Maize (Zea mays) has high genetic yield potential than other cereal crops. Hence, it is called as ‘miracle crop’ and also as ‘queen of cereals’. Being a C_4 plant, it is very efficient in converting solar energy into dry matter. As heavy feeder of nutrients, maize productivity is largely dependent on nutrient management. Among the essential nutrient elements of plants, nitrogen plays an important role as far as plant growth and development is concerned and accounts for 1 to 4 per cent of dry matter of plants. Nitrogen content in plant tissue depends on its availability in soil which in turn depends on soil factors like pH, organic matter status in soil and biological activity of soil. Many workers proved that available nitrogen status in soils increased with increased supply of nitrogen in the form of either fertilizers or organic manures which ultimately increased the productivity of maize. Further, they reported that only 30 to 40 per cent of the added nitrogen was recovered by crops due to its leaching, volatilization and denitrification losses. The nitrate that is leached from fields, moves with water and contaminates either ground water or surface water bodies and causes an environmental pollution. Hence, management practices may be vital to increase nitrogen use efficiency by crops and also to reduce environmental pollution.

In soils of sandy loam texture coming under high rainfall areas, owing to their low organic matter status and leaching loss of nitrogen from these soils, the availability of nitrogen in soils is low and this becomes a limiting factor for crop production. Therefore, to understand the transformation of nitrogen and their availability to plants becomes an essential part of nitrogen management in order to increase productivity and also to maintain the soil health.

**RESEARCH PROCEDURE**

The experiment was conducted at College of Agriculture, Navile, Shimoga during Kharif 2009 to study effect of integrated nutrient management practices on nitrogen fractions, nitrogen use efficiency and productivity of maize (Zea mays L.). Two levels of nitrogen applied through organics (FYM and Vermicompost) and inorganics involving nine treatment combinations were tried in a RCBD with three replications. An agronomic nitrogen use efficiency was found highest (73.00) in the treatments involving package of practices compared to other treatments. However, nitrogen use efficiency was found to be more at lower level of nitrogen application and also in the integrated treatments compared to the treatments which received only NPK fertilizers.
per cent N through fertilizer, T1 – 100 per cent N + 7.5 t ha\(^{-1}\) FYM (Package of practices), T2 – 150 per cent N + 7.5 t ha\(^{-1}\) FYM, T3 – 100 per cent N (50 % N through fertilizer + 50% N through FYM ), T4 – 150 per cent N (75% N through fertilizer + 75% N through FYM), T5 – 100 per cent N (50% N through fertilizer + 50% N through Vermicompost), T6 – 150 per cent N (75% N through fertilizer + 75% N through vermicompost) (Note: 100 % P and K applied to all treatments except absolute control)

**Nitrogen use efficiency (NUE):**

The agronomic nitrogen use efficiency (ANUE), physiological nitrogen use efficiency (PNUE), apparent recovery of applied nitrogen (ARN) and partial factor productivity for applied N (PFP\(_N\)) were calculated using the following equations (Cassman et al., 1998).

\[
\text{ANUE} = \frac{\text{GY}_F - \text{GY}_O}{\text{N}_F}
\]

where:

\[
\text{GY}_F = \text{Grain yield from nitrogen applied plot}
\]

\[
\text{GY}_O = \text{Grain yield from absolute controlled plot.}
\]

\[
\text{N}_F = \text{Fertilizer N applied}
\]

\[
\text{PNUE} = \frac{\text{GY}}{\text{TN}}
\]

where:

\[
\text{GY} = \text{Grain yield}
\]

\[
\text{TN} = \text{Total nitrogen uptake}
\]

\[
\text{ARN} = \frac{(\text{TN}_F - \text{TN}_O)}{\text{N}_F}
\]

where:

\[
\text{TN}_F = \text{Total plant N uptake with fertilizer N application}
\]

\[
\text{TN}_O = \text{Total plant N uptake without N application}
\]

\[
\text{N}_F = \text{Fertilizer N applied}
\]

\[
\text{PFP}_N = \frac{\text{GY}_F}{\text{N}_F}
\]

where:

\[
\text{GY}_F = \text{Grain yield with fertilizer N application}
\]

\[
\text{N}_F = \text{Fertilizer N applied}
\]

All of the above quantities are expressed in kg ha\(^{-1}\)

### RESEARCH ANALYSIS AND REASONING

The results obtained from the present investigation have been discussed below:

**Effect of integrated nutrient management practices on nitrogen use efficiency by maize crop:**

The differential effect of treatments on nitrogen use efficiency was quite obvious in this study. Data presented in (Table 1) reveal that agronomic nitrogen use efficiency (ANUE), physiological nitrogen use efficiency(PNUE), apparent recovery of applied nitrogen(AR) and partial factor productivity for applied N of maize were significantly higher in the treatment T4 (100% N + 7.5 t ha\(^{-1}\) FYM) compared to other treatments. Further integrated treatments (T6, T7, T8 and T9) recorded better nitrogen use efficiency over control and treatments which received

<table>
<thead>
<tr>
<th>Properties</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil taxonomy</td>
<td>Typic haplustalf</td>
</tr>
<tr>
<td>Sand (%)</td>
<td>71.78</td>
</tr>
<tr>
<td>Silt (%)</td>
<td>11.89</td>
</tr>
<tr>
<td>Clay (%)</td>
<td>16.33</td>
</tr>
<tr>
<td>Textural class of soil</td>
<td>Sandy loam</td>
</tr>
<tr>
<td>Soil pH</td>
<td>5.10</td>
</tr>
<tr>
<td>Organic carbon (%)</td>
<td>0.33</td>
</tr>
<tr>
<td>Nitrogen (kg ha(^{-1}))</td>
<td>197.20</td>
</tr>
<tr>
<td>Phosphorus (kg P(_2)O(_5) ha(^{-1}))</td>
<td>52.80</td>
</tr>
<tr>
<td>Potassium (kg K(_2)O ha(^{-1}))</td>
<td>182.40</td>
</tr>
</tbody>
</table>

**Table 1: Effect of integrated nutrient management practices on nitrogen use efficiency of maize**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>ANUE</th>
<th>PNUE</th>
<th>AR</th>
<th>PFP(_N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1- Absolute control</td>
<td>0.00</td>
<td>141.52</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>T2-100% N through fertilizer</td>
<td>36.00</td>
<td>111.14</td>
<td>36.53</td>
<td>58.00</td>
</tr>
<tr>
<td>T3-150% N through fertilizer</td>
<td>26.73</td>
<td>108.72</td>
<td>27.56</td>
<td>41.33</td>
</tr>
<tr>
<td>T4-100%N +7.5t ha(^{-1}) FYM</td>
<td>73.00</td>
<td>83.34</td>
<td>98.24</td>
<td>95.00</td>
</tr>
<tr>
<td>T5-150%N +7.5t ha(^{-1})FYM</td>
<td>46.50</td>
<td>81.52</td>
<td>64.57</td>
<td>61.11</td>
</tr>
<tr>
<td>T6- 100%N (50%N through fertilizer+50%N through FYM)</td>
<td>67.00</td>
<td>83.33</td>
<td>91.24</td>
<td>89.00</td>
</tr>
<tr>
<td>T7- 150%N (75%N through fertilizer+75%N through FYM)</td>
<td>45.90</td>
<td>83.33</td>
<td>62.16</td>
<td>60.44</td>
</tr>
<tr>
<td>T8- 100%N (50%N through fertilizer+50%N through Vermicompost)</td>
<td>65.56</td>
<td>83.34</td>
<td>89.47</td>
<td>84.56</td>
</tr>
<tr>
<td>T9- 150%N (75%N through fertilizer+75%N through Vermicompost)</td>
<td>44.86</td>
<td>81.96</td>
<td>62.22</td>
<td>59.51</td>
</tr>
</tbody>
</table>

Note: 100% P & K applied to all treatments except absolute control.

ANUE - Agronomic nitrogen use efficiency

PNUE - Physiological nitrogen use efficiency

AR - Apparent recovery of applied N

PFP\(_N\) - Partial factor productivity for applied N
only fertilizers without any organic manure. This may be due to favourable influence of soil moisture coupled with adequate nutrient supply during crop growth. The maximum nitrogen use efficiency seemed to have been registered in the treatment $T_4$ ($100\% \text{ N} + 7.5 \text{ t ha}^{-1} \text{ FYM}$) in all the parameters studied. Finally, it is recognized that efficiency of added nitrogen would increase when other nutrient are in adequate supply for crop growth.

On the whole it can be concluded that blending of 50 and 75 per cent N fertilizer integrating with 50 and 75 per cent N through organic manures had the potential to substitute recommend fertilizer N and is likely that N losses due to leaching, de-nitrification might have reduced due to blending of N fertilizer with manures resulting in improved N use efficiency and long term release of nutrients from manures (Table 1 and Fig. 1). This premise is supported by the fact of N contents in stover and grain and total N uptake by maize. These results are in line with the findings of (Wolkowski, 2003, Rizwan Ahmad et al., 2006; Moll et al., 1982).

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**LITERATURE CITED**

