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YIELD AND WATER USE EFFICIENCY OF COLOURED CAPSICUM INFLUENCED BY DIFFERENT IRRIGATION LEVELS UNDER SHADE NET

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ABSTRACT

A field experiment was conducted at Horticultural farm, College of Agriculture, PJTAU, Rajendranagar, Hyderabad during *rabi* season. The experiment was laid out in split plot design and the treatment comprises of four irrigation levels *viz.,* drip irrigation at 0.6, 0.8, 1.0 and 1.2 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, P_2O_5 and K_2O kg ha^{-1} and entire dose of P_2O_5 was applied as basal, N and K_2O 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 amount of water applied for 0.6, 0.8, 1.0 and 1.2 Epan was 386.37, 523.24, 643.95 and 772.74 mm, respectively. 1.0 Epan recorded higher yield (48.36 t ha^{-1}) followed by 1.2 (42.32 t ha^{-1}) which was on par with 0.8 Epan (39.30 t ha^{-1}) and 0.6 Epan (28.90 t ha^{-1}). Among the varieties, highest yield was observed under Indra (46.4 t ha^{-1}) compared to Bomby (37.9 t ha^{-1}) which was on par with Orobelle (34.8 t ha^{-1}). Water use efficiency was significantly higher under 0.6 Epan (9.67 kg m^{-3}) followed by 0.8 Epan (8.37 kg m^{-3}), 1.0 Epan (7.38 kg m^{-3}) and lowest under 1.2 Epan (5.38 kg m^{-3}). Indra (8.56 kg m^{-3}) among the varieties showed higher water use efficiency followed by Bomby (7.48 kg m^{-3}) and Orobelle (7.06 kg m^{-3}).

Keywords **:** Water use efficiency, Capsicum influenced, Different irrigation levels.

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). The term *Shimla* mirch originated because probably it was first cultivated in *Shimla* region (temperate climate), which was suitable for its cultivation. 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 (Jessy, 2012).

Water is the vital source for crop production and is the most limiting factor in Indian agricultural scenario. Though India has the largest irrigation network, the irrigation efficiency achieved is not more than 40 per cent. 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.

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 of crops are adversely affected with excess or inadequate water supply. Yields can be considerably increased by adopting proper irrigation management. For proper irrigation management scheduling of water is essential. Irrigation scheduling is the process by which an irrigator/farmer determines the timing and quantity of water to be applied to the crops. 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 economic aspects of capsicum production. Keeping all this in view, the present study was initiated to increase the yield potential of capsicum and also to assess the effect of drip irrigation levels on growth and yield 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. 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 0.6 Epan (I_1), drip irrigation at 0.8 Epan (I_2), drip irrigation at 1.0 Epan (I_3) and 1.2 Epan (I_4) as main treatments and three hybrids *viz.,* Indra (V_1), Orobelle (V_2), Bomby (V_3). The recommended dose of (RD) nutrients were 100-80-60 kg N- P_2O_5-K_2O ha^{-1}. The spacing adopted for sowing was 45 cm × 40 cm, experimental soil was sandy loam in texture, slightly alkaline in reaction (pH=7.7), non-saline (EC=0.41 dS m^{-1}), low in organic carbon (0.22 %), low in available nitrogen (175.51 kg ha^{-1}), medium in available phosphorus (47.15 kg ha^{-1}) and low in available potassium (169.8 kg ha^{-1}).

Drip irrigation was scheduled at 0.6, 0.8, 1.0 and 1.2 Epan for different treatments during the entire crop growth period. 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 selected from Syngenta company, Indra (green), Orobelle (yellow), Bomby (red). Shade net colour was green with 50% shade and tape type was used.

Results and Discussion

Table 1: Fruit yield (g), plant yield (kg) and yield (t ha^{-1})) of capsicum as influenced by different drip irrigation levels and varieties under shade net

Treatments	Fruit yield (g)	Plant yield (kg)	Yield (t ha^{-1})
Main treatments			
I_1: Drip irrigation at 0.6 Epan	88.21	0.87	28.90
I_2: Drip irrigation at 0.8 Epan	100.85	1.09	39.30
I_3: Drip irrigation at 1.0 Epan	105.65	1.29	48.36
I_4: Drip irrigation at 1.2 Epan	100.53	1.12	42.32
SEm ±	0.77	0.10	2.59
C.D (*P=0.05*)	2.71	0.036	3.26
Sub varieties:			
V_1 : Indra	101.96	1.31	46.40
V_2 : Orobelle	86.67	0.91	34.80
V_3 : Bomby	107.84	1.05	37.90
SEm ±	0.32	0.15	5.63
C.D (*P=0.05*)	0.97	0.021	4.21
Factor B at same level of A			
SEm ±	1.06	2.09	1.33
C.D (*P=0.05*)	3.26	9.94	2.16
Factor A at same level of B			
SEm ±	0.93	0.12	4.32
C.D (*P=0.05*)	3.13	NS	0.99

Fruit yield was significantly influenced by different irrigation levels and varieties. Irrigation level at 1.0 Epan (105.6 g) recorded higher fruit yield followed by 0.8 Epan (100.85 g) on par with 1.2 Epan (100.53 g) and lowest was under 0.6 Epan (88.21 g). Sankar *et al.* (2008) stated that more nutrient availability, especially near the root zone might have increased the translocation of photosynthates to storage organ resulting in an increased fruit weight of capsicum under drip irrigation. The increased biochemical activities in the soil, high uptake of nutrients, reduction of evaporation led to higher soil moisture content, buildup of sufficient photosynthates and better nutrient availability to the plants.

Among the varieties, highest fruit yield was observed in Bomby (107.84 g) followed by Indra (101.96 g) and Orobelle (86.67 g). Higher uptake of nutrients and building up of sufficient photosynthates enabled the increase in size of fruits which resulted in increase of fruit weight and volume. The results are in similarity to the observations of Roy *et al.* (2011).

Irrigation levels and varieties showed non-significant interaction on plant yield. Highest plant yield was observed at irrigation level 1.0 Epan (1.29 kg) followed by 1.2 Epan (1.12 kg) which was on par with 0.8 Epan (1.09 kg). Irrigation level at 0.6 Epan (0.87 kg) recorded lower plant yield over other treatments. Indra (1.31 kg) among the varieties, recorded higher plant yield compared to bomby (1.05 kg) which was on par with orobelle (0.91 kg).

Fruit yield of capsicum was significantly influenced between different drip irrigation levels. Significantly higher fruit yield was recorded in drip irrigation at 1.0 Epan (48.36 t ha^{-1}) than rest of the treatments. Drip irrigation at 1.2 Epan (42.32 t ha^{-1}) was significantly higher than drip irrigation at 0.8 Epan (39.30 t ha^{-1}). Significantly lower fruit yield was observed with drip irrigation at 0.6 Epan (28.90 t ha^{-1}). This might be due to higher total matter accumulation and proper translocation of food materials to the fruits, helped in more number of shoots per plant, higher number of flowers, fruits and maximum extent of fruit set as well as better uptake of nutrient and moisture due to favourable conditions created by micro climate. Similar observations were reported by Salunkhe *et al.* (2017), Choudhary and Bhambri (2012) and Kumar *et al.* (2016) in bell pepper.

Among the varieties, significantly higher fruit yield was recorded with Indra (46.4 t ha^{-1}) than Bomby (37.9 t ha^{-1}) which was on par with Orobelle (34.8 t ha^{-1}). Bomby recorded significantly lower fruit yield than Orobelle. This was due to inherent character of that variety to produce vigorous growth, more internodes and higher number branches bearing more fruits leading to maximum fruit yield. Similar observations were reported by Grangs and Leger (1989) in capsicum.

Water use efficiency (kg m^{-3})

Irrigation water was applied separately for each treatment based on Epan indicated that the quantity of water increased as Epan ratio increased from 0.6 to 1.2 Epan. The quantity of irrigation water applied for different drip irrigation treatments such as 0.6, 0.8, 1.0 and 1.2 Epan including special operations was 386.3, 523.2,643.9 and 772.74 mm, respectively.

Different irrigation practices significantly influenced the WUE of the capsicum crop. The WUE was significantly higher with drip irrigation at 0.6 Epan (9.67 Kg m^{-3}) than 0.6, 0.8, 1.0 and 1.2 Epan. Drip irrigation at 0.8 (8.37 Kg m^{-3}) was significantly higher than drip irrigation at 1.0 Epan (7.38 Kg m^{-3}). The lowest water use efficiency was recorded under 1.2 Epan (5.38 kg m^{-3}) Though the fruit yield was higher, drip irrigation at 1.0 Epan recorded significantly lower WUE With the increase in irrigation level, the water productivity decreases gradually. Similar results were obtained and reported by Lodhi *et.al.* (2014), Edossa and Emana (2011). Significantly higher WUE (8.56 Kg m^{-3}) was recorded with Indra than (7.48 Kg m^{-3}) Bomby and Orobelle (7.06 Kg m^{-3}) among the varieties.

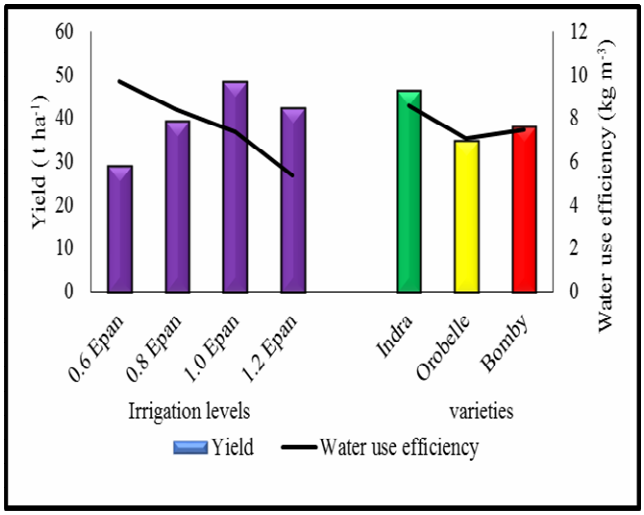

Fig. 1 : Influence of different drip irrigation levels and varieties on capsicum under shade net.

Table 2: Total water applied (mm) and Water productivity (Kg m^{-3}) of capsicum as influenced by different drip irrigation levels and varieties under shade net.

Treatments	Total water applied (mm)	Total water applied (m^3)	Water Productivity (Kg m^{-3})
Main treatments			
I_1: Drip irrigation at 0.6 Epan	386.37	3863.7	9.67
I_2: Drip irrigation at 0.8 Epan	523.24	5232.4	8.37
I_3: Drip irrigation at 1.0 Epan	643.95	6439.5	7.38
I_4: Drip irrigation at 1.2 Epan	772.74	7727.4	5.38
SEm ±			0.211
C.D (*P=0.05*)			0.745
Sub varieties:			
V_1 : Indra	643.95	6439.5	8.56
V_2 : Orobelle	643.95	6439.5	7.06
V_3 : Bomby	643.95	6439.5	7.48
SEm ±	-	-	0.050
C.D (*P=0.05*)	-	-	0.152
Factor B at same level of A			
SEm ±	-	-	0.366
C.D (*P=0.05*)	-	-	0.349
Factor A at same level of B			
SEm ±	-	-	0.227
C.D (*P=0.05*)	-	-	0.784

Conclusion

Drip irrigation at 1.0 Epan and Indra among the varieties showed higher fruit yield. WUE was significantly higher at 0.6 Epan and Indra. From the above we can conclude that, optimum application of water could give the better yield and water productivity than the excess application of water.

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