Chickpea is an important rabi pulse crop of the arid and semi-arid regions where it is grown with or without irrigation. The grain contains about 20 percent protein and forms an essential part of human diet in many countries. In Haryana, it is grown over an area of 1,07,000 hectares with total production of 91,000 tonnes and productivity of 850 kg/ha. It is usually grown after rainy season on conserved soil moisture, during winter in tropics and spring in temperate and the Mediterranean regions. Despite its economic and nutritive importance, the yield of chickpea is very low in India. There are many factors responsible for the low yield. The use of traditional or low yielding varieties and adoption of poor management practices are of great importance. With the development of new genotypes, it becomes essential to test them at different sowing dates to exploit their full production potential. Amongst the agronomic practices, sowing methods and proper seed rate are of great importance. Since very little scope exists for horizontal growth, the alternative seems by achieving vertical growth through increasing its productivity level. Thus, there is need to adopt suitable management practice like proper sowing time and to use high yielding varieties. Keeping in view, the scanty information available on these aspects, present investigation entitled, "Nutrient and quality studies of chickpea cultivars as influenced by sowing time and seed rate" has been planned to be carried out.

MATERIAL AND METHODS

The study was conducted at Research Area of CCS Haryana Agricultural University, Hisar during rabi season, 2012-13 on sandy loam soils under irrigated conditions. The factorial experiment consisting of 24 treatment combinations with two sowing time i.e. 1st fortnight of November and 1st fortnight of December and four cultivars (H09-23, H08-18, C-235 and HC-1) kept in main plots while three seed rates viz. 40 kg ha\(^{-1}\), 50 kg ha\(^{-1}\) and 60 kg ha\(^{-1}\) was laid out in split plot design with three replications. The crop was sown with common row spacing of 30 cm as per the dates of sowing. The fertilizer was applied in the form of di-ammonium phosphate. The soil of the experimental site was deep sandy loam having pH of 7.9, EC of 0.13 dS/m and low in organic carbon (0.34%), low in available N status (193.36 kg ha\(^{-1}\)), medium in available P\(_2\)O\(_5\) (32.18 kg ha\(^{-1}\)) and high in available K\(_2\)O (249.67 kg ha\(^{-1}\)). The crop was irrigated as and when required so as to maintain adequate soil moisture in the root zone. The crop was sprayed with monocrotophos (1.25 l/ha) at initiation of flowering and at pod filling stage to protect the crop from pod borer attack. The N content in chickpea was determined by standard methods, P content by Vane domolybdo Phosphoric Acid Yellow Colour Method and K content by Flame Photometric Method. The uptake of N, P and K by chickpea cultivars was calculated by multiplying the yield of the crop by the respective percentage.
composition of N, P and K. The composite soil samples from 0-15 cm depth were analysed before sowing and after harvesting for determining the available nitrogen, phosphorus and potassium. Available N in soil was determined according to alkaline permanganate method, available P and available K in soil was extracted by neutral normal ammonium acetate and estimated by flame photometer. 

**RESULTS AND DISCUSSION**

**Effect of sowing dates:** The data pertaining to N, P and K content and its uptake by grain and stover indicate that date of sowing significantly influenced the N content and its uptake in grain, N uptake in stover and total N uptake. Higher values were recorded in early sowing (1st fortnight of November) compared to late sowing (1st fortnight of December). Sowing time did not affect N content in stover, P and K content in grain and stover (Table-1, 2 and 3). More uptakes of N, P and K in grain and stover as well as its total uptake were recorded in 1st fortnight of November sowing as compared to delayed sowing. There was 42.04% increase in total N, 42.03% increase in total P and 61.70% increase in total K uptake in 1st fortnight of November sowing as compared to as compared to delayed sowing. This could be due to higher dry matter production in case of early sowing. Similar results were recorded by some workers who observed higher total N and P uptake in chickpea as well as individual uptake of these nutrients in stalk and grain in 20th November sown crop and deviation from this date significantly reduced the uptake of N and P. Time of sowing did not influence protein content in stover of chickpea cultivars. But, grain protein content was found significantly better in early sown (1st fortnight of November) as compared to late sown chickpea (Table-4). Lower grain protein content in
Table-2. Effect of seed rates and sowing time on P content (%) and its uptake (kg ha\(^{-1}\)) by chickpea cultivars

<table>
<thead>
<tr>
<th>Treatments</th>
<th>P Content (%)</th>
<th>P uptake (kg ha(^{-1}))</th>
<th>Total P uptake (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain</td>
<td>Stover</td>
<td>Grain</td>
</tr>
<tr>
<td>Date of sowing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st fortnight of November</td>
<td>0.429</td>
<td>0.129</td>
<td>8.85</td>
</tr>
<tr>
<td>1st fortnight of December</td>
<td>0.415</td>
<td>0.126</td>
<td>6.70</td>
</tr>
<tr>
<td>SEM ±</td>
<td>0.009</td>
<td>0.005</td>
<td>0.148</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>0.450</td>
</tr>
<tr>
<td>Cultivars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H08-18</td>
<td>0.431</td>
<td>0.127</td>
<td>8.30</td>
</tr>
<tr>
<td>H09-23</td>
<td>0.434</td>
<td>0.129</td>
<td>8.65</td>
</tr>
<tr>
<td>C235</td>
<td>0.422</td>
<td>0.126</td>
<td>6.34</td>
</tr>
<tr>
<td>HC-1</td>
<td>0.401</td>
<td>0.128</td>
<td>7.81</td>
</tr>
<tr>
<td>SEM ±</td>
<td>0.013</td>
<td>0.007</td>
<td>0.210</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>0.636</td>
</tr>
<tr>
<td>Seed rates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 kg ha(^{-1})</td>
<td>0.427</td>
<td>0.127</td>
<td>7.807</td>
</tr>
<tr>
<td>50 kg ha(^{-1})</td>
<td>0.433</td>
<td>0.132</td>
<td>8.090</td>
</tr>
<tr>
<td>60 kg ha(^{-1})</td>
<td>0.405</td>
<td>0.124</td>
<td>7.427</td>
</tr>
<tr>
<td>SEM ±</td>
<td>0.012</td>
<td>0.005</td>
<td>0.183</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>0.527</td>
</tr>
</tbody>
</table>

late sown chickpea has also been reported by earlier workers\(^7\). They obtained maximum protein content when the crop was sown on 21\(^{st}\) November and early planting of chickpea on 20\(^{th}\) October produced significantly higher protein content than all other late sowings in chickpea. Chickpea cultivars did not differ significantly in respect of N, P and K content (%) in grain and straw (Table-1, 2 and 3). Grain protein content was also not influenced by cultivars. Early sowing result in higher grain protein content of chickpea as compared to delayed sowing.

**Performance of chickpea cultivars:** N uptake by grain and total N uptake were significantly higher in H09-23 as compared to other cultivars. The difference between the cultivar H09-23 and H08-18 for total N uptake was, however, not significant. P content in grain and stover, P uptake in stover and total P uptake of chickpea was not influenced by cultivars. Among different cultivars, H09-23 showed the superiority in P uptake by grain as compared to other cultivars content in grain and stover, K uptake in stover and total K uptake of chickpea were not influenced by cultivars. Among different cultivars K uptake in grain was highest in H09-23 followed by H08-18 and HC-1.

Relatively higher N, P and K content (%) and uptake in grain and straw of H09-23 as compared to other cultivars might be ascribed to its relatively higher grain and stover yield (s) than rest of the chickpea cultivars. Corroborative findings have also been reported by some workers\(^8\). Various chickpea cultivars did not influence the protein content in stover and grain.

**Effect of seed rates:** N content and its uptake by stover and
Table 3. Effect of seed rates and sowing time on K content (%) and its uptake (kg ha⁻¹) by chickpea cultivars

<table>
<thead>
<tr>
<th>Treatments</th>
<th>K Content (%)</th>
<th>K uptake (kg ha⁻¹)</th>
<th>Total K uptake (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grain</td>
<td>Stover</td>
<td>Grain</td>
</tr>
<tr>
<td>Date of sowing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st fortnight of November</td>
<td>0.747</td>
<td>1.69</td>
<td>15.34</td>
</tr>
<tr>
<td>1st fortnight of December</td>
<td>0.691</td>
<td>1.53</td>
<td>10.82</td>
</tr>
<tr>
<td>SEm ±</td>
<td>0.020</td>
<td>0.080</td>
<td>0.458</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>1.389</td>
</tr>
<tr>
<td>Cultivars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H08-18</td>
<td>0.723</td>
<td>1.62</td>
<td>14.11</td>
</tr>
<tr>
<td>H09-23</td>
<td>0.732</td>
<td>1.62</td>
<td>14.59</td>
</tr>
<tr>
<td>C235</td>
<td>0.704</td>
<td>1.59</td>
<td>10.51</td>
</tr>
<tr>
<td>HC-1</td>
<td>0.716</td>
<td>1.61</td>
<td>13.12</td>
</tr>
<tr>
<td>SEm ±</td>
<td>0.029</td>
<td>0.114</td>
<td>0.647</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>1.96</td>
</tr>
<tr>
<td>Seed rates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 kg ha⁻¹</td>
<td>0.713</td>
<td>1.62</td>
<td>13.12</td>
</tr>
<tr>
<td>50 kg ha⁻¹</td>
<td>0.739</td>
<td>1.65</td>
<td>13.71</td>
</tr>
<tr>
<td>60 kg ha⁻¹</td>
<td>0.704</td>
<td>1.59</td>
<td>12.41</td>
</tr>
<tr>
<td>SEm ±</td>
<td>0.031</td>
<td>0.080</td>
<td>0.625</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

total N uptake were not influenced by seed rates. While N content and its uptake by grain were significantly higher with seed rate of 50 kg ha⁻¹ as compared to rest two (40 and 60 kg ha⁻¹). N uptake by grain was 8.24% higher in case of 50 kg ha⁻¹ seed rate as compared to other two. The difference between the seed rate of 40 and 50 kg ha⁻¹ was, however, non significant. In seed rate there were no significant differences observed in P content in grain and stover and P uptake in stover. Sowing of chickpea with seed rate of 50 kg ha⁻¹ resulted in significantly higher P uptake in grain and total P uptake as compared to other two seed rates (40 and 50 kg ha⁻¹). Varying seed rate fail to influence K content and its uptake in grain and stover and total K uptake and protein content in stover of chickpea cultivars. Among different seed rates, 50 kg ha⁻¹ showed the superiority in grain protein content of chickpea as compared to other two (40 kg ha⁻¹ and 60 kg ha⁻¹). This is in complete agreement with the findings of many authors who found that the N and P accumulation in grain and straw were significantly higher in wider row spacing of 30 cm as compared to closer row spacing of 20 cm². Similar results of seed rates on the nutrient content of chickpea cultivars have been reported by some other workers. Among different seed rates 50 kg ha⁻¹ showed the superiority in grain protein content of chickpea as compared to other two (40 kg ha⁻¹ and 60 kg ha⁻¹).

Soil Analysis: All the three factors in the present investigation (Chickpea cultivars, seed rate and date of sowing) fail to influence N, P and K status of the soil after harvesting of chickpea (Table 4). The chickpea cultivar H09-23 slightly
Figure-1. Effect of seed rates and sowing time on grain and stover protein of chickpea cultivars.

Table-4. Effect of sowing time, chickpea cultivars and seed rates on NPK status of Soil.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>N (kg ha⁻¹) Before</th>
<th>N (kg ha⁻¹) After</th>
<th>P₂O₅ (kg ha⁻¹) Before</th>
<th>P₂O₅ (kg ha⁻¹) After</th>
<th>K₂O (kg ha⁻¹) Before</th>
<th>K₂O (kg ha⁻¹) After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of sowing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st fortnight of November</td>
<td>194.65</td>
<td>208.42</td>
<td>35.18</td>
<td>35.69</td>
<td>253.67</td>
<td>210.78</td>
</tr>
<tr>
<td>1st fortnight of December</td>
<td>190.77</td>
<td>211.26</td>
<td>28.82</td>
<td>41.86</td>
<td>244.79</td>
<td>219.67</td>
</tr>
<tr>
<td>SEM ±</td>
<td>8.44</td>
<td>8.44</td>
<td>3.73</td>
<td>3.80</td>
<td>5.19</td>
<td>5.19</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Cultivars</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H08-18</td>
<td>199.76</td>
<td>216.89</td>
<td>33.21</td>
<td>39.69</td>
<td>251.87</td>
<td>217.86</td>
</tr>
<tr>
<td>H09-23</td>
<td>191.67</td>
<td>218.80</td>
<td>32.95</td>
<td>39.82</td>
<td>249.10</td>
<td>217.08</td>
</tr>
<tr>
<td>C235</td>
<td>182.52</td>
<td>199.65</td>
<td>30.53</td>
<td>37.40</td>
<td>244.94</td>
<td>210.93</td>
</tr>
<tr>
<td>HC-1</td>
<td>196.89</td>
<td>204.02</td>
<td>31.30</td>
<td>38.17</td>
<td>251.03</td>
<td>215.02</td>
</tr>
<tr>
<td>SEM ±</td>
<td>11.94</td>
<td>11.94</td>
<td>5.27</td>
<td>5.37</td>
<td>7.34</td>
<td>7.34</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Seed rates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 kg ha⁻¹</td>
<td>193.07</td>
<td>210.20</td>
<td>32.44</td>
<td>39.31</td>
<td>249.51</td>
<td>215.50</td>
</tr>
<tr>
<td>50 kg ha⁻¹</td>
<td>194.14</td>
<td>211.27</td>
<td>33.30</td>
<td>40.17</td>
<td>250.35</td>
<td>216.34</td>
</tr>
<tr>
<td>60 kg ha⁻¹</td>
<td>190.92</td>
<td>208.05</td>
<td>30.25</td>
<td>36.83</td>
<td>247.84</td>
<td>213.83</td>
</tr>
<tr>
<td>SEM ±</td>
<td>8.97</td>
<td>8.97</td>
<td>1.89</td>
<td>1.89</td>
<td>6.71</td>
<td>6.72</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>
improves the available N status of the soil after the harvest of chickpea as compared to the other cultivars (H08-18, HC-1 and C235).

CONCLUSION

Chickpea sown on 1st fortnight of November resulted in significantly higher total N, P and K uptake and grain protein content. Seed rate of 50 kg ha⁻¹ produced maximum N content and uptake in grain, P uptake by grain, total P uptake and protein content in grain. Various chickpea cultivar failed to influence N, P and K content and uptake in stover, total P and K uptake and protein content in stover and grain. There was no significant difference observed due to time of sowing, cultivars and seed rates on nutrient status of the soil after crop harvesting.

REFERENCES