Effect of Different Temperature and Rainfall Regimes with Different Levels of Soil Fertility on Uptake Pattern of N, P and K of Chilli (Capsicum annuum L.) under Terai Zone of West Bengal

S. Datta* and J.C. Jana

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Abstract

There was a significant variation in nitrogen (N), phosphorus (P) and potassium (K) content and their uptake by different plant parts with respect to growing seasons, fertility levels and genotypes. Similarly, N, P and K content and uptake (except fruit N and fruit P uptake) increased with increase in the levels of soil fertility from 0 to 200% of recommended dose of fertilizers (RDF). Considering yield performance of different genotypes, ‘Ulka 686 F1’ (24.9 t/ha), ‘Jwalan’ (20.0 t/ha) and ‘CA-29’ (19.3 t/ha), were selected for growing at 150% RDF in the winter season (low temperature and low rainfall regime). Similarly for rainy season (high temperature and high rainfall regime), ‘Jwalan’ (12.2 t/ha), ‘Ulka 686 F1’ (11.3 t/ha) at 100% RDF and ‘Pusa Sadabahar’ at 150% RDF (10.4 t/ha) were selected. Highest amount of total N, P and K uptake of 158.55, 68.51 and 195.35 kg/ha, respectively was recorded by Ulka 686 F1 at 200% RDF. Partitioning of nutrient revealed that fruit N, P and K content increased with increasing fertility level upto 150% RDF in winter season and 100% RDF in rainy season thereafter decreased subsequently. Stem N, P and K percent increased with increasing fertility level whereas reverse case was noticed in the case of root N, P and K content irrespective of season.

Keywords: Genotypes; N; P; K content; Seasons; Nutrient uptake; Yield

1. Introduction

Chilli (Capsicum annuum L.) is an important cash crop in India and is cultivated both for domestic and international market. During 2009-2010, India earned approximately 215.10 million US$ by exporting chilli and chilli products, which contributed to 23 per cent value in terms of total spice
export as reported by Spice Board, India during the year 2010. It is an indispensable vegetable cum spice crop in every home of the tropical countries. It is used for its pungency, colour and its spicy taste. Green chillies are also rich in vitamin A and vitamin C. Hedge (1989) reported that chilli takes up large amount of nutrients. The amount of nutrients taken up by solanaceous vegetables is influenced by a number of genetic and environmental variables (Shukla and Naik, 1993). Chilli needs to absorb more nutrients than tomato or brinjal to produce a unit of dry matter. The genetic potential could be further exploited by supplementing with nutrition. Being a short growing season crop, the beneficial response of applied nutrient has been reported by several researchers (Hedge, 1989; Khurana et al. 2006; Singh et al. 1999). The inorganic fertilizers like N, P and K have played significant role in increasing yield and quality of chilli (Singh et al. 1999; Hari et al. 2007). It is necessary to adopt appropriate nutrient management practices which help to supply nutrients in adequate quantities to just meet the crop tropical countries. It is used for its pungency, colour and its spicy taste. Green chillies are also rich demand and minimize losses, thereby increasing nutrient use efficiency. On the other hand information regarding the N, P and K uptake pattern of chilli under different fertility level is very meager. So, need based fertilizer management is an important and urgent task in the present scenario to restore soil fertility because fertilizer requirement of any crop mainly varies from genotype to genotype and growing season in a particular agroclimatic region. Keeping this view, an experiment was undertaken to study the nutrient uptake pattern of chilli genotypes and to select suitable green chilli genotypes under different fertility levels and different growing seasons.

2. Materials and Methods

The experiment was undertaken with fifteen chili genotypes (five genotypes each from local genotypes viz. ‘CA-29’, ‘CA-30’, ‘CA-39’, ‘CA-47’ and ‘CA-48’, improved varieties viz. ‘Chilli Phiilhal’, ‘Pusa Sadabahar’, ‘DKC-8’, ‘Pusa Jwala’ and ‘G-4’ and hybrids viz. ‘Diamond F1’, ‘Tejaswini’, ‘NS-1701’, ‘Jwalan’, and ‘Ulka 686 F1’) were evaluated under 5 fertility levels created artificially by applying 0, 50, 100, 150 and 200% of recommended dose of fertilizers (RDF) of 100 : 50 : 50 Kg N, P2O5 and K2O/ha during winter season (low temperature and low rainfall regime) of 2006-07 (Table 1A) and rainy season (high temperature and high rainfall regime) of 2007 (Table 1B). RDF for chilli was fixed as per suggestion of Department FPI and Horticulture (2003). The experiment was laid out in Factorial Randomized Block Design with three replications at the Experimental Farm (26°19’96” N latitude and 89°23’53” E, at an elevation of 43 meter above mean sea level) of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal, India. The soil was sandy clay loam having pH 5.5, 0.91% organic carbon, 133.81 kg/ha available N 45.62 kg/ha available P and 59.43 kg/ha K. The climatic condition of this region is sub-tropical humid in nature. Transplanting was done in the third week of November and April for winter and rainy seasons respectively in a plot size of 3.60 m x 3.00 m with a spacing of 45 cm x 30 cm. Well rotten farmyard manure was applied at 15 t/ha as basal. Full dose of P2O5, one third of N and half of K was applied at the time of land preparation. After 45 days of transplanting top dressing was done with one third of nitrogen and rest half of K2O. Second top dressing was done with rest one third of nitrogen at 75 days after transplanting. After transplanting one light irrigation was given for quick establishment of seedlings and there after irrigation was given as and when required. Weeding, hoeing, staking and other intercultural operations were also done as and when required. A regular spray schedule was followed for controlling pest and diseases. Harvesting of chilli was done at the mature green stage when a few number of fruits change colour from green to red considering consumer preference.
Harvesting of the mature fruit was done at 15 days interval. Ascorbic acid in chilli fruit was determined by colorimetric method based on the reduction of 2, 6- dichlorophenol indophenol by ascorbic acid and was expressed in milligram of ascorbic acid per 100 g of sample (Ranganna 2001). Capsaicin content (%) of green fruits was measured by Spectrophotometer method as described by Sadasivam and Manickam (1996). Soil and plant nitrogen content in chilli was determined by modified Kjeldahl method (Jackson, 1973), phosphorus content by Olsen method (Jackson, 1973) and potassium content by Flame photometer method, as described by Jackson (1973). Statistical analysis was done by method suggested by Gomez and Gomez (1984).

Table 1A The meteorological parameter during the growing period of winter chilli

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
<th>Relative Humidity (%)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>November, 2006</td>
<td>26.9</td>
<td>16.3</td>
<td>96</td>
</tr>
<tr>
<td>December, 2006</td>
<td>25.8</td>
<td>10.5</td>
<td>100</td>
</tr>
<tr>
<td>January, 2007</td>
<td>23.0</td>
<td>8.8</td>
<td>95</td>
</tr>
<tr>
<td>February, 2007</td>
<td>26.1</td>
<td>13.7</td>
<td>92</td>
</tr>
<tr>
<td>March, 2007</td>
<td>29.2</td>
<td>15.5</td>
<td>92</td>
</tr>
<tr>
<td>April, 2007</td>
<td>30.3</td>
<td>20.7</td>
<td>87</td>
</tr>
</tbody>
</table>

Source: Principal Agricultural Office, Cooch Behar, West Bengal, India.

Table 1B The meteorological parameter during the growing period of kharif chilli.

<table>
<thead>
<tr>
<th>Month</th>
<th>Temperature (°C)</th>
<th>Relative Humidity (%)</th>
<th>Rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>May, 2007</td>
<td>32.3</td>
<td>23.1</td>
<td>88</td>
</tr>
<tr>
<td>June, 2007</td>
<td>30.5</td>
<td>24.4</td>
<td>94</td>
</tr>
<tr>
<td>July, 2007</td>
<td>30.5</td>
<td>24.8</td>
<td>94</td>
</tr>
<tr>
<td>August, 2007</td>
<td>32.2</td>
<td>25.7</td>
<td>94</td>
</tr>
<tr>
<td>September, 2007</td>
<td>30.9</td>
<td>24.6</td>
<td>92</td>
</tr>
<tr>
<td>October, 2007</td>
<td>30.7</td>
<td>21.7</td>
<td>92</td>
</tr>
</tbody>
</table>

Source: Principal Agricultural Office, Cooch Behar, West Bengal, India.

3. Results and Discussion

3.1 NPK content and their uptake by different plant part
Mean performance revealed that there was a significant variation in N, P and K content and their uptake by different plant parts with respect to growing seasons, fertility levels and genotypes (Table 2 and Table 3). Higher N, P and K content and subsequently uptake of these nutrients were recorded in winter season as compared to rainy season. Similarly N, P and K content and uptake (except fruit N and fruit P uptake) increased with increase in the levels of soil fertility from 0 to 200% RDF. A linear increase in the leaf nitrogen was noticed with the corresponding increase in the application of nitrogen levels. Narasappa et al. (1985) also reported the similar type of observation.
Among the different genotypes significantly the highest fruit N content was recorded in Pusa Sadabahar (1.92%) and it was lowest in DKC-8 (1.70%) which was statistically at par with Chilli Philhal (1.71%). The highest P content was recorded in Pusa Sadabahr, Daiamond F₁ and NS-1701 (0.84% in each genotype) whereas it was lowest in Chilli Philhal (0.73%) and it was statistically at par with G-4 (0.74%) whereas the highest K content was recorded in Chilli Philhal (2.18%) and it was lowest in CA-39 (1.97%). Higher leaf N content was recorded in Ulka 686 F₁ and Tejaswini (3.48% in each) and Diamond F₁ (3.27%). Higher leaf P and K content was recorded in NS-1701 (1.14% and 4.24% respectively) and it was lowest P content in Pusa Jwala (0.87%) which was statistically at par with CA-39 (0.89%) and lowest K content CA-39 (3.50%). Stem N, P and K content varied from 1.27%–1.50%, 0.57%–0.73% and 1.45%–1.70% respectively. Similarly root N, P and K content varied from 0.98%–1.54%, 0.44%–0.56% and 1.08%–1.41% respectively.

The highest concentrations of N, P and K in leaf, followed by that in fruit and the stem and same was also recorded by Hedge (1989).

Table 2. Effect of seasons, soil fertility levels and genotypes on fruit and leaf N, P and K content by different plant parts of chilli

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Fruit N %</th>
<th>Fruit P%</th>
<th>Fruit K%</th>
<th>Leaf N %</th>
<th>Leaf P%</th>
<th>Leaf K%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter (S₁)</td>
<td>1.90</td>
<td>0.81</td>
<td>2.15</td>
<td>3.33</td>
<td>1.04</td>
<td>4.27</td>
</tr>
<tr>
<td>Rainy (S₂)</td>
<td>1.71</td>
<td>0.75</td>
<td>2.00</td>
<td>3.11</td>
<td>0.91</td>
<td>3.51</td>
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<tr>
<td>C D (P = 0.05)</td>
<td>0.01</td>
<td>0.003</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
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<tr>
<td>Fertility level</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 NPK (F₁)</td>
<td>1.64</td>
<td>0.70</td>
<td>1.77</td>
<td>2.91</td>
<td>0.85</td>
<td>3.43</td>
</tr>
<tr>
<td>50% RDF (F₂)</td>
<td>1.72</td>
<td>0.74</td>
<td>1.91</td>
<td>3.07</td>
<td>0.91</td>
<td>3.67</td>
</tr>
<tr>
<td>100% RDF (F₃)</td>
<td>1.81</td>
<td>0.79</td>
<td>2.08</td>
<td>3.22</td>
<td>0.98</td>
<td>3.92</td>
</tr>
<tr>
<td>150% RD F (F₄)</td>
<td>1.88</td>
<td>0.82</td>
<td>2.23</td>
<td>3.38</td>
<td>1.05</td>
<td>4.14</td>
</tr>
<tr>
<td>200% RDF (F₅)</td>
<td>1.95</td>
<td>0.87</td>
<td>2.39</td>
<td>3.52</td>
<td>1.11</td>
<td>4.33</td>
</tr>
<tr>
<td>C D (P = 0.05)</td>
<td>0.01</td>
<td>0.01</td>
<td>0.02</td>
<td>0.03</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Genotypes</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA-29(V₁)</td>
<td>1.81</td>
<td>0.75</td>
<td>2.05</td>
<td>3.03</td>
<td>0.93</td>
<td>3.80</td>
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<tr>
<td>CA-30(V₂)</td>
<td>1.85</td>
<td>0.77</td>
<td>2.10</td>
<td>3.29</td>
<td>0.95</td>
<td>3.94</td>
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<tr>
<td>CA-39(V₃)</td>
<td>1.77</td>
<td>0.76</td>
<td>1.97</td>
<td>3.05</td>
<td>0.89</td>
<td>3.50</td>
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<tr>
<td>CA-47(V₄)</td>
<td>1.88</td>
<td>0.82</td>
<td>2.16</td>
<td>3.05</td>
<td>0.92</td>
<td>3.92</td>
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<tr>
<td>CA-48(V₅)</td>
<td>1.84</td>
<td>0.75</td>
<td>2.00</td>
<td>3.20</td>
<td>1.00</td>
<td>3.84</td>
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<tr>
<td>DKC-8(V₆)</td>
<td>1.70</td>
<td>0.75</td>
<td>2.05</td>
<td>3.24</td>
<td>0.90</td>
<td>3.82</td>
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<tr>
<td>Chilli Philhal (V₇)</td>
<td>1.71</td>
<td>0.73</td>
<td>2.18</td>
<td>2.95</td>
<td>0.90</td>
<td>3.75</td>
</tr>
<tr>
<td>Pusa Sadabahar (V₈)</td>
<td>1.92</td>
<td>0.84</td>
<td>2.15</td>
<td>3.39</td>
<td>0.96</td>
<td>3.93</td>
</tr>
<tr>
<td>Pusa Jwala (V₉)</td>
<td>1.73</td>
<td>0.77</td>
<td>2.04</td>
<td>3.22</td>
<td>0.87</td>
<td>3.60</td>
</tr>
<tr>
<td>G-4(V₁₀)</td>
<td>1.80</td>
<td>0.74</td>
<td>2.08</td>
<td>3.24</td>
<td>1.06</td>
<td>3.97</td>
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<tr>
<td>Diamond F₁(V₁₁)</td>
<td>1.78</td>
<td>0.84</td>
<td>2.16</td>
<td>3.37</td>
<td>0.93</td>
<td>3.69</td>
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<tr>
<td>Tejaswini(V₁₂)</td>
<td>1.90</td>
<td>0.79</td>
<td>2.04</td>
<td>3.48</td>
<td>1.08</td>
<td>4.14</td>
</tr>
<tr>
<td>NS-1701(V₁₃)</td>
<td>1.78</td>
<td>0.84</td>
<td>2.10</td>
<td>3.17</td>
<td>1.14</td>
<td>4.12</td>
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<tr>
<td>Jwalan(V₁₄)</td>
<td>1.73</td>
<td>0.77</td>
<td>1.98</td>
<td>3.15</td>
<td>1.11</td>
<td>4.24</td>
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<tr>
<td>Ulka 686 F1(V₁₅)</td>
<td>1.85</td>
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<td>0.03</td>
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</table>
Table 3 Effect of seasons, soil fertility levels and genotypes on stem and root N, P and K content by different plant parts of chilli

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Stem N %</th>
<th>Stem P %</th>
<th>Stem K%</th>
<th>Root N%</th>
<th>Root P%</th>
<th>Root K%</th>
</tr>
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<tbody>
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<td><strong>Season</strong></td>
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<tr>
<td>Winter ($S_1$)</td>
<td>1.44</td>
<td>0.66</td>
<td>1.57</td>
<td>1.11</td>
<td>0.49</td>
<td>1.22</td>
</tr>
<tr>
<td>Rainy ($S_2$)</td>
<td>1.40</td>
<td>0.62</td>
<td>1.51</td>
<td>1.08</td>
<td>0.49</td>
<td>1.22</td>
</tr>
<tr>
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<td>0.003</td>
<td>0.004</td>
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<td>0.004</td>
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</tr>
<tr>
<td>0 NPK ($F_1$)</td>
<td>1.33</td>
<td>0.57</td>
<td>1.45</td>
<td>1.04</td>
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<tr>
<td>50% RDF ($F_2$)</td>
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<td>0.60</td>
<td>1.49</td>
<td>1.07</td>
<td>0.46</td>
<td>1.19</td>
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<tr>
<td>100% RDF ($F_3$)</td>
<td>1.42</td>
<td>0.64</td>
<td>1.54</td>
<td>1.10</td>
<td>0.49</td>
<td>1.22</td>
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<tr>
<td>150% RDFF ($F_4$)</td>
<td>1.47</td>
<td>0.68</td>
<td>1.59</td>
<td>1.12</td>
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<tr>
<td>200% RDF ($F_5$)</td>
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<td>0.71</td>
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<td>1.27</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
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<td>0.01</td>
<td>0.004</td>
<td>0.01</td>
<td>0.004</td>
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<tr>
<td>CA-29($V_1$)</td>
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<td>0.63</td>
<td>1.46</td>
<td>1.14</td>
<td>0.49</td>
<td>1.25</td>
</tr>
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<td>CA-30($V_2$)</td>
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<td>0.67</td>
<td>1.53</td>
<td>1.19</td>
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<td>1.24</td>
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<td>CA-39($V_3$)</td>
<td>1.41</td>
<td>0.57</td>
<td>1.53</td>
<td>1.08</td>
<td>0.46</td>
<td>1.14</td>
</tr>
<tr>
<td>CA-47($V_4$)</td>
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<td>1.54</td>
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<td>0.46</td>
<td>1.31</td>
</tr>
<tr>
<td>CA-48($V_5$)</td>
<td>1.40</td>
<td>0.61</td>
<td>1.49</td>
<td>1.20</td>
<td>0.46</td>
<td>1.32</td>
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<tr>
<td>DKC-8($V_6$)</td>
<td>1.45</td>
<td>0.71</td>
<td>1.70</td>
<td>1.54</td>
<td>0.47</td>
<td>1.41</td>
</tr>
<tr>
<td>Chilli Philhal ($V_7$)</td>
<td>1.41</td>
<td>0.66</td>
<td>1.51</td>
<td>1.01</td>
<td>0.45</td>
<td>1.25</td>
</tr>
<tr>
<td>Pusa Sadabahar ($V_8$)</td>
<td>1.50</td>
<td>0.73</td>
<td>1.61</td>
<td>1.12</td>
<td>0.56</td>
<td>1.30</td>
</tr>
<tr>
<td>Pusa Jwala ($V_9$)</td>
<td>1.32</td>
<td>0.61</td>
<td>1.48</td>
<td>0.98</td>
<td>0.50</td>
<td>1.17</td>
</tr>
<tr>
<td>G-4($V_{10}$)</td>
<td>1.42</td>
<td>0.64</td>
<td>1.45</td>
<td>0.98</td>
<td>0.50</td>
<td>1.11</td>
</tr>
<tr>
<td>Diamond F1($V_{11}$)</td>
<td>1.44</td>
<td>0.61</td>
<td>1.53</td>
<td>1.00</td>
<td>0.49</td>
<td>1.08</td>
</tr>
<tr>
<td>Tejaswini($V_{12}$)</td>
<td>1.48</td>
<td>0.62</td>
<td>1.61</td>
<td>1.02</td>
<td>0.49</td>
<td>1.11</td>
</tr>
<tr>
<td>NS-1701($V_{13}$)</td>
<td>1.45</td>
<td>0.63</td>
<td>1.52</td>
<td>1.12</td>
<td>0.52</td>
<td>1.21</td>
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<tr>
<td>Jwalan($V_{14}$)</td>
<td>1.27</td>
<td>0.59</td>
<td>1.51</td>
<td>1.06</td>
<td>0.44</td>
<td>1.13</td>
</tr>
<tr>
<td>Ulka 686 F1($V_{15}$)</td>
<td>1.48</td>
<td>0.65</td>
<td>1.63</td>
<td>1.17</td>
<td>0.49</td>
<td>1.25</td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

**Interaction $CD(P=0.05)$**

<table>
<thead>
<tr>
<th></th>
<th>Stem N</th>
<th>Stem P</th>
<th>Stem K</th>
<th>Root N</th>
<th>Root P</th>
<th>Root K</th>
</tr>
</thead>
<tbody>
<tr>
<td>SXF</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
<td>N.S.</td>
<td>N.S.</td>
<td>0.01</td>
</tr>
<tr>
<td>FXG</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>SXG</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>SXFXG</td>
<td>0.05</td>
<td>0.03</td>
<td>0.04</td>
<td>N.S.</td>
<td>N.S.</td>
<td>0.03</td>
</tr>
</tbody>
</table>

3.2 Yield and Quality parameters

Higher yield was recorded in winter season than in the rainy season because of the persistence of environmental conditions favourable (especially moderate temperature, clear sunshine, etc) for the
crop under mention. Mini and Vahab (2000) also made similar observation. With increasing fertility, ascorbic acid and capsaicin content increased noticeably (Table 4). In many studies, yield attributing characters have been found improved following higher N application rates (Shukla and Naik 1993). Among the different genotypes ‘Ulka 686 F1’ and ‘Jwalan’ were rated the best in respect to yield (Table 4). The highest yield was observed in ‘Ulka 686 F1’ (14.2 t/ha), followed by ‘Jwalan’ (12.8 t/ha), ‘CA-29’ (10.9 t/ha) and ‘CA-48’ (9.4 t/ha) and it was lowest in ‘G-4’ (4.6 t/ha). Similarly higher ascorbic acid content was noticed in ‘G-4’ (151 mg/100g of fresh fruit) and the highest capsaicin content in ‘Tejaswini’ (0.97%) followed by ‘G-4’ (0.83%) and ‘Ulka 686 F1’ (0.77%). The capsaicin content in green fruit was lowest in ‘CA-47’ (0.33%). Interaction effect revealed yield variation from 2.4 – 24.9 t/ha. In winter season, Jwalan, CA-29, CA-48 and CA-47 produced higher yield at 150% RDF (19.96, 19.28, 18.07 and 17.98 t/ha, respectively). In the rainy season, Jwalan recorded higher yield (12.42 t/ha) at 150% RDF which was statistically at par with the same genotypes at 100% RDF (12.20 t/ha). Ulka 686 F1 also produced higher yield at 150% RDF (11.76 t/ha) was also statistically at par with 100% RDF (11.25 t/ha) and 200% RDF (11.23 t/ha). Pusa Sadabahar at 150% RDF also produced higher yield (10.43 t/ha). Hari et al. (2007) reported that N and K and their combinations exhibited significant differences (at P = 0.05) with respect to yield. Irrespective of season ‘Ulka 686 F1’ and ‘Jwalan’ produced higher yields than all other types of genotypes. The increase in yield at higher fertility level was possibly due to increased photosynthates associated with more vegetative growth as evident from differences in plant height and number of branches (Khurana et al. 2006).

3.3 Nutrient uptake
Higher fruit N, P and K uptake were recorded in the genotypes Jwalan and Ulka 686 F1 due to their higher fruit yield, whereas maximum leaf uptake in Tejaswini, and stem and root uptake in Pusa Sadabahar. Highest amount of total N, P and K uptake of 158.55, 68.51 and 195.35 kg/ha, respectively was recorded by Ulka 686 F1 at 200% RDF followed by same genotype at 150% RDF and genotype Jwalan at 150% RDF during winter season. Due to more vegetative growth and yield, higher uptake of N, P and K occurred and their increased supply is natural and has been supported by Hari et al. (2007).

3.4 Partitioning of N, P and K
Partitioning of nutrient (Table 5 and Table 6) revealed that fruit N, P and K content increased with increasing fertility level upto 150% RDF in winter season and 100% RDF in rainy season thereafter decreased subsequently. With respect to partitioning, leaf N, P and K varied from 21.93 - 26.44%, 18.02 - 20.88% and 23.85 - 28.85% respectively in winter season and

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fresh green yield (t/ha)</th>
<th>Ascorbic Acid (mg/100g fresh)</th>
<th>Capsaicin in green fruit (%)</th>
<th>Uptake (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season</td>
<td></td>
<td></td>
<td></td>
<td>Nitrogen</td>
</tr>
<tr>
<td>Winter (S1)</td>
<td>11.08</td>
<td>128.40</td>
<td>0.58</td>
<td>90.75</td>
</tr>
<tr>
<td>Rainy (S2)</td>
<td>6.13</td>
<td>127.39</td>
<td>0.55</td>
<td>57.25</td>
</tr>
<tr>
<td>C D (P = 0.05)</td>
<td>0.08</td>
<td>0.60</td>
<td>0.01</td>
<td>0.41</td>
</tr>
</tbody>
</table>
Table 5 Partitioning of nutrient uptake in chilli in relation to soil fertility level during winter season

<table>
<thead>
<tr>
<th>Fertility level</th>
<th>Plant parts</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 NPK (F₁)</td>
<td>Fruit</td>
<td>45.72</td>
<td>49.52</td>
<td>43.42</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>26.44</td>
<td>19.89</td>
<td>28.85</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>19.97</td>
<td>22.2</td>
<td>19.8</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>7.87</td>
<td>8.39</td>
<td>7.93</td>
</tr>
<tr>
<td>50% RDF (F₂)</td>
<td>Fruit</td>
<td>50.12</td>
<td>52.43</td>
<td>49.46</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>23.04</td>
<td>19.49</td>
<td>25.32</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>20.51</td>
<td>21.46</td>
<td>19.08</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>6.33</td>
<td>6.62</td>
<td>6.14</td>
</tr>
<tr>
<td>100% RDF (F₃)</td>
<td>Fruit</td>
<td>51.06</td>
<td>53.86</td>
<td>51.01</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>21.93</td>
<td>18.03</td>
<td>25.07</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>21.29</td>
<td>21.81</td>
<td>18.76</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>5.72</td>
<td>6.30</td>
<td>5.16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Genotypes</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-29(V₁)</td>
<td>10.93</td>
<td>141.67</td>
<td>0.51</td>
<td>82.93</td>
</tr>
<tr>
<td>CA-30(V₂)</td>
<td>6.86</td>
<td>133.46</td>
<td>0.36</td>
<td>62.22</td>
</tr>
<tr>
<td>CA-39(V₃)</td>
<td>7.81</td>
<td>132.71</td>
<td>0.45</td>
<td>58.79</td>
</tr>
<tr>
<td>CA-47(V₄)</td>
<td>9.21</td>
<td>128.19</td>
<td>0.33</td>
<td>73.50</td>
</tr>
<tr>
<td>CA-48(V₅)</td>
<td>9.43</td>
<td>113.42</td>
<td>0.56</td>
<td>77.96</td>
</tr>
<tr>
<td>DKC-8(V₆)</td>
<td>6.99</td>
<td>123.65</td>
<td>0.34</td>
<td>65.42</td>
</tr>
<tr>
<td>Chilli Philhal (V₇)</td>
<td>6.68</td>
<td>126.51</td>
<td>0.51</td>
<td>56.96</td>
</tr>
<tr>
<td>Pusa Sadabahar (V₈)</td>
<td>8.80</td>
<td>138.67</td>
<td>0.49</td>
<td>98.78</td>
</tr>
<tr>
<td>Pusa Jwala (V₉)</td>
<td>4.73</td>
<td>142.67</td>
<td>0.53</td>
<td>48.51</td>
</tr>
<tr>
<td>G-4(V₁₀)</td>
<td>4.60</td>
<td>150.81</td>
<td>0.83</td>
<td>64.32</td>
</tr>
<tr>
<td>Diamond F₁ (V₁₁)</td>
<td>8.47</td>
<td>138.35</td>
<td>0.44</td>
<td>70.47</td>
</tr>
<tr>
<td>Tejaswini(V₁₂)</td>
<td>8.86</td>
<td>105.84</td>
<td>0.97</td>
<td>83.87</td>
</tr>
<tr>
<td>NS-1701(V₁₃)</td>
<td>8.76</td>
<td>100.56</td>
<td>0.62</td>
<td>75.64</td>
</tr>
<tr>
<td>Jwalan(V₁₄)</td>
<td>12.76</td>
<td>129.92</td>
<td>0.70</td>
<td>93.15</td>
</tr>
<tr>
<td>Ulka 686 F₁(V₁₅)</td>
<td>14.17</td>
<td>111.95</td>
<td>0.77</td>
<td>98.46</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interaction CD(P=0.05)</th>
<th>SXF</th>
<th>FXG</th>
<th>SXG</th>
<th>SXFXG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.18</td>
<td>0.51</td>
<td>0.32</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>1.33</td>
<td>NS</td>
<td>2.32</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>NS</td>
<td>NS</td>
<td>2.96</td>
<td>NS</td>
</tr>
</tbody>
</table>

Note: CD (P = 0.05) indicates the critical difference at a 5% probability level.
In rainy season, leaf N, P and K varied from 25.46 - 29.38 %, 19.09 - 19.92% and 25.99 – 28.34 % respectively. Irrespective of seasons, stem N, P and K percent increased with increasing fertility level whereas root N, P and K percent decreased with increasing the fertility levels. This indicated that at higher soil fertility level stem growth will be more over the respective root growth. Maestrey et al. (1987) observed the highest and lowest concentrations of N, P and K in the fruits and roots, respectively in tomato. Similar types of findings were also observed in our experiment.

Table 6 Partitioning of nutrient uptake in chiltto soil fertility level during rainy season

<table>
<thead>
<tr>
<th>Fertility level</th>
<th>Plant parts</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 NPK (F₁)</td>
<td>Fruit</td>
<td>40.66</td>
<td>44.83</td>
<td>40.08</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>25.46</td>
<td>19.78</td>
<td>26.59</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>25.52</td>
<td>26.23</td>
<td>24.77</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>8.36</td>
<td>9.16</td>
<td>8.56</td>
</tr>
<tr>
<td>50% RDF (F₂)</td>
<td>Fruit</td>
<td>40.19</td>
<td>44.46</td>
<td>40.43</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>26.77</td>
<td>19.68</td>
<td>27.09</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>25.71</td>
<td>27.85</td>
<td>25.02</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>7.33</td>
<td>8.01</td>
<td>7.46</td>
</tr>
<tr>
<td>100% RDF (F₃)</td>
<td>Fruit</td>
<td>41.05</td>
<td>45.38</td>
<td>41.19</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>26.28</td>
<td>19.09</td>
<td>25.99</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>25.8</td>
<td>27.54</td>
<td>26.05</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>6.87</td>
<td>7.99</td>
<td>6.77</td>
</tr>
<tr>
<td>150% RD F (F₄)</td>
<td>Fruit</td>
<td>38.78</td>
<td>42.53</td>
<td>40.71</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>27.87</td>
<td>19.89</td>
<td>28.34</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>26.61</td>
<td>29.95</td>
<td>26.29</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>6.74</td>
<td>7.63</td>
<td>6.66</td>
</tr>
<tr>
<td>200% RDF (F₅)</td>
<td>Fruit</td>
<td>36.07</td>
<td>41.1</td>
<td>38.41</td>
</tr>
<tr>
<td></td>
<td>Leaf</td>
<td>29.38</td>
<td>19.92</td>
<td>27.87</td>
</tr>
<tr>
<td></td>
<td>Stem</td>
<td>27.91</td>
<td>31.58</td>
<td>27.20</td>
</tr>
<tr>
<td></td>
<td>Root</td>
<td>6.64</td>
<td>7.40</td>
<td>6.52</td>
</tr>
</tbody>
</table>
4. Conclusion

N, P and K content and their uptake by different plant parts significantly varied with respect to growing seasons, fertility levels and genotypes. Considering yield performance of different genotypes, ‘Ulka 686 F1’ (24.9 t/ha), ‘Jwalan’ (20.0 t/ha) and ‘CA-29’ (19.3 t/ha) were selected for growing at 150% RDF in the winter season whereas, ‘Jwalan’ (12.2 t/ha), ‘Ulka 686 F1’ (11.3 t/ha) at 100% RDF and ‘Pusa Sadabahar’ at 150% RDF (10.4 t/ha) in rainy season.

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Spice Board, 2010. Export performance of different spices during 2009-10. Spice India 23(7), 4-10