EFFECT OF IPNS ON PRODUCTIVITY, PROFITABILITY
AND ECONOMIC FEASIBILITY OF MAIZE BASED
CROPPING SYSTEM ON FARMERS’ FIELD

G.C. Munda, Mokidul Islam* and D.P. Patel
Division of Agronomy,
ICAR Research Complex for NEH Region, Umroi Road, Umiam - 793 103, Meghalaya, India

ABSTRACT

The adaptive trials were conducted during 2002-04 in four villages of two districts in Meghalaya to find out the productivity, profitability and economic feasibility of maize – mustard cropping system. Significantly higher grain yield (36.18 q ha⁻¹), increase of grain yield over farmers’ practices (74.94%), productivity (50.18 q ha⁻¹ MEY), net return (Rs. 10178 ha⁻¹ year⁻¹) and benefit: cost ratio (2.03) were recorded maximum with IPNS technology of FYM @ 5 t ha⁻¹ + recommended dose of fertilizers in maize (80:60:40 kg NPK ha⁻¹) on farmers field at all the locations. The highest production potential (40.91 q ha⁻¹) was recorded at Lumkremmonbhut followed by Mawlasnai (38.65 q ha⁻¹). However, the highest harvest index (0.126) was recorded at Mawlasnai and land utilization efficiency (71.78%) at Mawbri.

INTRODUCTION

Maize (Zea mays L.) is the major stable food crop of Meghalaya after rice occupying more than 80 percent of net sown area. The total area under maize in Meghalaya is 0.017 m ha with the average productivity of 14.12 q ha⁻¹ that is lower than the national average (18.41 q ha⁻¹) (India Directorate of Economics and Statistics, 2001). The low productivity and cropping intensity in Meghalaya are due to use of local tall varieties, mono-cropping and the shifting cultivation with improper nutrient management. The Integrated Plant Nutrient System (IPNS) management is the only way to increase the productivity and cropping intensity with the integrated use of organic, inorganic and locally available materials as supplementary sources of nutrients. A single nutrient source alone can not meet the complete plant nutritional demand, although integrated nutrient management was attempted by Jayakumar et al., 1995, its conjunctive use of nutrient sources in maize and their residual effects are meagre. Therefore, this investigation was undertaken to study the effect of IPNS on productivity, profitability and economic feasibility of maize based cropping systems on farmers’ field of Meghalaya.

MATERIAL AND METHODS

The adaptive trials on maize (Vijay Composite) - mustard (M 27) cropping system were conducted during 2002-03 and 2003-04 with active participation of farmers at four different locations viz., Lumkremmonbhut (Umsamlem), Mawlasnai and Mawbri in Ri-Bhoi district and Mawklot in East Khasi Hills district of Meghalaya with five treatments viz., (T₁) No FYM + recommended fertilizers (80:60:40 kg NPK ha⁻¹), (T₂) FYM @ 5 t ha⁻¹ + recommended fertilizers, (T₃) FYM @ 5 t ha⁻¹ + 50% of recommended fertilizers, (T₄) Farmers’ practices (FYM + N fertilizer) and (T₅) No FYM + No recommended fertilizers. The treatments were replicated four times in each location in the randomized block design. On an average, the fertility status of all the locations were acidic in reaction (pH 4.83 - 5.53), high in organic carbon (0.79-1.23%), medium to high in available N (454.63-557.78 kg ha⁻¹), low in available P (6.7-8.2 kg ha⁻¹) and medium to high in available K (283.33-303.33 kg ha⁻¹). The fertilizers were applied 80:60:40 kg NPK ha⁻¹ in maize and 50:30:20 kg NPK

* Address for correspondence: Department of RDAP, NEHU, Tura Campus, Chandmari -794 002, Meghalaya, India.
ha⁻¹ in mustard at all the locations. Crops were grown with the recommended package of practices. Maize variety Vijay composite was sown during the month of April and mustard during October in each year in each location as per treatments.

Growth and yield attributes of crops were recorded at the time of harvesting. Net returns (Rs/ha/year) were calculated for every year and pooled. Land utilization efficiency was calculated from total duration of crops in the cropping system divided by 365 and production efficiency from total economic yield in the cropping system divided by total duration of crops in a system. Production potential in terms of maize equivalent yield in the cropping system was calculated as the economic yield of mustard multiplied by price per quintal of mustard divided by price per quintal of maize (Ram, Sewa et al., 2000).

**RESULTS AND DISCUSSION**

**Growth and yield components**

At Lumkremmonbhut (Umsamlem) village, the data revealed that the significantly highest plant height (263.82 cm), basal girth (7.88 cm), cob length (16.75 cm), grains/cob (406.13) and grain yield (36.18 q ha⁻¹) were recorded with FYM @ 5 t ha⁻¹ + recommended fertilizers as compared to others. However, there was no significant difference in grain weight/cob, seed index and stover yield of maize. At Mawlasnai, significantly higher plant height (225.18 cm), basal girth (7.25 cm), cob length (15.61 cm) and grain yield (35.82 q ha⁻¹) were recorded with FYM @ 5 t ha⁻¹ + recommended fertilizers. At Mawklot village, most of the attribute had no significant difference except basal girth, grain yield and stover yield. The maximum grain yield (30.72 q ha⁻¹) was recorded with FYM @ 5 t ha⁻¹ + recommended dose of fertilizers. At Mawbri, the significantly higher plant height (277.33 cm), basal girth (7.63 cm), grains/cob (309.55), seed index (42.67 g) and stover yield (20.56 t ha⁻¹) were recorded with FYM@5 t ha⁻¹ + 50% recommended dose of fertilizers. However, the highest grain yield (33.61 q ha⁻¹) was recorded with FYM@ 5 t ha⁻¹ + recommended dose of fertilizers, which was at with FYM@ 5 t ha⁻¹ + 50 % recommended dose of fertilizers (31.25 q ha⁻¹, Table 1). Brar et al. (2001) reported that the maize crop gave optimum yield with FYM @ 10 t ha⁻¹ + 100:50:50 kg NPK ha⁻¹.

**Crop productivity**

The grain yield of maize was increased in all the locations with FYM @ 5 t ha⁻¹ + recommended dose of fertilizer over control. The maximum increased yield of 84.06 % was recorded at Mawklot village followed by Mawbri (74.33%), Mawlasnai (66.84%) and Lumkremmonbhut (49.88%). However, the maximum increase of grain yield of 74.94% was recorded with FYM @ 5 t ha⁻¹ + recommended dose of fertilizer over farmers’ practice among all the locations (Table 1). The productivity performance of maize-mustard cropping system was found better with FYM 5 t ha⁻¹ + recommended dose of fertilizer in all the locations. The highest productivity of 50.18 q ha⁻¹ year⁻¹ was recorded with FYM 5 t ha⁻¹ + recommend dose of fertilizers at Lumkremmonbhut village (Table 2).

Residual effect of treatments on mustard revealed that the highest seed yield (5.04 q ha⁻¹) was recorded with FYM@5 t ha⁻¹ + recommended fertilizers at Mawklot village, most of the attribute had no significant difference except basal girth, grain yield and stover yield. The maximum grain yield (30.72 q ha⁻¹) was recorded with FYM@5 t ha⁻¹ + recommended dose of fertilizers. At Mawbri, the significantly higher plant height (277.33 cm), basal girth (7.63 cm), grains/cob (309.55), seed index (42.67 g) and stover yield (20.56 t ha⁻¹) were recorded with FYM@5 t ha⁻¹ + 50% recommended dose of fertilizers. However, the highest grain yield (33.61 q ha⁻¹) was recorded with FYM@ 5 t ha⁻¹ + recommended dose of fertilizers, which was at with FYM@ 5 t ha⁻¹ + 50 % recommended dose of fertilizers (31.25 q ha⁻¹, Table 1). Brar et al. (2001) reported that the maize crop gave optimum yield with FYM @ 10 t ha⁻¹ + 100:50:50 kg NPK ha⁻¹.

**System productivity**

The highest production potential (40.91 q ha⁻¹) was recorded at Lumkremmonbhut followed by Mawlasnai (38.65 q ha⁻¹). However, the highest harvest index was recorded at Mawlasnai (0.126) which may be due to higher production of biological yield (Table 3). The highest land utilization efficiency (71.78 %) was recorded at Mawbri followed by Mawklot and Mawlasnai village because the crop sequence occupied the field for the largest duration (262 days).
### Table 1. Effect of IPNS on growth and yield attributes of Maize at different locations on farmers' field

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th>Basal girth (cm)</th>
<th>Cob length (cm)</th>
<th>Grains/ cob (Nos)</th>
<th>Grain cob weight (g)</th>
<th>Seed index (g)</th>
<th>Grain yield (t ha⁻¹)</th>
<th>Stover yield (t ha⁻¹)</th>
<th>Increase over control (%)</th>
<th>Increase over farmers' practice (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumkremmonbhut (Umsamlem)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>248.17</td>
<td>7.54</td>
<td>15.99</td>
<td>337.84</td>
<td>126.21</td>
<td>35.14</td>
<td>30.42</td>
<td>24.59</td>
<td>26.01</td>
<td>7.04</td>
</tr>
<tr>
<td>T₂</td>
<td>263.82</td>
<td>7.88</td>
<td>16.75</td>
<td>406.13</td>
<td>146.02</td>
<td>35.84</td>
<td>36.18</td>
<td>24.48</td>
<td>49.89</td>
<td>27.30</td>
</tr>
<tr>
<td>T₃</td>
<td>243.84</td>
<td>7.47</td>
<td>15.57</td>
<td>359.36</td>
<td>120.82</td>
<td>32.66</td>
<td>33.48</td>
<td>23.34</td>
<td>38.69</td>
<td>17.80</td>
</tr>
<tr>
<td>T₄</td>
<td>251.58</td>
<td>7.25</td>
<td>15.23</td>
<td>378.71</td>
<td>110.35</td>
<td>32.05</td>
<td>28.42</td>
<td>23.70</td>
<td>17.73</td>
<td>-</td>
</tr>
<tr>
<td>T₅</td>
<td>212.27</td>
<td>6.72</td>
<td>14.36</td>
<td>266.38</td>
<td>112.42</td>
<td>29.85</td>
<td>24.14</td>
<td>24.07</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>28.88</td>
<td>0.57</td>
<td>1.78</td>
<td>82.11</td>
<td>NS</td>
<td>NS</td>
<td>9.55</td>
<td>NS</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mawlasnai</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂</td>
<td>225.18</td>
<td>7.25</td>
<td>15.61</td>
<td>361.09</td>
<td>114.79</td>
<td>27.97</td>
<td>35.82</td>
<td>22.14</td>
<td>66.84</td>
<td>34.56</td>
</tr>
<tr>
<td>T₃</td>
<td>215.55</td>
<td>6.92</td>
<td>15.59</td>
<td>387.36</td>
<td>110.19</td>
<td>28.08</td>
<td>33.46</td>
<td>23.06</td>
<td>55.85</td>
<td>25.69</td>
</tr>
<tr>
<td>T₄</td>
<td>201.48</td>
<td>6.38</td>
<td>14.32</td>
<td>336.79</td>
<td>100.18</td>
<td>26.02</td>
<td>26.62</td>
<td>23.27</td>
<td>23.99</td>
<td>-</td>
</tr>
<tr>
<td>T₅</td>
<td>173.36</td>
<td>6.21</td>
<td>13.84</td>
<td>339.79</td>
<td>85.33</td>
<td>21.19</td>
<td>21.47</td>
<td>19.92</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>41.35</td>
<td>0.48</td>
<td>1.41</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>4.94</td>
<td>NS</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mawklot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>172.22</td>
<td>7.28</td>
<td>14.61</td>
<td>354.29</td>
<td>108.33</td>
<td>33.67</td>
<td>19.83</td>
<td>20.84</td>
<td>18.81</td>
<td>12.93</td>
</tr>
<tr>
<td>T₂</td>
<td>207.54</td>
<td>6.79</td>
<td>16.89</td>
<td>357.34</td>
<td>111.89</td>
<td>34.33</td>
<td>30.72</td>
<td>20.84</td>
<td>84.06</td>
<td>74.94</td>
</tr>
<tr>
<td>T₃</td>
<td>194.56</td>
<td>6.84</td>
<td>17.0</td>
<td>325.78</td>
<td>105.56</td>
<td>35.33</td>
<td>30.33</td>
<td>18.61</td>
<td>81.73</td>
<td>72.72</td>
</tr>
<tr>
<td>T₄</td>
<td>195.89</td>
<td>7.17</td>
<td>17.0</td>
<td>334.45</td>
<td>100.00</td>
<td>35.33</td>
<td>17.56</td>
<td>26.39</td>
<td>36.25</td>
<td>-</td>
</tr>
<tr>
<td>T₅</td>
<td>175.78</td>
<td>5.95</td>
<td>12.84</td>
<td>241.67</td>
<td>77.78</td>
<td>28.33</td>
<td>16.69</td>
<td>22.23</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>1.01</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>11.77</td>
<td>4.70</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mawbri</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>221.89</td>
<td>6.78</td>
<td>16.78</td>
<td>304.55</td>
<td>121.11</td>
<td>36.13</td>
<td>24.73</td>
<td>19.47</td>
<td>28.27</td>
<td>14.12</td>
</tr>
<tr>
<td>T₂</td>
<td>274.00</td>
<td>7.28</td>
<td>19.11</td>
<td>317.67</td>
<td>155.56</td>
<td>36.70</td>
<td>33.61</td>
<td>20.22</td>
<td>74.33</td>
<td>55.10</td>
</tr>
<tr>
<td>T₃</td>
<td>277.33</td>
<td>7.63</td>
<td>17.78</td>
<td>359.55</td>
<td>141.11</td>
<td>42.67</td>
<td>31.25</td>
<td>20.56</td>
<td>62.09</td>
<td>44.21</td>
</tr>
<tr>
<td>T₄</td>
<td>258.56</td>
<td>6.89</td>
<td>16.78</td>
<td>315.55</td>
<td>129.44</td>
<td>38.67</td>
<td>21.67</td>
<td>22.16</td>
<td>12.40</td>
<td>-</td>
</tr>
<tr>
<td>T₅</td>
<td>197.78</td>
<td>6.56</td>
<td>15.67</td>
<td>220.44</td>
<td>80.55</td>
<td>31.00</td>
<td>19.28</td>
<td>20.61</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>41.93</td>
<td>0.29</td>
<td>3.29</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>4.71</td>
<td>NS</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Table 2. Maize equivalent yield (q/ha), net return and benefit cost ratio in maize-mustard cropping system on farmers' field of Meghalaya

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Economic yield (q/ha/year)</th>
<th>MEY (Rs./ha/year)</th>
<th>Net return (Rs./ha/year)</th>
<th>B : C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumkremmonbhut (Umsamlem)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>30.42</td>
<td>2.91</td>
<td>30.42</td>
<td>7011</td>
</tr>
<tr>
<td>T₂</td>
<td>36.18</td>
<td>5.09</td>
<td>50.18</td>
<td>10178</td>
</tr>
<tr>
<td>T₃</td>
<td>33.48</td>
<td>4.30</td>
<td>45.31</td>
<td>9029</td>
</tr>
<tr>
<td>T₄</td>
<td>28.42</td>
<td>3.68</td>
<td>38.54</td>
<td>6647</td>
</tr>
<tr>
<td>T₅</td>
<td>24.14</td>
<td>2.90</td>
<td>32.11</td>
<td>5091</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>9.55</td>
<td>0.74</td>
<td>9.61</td>
<td>-</td>
</tr>
</tbody>
</table>

### Mawlasnai |

| T₁  | 25.19                       | 3.40              | 34.54                    | 3303  | 1.31                         |
| T₂  | 35.82                       | 4.49              | 48.17                    | 6508  | 1.51                         |

(Contd.)
### Table 3. Efficiency parameters of maize-mustard cropping systems on farmers’ field

<table>
<thead>
<tr>
<th>Location (Village)</th>
<th>Duration (days)</th>
<th>Production potential (q/ha)</th>
<th>Harvest index</th>
<th>Land use efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumkremmonbhut</td>
<td>226</td>
<td>40.91</td>
<td>0.124</td>
<td>61.92</td>
</tr>
<tr>
<td>Mawlasnai</td>
<td>228</td>
<td>38.65</td>
<td>0.126</td>
<td>62.47</td>
</tr>
<tr>
<td>Mawklot</td>
<td>247</td>
<td>30.57</td>
<td>0.106</td>
<td>67.67</td>
</tr>
<tr>
<td>Mawbri</td>
<td>262</td>
<td>34.46</td>
<td>0.122</td>
<td>71.78</td>
</tr>
</tbody>
</table>

### Profitability and economic feasibility

Maximum net return (Rs. 10178) was recorded with FYM @ 5 t ha⁻¹ + recommended dose of fertilizers followed by FYM @ 5 t ha⁻¹ + 50% recommended dose of fertilizer (Rs. 9029) at Lumkremmonbhut (Umsamlem) among all the locations. However, the reverse trend was recorded at Mawlasnai that may be due to higher yield of mustard as well as higher price of oilseed (Table 2). The higher net return found under maize based cropping sequence confirms the finding of Tomar and Tiwari (1990), Chaudhary et al. (2000). Among the various treatments, at different locations, the maximum benefit: cost ratio of 2.03 was found with FYM @ 5 t ha⁻¹ + recommended dose of fertilizers which may be due to higher maize equivalent yield (Verma 1997).

Hence the maize - mustard cropping system with FYM @ 5 t ha⁻¹ plus recommended dose of fertilizers (80:60:40 kg NPK ha⁻¹) was found to be better in terms of productivity, profitability and economic feasibility in the mid hill altitude (980 m above MSL) of Meghalaya.
References