Effect of potassium and sulphur on nutrient uptake, yield and quality of pigeon pea (*Cajanus cajan*)

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**ABSTRACT**

A study was conducted with graded levels of potassium and sulphur on pigeon pea to assess the nutrient uptake, yield and quality at Agronomy Farm, College of Agriculture, Nagpur (M.S.). The data revealed that application of K and S levels significantly influenced the uptake of major and micronutrient in pigeon pea. High N and P uptake was observed due to application of 30 kg potassium and 20 kg sulphur per hectare. Potassium uptake was increased significantly with increasing the levels of K. The highest K uptake was noticed in 45 kg K and 20 kg S per hectare combination. The recovery of NPK was higher in 30 kg potassium per hectare. Due to increased level of potassium and sulphur there was no adverse effect on calcium assimilation and highest uptake of calcium was observed in the application 30 kg K and 20 kg S per hectare. The optimum supply of K and S improves the uptake of micronutrients. Significantly high grain yield and protein yield was observed due to application 30 kg K and 20 kg S per hectare. Therefore balanced fertilization of NPKS nutrients is required in pigeon pea.

**Key words:** Nutrient recovery, Nutrient uptake, Pigeon pea, Potassium, Sulphur.

**INTRODUCTION**

Pigeon pea (*Cajanus cajan*) crop is generally cultivated as intercrop with Cotton, Soybean, Sorghum and others. Farmers applied fertilizers to main crop and pigeon pea remains under fertilized. Now a days with increasing demand and prices of pigeon pea, it has been taken as a sole crop with N and P fertilization @ 25:50 kg/ha. The dose was recommended considering sufficiency of K in soils of this region by State Agricultural Universities. Mallesha *et al*. (2014) reported higher protein and grain yield of pigeonpea fertilizer dose of 25:50:00 NPK kg/ha along with foliar spray of 1% 19:19:19 NPK grade. Unlike the nitrogen and phosphorus, potassium does not directly participated in formation of a biomolecule, however it is involved in all processes needed to sustain the plant life. Potassium nutrition is associated with grain quality including the protein content. Effective response to K application sets in when level of K satisfies the K hunger in soil (Ravichandran and Sriramchandrasekharan, 2011). Inadequate sulphur content (less than 10ppm) cannot provide sufficient sulphur to meet crop demand resulting in suboptimal yield and quality. Optimum supply of sulphur improves yield and quality of pulse grain. The sulphur use efficiency was observed higher at application 35 kg S per hectare in pigeon pea- groundnut intercropping system (Jat and Ahalawat, 2010). In view of the above the present study was carried out to understand the nutrient uptake and quality of pigeon pea.

**MATERIALS AND METHODS**

Field experiment was conducted during *kharif* season (July to January 2012-13) at Agronomy farm, College of Agriculture, Nagpur in a factorial randomized block design replicated thrice. The pigeon pea variety PKV-Tara was sown by drilling method. The treatment consisted of four levels of potassium viz. K<sub>0</sub> - no potassium, K<sub>15</sub> - 15kg/ha, K<sub>30</sub> - 30kg/ha and K<sub>45</sub> - 45kg/ha potassium respectively and three levels of sulphur viz. S<sub>10</sub> - 10kg/ha, S<sub>20</sub> - 20kg/ha, and S<sub>30</sub> - 30kg/ha sulphur respectively. The recommended dose (25:50 kg NP per hectare) of N and P was applied to all the treatments. The rainfall distribution during the cropping season was normal and mean annual precipitation was 938 mm. The minimum and maximum temperature ranged from 29.6 to 34.1°C and 9.9 to 19.4°C, respectively. The crop was rainfed during its whole cropping period. The source of fertilizer was murate of potash, bentonite sulphur, urea and DAP. The soil of the experimental site was clayey, slightly alkaline in reaction and medium in organic carbon and NPK. The available sulphur in soil was at critical level of 10.2 mg/kg. The DTPA extractable micronutrients were Fe - 3.12, Mn - 6.15, Zn - 1.09 and Cu - 1.23 mg/kg respectively.
Table 1: Effect of potassium and sulphur levels on nutrient uptake in pigeon pea

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N (kg/ha)</th>
<th>P (kg/ha)</th>
<th>K (kg/ha)</th>
<th>S (kg/ha)</th>
<th>Ca (g/ha)</th>
<th>Fe (g/ha)</th>
<th>Mn (g/ha)</th>
<th>Zn (g/ha)</th>
<th>Cu (g/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K_0</td>
<td>61.41</td>
<td>29.18</td>
<td>76.31</td>
<td>13.29</td>
<td>16.46</td>
<td>391.8</td>
<td>176.7</td>
<td>88.6</td>
<td>224.1</td>
</tr>
<tr>
<td>K_10</td>
<td>71.47</td>
<td>34.27</td>
<td>82.29</td>
<td>15.02</td>
<td>19.11</td>
<td>438.9</td>
<td>197.7</td>
<td>100.6</td>
<td>252.3</td>
</tr>
<tr>
<td>K_20</td>
<td>84.21</td>
<td>45.96</td>
<td>95.48</td>
<td>19.34</td>
<td>23.68</td>
<td>536.2</td>
<td>247.6</td>
<td>122.6</td>
<td>312.1</td>
</tr>
<tr>
<td>K_30</td>
<td>82.13</td>
<td>41.57</td>
<td>95.32</td>
<td>18.57</td>
<td>21.93</td>
<td>495.4</td>
<td>221.8</td>
<td>113.2</td>
<td>286.3</td>
</tr>
<tr>
<td>K x S</td>
<td>3.81</td>
<td>2.70</td>
<td>2.56</td>
<td>0.58</td>
<td>0.99</td>
<td>22.3</td>
<td>9.5</td>
<td>5.5</td>
<td>13.4</td>
</tr>
<tr>
<td>CD(P=0.05)</td>
<td>11.18</td>
<td>7.91</td>
<td>1.70</td>
<td>0.29</td>
<td>2.91</td>
<td>65.5</td>
<td>27.9</td>
<td>16.2</td>
<td>39.2</td>
</tr>
<tr>
<td>S_10</td>
<td>68.33</td>
<td>32.19</td>
<td>78.97</td>
<td>14.94</td>
<td>18.17</td>
<td>412.1</td>
<td>187.4</td>
<td>94.3</td>
<td>237.9</td>
</tr>
<tr>
<td>S_20</td>
<td>84.72</td>
<td>43.24</td>
<td>92.85</td>
<td>16.79</td>
<td>22.74</td>
<td>511.3</td>
<td>231.0</td>
<td>117.1</td>
<td>295.3</td>
</tr>
<tr>
<td>S_30</td>
<td>75.11</td>
<td>37.80</td>
<td>90.20</td>
<td>17.92</td>
<td>19.97</td>
<td>473.4</td>
<td>214.5</td>
<td>107.3</td>
<td>272.9</td>
</tr>
<tr>
<td>K x S (CD 0.05)</td>
<td>3.30</td>
<td>2.34</td>
<td>2.22</td>
<td>0.50</td>
<td>0.86</td>
<td>19.3</td>
<td>8.2</td>
<td>4.8</td>
<td>11.6</td>
</tr>
<tr>
<td>K x S</td>
<td>9.68</td>
<td>6.85</td>
<td>6.50</td>
<td>1.48</td>
<td>2.52</td>
<td>56.7</td>
<td>24.2</td>
<td>14.1</td>
<td>33.9</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

The data on effect of potassium and sulphur levels on nutrient uptake in pigeon pea (Table 1) revealed that the K and S levels significantly influenced the uptake of major and micronutrients in pigeon pea. The nitrogen uptake was high at 30 kg potassium per hectare. Increased potassium level K_30 showed reduction in nitrogen assimilation. Tiwari et al. (2012) reported that improved potassium supply enhances uptake of N and protein content in pulses. High N uptake was also observed due to application 20 kg sulphur per hectare. The phosphorus uptake was significantly high at K_30 level (45.96 kg/ha) which was on par with K_15 level. Similarly sulphur level S_20 showed more uptake of phosphorus and on par with 30 kg level. Deo and Khandelwal (2009) observed the synergistic effect of sulphur and phosphorus on its uptake. The potassium assimilation in pigeon pea was increased significantly with increased levels of K however the K_30 and K_15 levels were on par. Synergistic effect of sulphur was also noticed on potassium uptake. Highest K assimilation was noticed due to application of 20 kg sulphur per hectare. Combined effect of potassium and sulphur levels on total uptake of potassium was observed significant (Table 2). The highest K assimilation was observed in K_30 and S_0 combination which was on par with K_20 and S_20 level. Highest sulphur assimilation was observed in K_30 and S_30 level of potassium and sulphur. Due to increased level of potassium and sulphur there is no adverse effect on calcium assimilation and highest uptake of calcium was observed in the K_30 and S_30 treatment. Application of optimum potassium significantly increased the Ca uptake in pulses (Tiwari et al., 2012).

The micronutrient uptake was significantly high in K_30 and S_30 level indicating optimum supply improves the uptake of Fe, Mn, ZN and Cu. Goud and Kale (2010) reported that the uptake of NPK and S by pigeon pea increased significantly due to application of 18:46:20:20 kg N:P:K:S/ha compared with it reduced levels. The recovery of major nutrient NPK was observed higher in 30 kg

Table 2: Combined effect of potassium and sulphur on total uptake (kg/ha) of K by pigeon pea

<table>
<thead>
<tr>
<th>Combined effect K x S</th>
<th>S_10</th>
<th>S_20</th>
<th>S_30</th>
</tr>
</thead>
<tbody>
<tr>
<td>K_0</td>
<td>66.01</td>
<td>76.29</td>
<td>86.63</td>
</tr>
<tr>
<td>K_15</td>
<td>75.95</td>
<td>83.33</td>
<td>87.57</td>
</tr>
<tr>
<td>K_30</td>
<td>95.62</td>
<td>101.83</td>
<td>88.99</td>
</tr>
<tr>
<td>K_45</td>
<td>78.32</td>
<td>109.98</td>
<td>97.63</td>
</tr>
<tr>
<td>SE(m)</td>
<td>4.43</td>
<td>CD(P=0.05)</td>
<td>12.99</td>
</tr>
</tbody>
</table>

Table 3: Effect of K levels on NPK recovery in pigeon pea

<table>
<thead>
<tr>
<th>K levels (kg/ha)</th>
<th>N (kg/ha)</th>
<th>P (kg/kg applied)</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>K_0</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>K_15</td>
<td>0.400</td>
<td>0.102</td>
<td>0.598</td>
</tr>
<tr>
<td>K_30</td>
<td>0.910</td>
<td>0.336</td>
<td>0.639</td>
</tr>
<tr>
<td>K_45</td>
<td>0.829</td>
<td>0.248</td>
<td>0.422</td>
</tr>
</tbody>
</table>
Table 4: Effect of potassium and sulphur levels on grain yield and protein content of pigeon pea

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Grain yield (q/ha)</th>
<th>Protein content (%)</th>
<th>Protein Yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K &amp; S-levels kg/ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K&lt;sub&gt;o&lt;/sub&gt;</td>
<td>14.10</td>
<td>19.21</td>
<td>270.9</td>
</tr>
<tr>
<td>K&lt;sub&gt;15&lt;/sub&gt;</td>
<td>15.85</td>
<td>20.50</td>
<td>324.9</td>
</tr>
<tr>
<td>K&lt;sub&gt;30&lt;/sub&gt;</td>
<td>17.50</td>
<td>22.96</td>
<td>401.8</td>
</tr>
<tr>
<td>K&lt;sub&gt;45&lt;/sub&gt;</td>
<td>16.52</td>
<td>22.38</td>
<td>368.7</td>
</tr>
<tr>
<td>SE(m)&lt;sup&gt;+&lt;/sup&gt;</td>
<td>-</td>
<td>0.46</td>
<td>17.31</td>
</tr>
<tr>
<td>CD(P=0.05)</td>
<td>-</td>
<td>1.34</td>
<td>52.01</td>
</tr>
<tr>
<td>S&lt;sub&gt;10&lt;/sub&gt;</td>
<td>15.42</td>
<td>19.91</td>
<td>307.0</td>
</tr>
<tr>
<td>S&lt;sub&gt;20&lt;/sub&gt;</td>
<td>16.96</td>
<td>22.58</td>
<td>382.10</td>
</tr>
<tr>
<td>S&lt;sub&gt;30&lt;/sub&gt;</td>
<td>15.60</td>
<td>21.30</td>
<td>332.3</td>
</tr>
<tr>
<td>SE(m)&lt;sup&gt;+&lt;/sup&gt;</td>
<td>-</td>
<td>0.39</td>
<td>15.1</td>
</tr>
<tr>
<td>CD(P=0.05)</td>
<td>-</td>
<td>1.16</td>
<td>45.0</td>
</tr>
<tr>
<td>Combined effect-K x S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE(m)&lt;sup&gt;+&lt;/sup&gt;</td>
<td>0.79</td>
<td>1.06</td>
<td>30.95</td>
</tr>
<tr>
<td>CD(P=0.05)</td>
<td>2.33</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Grain and protein yield of pigeon pea was significantly influenced due to application of potassium and sulphur (Table 4). Highest yield (17.50 and 16.96 kg/ha) was obtained in K<sub>30</sub> level and S<sub>20</sub> level. Combine effect of potassium and sulphur was also significantly high at above levels of potassium and sulphur. Increased grain and protein yield was due to more assimilation of nutrients and recovery of applied NPK in pigeon pea crop. Therefore, application of potassium (30 kg) and sulphur (20 kg) along with nitrogen (25 kg) and Phosphorus (50 kg) increases the nutrient uptake, yield and quality of pigeon pea.

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REFERENCES


