ASSESSMENT OF CAPSICUM VARIETIES AND HYBRIDS FOR QUALITATIVE TRAITS UNDER SHADE NET

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Abstract
A field experiment was conducted to assess the quality of fruits in different varieties and hybrids of capsicum under 50% shade net. As regards to fruit parameters such as fruit length, fruit width, fruit volume, fruit wall thickness and number of locules fruit−1, higher values were recorded in the hybrids viz., Indra (10.42 cm, 8.03 cm, 313.36 cc, 1.05 cm and 4.00, respectively) and NS-280 (8.97 cm, 7.98 cm, 310.66 cc, 0.98 cm and 3.87, respectively). Average fruit weight was maximum in the hybrid, Indra (124.70 g) followed by the hybrid, NS-280 (115.31 g). With respect to quality parameters, high ascorbic acid content was recorded in the hybrid, Angel (179.34 mg g−1) and in the variety, Arka Gaurav (170.85 mg g−1). Capsaicin content was found negligible in all the varieties and hybrids evaluated and the values ranged from 0.003% (Arka Gaurav) to 0.010% (Arka Basant, Royal Wonder, Angel and Indra). Total carotenoid content was high in the hybrid, NS-280 (0.178%). High TSS was observed in the variety, Arka Gaurav (8.37 °Brix) and in the hybrid, Angel (7.53 °Brix). Colour value (ASTA units) was maximum in the hybrid, NS-280 (46.53) followed by the variety, Arka Basant (40.06).

Key words : Capsicum (Capsicum annuum L.), shade net, total soluble solids, chemical fertilizers.

Introduction
Capsicum (Capsicum annuum L. var. grossum Sendt.) also known as Bell pepper or Shimla mirch is one of the highly priced-nutritious vegetables having great market potential in the domestic as well as export market. In India, capsicums are grown throughout the year in open as well as protected environments. It holds a very coveted position as a leading vegetable in Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir and Nilgiri hills during summer months. As an autumn crop, it extends up to winter months in Karnataka, Maharashtra, Tamil Nadu, Bihar, West Bengal, Madhya Pradesh and Andhra Pradesh. The average annual production of capsicum in India is 1.60 lakh MT from an area of 12,000 ha (NHB, 2012-13). Capsicums are used as vegetable as well as condiment. The mature fruits (green, red and yellow) of capsicum are eaten raw (salads) or widely used in stuffings, bakings, pizza and burger preparations. Capsicum attained a status of high value low volume crop in India in recent years and occupies a place of pride among vegetables in Indian cuisine, because of its delicacy and pleasant flavour coupled with rich content of ascorbic acid along with other vitamins and minerals (Kurubetta and Patil, 2009).

Owing to increased demand for quality capsicums, cultivating the crop under protected structures is gaining momentum in southern region of Andhra Pradesh. Through, there are no. of varieties/hybrids of capsicum available for growing their in this area, the information on their performance, with particular reference to fruit quality, under shade net environment is lacking. Hence, the present study was conducted to assess the performance of different varieties and hybrids of capsicum in terms of quality parameters under shade net condition.

Materials and Methods
An experiment was conducted at Horticultural College and Research Institute, Anantharajupet, Y.S.R. District, Andhra Pradesh (India), during the period from September, 2012-March 2013. The trial was laid out in randomized block design with three replications and eight treatments (four varieties viz., Arka Basant, Arka Gaurav,
Arka Mohini and Royal Wonder and four hybrids viz., Angel, Indra, Inspiration and NS-280. The crop was raised under 50% green coloured shade net house of 250 m².

Thirty days old seedlings were transplanted by adopting a spacing of 45 cm × 30 cm. A basal dose of chemical fertilizers viz., calcium ammonium nitrate @ 50 g, single super phosphate @ 35 g and muriate of potash @125 gm⁻² were applied as per recommended dose of fertilizers (80 kg calcium ammonium nitrate, 125 kg single super phosphate and 32 kg muriate of potash acre⁻¹) along with 20 kg farm yard manure, 1 kg coco peat, 1 kg vermicompost and 200 g neem cake m⁻². Fertigation was given twice a week by applying liquid fertilizers (19:19:19, calcium nitrate and potassium nitrate) three weeks after transplanting and was stopped 15 days before final harvest. Irrigation through drip was given to provide 2-4 l m⁻² day⁻¹ depending on stage of crop. Pinching of terminal bud was done at 30 days after transplanting. Plants were trained to ‘v’ shape to enhance productivity.

The observations were recorded from ten randomly selected plants from each treatment on various fruit parameters such as fruit length, fruit width, fruit volume, fruit wall thickness, number of locules fruit⁻¹ and average fruit weight. Fruit length, fruit width and fruit wall thickness were measured in centimeters by using verniercallipers. Volume of fruit was recorded in cubic centimeter (cc) by water displacement method. Average fruit weight was calculated by dividing the total weight of fruits plant⁻¹ by number of fruits plant⁻¹ and the values were recorded in grams. The ascorbic acid content (mg g⁻¹) in the fruit was estimated by volumetric method as proposed by Sadasivam and Manickam (2009) using 2, 6-dichloro phenol-indophenol dye. ASTA (American Spice Trade Association) method 21.3 (2004) was used for determination of capsaicin content in capsicum fruits at marketable stage. Total carotenoids were estimated as per the procedure developed by Hornero-Mendez and Minguez-Mosquera (2001). Total soluble solids (TSS) (°Brix) was recorded with the help of a digital hand refractometer. Colour value of fruits at marketable stage was measured in ASTA units by using the procedure developed by ASTA (1986). The experimental data was subjected to statistical analysis as per the methods outlined by Panse and Sukhatme (1985).

Results and Discussion

I. Fruit parameters

Fruit length and fruit width (cm)

The data on fruit length and fruit width of different varieties and hybrids of capsicum revealed that the hybrid, Indra recorded higher values (10.42 cm and 8.03 cm, respectively) of these traits followed by the hybrid NS-280 (8.97 cm and 7.98 cm, respectively) (table 1). Lower values of fruit length (8.03 cm) and fruit width (4.12 cm) were recorded in the varieties viz., Arka Gaurav and Arka Basant, respectively. The variations in length and width of capsicum fruits were most probably due to their inherited traits and to some extent by environmental factors as reported by Sundaram (1992), Aruna and Sudagar (2010) made similar observations in capsicum and Delelegn et al. (2011) in chilli. The positive association between higher dimensions of fruit and fruit yield was also earlier documented by Sweta (2003) in bell pepper.

Fruit volume (cc)

Volume of the individual fruit varied significantly among varieties and hybrids of capsicum (table 1). The hybrids viz., Indra (313.36 cc), NS-280 (310.66 cc) and Inspiration (291.66 cc) recorded higher fruit volume and were on par with one another. Fruit volume was low recorded in the variety, Arka Basant (243.78 cc). Higher values of fruit length and fruit width are the probable reason for higher fruit volume as opined by Zende (2008) and Kurubetta and Patil (2009) in capsicum.

Fruit wall thickness (cm)

The varieties and hybrids of capsicum differed significantly for fruit wall thickness (table 1). Maximum fruit wall thickness was observed in the hybrid, Indra (1.05 cm), which was closely followed by the variety, Royal Wonder (1.01 cm) and the hybrid, NS-280 (0.98 cm). The fruit wall thickness was observed minimum in the varieties viz., Arka Basant (0.68 cm) and Arka Gaurav (0.67 cm).

Capsicum fruits are hollow from inside therefore, a thick fruit wall is preferred to help the fruits withstand long distant transportation and retain firmness for a longer shelf life. The hybrid, Indra and the variety, Royal Wonder were identified superior with respect to this trait. These findings are similar to those of Arya and Saini (1977), Sweta (2003), Valsikova and Belko (2004) and Choudhary et al. (2011) in bell pepper.

Number locules fruit⁻¹

Number of locules fruit⁻¹ showed non-significant variation among the varieties and hybrids of capsicum (table 1). Higher number of locules fruit⁻¹ were recorded in the hybrids viz., Indra (4.00) and NS-280 (3.87), respectively. The number of locules fruit⁻¹ was recorded less in Arka Basant (3.07).

Number of locules (lobes) is an important character
which ultimately decides the quality of capsicum for export purpose. Sweta (2003) and Valsikova and Belko (2004) made similar observations with regard to number of locules per fruit in capsicum.

Fruits with four lobes are considered as export grade (A), which reflects higher price on the market as opined by Zende (2008). In the present, the fruits of hybrid, Indra were categorized as A-grade.

**Average fruit weight (g)**

Varieties and hybrids of capsicum showed significant variation for the trait, average fruit weight (table 1). The maximum average fruit weight was observed in the hybrid, Indra (124.70 g) followed by the hybrid, NS-280 (115.31 g). While, minimum average fruit weight recorded in the variety, Arka Basant (50.36 g). Higher values of fruit length, fruit width and fruit wall thickness contributed for maximum average fruit weight in the hybrids, Indra and NS-280. Similar observations were recorded by Valsikova and Belko (2004), Zende (2008) and Kurubetta and Patil (2009) in capsicum.

### Table 1: Fruit parameters of different varieties and hybrids of capsicum.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fruit length (cm)</th>
<th>Fruit width (cm)</th>
<th>Fruit volume (cc)</th>
<th>Fruit wall thickness (cm)</th>
<th>Number of locules per fruit</th>
<th>Average fruit weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arka Basant</td>
<td>8.18</td>
<td>4.12</td>
<td>243.78</td>
<td>0.68</td>
<td>3.07</td>
<td>50.36</td>
</tr>
<tr>
<td>Arka Gaurav</td>
<td>8.03</td>
<td>5.64</td>
<td>262.58</td>
<td>0.67</td>
<td>3.67</td>
<td>74.42</td>
</tr>
<tr>
<td>Arka Mohini</td>
<td>8.53</td>
<td>6.48</td>
<td>267.07</td>
<td>0.84</td>
<td>3.53</td>
<td>90.03</td>
</tr>
<tr>
<td>Royal Wonder</td>
<td>8.73</td>
<td>6.96</td>
<td>282.50</td>
<td>1.01</td>
<td>3.73</td>
<td>110.08</td>
</tr>
<tr>
<td>Angel</td>
<td>8.17</td>
<td>7.11</td>
<td>265.86</td>
<td>0.89</td>
<td>3.67</td>
<td>108.15</td>
</tr>
<tr>
<td>Indra</td>
<td>10.42</td>
<td>8.03</td>
<td>313.36</td>
<td>1.05</td>
<td>4.00</td>
<td>124.70</td>
</tr>
<tr>
<td>Inspiration</td>
<td>8.45</td>
<td>7.41</td>
<td>291.66</td>
<td>0.93</td>
<td>3.73</td>
<td>113.75</td>
</tr>
<tr>
<td>NS-280</td>
<td>8.97</td>
<td>7.98</td>
<td>310.66</td>
<td>0.98</td>
<td>3.87</td>
<td>115.31</td>
</tr>
<tr>
<td>S.Em ±</td>
<td>0.26</td>
<td>0.35</td>
<td>6.76</td>
<td>0.06</td>
<td>0.21</td>
<td>1.76</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>0.79</td>
<td>1.07</td>
<td>20.71</td>
<td>0.19</td>
<td>NS</td>
<td>5.39</td>
</tr>
</tbody>
</table>

### Table 2: Quality attributes of different varieties and hybrids of capsicum.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Ascorbic acid content (mg g⁻¹)</th>
<th>Capsaicin content (%)</th>
<th>Total carotenoids (%)</th>
<th>TSS (°Brix)</th>
<th>Colour value (ASTA units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arka Basant</td>
<td>146.00</td>
<td>0.010</td>
<td>0.139</td>
<td>6.83</td>
<td>40.06</td>
</tr>
<tr>
<td>Arka Gaurav</td>
<td>170.85</td>
<td>0.003</td>
<td>0.028</td>
<td>8.37</td>
<td>18.05</td>
</tr>
<tr>
<td>Arka Mohini</td>
<td>133.33</td>
<td>0.004</td>
<td>0.116</td>
<td>6.06</td>
<td>27.56</td>
</tr>
<tr>
<td>Royal Wonder</td>
<td>91.75</td>
<td>0.010</td>
<td>0.001</td>
<td>3.37</td>
<td>17.06</td>
</tr>
<tr>
<td>Angel</td>
<td>179.34</td>
<td>0.010</td>
<td>0.047</td>
<td>7.53</td>
<td>20.38</td>
</tr>
<tr>
<td>Indra</td>
<td>76.84</td>
<td>0.010</td>
<td>0.001</td>
<td>4.00</td>
<td>16.10</td>
</tr>
<tr>
<td>Inspiration</td>
<td>159.32</td>
<td>0.007</td>
<td>0.114</td>
<td>6.35</td>
<td>32.26</td>
</tr>
<tr>
<td>NS-280</td>
<td>149.81</td>
<td>0.007</td>
<td>0.178</td>
<td>5.31</td>
<td>46.53</td>
</tr>
<tr>
<td>S.Em ±</td>
<td>15.79</td>
<td>0.002</td>
<td>0.01</td>
<td>0.10</td>
<td>1.81</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>48.39</td>
<td>N.S</td>
<td>0.02</td>
<td>0.30</td>
<td>5.54</td>
</tr>
</tbody>
</table>

II. Quality parameters

**Ascorbic acid (mg g⁻¹)**

It is evident from data presented in table 2 that the varieties and hybrids of capsicum differed significantly for ascorbic acid content. High ascorbic acid content was recorded in the hybrid, Angel (179.34 mg g⁻¹), which was closely followed by the variety, Arka Gaurav (170.85 mg g⁻¹). The hybrid, Indra and the variety, Royal Wonder recorded the lowest ascorbic acid content of 76.84 mg g⁻¹ and 91.75 mg g⁻¹, respectively.

Generally, the higher ascorbic acid content would increase the nutritive value of capsicums, which would help better retention of colour and flavor. Capsicum varieties and hybrids possessing high ascorbic acid content are of great demand in export markets as opined by Sweta (2003) and Choudhary *et al.* (2011).

**Capsaicin content (%)**

Capsaicin content showed non-significant variation among varieties and hybrids of capsicum (table 2). Capsaicin content was found negligible in all the varieties.
and hybrids evaluated and the values ranged from 0.003% (Arka Gaurav) to 0.010% (Arka Basant, Royal Wonder, Angel and Indra). Similar findings were reported in capsicum genotypes by Valsikova and Belko (2004), Sood et al. (2007) and Choudhary et al. (2011).

**Total carotenoids (%)**

There was significant difference among varieties and hybrids of capsicum respect to total carotenoids (table 2). Total carotenoids was high in red coloured capiscums compared to yellow and green coloured capiscums. The hybrid, NS-280 which produced red coloured fruits recorded high percentage of total carotenoids (0.178) followed by the varieties viz., Arka Basant (0.139 ) and Arka Mohini (0.116 ), which produced orange red and red coloured fruits, respectively. The green coloured capsicum variety, Royal Wonder and the hybrid, Indra had low total carotenoids (0.001%). These results are in conformity with the findings of Aherne et al. (2010) and Choudhary et al. (2011) in capsicum.

**TSS (Brix)**

Significant variation was observed among varieties and hybrids of capsicum with regard to TSS (table 2).

The variety, Arka Gaurav recorded high TSS (8.37 °Brix) followed by the hybrid, Angel (7.53 °Brix) and the variety, Arka Basant (6.83 °Brix). Low TSS was observed in the variety, Royal Wonder (3.37 °Brix) and in the hybrid, Indra (4.00 °Brix).

**Conclusion**

From the present study, it is concluded that the capsicum hybrids viz., Indra and NS-280 produced fruits with maximum fruit length, fruit width, fruit wall thickness and higher values of volume, number of locules fruit-1 and mean fruit weight. The hybrid, Angel and the variety, Arka Gaurav, which produced yellow coloured fruits were rated superior in quality as they recorded higher values of ascorbic acid and TSS. Total colouring matter and total carotenoid content were high in the hybrid, NS-280 which produced red coloured fruits.

**References**


