Effect of lime, organic and inorganic nutrients on wheat (Triticum aestivum) – soybean (Glycine max) cropping system in acidic red soils

S.N. MISHRA, R.K. PAIKARAY AND K.N. MISHRA

Regional Agricultural Research Station, Orissa University of Agriculture and Technology, Semiliguda, Orissa

Received: August 1996

ABSTRACT

A field experiment was carried out during 1988–89, 1989–90 and 1990–92 to study the direct effect of lime, organic and inorganic nutrients on wheat (Triticum aestivum L. emend. Fiori & Paol.) and its carry-over effect on soybean [Glycine max (L.) Merr.]. Lime (1.25 tonnes/ha), FYM (4 tonnes/ha) and boron (10 kg/ha) in combination with 60 kg N + 30 kg P₂O₅ + 20 kg K₂O/ha resulted in the highest yield of wheat (29.3 q/ha). A significant residual effect was also observed for soybean (23.4 q/ha) with application of 30 kg N + 60 kg P₂O₅ + 30 kg K₂O/ha. The direct and the carry-over effects of lime and organic manure along with inorganic nutrients application significantly increased the uptake of N, P and K by both the crops in the cropping system.

Key words: Wheat – soybean cropping, Lime, Nutrients, Acidic red soil

Wheat–soybean system is gaining popularity in the soybean-growing areas of the country. In recent years, wheat harvest/ha multiplied many times, resulting in severe soil depletion by way of removal of essential nutrients. Soybean, unlike other legumes, having higher N content, requires higher amount of nitrogen. Our fertilizer recommendations so far are mostly macronutrient-oriented and single crop based, lacking in basic requirement of balanced nutrition. In such a system, effect of fertilizers must be assessed well because the crops grown in fixed cropping sequence behave differently than grown in individually (Dixit et al., 1993). Hence an experiment was conducted to study the effect of lime, organic and inorganic nutrients on wheat–soybean cropping system in acidic red soils.

MATERIALS AND METHODS

The field experiment was conducted at Semiliguda during 1988–89, 1989–90 and 1990–91. The soil was acidic (pH 5.8) and sandy loam, with organic carbon 0.61%, total N 0.059%, available P₂O₅ 17.08 kg/ha, available K₂O 142 kg/ha and available boron 0.3 mg/kg soil. The experiment was laid out in randomized block design, replicated 4 times. The treatments consisted of T₁, 80 kg
RESULTS AND DISCUSSION

Phosphorus and K (Kramphosphor) provided good yellow corn yield of sorghum, and the crop was grown under field conditions. The second sowing of sorghum was not affected by P deficiency in the plots. The second crop, where the second sowing of sorghum was sown, showed an increase in crop yield. The second crop was grown under field conditions.

Table 1. Effect of different treatments of fertilizer management on yield (q/ha) of wheat-soybean cropping system

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain yield of wheat (q/ha)</th>
<th>Seed yield of soybean (q/ha)</th>
<th>Wheat-equivalent yield (q/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>27.9</td>
<td>19.2</td>
<td>47.1</td>
</tr>
<tr>
<td>N + 10 kg P + 20 kg K, Oa + lime (1.25 tonnes)</td>
<td>27.1</td>
<td>20.1</td>
<td>47.2</td>
</tr>
<tr>
<td>N + 20 kg P + 20 kg K, Oa + lime (1.25 tonnes)</td>
<td>27.3</td>
<td>20.3</td>
<td>47.6</td>
</tr>
<tr>
<td>N + 30 kg P + 20 kg K, Oa + lime (1.25 tonnes)</td>
<td>27.5</td>
<td>20.5</td>
<td>47.9</td>
</tr>
<tr>
<td>N + 40 kg P + 20 kg K, Oa + lime (1.25 tonnes)</td>
<td>27.7</td>
<td>20.7</td>
<td>48.3</td>
</tr>
</tbody>
</table>

DISCUSSION

The results showed that the application of N, P, K, and lime in combination with FYM (4 tonnes) resulted in the highest yield of wheat and soybean. The application of N, P, K, and lime alone or in combination with FYM (4 tonnes) resulted in a significant increase in yield compared to the control treatment. The results also showed that the application of N, P, K, and lime in combination with FYM (4 tonnes) resulted in the highest yield of wheat and soybean.
Table 2. Effect of different treatments on yield attributes and straw or stalk yield of wheat and soybean (pooled data of 3 years)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th>Ear length (cm)</th>
<th>Grains/ear</th>
<th>Ears/m length</th>
<th>1,000-grain weight (q/ha)</th>
<th>Straw height (cm)</th>
<th>Seedstalk yield (q/ha)</th>
<th>Plant height (cm)</th>
<th>Pods/plant</th>
<th>Seed/plant</th>
<th>Stalk yield (q/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>76.6</td>
<td>9.08</td>
<td>28.1</td>
<td>54.8</td>
<td>42.5</td>
<td>44.5</td>
<td>41.6</td>
<td>36.4</td>
<td>2.66</td>
<td>38.7</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>77.0</td>
<td>9.22</td>
<td>28.2</td>
<td>55.2</td>
<td>42.5</td>
<td>44.3</td>
<td>42.4</td>
<td>37.3</td>
<td>2.72</td>
<td>39.6</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>77.2</td>
<td>9.23</td>
<td>28.2</td>
<td>55.0</td>
<td>42.5</td>
<td>47.1</td>
<td>43.5</td>
<td>38.2</td>
<td>2.82</td>
<td>41.5</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>78.6</td>
<td>9.41</td>
<td>28.6</td>
<td>56.8</td>
<td>42.6</td>
<td>50.1</td>
<td>45.3</td>
<td>40.2</td>
<td>2.90</td>
<td>41.8</td>
<td></td>
</tr>
<tr>
<td>T5</td>
<td>76.0</td>
<td>9.19</td>
<td>28.0</td>
<td>54.7</td>
<td>42.4</td>
<td>43.3</td>
<td>39.1</td>
<td>36.0</td>
<td>2.62</td>
<td>34.3</td>
<td></td>
</tr>
<tr>
<td>T6</td>
<td>72.2</td>
<td>8.82</td>
<td>27.4</td>
<td>53.9</td>
<td>42.3</td>
<td>38.6</td>
<td>38.0</td>
<td>36.9</td>
<td>2.70</td>
<td>31.9</td>
<td></td>
</tr>
<tr>
<td>T7</td>
<td>72.1</td>
<td>8.81</td>
<td>27.3</td>
<td>53.8</td>
<td>42.3</td>
<td>38.2</td>
<td>36.9</td>
<td>31.8</td>
<td>2.28</td>
<td>26.9</td>
<td></td>
</tr>
<tr>
<td>T8</td>
<td>70.2</td>
<td>8.76</td>
<td>27.1</td>
<td>52.4</td>
<td>42.1</td>
<td>35.1</td>
<td>35.8</td>
<td>30.7</td>
<td>1.98</td>
<td>24.4</td>
<td></td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>2.6</td>
<td>0.42</td>
<td>1.2</td>
<td>2.8</td>
<td>NS</td>
<td>8.9</td>
<td>6.42</td>
<td>6.81</td>
<td>0.64</td>
<td>8.6</td>
<td></td>
</tr>
</tbody>
</table>

Details of treatments are given under Materials and Methods.

Table 3. Effect of different treatments on nutrient uptake (kg/ha) by wheat-soybean cropping system (pooled data of 3 years)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Uptake by wheat (kg/ha)</th>
<th>Uptake by soybean (kg/ha)</th>
<th>Total uptake in system (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>P</td>
<td>K</td>
<td>N</td>
</tr>
<tr>
<td>T1</td>
<td>86.2</td>
<td>7.8</td>
<td>52.6</td>
</tr>
<tr>
<td>T2</td>
<td>96.4</td>
<td>8.1</td>
<td>54.0</td>
</tr>
<tr>
<td>T3</td>
<td>102.0</td>
<td>8.6</td>
<td>58.0</td>
</tr>
<tr>
<td>T4</td>
<td>105.8</td>
<td>9.0</td>
<td>63.0</td>
</tr>
<tr>
<td>T5</td>
<td>82.8</td>
<td>7.7</td>
<td>51.8</td>
</tr>
<tr>
<td>T6</td>
<td>66.4</td>
<td>7.0</td>
<td>48.0</td>
</tr>
<tr>
<td>T7</td>
<td>65.1</td>
<td>6.6</td>
<td>44.6</td>
</tr>
<tr>
<td>T8</td>
<td>58.9</td>
<td>6.2</td>
<td>42.0</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>21.24</td>
<td>1.62</td>
<td>8.84</td>
</tr>
</tbody>
</table>

Details of treatments are given under Materials and Methods.

The highest P uptake could be due to increased mineralization of organic P and breaking of Fe and Al phosphate complexes and ultimately increased available P content in the soil. The increased K-supplying capacity of acid soils could be due to lime application. Similar results were also reported by Prasad and Singh (1987). The plant uptake of N, P and K followed the pattern of wheat-grain yield. The higher nutrients could enable the wheat plant to produce longer ear length, more seeds/ear, ears/m length and 1,000-grain weight which were positively correlated with the yield.
The residual effect of lime or lime + FYM or lime + boron or lime + FYM + boron resulted in significantly higher seed or grain yield, yield attributes and nutrient uptake of soybean. But the carry-over effect of 50% P\textsubscript{2}O\textsubscript{5} as SSP + 50% P\textsubscript{2}O\textsubscript{5} as MRP was not found significant in increasing yield of soybean over that of recommended dose of fertilizer for wheat. The improvement in soybean could be attributed to increased rhizobial population in the rhizosphere. The similar results of increase in yield and nutrient uptake due to lime in wheat–soybean cropping system was also reported by Dixit et al. (1993).

Pooled data indicate that application of 60 kg N + 30 kg P\textsubscript{2}O\textsubscript{5} + 20 kg K\textsubscript{2}O + lime (1.25 tonnes/ha) + FYM (4 tonnes/ha) + B (10 kg/ha) proved beneficial to wheat crop and also to soybean crop grown with 30 kg N + 60 kg P\textsubscript{2}O\textsubscript{5} + 30 kg K\textsubscript{2}O/ha to a great extent. It indicates that the crops should also receive fertilizer directly to achieve higher productivity of wheat–soybean cropping system.

**REFERENCES.**

