GROWTH AND YIELD OF RABI GROUNDNUT (ARACHIS HYPOGAEA L.) AS INFLUENCED BY MOISTURE REGIMES, POLYTHENE MULCH AND PLANT DENSITIES

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ABSTRACT

A field trial to study the effect of growth wise irrigation regimes, mulching and plant densities on growth and yield attributing characters and yield of rabi groundnut was conducted at College of Agriculture Farm, Depoli, Distt. Ratnagiri (M.S.) during rabi season of 2001-02 and 2002-03. Results based on pooled data indicated that growth wise irrigation scheduling at 0.6:1.0:0.8 IW/CPE ratios recorded significantly higher per plant growth in terms of height, number of leaves, branches and dry matter accumulation, from 60 days after sowing (DAS) to harvest (120 DAS) and subsequently the per plant yield parameters such as number and weight of mature pods, kernels and 100 kernel weight, shelling percentage; which resulted into significantly higher dry pod and haulm yield over all other irrigation treatments. Similarly, polythene mulch recorded significantly higher growth, attributing characters from 30 DAS upto harvest and subsequently the yield attributing characters and yield, as compared to no mulch treatment. Further, the lower plant density (4,444,444 plant ha\(^{-1}\)) produced significantly higher growth, yield attributing characters refered above and yield of groundnut, over higher plant density (5,555,555 plant ha\(^{-1}\)) except in case of height that was significantly higher under the higher plant density than the lower plant density.

Key words: Irrigation regimes, polythene mulch, planting density, growth and yield.

India holds premier position in the global oil seeds scenario accounting for 19 per cent of the total area and 9 per cent of the total oil seed production. However, the productivity per unit area is only 935 kg/ha (1998-99) as compared to world level of 1632 kg/ha. Average productivity of groundnut is relatively low as it is mostly growth rainfed during the kharif season. Productivity of the irrigated summer crop is 2 to 3 times higher than the rainfed crop crop. In Konkan region, under lateritic soil conditions, groundnut crop is irrigated at 0.8 IW/CPE ratio from sowing upto maturity. However, at early vegetative stage because of small growth and at maturity stage because of senescence, the water requirement of groundnut crop is less as compared to flowering, pegging and pod formation stages which are most sensitive to irrigation. Taking into consideration the differential water requirement of the crop at various growth stages it was necessary to quantify the stage wise optimum requirement of irrigation water for better growth and higher yield of rabi groundnut. Secondly, the polythene mulch has a positive effect in developing the congenial condition in terms of soil moisture and temperature that enhance the moisture extraction, nutrient uptake simultaneously growth and ultimately the yield of groundnut. Therefore, to assess the extent of positive effect of polythene mulch over control, three treatments were incorporated in the study. The medium duration bunch varieties required comparatively less area than the late spreading types. Therefore, there is scope to increase the plant density either by changing the row spacing or by increasing number of plants in a row. Therefore, the present investigation was undertaken to study the effect of irrigation regimes, polythene mulch and plant densities on growth and yield of rabi groundnut under lateritic soil conditions of Konkan region in Maharashtra.

MATERIALS AND METHODS

A field experiment was conducted at the College of Agriculture Farm, Dapoli, Distt.
Ratnagiri (M.S.) during rabi season of 2001-02 and 2002-03. The soil of experimental plot was lateritic, clay loam with acidic reaction (pH 6.35), the water table was below 5 metre. Field capacity and permanent wilting point were 28.0 and 16.4 per cent, respectively. The soil was medium in available nitrogen (197.32 kg ha⁻¹), low in available phosphorus (18.91 kg ha⁻¹) and fairly high in available K₂O (295.0 kg ha⁻¹). In all five irrigation schedules viz., 0.8:0.8:0.8 IW/CPE ratios (I₁), 0.6:0.8:0.8 IW/CPE ratios (I₂), 0.6:0.8:1.0 IW/CPE ratios (I₃), 0.6:1.0:0.8 IW/CPE ratios (I₄) and 0.6:0.8:0.6 IW/CPE ratios (I₅) were included under the main plots, two mulching treatments i.e., polythene mulch (P₁) and no mulch (P₀) were taken under sub-plot and two plant densities i.e., 4,44,444 plants ha⁻¹ (D₁) and 5,55,5555 plants ha⁻¹ (D₂) were included under sub-sub plot. The trial was laid out in split plot design with three replications. The gross and net plot sizes were 4.5 x 3.5 m² and 4.2 x 3.3 m², respectively. The crop was sown on 9 and 12, December during 2001 and 2002, respectively. FYM @ 10 t ha⁻¹ was thoroughly mixed with soil at the time of land preparation. Broad bed furrow having width of 90 cm at bottom, 60 cm at top with 10 cm height were prepared. All the treatments received uniform basal dose of 50 kg N, 100 kg P₂O₅, 50 kg K₂O and 300 kg gypsum ha⁻¹. Irrigation were applied at different IW/CPE ratios of 0.6, 0.8 and 1.0 as per the treatment schedule. In all 8, 8, 8, 9, and 7 irrigations were given to I₁, I₂, I₃, I₄ and I₅ treatments, respectively including two common irrigations given to all treatments, at the time of sowing and emergence. Polythene mulch of 7 micron having holes of 5 cm diameter at 15x10 cm² (D₁) and 10x10 cm² spacing (D₂) was spread on broad bed furrow (BBF) just before sowing. Sowing on BBF was done by dibbling two seeds per hill as per the spacings. Observations on growth parameters (Table 1) were recorded at 30 days interval. Similarly, the observation on yield attributes and yield (Table 2) were recorded after harvesting. Common plant protection measures for controlling insect, pest and weeds were undertaken as and when necessary during the life period of the crop.

RESULTS AND DISCUSSION

Effect of irrigation

Data presented in Table 1 revealed that the scheduling of irrigation @ 0.6:1.0:0.8 IW/CPE ratios (I₄) i.e., upto 40 DAS (upto flowering initiation) : 40 to 80 DAS (flowering to early pod formation) : 80 DAS to maturity (pod formation to maturity) recorded significantly higher plant growth in terms of height, number of leaves, number of branches, dry matter accumulation, from 60 DAS to maturity and yield parameters such as number of mature pods and kernels and their weight per plant, 100 kernel weight, shelling percentage and subsequently dry pod and haulm yield over all other irrigation treatments. Irrigation scheduling @ 0.6:0.8:0.6 I/W/CPE ratios recorded significantly the lowest growth and yield attributing parameters and yield, than all the other irrigation treatments. This has indicated that the initial stress upto 40 DAS (upto flowering initiation) @ 0.6 IW/CPE ratio has beneficial effect in terms of better root growth and synchronous early flowering. Further, flowering, pegging and pod formation stages are most sensitive to moisture stress and during these stages, crop obtained sufficient moisture @ 1.0 IW/CPE ratio and hence it has produced higher growth and yield while in other irrigation levels the crop was irrigated at 0.6 or 0.8 IW/CPE ratios during the above referred critical stages and hence these treatments experienced greater stress than the above referred treatment (I₄) and therefore, recorded significantly less growth and yield in the pooled data. These results are in conformation with those reported by Shinde and Pawar (1984).

Effect of polythene mulch

As regards the mulching, polythene mulch produced significantly higher values of the growth attributing characters such as height, number of leaves, branches and dry matter accumulation per plant from 30 DAS to maturity ; yield attributing characters such as number and weight of mature pods and kernels per plant, 100 kernel weight, shelling percentage and dry pod and haulm yield ha⁻¹ than no mulch in the pooled data. The increase in dry pod yield due to polythene mulch was to the tune of 46.54
Table 1. Growth attributing characters of groundnut as influenced by different treatments during 30, 60, 90 DAS and at harvest (Pooled data, 2001-02, 2002-03)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>No. of Leaves/plant</th>
<th>No. of Branches/plant</th>
<th>Dry matter/plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrigation (IW/CPE ratio)</td>
<td>30 DAS</td>
<td>60 DAS</td>
<td>90 DAS</td>
</tr>
<tr>
<td>I</td>
<td>I 0.8:0.8:0.8</td>
<td>2.16 8.05 16.48 16.89</td>
<td>18.60 37.90 45.49 39.20</td>
<td>4.77 5.79 5.48 5.48</td>
</tr>
<tr>
<td>I</td>
<td>II 0.6:0.8:0.8</td>
<td>2.11 7.80 16.38 16.60</td>
<td>18.50 38.40 45.09 38.50</td>
<td>4.69 5.76 4.88 4.91</td>
</tr>
<tr>
<td>I</td>
<td>III 0.6:0.8:0.1</td>
<td>2.11 7.65 16.45 16.65</td>
<td>18.60 38.00 45.05 38.00</td>
<td>4.68 5.75 4.89 4.90</td>
</tr>
<tr>
<td>I</td>
<td>IV 0.6:0.1:0.8</td>
<td>2.11 8.50 18.05 18.60</td>
<td>18.50 40.21 47.60 45.70</td>
<td>4.69 6.33 6.58 6.39</td>
</tr>
<tr>
<td>I</td>
<td>V 0.6:0.8:0.6</td>
<td>2.11 7.80 16.48 16.50</td>
<td>18.00 38.10 45.05 34.90</td>
<td>4.69 5.75 4.89 4.85</td>
</tr>
<tr>
<td>SE±</td>
<td>No mulch</td>
<td>2.00 7.45 15.45 15.60</td>
<td>16.65 33.70 38.70 36.10</td>
<td>4.37 5.10 4.95 4.47</td>
</tr>
<tr>
<td>Mulch</td>
<td>Polythene mulch</td>
<td>2.24 9.10 18.21 18.72</td>
<td>20.15 43.00 48.00 42.70</td>
<td>5.05 6.85 5.71 6.13</td>
</tr>
<tr>
<td>SE±</td>
<td>0.05 0.30 0.40 0.30</td>
<td>0.11 0.40 0.05 0.64</td>
<td>0.20 0.30 0.23 0.35</td>
<td>0.70 0.31 0.80 0.30</td>
</tr>
<tr>
<td>CD at 5% level</td>
<td>No mulch</td>
<td>0.15 0.90 1.20 0.90</td>
<td>0.33 1.20 0.15 1.90</td>
<td>0.60 0.90 0.70 0.05</td>
</tr>
</tbody>
</table>

Plant density (Plant ha⁻¹)

| D1 4, 44, 444 | 2.05 7.55 16.31 16.40 | 19.45 39.60 45.59 42.70 | 4.84 6.29 5.64 5.72 | 0.85 5.21 18.60 24.50 |
| D2 5, 55, 555 | 2.18 8.20 17.35 17.50 | 17.20 37.00 39.89 36.00 | 4.60 5.43 5.22 4.88 | 0.79 4.20 16.40 22.20 |
| SE±          | 0.05 0.20 0.20 0.30 | 0.78 0.40 0.05 1.10 | 0.20 0.28 0.14 0.28 | 0.03 0.30 0.70 0.60 |
| CD at 5% level | No mulch | 0.60 0.60 0.90 | 1.20 0.15 3.30 | 0.80 0.40 0.80 | NS 0.90 2.10 1.80 |

I: upto 40 DAS  II: 40 to 80 DAS  III: 80 DAS to maturity
Table 2. Yield attributes and yield of groundnut as influenced by different treatments (pooled data, 2001-02 and 2002-03)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>No. of matured pod/plant</th>
<th>Weight of matured pods/plant (g)</th>
<th>No. of Kernels/plant</th>
<th>Weight of Kernels/plant (g)</th>
<th>100 Kernel weight (g)</th>
<th>Shelling percentage</th>
<th>Dry pod yield (q/ha)</th>
<th>Haulm yield (q/ha.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;1&lt;/sub&gt; 0.8:0.8:0.8</td>
<td>15.20</td>
<td>13.16</td>
<td>30.60</td>
<td>10.22</td>
<td>43.00</td>
<td>71.65</td>
<td>40.60</td>
<td>40.20</td>
</tr>
<tr>
<td>I&lt;sub&gt;2&lt;/sub&gt; 0.6:0.8:0.8</td>
<td>14.30</td>
<td>12.46</td>
<td>30.10</td>
<td>9.95</td>
<td>42.77</td>
<td>71.50</td>
<td>39.90</td>
<td>39.34</td>
</tr>
<tr>
<td>I&lt;sub&gt;3&lt;/sub&gt; 0.6:0.8:0.1</td>
<td>14.20</td>
<td>12.30</td>
<td>30.60</td>
<td>9.91</td>
<td>42.71</td>
<td>71.25</td>
<td>39.60</td>
<td>40.05</td>
</tr>
<tr>
<td>I&lt;sub&gt;4&lt;/sub&gt; 0.6:0.1:0.8</td>
<td>17.21</td>
<td>16.10</td>
<td>43.50</td>
<td>11.30</td>
<td>43.30</td>
<td>73.80</td>
<td>43.80</td>
<td>44.36</td>
</tr>
<tr>
<td>I&lt;sub&gt;5&lt;/sub&gt; 0.6:0.8:0.6</td>
<td>11.00</td>
<td>9.38</td>
<td>21.00</td>
<td>7.20</td>
<td>40.60</td>
<td>62.40</td>
<td>29.40</td>
<td>28.11</td>
</tr>
<tr>
<td>SE±</td>
<td>0.08</td>
<td>0.36</td>
<td>0.20</td>
<td>0.11</td>
<td>0.40</td>
<td>0.23</td>
<td>0.40</td>
<td>0.36</td>
</tr>
<tr>
<td>CD at 5% level</td>
<td>0.21</td>
<td>1.08</td>
<td>0.60</td>
<td>0.33</td>
<td>1.20</td>
<td>0.67</td>
<td>1.20</td>
<td>1.09</td>
</tr>
<tr>
<td>Mulch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P0 No mulch</td>
<td>14.53</td>
<td>10.19</td>
<td>26.00</td>
<td>7.74</td>
<td>40.80</td>
<td>69.19</td>
<td>28.66</td>
<td>30.25</td>
</tr>
<tr>
<td>P1 Polythene mulch</td>
<td>16.32</td>
<td>15.16</td>
<td>35.60</td>
<td>11.62</td>
<td>44.00</td>
<td>71.48</td>
<td>48.70</td>
<td>45.10</td>
</tr>
<tr>
<td>SE±</td>
<td>0.03</td>
<td>0.31</td>
<td>0.40</td>
<td>0.40</td>
<td>0.30</td>
<td>0.21</td>
<td>0.37</td>
<td>0.40</td>
</tr>
<tr>
<td>CD at 5% level</td>
<td>0.08</td>
<td>0.93</td>
<td>1.20</td>
<td>1.20</td>
<td>0.90</td>
<td>0.63</td>
<td>1.04</td>
<td>1.20</td>
</tr>
<tr>
<td>Plant density</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1 4, 44, 444</td>
<td>16.30</td>
<td>14.75</td>
<td>37.60</td>
<td>11.13</td>
<td>43.50</td>
<td>71.17</td>
<td>40.11</td>
<td>39.94</td>
</tr>
<tr>
<td>D2 5, 55, 555</td>
<td>12.00</td>
<td>10.60</td>
<td>29.00</td>
<td>8.21</td>
<td>41.40</td>
<td>69.49</td>
<td>37.26</td>
<td>35.36</td>
</tr>
<tr>
<td>SE±</td>
<td>0.07</td>
<td>0.36</td>
<td>0.90</td>
<td>0.40</td>
<td>0.13</td>
<td>0.21</td>
<td>0.49</td>
<td>0.50</td>
</tr>
<tr>
<td>CD at 5% level</td>
<td>NS</td>
<td>1.08</td>
<td>NS</td>
<td>1.20</td>
<td>0.37</td>
<td>0.60</td>
<td>1.40</td>
<td>1.50</td>
</tr>
</tbody>
</table>

I: upto 40 DAS  II: 40 to 80 DAS  III: 80 DAS to maturity
Groundnut growth by moisture, mulch and plant density

Groundnut growth by moisture, mulch and plant density. It might be due to the beneficial effect of polythene mulch in terms of higher soil temperature and water which might have resulted into better root growth, microbial activities, nutrient availability and hence better growth and yield performance of groundnut crop under polythene mulch than no mulch. Similar findings were reported by Hu, et al. (1995).

Effect of plant density

Plant population of 4, 44, 444 plant ha\(^{-1}\) (D\(_1\)) recorded significantly higher plant growth in terms of number of leaves, branches and dry matter accumulation per plant from 60 DAS to maturity than higher plant population of 5,55,555 (D\(_2\)) plants ha\(^{-1}\) in the pooled data. However, the plant height was significantly higher under the higher plant population than the lower plant population due to competition for sunlight under the higher plant density. This significant performance of groundnut plant under lower plant density further resulted into significantly higher number and weight of mature pods and kernels per plant and subsequently higher dry pod and haulm yield under the lower plant density (D\(_1\)) than under the higher density (D\(_2\)) in the pooled data. It was the effect of less interplant competition among the lower plant density. Due to the intense interplant competition among the high density crop for the various resources, the yield reduced significantly than the lower plant density. Similar results were also obtained by Deshmukh and Bhoi (1999).

REFERENCES

