁻¹ (3433.33), test weight (8.39 g), grain yield (4.97 t ha⁻¹), straw yield (12.99 t ha⁻¹), protein content (13.03 %) and harvest index (27.67 %). Whereas the lowest value in terms of plant height (246.33 cm), dry weight (98.83 g), number of grains ear⁻¹ (3433.33), test weight (7.15 g), protein content (9.15 %), harvest index (21.06 %) was recorded in the treatment T3 (100 % RDN through Urea). Further, number of tillers (2.03 plant⁻¹), crop growth rate (2.29 g m⁻² day⁻¹), relative growth rate (0.03 g g⁻¹ day⁻¹), number of ear (2.33 plant⁻¹), length of ear (26.07 cm), test weight (7.15 g), protein content (9.15 %), harvest index (21.06 %) was recorded in the treatment T3 (100 % RDN through Urea). The highest gross return (₹ 85620.00 ha⁻¹), net return (₹ 59522.00 ha⁻¹) and benefit cost ratio (2.28) were registered in treatment T1 (25% RDN through VC + 75 % N through Urea + Azotobactor). However, the lowest of value (₹ 49900.00 ha⁻¹), (₹ 5884.00 ha⁻¹) and (0.13) respectively in the treatment T3 (100 % RDN through VC).

Keywords: Kharif pearl millet, organic, nitrogen resources, plant height, grain yield and straw yield

Introduction
Pearl millet (Pennisetum glaucum L.) is largely grown for grain and fodder purpose under those situations where other crops generally fail. Pearl milletas a food crop is limited to the developing countries in Asia, and particularly in Africa and ranked sixth in the world followed by rice, wheat, maize, barley and sorghum (Anonymous, 2010-11). The important pearl millet growing countries are India, China, Nigeria, Pakistan, Sudan, Egypt, Arabia, and Russia. It is estimated that over 95% of pearl millet production is used as food, the remainder being divided between animal and poultry feed (7%), other uses (seed, bakery products, snacks, etc.) and waste. Pearl milletis used in flat breads (roti) or mixed up to 25% with wheat flour for use in yeast breads. In India, pearl milletis popularly known as Bajra, and it is the fourth most important cereal crop after rice, wheat and sorghum. It has the greatest potential among all the millets. The major producing states are Rajasthan (46%), Maharahatra (19%), Gujrat (11%), Uttar Pradesh (8%) and Haryana (6%), (Sonawane et al., 2010) [9]. Nutrient management system refers to combined application of all nutrient source viz. Vermicompost, use of Biofertilizer (Azotobactor) and inorganic fertilizer (urea). The combined effect of organic and inorganic source of nutrient help in maintaining yield stability through correction of nutrients deficiencies, enhancing their efficiency and providing favourable soil physiological condition (Behera et al., 2007) [2]. Biofertilizers play an important role in increasing the availability of native and applied nutrients and productivity in sustainable manner. Azotobactor is a free-living nitrogen fixing bacteria. It has been reported to fix about 20 kg N ha⁻¹ per year in a field of non legume crop and also secretes some growth promoting substances (Kumawat and Jat 2005) [9].

Materials and Method
Field experiment was conducted during kharif season 2015 at Crop Research Farm, Sam Higginbottom Institute of Agriculture, Technology & Sciences (Deemed-to-be-University) Allahabad. The experimental site is located at 250 57 N latitude, 870 19 E longitude and at an altitude of above mean sea level. The soil of the experimental area was sandy loam with moderately alkaline pH; low in organic carbon (0.32%) and available N (188.30 kg ha⁻¹), available P (34.50 kg ha⁻¹) and available K (87.00 kg ha⁻¹) during kharif 2015 respectively.
The experiment was laid out in Randomized Block Design (RBD) with two organic and inorganic sources of nitrogen with ten treatments combination on a plot size of 4 x 3 m². Before sowing, line was formed in the field as the spacing in treatments. Pearl millet was sown in line and covered with the soil. Pearl millet seeds were hand dibbled. The total quantity of nitrogen, phosphorus and potassium as per treatment in the form of two split application are applied, one at basal and the second application at top dressing.

All the agronomic practices were carried out uniformly to raised the crop. For taking data on yield and yield components on pearl millet five plants were selected randomly in each plot. Cost of cultivation, gross return, net return and benefit cost ratio was worked out to evaluate the economics of each treatment, based on the existing market prices of inputs and output. The Cost of Cultivation (ha⁻¹) for each treatment was work out separately, on the following basis:

The Gross return (ha⁻¹) from each treatment was calculated by

\[
\text{Gross return (ha}^{-1}) = \text{Income from grain + income from Stover}
\]

Net return (ha⁻¹): The net profit from each treatment was calculated separately, by using the following formula

\[
\text{Net return} = \text{Gross return (ha}^{-1}) - \text{Cost of cultivation (ha}^{-1})
\]

**Benefit cost ratio**

The benefit cost ratio was calculated using the following formula

\[
\text{Benefit cost ratio} = \frac{\text{Gross return (ha}^{-1})}{\text{Total cost of cultivation (ha}^{-1})}
\]

**Results and Discussion**

Observations regarding the response of organic and inorganic sources of nitrogen on economics of pearl millet are given in table (1 to 2).

**Grain yield (t ha⁻¹)**

The result revealed that there was significant difference between different treatments and maximum grain yield found (4.97) with treatment T₁₀ (25 % through VC + 75 % N through Urea + Azotobactor), while minimum grain yield (2.51) was observed in treatment T₁ (100 % RDN through Urea). However T₉ (25 % RDN through VC + 75 % N through Urea), T₈ (50 % RDN through VC + 50 % N through Urea + Azotobactor) were found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + Azotobactor), Choudhary et al., (2007) [4].

**Straw yield (t ha⁻¹)**

The result revealed that there was significant difference between different treatments and Maximum Stover yield(t ha⁻¹) was found (12.99) with treatment T₁₀ (25 % through VC + 75 % N through Urea + Azotobactor), while minimum Stover yield(9.30) was observed in treatment T₁ (100 % RDN through VC), However T₉ (25 % RDN through VC + 75 % N through Urea) was found statistically at par with T₁₀ (25 % through VC + 75 % N through Urea + Azotobactor). Rathor et al., (2008) [7] and Chellamuthu et al. (2004) [8].

**Cost of cultivation**

Maximum cost of cultivation (44061.00) was recorded in treatment T₄ (100 % RDN through VC + Azotobactor), whereas the lowest value 19913.21 ha⁻¹ in T₄ (100 % RDN through Urea). Singh et al., (2003) [9] and Malik et al., (1990) [10].

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**Table 1: Variable cost and Cost of cultivation of each treatments.**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fixed cost</th>
<th>Variable cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ 100 % RDN through Urea</td>
<td>14016.00</td>
<td>5897.21</td>
<td>19913.21</td>
</tr>
<tr>
<td>T₂ 100 % RDN through Urea + Azotobactor</td>
<td>14016.00</td>
<td>5942.21</td>
<td>19958.21</td>
</tr>
<tr>
<td>T₃ 100 % RDN through VC</td>
<td>14016.00</td>
<td>30000.00</td>
<td>44016.00</td>
</tr>
<tr>
<td>T₄ 100 % RDN through VC + Azotobactor</td>
<td>14016.00</td>
<td>30045.00</td>
<td>44061.00</td>
</tr>
<tr>
<td>T₅ 75 % RDN through VC + 25 % N through Urea</td>
<td>14016.00</td>
<td>24041.80</td>
<td>38057.80</td>
</tr>
<tr>
<td>T₆ 75 % RDN through VC + 25 % N through Azotobactor</td>
<td>14016.00</td>
<td>24086.80</td>
<td>38102.80</td>
</tr>
<tr>
<td>T₇ 50 % RDN through VC + 50 % N through Urea</td>
<td>14016.00</td>
<td>18172.58</td>
<td>32188.58</td>
</tr>
<tr>
<td>T₈ 50 % RDN through VC + 50 % N through Azotobactor</td>
<td>14016.00</td>
<td>18217.58</td>
<td>32333.58</td>
</tr>
<tr>
<td>T₉ 25 % RDN through VC + 75 % N through Urea</td>
<td>14016.00</td>
<td>12036.41</td>
<td>26052.41</td>
</tr>
<tr>
<td>T₁₀ 25 % RDN through VC + 75 % N through Azotobactor</td>
<td>14016.00</td>
<td>12081.41</td>
<td>26097.41</td>
</tr>
</tbody>
</table>

Urea=6 kg⁻¹, SSP=8 kg⁻¹, MOP=17.8 kg⁻¹
Azotobactor=100 kg⁻¹, Vermicompost= 5 kg⁻¹

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Yield (t ha⁻¹)</th>
<th>Return (₹ ha⁻¹)</th>
<th>Gross return (₹ ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ 100 % RDN through Urea</td>
<td>3.14</td>
<td>37680.00</td>
<td>22780.00 60460.00</td>
</tr>
<tr>
<td>T₂ 100 % RDN through Urea + Azotobactor</td>
<td>3.29</td>
<td>39480.00</td>
<td>23020.00 62500.00</td>
</tr>
<tr>
<td>T₃ 100 % RDN through VC</td>
<td>2.51</td>
<td>30120.00</td>
<td>19780.00 49900.00</td>
</tr>
<tr>
<td>T₄ 100 % RDN through VC + Azotobactor</td>
<td>2.68</td>
<td>33600.00</td>
<td>19980.00 53580.00</td>
</tr>
<tr>
<td>T₅ 75 % RDN through VC + 25 % N through Urea</td>
<td>3.04</td>
<td>36480.00</td>
<td>20280.00 56760.00</td>
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<tr>
<td>T₆ 75 % RDN through VC + 25 % N through Azotobactor</td>
<td>3.11</td>
<td>37320.00</td>
<td>20520.00 57840.00</td>
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<td>T₇ 50 % RDN through VC + 50 % N through Urea</td>
<td>3.77</td>
<td>45240.00</td>
<td>22200.00 67440.00</td>
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<tr>
<td>T₈ 50 % RDN through VC + 50 % N through Azotobactor</td>
<td>4.68</td>
<td>56160.00</td>
<td>22680.00 78840.00</td>
</tr>
<tr>
<td>T₉ 25 % RDN through VC + 75 % N through Urea</td>
<td>4.72</td>
<td>56640.00</td>
<td>25340.00 81980.00</td>
</tr>
<tr>
<td>T₁₀ 25 % RDN through VC + 75 % N through Azotobactor</td>
<td>4.97</td>
<td>59640.00</td>
<td>25980.00 85620.00</td>
</tr>
</tbody>
</table>

Sales rate of grain=12.00 kg⁻¹
Sales rate of straw=2.00 kg⁻¹

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**Gross return:** Maximum gross return (85620.00 ha\(^{-1}\)) was recorded in treatment T10 (25 % through VC + 75 % N through Urea + Azotobactor), which was the lowest value 49900.0 ha\(^{-1}\) in T3 (100 % RDN through VC).

**Net return:** Maximum net return (59522.00 ha\(^{-1}\)) was recorded in treatment T10 (25 % through VC + 75 % N through Urea + Azotobactor), whereas the lowest value 5884.00 ha\(^{-1}\) in T3 (100 % RDN through VC).

**Benefit cost ratio:** Maximum benefit cost ratio (2:28) was recorded in treatment T10 (25 % through VC + 75 % N through Urea + Azotobactor), whereas the lowest value 0:13 in T3 (100 % RDN through VC).

This study has showed that integrated use of inorganic along with organic manure resulted in maximum returns per rupees invested on production inputs. The result suggested that application of recommended dose of NPK along with organic manure was important for improving productivity, grain quality and profitability of pearl millet.

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**References**