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Effect of different drip irrigation levels on quality parameters of coloured capsicum hybrids (*Capsicum annuum* var. *grossum* L.) under shade net

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Abstract

A field experiment was conducted at Horticultural farm, College of Agriculture, PJTSAU, Rajendranagar, Hyderabad during rabi 2018-19. The experiment was laid out in split plot design and the treatment comprises of four irrigation levels viz., drip irrigation at 0.4, 0.6, 0.8 and 1.0 Epan as main treatments and three hybrids viz., Indra (green), Orobelle (yellow), Bomby (red) as sub treatments and replicated thrice. The recommended dose (RD) of nutrients were 100:80:60 N, P₂O₅ and K₂O kg ha⁻¹ and entire dose of P₂O₅ was applied as basal, N and K₂O was applied through venturi meter as fertigation on three days interval from 9 to 153 DAT. The crop was transplanted at 45 cm × 40 cm spacing in September inside a tape type green shade net with 50 per cent shade. The experimental soil was sandy loam in texture, slightly alkaline in reaction, non saline, low in available nitrogen, available potassium and organic carbon content. Irrigation scheduling was done based on daily evaporation data recorded from USWB class 'A' pan evaporimeter. The cumulative daily evaporation during crop growth period was 737.5 mm. Quantity of water applied including special operations of 26 mm and effective rainfall during crop growth period were 245.3, 392.0, 546.5 and 698.5 mm and 58.6, 64.2, 74.6, 82.6 mm out of 127.4 mm of rainfall for 100, 80, 60 and 40 per cent irrigation treatments, respectively as per water balance method. The water source for irrigation was from a bore well. The irrigation water used to the experiment was neutral and categorized under Class II (C₂S₁). Bed size was 7.6 m × 0.9 m and plants were transplanted in zig-zag manner. The interaction effect between drip irrigation levels and hybrids was not significant on quality characters. TSS, ascorbic acid and Oleoresin of capsicum were not significantly effected by different drip irrigation levels. Drip irrigation at 0.8 Epan recorded significantly higher capsanthin than 0.6 and 0.4 Epan and was on par with 1.0 Epan. Capsaicin recorded significantly higher with drip irrigation at 1.0 Epan than rest of the drip irrigation levels. Among hybrids, Bomby recorded significantly higher TSS, Oleoresin, Capsanthin and Capsaicin than other Orobelle and Indra. Orobelle recorded significantly higher ascorbic acid than other two hybrids.

Keywords: Capsicum, drip irrigation, Epan, TSS, ascorbic acid, oleoresin, capsanthin, capsaicin.

Introduction

Capsicum is also known as bell pepper or sweet pepper and shimla mirch which is a cool season tropical crop belongs to the family Solanaceae, and is native of South and Central America. Fruits of Shimla mirch are large (usually bell shaped; hence called bell pepper) and non-pungent (hence also called sweet pepper). It attained a status of high value crop in India in recent years, occupying an area of 46 thousand hectares, producing 327 thousand metric tons. Capsicum varieties may occur in many shapes and colours. Capsaicin is the main chemical content in sweet pepper. It is rich in carbohydrates, Vitamin A (8493 IU), Vitamin C (283 mg) and minerals like Calcium (13.4 mg), Magnesium (14.9 mg) Phosphorus (28.3 mg) and Potassium, (263.7 mg) per 100 g fresh weight. The mature fruits (green, red and yellow) of sweet pepper are eaten raw or widely used in stuffings, bakings, pizza, burger preparations, spices and as external medicine. Red bell pepper contain 1.5 times more vitamin C, 8 times more vitamin A and 11 times more beta carotene than green bell peppers. Yellow bell peppers have more vitamin C than green ones, but less vitamin A and beta carotene. The high market price it fetches is attributed to the heavy demand from the urban consumers and for export which needs fruits with longer shelf life, medium size tetra lobed fruits with attractive colour, mild pungency with good taste. However, the supply is inadequate due to the low productivity

of the crop (Muthukrishnan *et al.*, 1986)^[2]. The target can be achieved by bringing additional improved agro techniques, perfection and promotion of protected cultivation of vegetables. Area under capsicum crop using hybrid seeds, rational use of irrigation water is important for increasing productivity and to save irrigation water, which is costly and a scarce resource. This can be achieved by advanced method of irrigation like micro irrigation systems particularly, drip method which is most efficient coupled with other improved water management practices.

Sweet pepper consumption in India is increasing now-a-days due to increasing demand among urban consumers as lot of farmers are also showing interest in the cultivation of this crop under protected condition, as it is having definite qualitative and quantitative advantage over the traditional cultivation (Sreedhara *et al.* 2013)^[3]. To obtain good quality produce, shade nets can be commercially exploited for successful year round cultivation of high value thermo sensitive crops like sweet pepper. Shade nets are perforated plastic materials used to cut down the solar radiation and prevent scorching or wilting of leaves caused by marked temperature increase with in leaf tissue from strong sunlight. Optimization and minimization of water to be applied to crops is essential in irrigation system. Yields can be considerably increased by adopting proper irrigation management. For proper irrigation management scheduling of water is essential. For proper irrigation management, the challenge is to estimate crops water requirement in the context of growth. There are only few studies on irrigation requirement and quality characters of capsicum production. Keeping all this in view, the present study was initiated to study the quality characters of capsicum and also to assess the effect of drip irrigation levels on quality parameters of coloured capsicum hybrids under shade net.

Material and Methods

The experiment was carried out at Horticultural farm, College of Agriculture, Rajendranagar, Hyderabad in a shade net during rabi season, 2018-2019. The farm is geographically situated in the Southern Telangana Zone at 17°19'11" N latitude and 78°24'58" E longitude at an altitude of 542.3 m above mean sea level.

The experiment was conducted in a split plot design with 12 treatments and replicated thrice, comprising of four drip irrigation levels *viz.*, drip irrigation at 0.4 Epan, 0.6 Epan, 0.8 Epan. and 1.0 Epan as main treatments and three hybrids *viz.*, Indra (V₁), Orobelle (V₂), Bomby (V₃). The recommended dose of (RD) nutrients were 100:80:60 kg N: P₂O₅: K₂O ha⁻¹. The spacing adopted for sowing was 45 cm × 40 cm, experimental soil was sandy loam in texture, slightly alkaline in reaction (pH=7.8), non saline (EC=0.31 dS m⁻¹), low in organic carbon (0.2 %), low in available nitrogen (145.51 kg ha⁻¹), medium in available phosphorus (47.15 kg ha⁻¹) and low in available potassium (156.7 kg ha⁻¹). The mean weekly maximum and minimum temperature ranged from 30.8 °C to 14.4 °C and 19.9 °C to 8.7 °C respectively.

The entire dose of phosphorus was applied to soil as basal whereas nitrogen and potassium were applied through fertigation at 3 days interval through venturi system. Coloured capsicum hybrids were Indra (green), Orobelle (yellow), Bomby (red). Shade net colour was green with 50% shade and tape type was used. Gross plot size, lateral spacing, emitter spacing and drip discharge rate were 7.6 m x 0.9 m, 0.6 m, 0.4 m and 4 L h⁻¹, respectively. The crop was transplanted on 2nd September, 2018, five pickings were done in all three

coloured hybrids and harvested (final picking) at 26th February, 2019.

Ascorbic acid content was analysed using 2, 6-dichlorophenolindophenol dye method and expressed as mg 100 g⁻¹ of samples. The content of total soluble solids was determined by refraction index using refractometer and expressed as Brix°. Oleoresin was estimated with capsicum dried ground powder in wide glass funnels whose bottom and top was plugged with non absorbent cotton. Then acetone was added till the powder becomes colourless. The filtrate was collected in to a pre weighed beaker. The collected solvent was evaporated on water bath. The beaker was cooled and weighed. Difference in weights was the oleoresin content in 5 g powder (%). The capsanthin content was estimated using UV-VIS spectrophotometer.

$$\text{Capsanthin content} = (\text{Sample reading} - \text{acetone blank}) \times \frac{100}{61,000}$$

The capsaicin content in the sample was estimated by the method given by Palacio (1977) using spectrophotometer at 720 nm. The optical density (OD) reading of the sample was matched with the standard curve to obtain the capsaicin content in mg L⁻¹ and it was expressed in percentage.

Results and Discussion

Quality Characters

Significant variation in TSS (°Brix), ascorbic acid (mg 100 g⁻¹) and Oleoresin (%) was not observed whereas Capsanthin (EOA values) and Capsaicin (%) was differed significantly due to different drip irrigation levels and varieties. However, there was no interaction effect between drip irrigation levels and varieties on these parameters (Table 1).

TSS (°Brix)

Significantly higher TSS was recorded with Bomby (6.15) than Orobelle (5.24). Significantly lower TSS was observed with Indra (4.48) than rest of the treatments. This might be due to TSS content of bell peppers is found to increase as the ripening of the fruit increases. This results in the greater degradation or biosynthesis of polysaccharides and the accumulation of sugars. The increase in the total soluble content may be due to the hydrolysis of polysaccharides like starch, cellulose and pectin sub-stances into simpler substances (Rathod and Chidanand, 2011)^[4].

Ascorbic acid (mg 100 g⁻¹)

Among hybrids, significantly higher ascorbic acid was found with Orobelle (124.7 mg 100 g⁻¹) than Bomby (119.5 mg 100 g⁻¹). Significantly lower ascorbic acid was recorded with Indra (87.6) than rest of the treatments. This huge difference in different coloured bell peppers is attributed to the cultivars and the growing conditions. The reduction in ascorbic acid content might be due to the activity of oxidative enzymes (Myrene, 2013)^[8].

Oleoresin (%)

Significantly higher oleoresin was found in Bomby (7.9 %) than Orobelle (7.23 %). Significantly lower oleoresin was observed with Indra (6.14 %). This might be due to bomby having various carotenoids with pungent properties and colorants superior to other hybrids.

Capsanthin (EOA values)

Among the irrigation levels, significantly higher capsanthin content was observed with drip irrigation at 0.8 Epan (19335)

than drip irrigation with 0.6 and 0.4 Epan and in turn was at par with drip irrigation at 1.0 Epan (18860). Drip irrigation at 0.4 Epan was significantly lower than rest of the treatments and was at par with drip irrigation at 0.6 Epan. Among the hybrids, significantly higher capsanthin content was found in Bomby (37627) than Orobelle (8510) and Indra (6900). Significantly lower capsanthin content was observed with Indra. The amount and intensity of surface colours of the Bell pepper depends on the type of the cultivar used and is of prime importance to its appeal (Sokona *et al.* 2013)^[5].

Capsaicin (%)

Capsaicin content among irrigation levels differed and drip irrigation with 1.0 Epan (0.108) was recorded significantly higher than drip irrigation at 0.6 and 0.4 Epan and was on par

with drip irrigation at 0.8 Epan (0.097). Drip irrigation at 0.6 Epan (0.103) which was on par with 0.4 Epan (0.091).

Among hybrids, significantly higher capsaicin content was observed with Bomby (0.143 %) than Indra (0.081) and Orobelle (0.076). However, lower capsanthin content was observed with Orobelle, which was on par with Indra. Pungency in pepper is due to the amount of capsaicinoids, including capsaicin and four other structurally related compounds, namely nordihydrocapsaicin, dihydrocapsaicin, homocapsaicin, and homodihydrocapsaicin (Hoffman *et al.*, 1983)^[6]. The increase or decrease in capsaicin content with maturity observed in different genotypes may be attributed to the inherent variation in the levels of peroxidase enzymes in different Bell pepper cultivars (Estrada *et al.* 2000)^[7].

Table 1: Quality parameters of capsicum as influenced by different drip irrigation levels and hybrids under shade net.

Treatments	TSS (^o Brix)	Ascorbic acid (mg 100g ⁻¹)	Oleoresin (%)	Capsanthin (EOA value)	Capsaicin (%)
Main – (Irrigation levels)					
I ₁ : Drip irrigation at 0.4 Epan	5.35	108	7.06	16783	0.097
I ₂ : Drip irrigation at 0.6 Epan	5.17	104	6.97	15736	0.091
I ₃ : Drip irrigation at 0.8 Epan	5.33	114	7.22	19335	0.103
I ₄ : Drip irrigation at 1.0 Epan	5.31	115	7.11	18860	0.108
S.Em ±	0.10	3.0	0.12	462	0.003
C.D (P=0.05)	NS	NS	NS	1599	0.009
Sub – (Hybrids)					
V ₁ : Indra (green)	4.48	87.6	6.14	6900	0.081
V ₂ : Orobelle (yellow)	5.24	124.7	7.23	8510	0.076
V ₃ : Bomby(red)	6.15	119.5	7.90	37627	0.143
S.Em ±	0.08	1.5	0.11	515	0.003
C.D (P=0.05)	0.24	4.4	0.34	1544	0.008
Interaction					
Hybrids at same level of irrigation levels					
S.Em ±	0.16	2.9	0.23	1030	0.005
C.D (P=0.05)	NS	NS	NS	NS	NS
Irrigation levels at same or different hybrids					
S.Em ±	0.16	3.9	0.22	959	0.005
C.D (P=0.05)	NS	NS	NS	NS	NS

Conclusion

From the present study it can be concluded that TSS, ascorbic acid and oleoresin of capsicum were not significantly influenced by different drip irrigation levels. Significantly higher capsanthin recorded with drip irrigation at 0.8 and capsaicin at 1.0 Epan respectively. Among hybrids, Bomby recorded significantly higher TSS, oleoresin, capsanthin and capsaicin than Orobelle and Indra. Orobelle recorded significantly higher ascorbic acid than other two hybrids.

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