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## DRY MATTER AND NUTRIENT UPTAKE OF COLOURED CAPSICUM HYBRIDS 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<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O kg ha<sup>-1</sup> and entire dose of P<sub>2</sub>O<sub>5</sub> was applied as basal, N and K<sub>2</sub>O 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. Total Dry Matter (TDM) Nutrient uptake (N, P & K) was higher at 1.0 Epan compared to 1.2, 0.8 and 0.6 Epan. Among the hybrids, Indra recorded higher TDM and nutrient uptake compared to Bomby and Orobelle.

**Keywords :** Capsicum, drip irrigation, shade net, dry matter production, nutrient uptake.

### 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. The major capsicum producing states in India are Himachal Pradesh, Karnataka, Madhya Pradesh, Haryana, Jharkhand, Uttarkhand and Orissa. In Telangana it occupies an area of 0.52 thousand hectares, producing 6.63 thousand tonnes (MoA&FW, 2017).

Capsicum hybrids 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 stuffing's, baking's, pizza, burger preparations, spices and as external medicine. Red bell pepper contains 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 (Jessy, 2012). 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). The target can be achieved by bringing additional area under capsicum crop using hybrid seeds, improved agro techniques, perfection and promotion of protected cultivation of vegetables.

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.

### 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 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, 1.0 Epan as main treatments and three hybrids *viz.*, Indra (green), Orobelle (yellow), Bomby (red). The recommended dose of (RD) nutrients were 100:80:60 kg N: P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O ha<sup>-1</sup>. 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<sup>-1</sup>), low in organic carbon (0.2 %), low in available nitrogen (145.51 kg ha<sup>-1</sup>), medium in available phosphorus (47.15 kg ha<sup>-1</sup>) and low in available potassium (156.7 kg ha<sup>-1</sup>).

Nitrogen and potassium were applied through fertigation at 3 days interval through venturi system and the entire dose of phosphorus was applied to soil as basal. Coloured capsicum hybrids were Indra (green), Orobelle (yellow), Bomby (red) and green colored shade net 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<sup>-1</sup>, respectively. The three plants were uprooted carefully at 30, 60, 90, 120 and 150 DAT and roots were removed from basal portions. Both samples were first air dried in shade for one day and then oven dried at 60°C till a constant weight was obtained. The mean dry weight of plant samples and dry fruit samples were expressed as kg ha<sup>-1</sup>. Uptake of N, P and K was calculated using nutrient concentrations and dry matter

yield as expressed by multiplying nutrient content and dry matter divided by 100.

## Results and Discussion

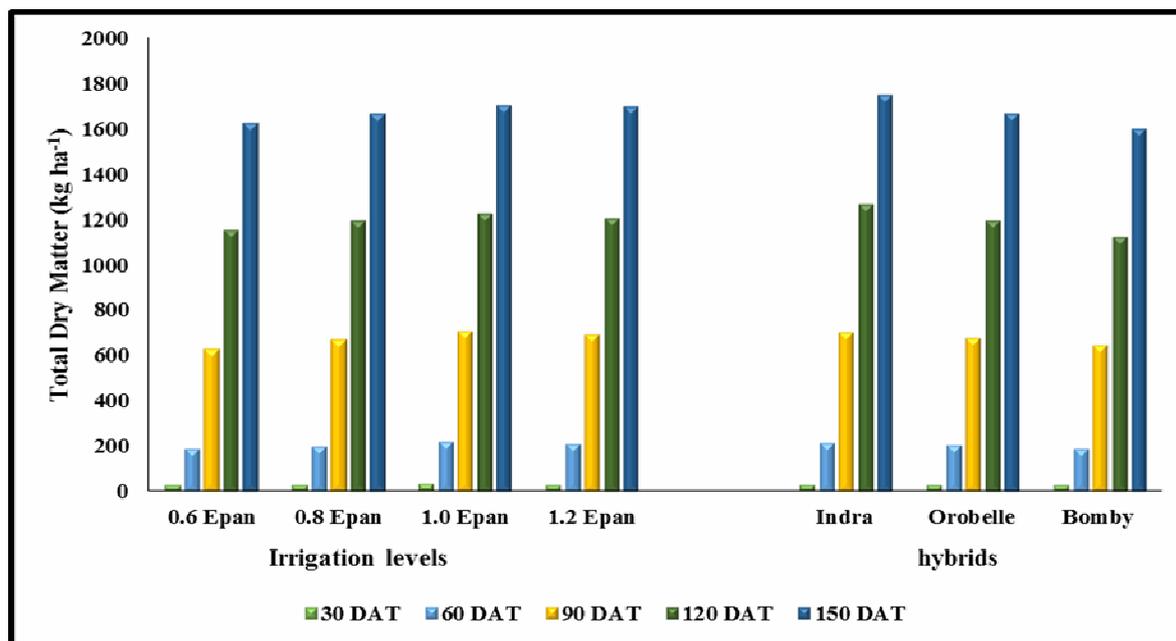
### Total dry matter (kg ha<sup>-1</sup>)

Different irrigation levels and capsicum hybrids showed significant influence on total dry matter at 30, 60, 90, 120 and 150 DAT. Among different irrigation levels, 1.0 Epan (29.4 kg ha<sup>-1</sup>) recorded significantly higher dry matter at 30 DAT followed by 1.2 Epan (26.1 kg ha<sup>-1</sup>) on par with 0.8 Epan (24.8 kg ha<sup>-1</sup>) and 0.6 Epan (23.5 kg ha<sup>-1</sup>). Indra (27.6 kg ha<sup>-1</sup>) among the hybrids showed higher dry matter followed by Orobelle (26.1 kg ha<sup>-1</sup>) and lowest under Bomby (24.1 kg ha<sup>-1</sup>).

At 60 DAT, the significantly higher TDM was observed at 1.0 Epan (215.4 kg ha<sup>-1</sup>) followed by 1.0 Epan which was on par with 0.8 Epan (196.3 kg ha<sup>-1</sup>) and lowest was recorded at 0.6 Epan (183.1 kg ha<sup>-1</sup>). Among the hybrids, Indra (2108.9 kg ha<sup>-1</sup>) recorded higher TDM followed by Orobelle (201.8 kg ha<sup>-1</sup>) and Bomby (185.8 kg ha<sup>-1</sup>). At different irrigation levels, 1.0 Epan (705.5 kg ha<sup>-1</sup>) at 90 DAT recorded showed higher TDM which was on par with 1.2 Epan (689.2 kg ha<sup>-1</sup>) followed by 0.8 Epan (666.4 kg ha<sup>-1</sup>) and lowest under 0.6 Epan (624.8 kg ha<sup>-1</sup>). Among the hybrids, Indra (699.0 kg ha<sup>-1</sup>) recorded higher TDM followed by Orobelle (627.7 kg ha<sup>-1</sup>) and Bomby (642.8 kg ha<sup>-1</sup>).

At 120 DAT, 1.0 Epan (1222.6 kg ha<sup>-1</sup>) recorded significantly higher TDM which was on par with 1.2 Epan (1204.5 kg ha<sup>-1</sup>) followed by 0.8 Epan (1194.5 kg ha<sup>-1</sup>) and lowest at 0.6 Epan (1151.3 kg ha<sup>-1</sup>). Higher TDM among the hybrids was showed by Indra (1264.2 kg ha<sup>-1</sup>) followed by Orobelle (1121.8 kg ha<sup>-1</sup>) and lowest under Bomby (1121.8 kg ha<sup>-1</sup>).

At 150 DAT, irrigation level at 1.0 Epan (1702.3 kg ha<sup>-1</sup>) showed significantly higher TDM which was on par with 1.2 Epan (1694.1 kg ha<sup>-1</sup>) followed by 0.8 Epan (1667.2 kg ha<sup>-1</sup>) and lowest TDM was observed under 0.6 Epan (1625.3 kg ha<sup>-1</sup>). Among the hybrids, Indra (1749.3 kg ha<sup>-1</sup>) recorded higher TDM followed by Orobelle (1666.9 kg ha<sup>-1</sup>) and Bomby (1600.4 kg ha<sup>-1</sup>). Increase in TDM was observed due to higher uptake of nutrients (fig. 1) and moisture from early stage of the crop resulted in better utilization of nitrogen led to higher plant height, higher leaf area and leaf area index with higher photosynthetic rate for building of organic substances in the plant and these increase in TDM results are in accordance with those of Antony and Singandhupe (2004) and Choudhary and Bhambri (2012) in capsicum and Veeranna *et al.* (2000), Ramakrishna and Palled (2004) and Katttimani (2004) in chilli.



**Fig. 1 :** Total dry matter ( $\text{kg ha}^{-1}$ ) of capsicum influenced by different drip irrigation levels and hybrids under shade net at different days after transplanting.

### Nitrogen uptake

Different irrigation levels showed no significant interaction on capsicum hybrids under shadenet at different days of transplanting. At 30 DAT, 1.0 Epan ( $1.16 \text{ kg ha}^{-1}$ ) recorded higher N uptake followed by 1.2 Epan ( $1.02 \text{ kg ha}^{-1}$ ) and 0.8 Epan ( $0.99 \text{ kg ha}^{-1}$ ) which was on par with 0.6 Epan ( $0.95 \text{ kg ha}^{-1}$ ) (Table-1). Among the hybrids, Indra ( $1.20 \text{ kg ha}^{-1}$ ) showed significantly higher N uptake compared to Orobelle ( $1.01 \text{ kg ha}^{-1}$ ) and Bomby ( $0.88 \text{ kg ha}^{-1}$ ). Among the different irrigation levels, 1.0 Epan ( $8.06 \text{ kg ha}^{-1}$ ) showed higher N uptake which was on par with 1.2 Epan ( $7.94 \text{ kg ha}^{-1}$ ) followed by 0.8 Epan ( $7.59 \text{ kg ha}^{-1}$ ) and lowest was recorded under 0.6 Epan ( $7.05 \text{ kg ha}^{-1}$ ) at 60 DAT. Indra ( $8.30 \text{ kg ha}^{-1}$ ) recorded higher N uptake followed by Orobelle ( $7.65 \text{ kg ha}^{-1}$ ) and Bomby ( $7.05 \text{ kg ha}^{-1}$ ) among the hybrids.

At 90 DAT, irrigation level at 1.0 Epan ( $25.17 \text{ kg ha}^{-1}$ ) recorded higher N uptake and was on par with 1.2

Epan ( $24.59 \text{ kg ha}^{-1}$ ) followed by 0.8 Epan ( $23.97 \text{ kg ha}^{-1}$ ) and lowest was recorded under 0.6 Epan ( $22.59 \text{ kg ha}^{-1}$ ). Among the hybrids, Indra recorded significantly higher N uptake followed by Orobelle ( $24.24 \text{ kg ha}^{-1}$ ) and Bomby ( $23.43 \text{ kg ha}^{-1}$ ). 1.0 Epan ( $45.21 \text{ kg ha}^{-1}$ ) at 120 DAT showed significantly higher N uptake followed by 1.2 Epan ( $43.28 \text{ kg ha}^{-1}$ ) and 0.8 Epan ( $40.26 \text{ kg ha}^{-1}$ ) which was on par with 0.6 Epan ( $38.95 \text{ kg ha}^{-1}$ ). The highest N uptake among the hybrids was shown by Indra ( $40.52 \text{ kg ha}^{-1}$ ) followed by Orobelle ( $38.01 \text{ kg ha}^{-1}$ ) and lowest under Bomby ( $33.34 \text{ kg ha}^{-1}$ ).

1.0 Epan ( $83.54 \text{ kg ha}^{-1}$ ) at 150 DAT showed higher N uptake and was on par with 1.2 Epan ( $80.67 \text{ kg ha}^{-1}$ ), 0.8 Epan ( $79.24 \text{ kg ha}^{-1}$ ). 0.6 Epan ( $64.29 \text{ kg ha}^{-1}$ ) showed lowest N uptake. Among the varieties, Indra recorded significantly higher N uptake ( $81.38 \text{ kg ha}^{-1}$ ) followed by Orobelle ( $77.27 \text{ kg ha}^{-1}$ ) and Bomby ( $72.16 \text{ kg ha}^{-1}$ ).

**Table 1:** Nitrogen uptake ( $\text{kg ha}^{-1}$ ) of capsicum influenced by different drip irrigation levels and hybrids under shade net at different days after transplanting.

Treatments	30 DAT	60 DAT	90 DAT	120 DAT	150 DAT
<b>Main treatments (Irrigation levels):</b>					
<b>I<sub>1</sub>: Drip irrigation at 0.6 Epan</b>	0.95	7.05	22.59	38.95	64.29
<b>I<sub>2</sub>: Drip irrigation at 0.8 Epan</b>	0.99	7.59	23.97	40.26	79.24
<b>I<sub>3</sub>: Drip irrigation at 1.0 Epan</b>	1.16	8.06	25.17	45.21	83.54
<b>I<sub>4</sub>: Drip irrigation at 1.2 Epan</b>	1.02	7.94	24.59	43.28	80.67
<b>SEm <math>\pm</math></b>	0.016	0.078	0.224	0.493	1.244
<b>C.D (<math>P=0.05</math>)</b>	0.057	0.275	0.790	1.738	4.390

Sub treatments (hybrids):					
V <sub>1</sub> : Indra	1.20	8.30	25.33	40.52	81.38
V <sub>2</sub> : Orobelle	1.01	7.65	24.24	38.01	77.27
V <sub>3</sub> : Bomby	0.88	7.04	23.43	33.34	72.16
SEm ±	0.015	0.055	0.108	0.293	0.339
C.D (P=0.05)	0.044	0.166	0.326	0.885	1.025
Factor B at same level of A					
SEm ±	0.028	0.135	0.388	0.854	2.155
C.D (P=0.05)	NS	NS	NS	NS	NS
Factor A at same level of B					
SEm ±	0.029	0.119	0.285	0.686	1.362
C.D (P=0.05)	NS	NS	NS	NS	NS

### Phosphorous uptake

At 30DAT, the P uptake of capsicum was significantly higher at 1.0 Epan (0.055 kg ha<sup>-1</sup>) followed by 1.2 Epan (0.049 kg ha<sup>-1</sup>), 0.8 Epan (0.043 kg ha<sup>-1</sup>) and lowest was observed at 0.6 Epan (0.039 kg ha<sup>-1</sup>) (depicted in table 1.2). Among the hybrids, Indra (0.051 kg ha<sup>-1</sup>) recorded higher P uptake compared to Orobelle (0.047 kg ha<sup>-1</sup>) and Bomby (0.042 kg ha<sup>-1</sup>). 1.0 Epan (0.41 kg ha<sup>-1</sup>) at 60 DAT recorded higher P uptake of capsicum which was on par with 1.2 Epan (0.38 kg ha<sup>-1</sup>) followed by 0.8 Epan (0.31 kg ha<sup>-1</sup>) and lowest under 0.6 Epan (0.26 kg ha<sup>-1</sup>). Indra (0.39 kg ha<sup>-1</sup>) among the hybrids recorded higher P uptake of capsicum followed by Orobelle (0.33 kg ha<sup>-1</sup>) and Bomby (0.29 kg ha<sup>-1</sup>).

At 90 DAT, P uptake of capsicum was higher under 1.0 Epan (1.55 kg ha<sup>-1</sup>) which was on par with 1.2 Epan (1.46 kg ha<sup>-1</sup>) followed by 0.8 Epan (1.31 kg

ha<sup>-1</sup>) and lowest under 0.6 Epan (1.19 kg ha<sup>-1</sup>). Among the hybrids, Indra (1.43 kg ha<sup>-1</sup>) showed higher P uptake followed by Orobelle (1.37 kg ha<sup>-1</sup>) and Bomby (1.33 kg ha<sup>-1</sup>). P uptake of capsicum was higher under 1.0 Epan (2.55 kg ha<sup>-1</sup>) which was on par with 1.2 Epan (2.49 kg ha<sup>-1</sup>) followed by 0.8 Epan (2.38 kg ha<sup>-1</sup>) and lowest under 0.6 Epan (2.21 kg ha<sup>-1</sup>) at 120 DAT. Among the hybrids, Indra (2.45 kg ha<sup>-1</sup>) recorded higher P uptake followed by Orobelle (2.40 kg ha<sup>-1</sup>) and Bomby (2.36 kg ha<sup>-1</sup>).

The higher P uptake of capsicum at 150 DAT was recorded by 1.0 Epan (4.47 kg ha<sup>-1</sup>) followed by 1.2 Epan (4.13 kg ha<sup>-1</sup>) which was on par with 0.8 Epan (3.94 kg ha<sup>-1</sup>) and lowest under 0.6 Epan (3.49 kg ha<sup>-1</sup>). Among the hybrids, Indra (4.07 kg ha<sup>-1</sup>) showed higher P uptake followed by Orobelle (4.01 kg ha<sup>-1</sup>) and Indra (3.94 kg ha<sup>-1</sup>).

**Table 2:** Phosphorous uptake (kg ha<sup>-1</sup>) of capsicum influenced by different drip irrigation levels and hybrids under shade net at different days after transplanting.

Treatments	30 DAT	60 DAT	90 DAT	120 DAT	150 DAT
Main treatments (Irrigation levels):					
I <sub>1</sub> : Drip irrigation at 0.6 Epan	0.039	0.26	1.19	2.21	3.49
I <sub>2</sub> : Drip irrigation at 0.8 Epan	0.043	0.31	1.31	2.38	3.94
I <sub>3</sub> : Drip irrigation at 1.0 Epan	0.055	0.41	1.55	2.55	4.47
I <sub>4</sub> : Drip irrigation at 1.2 Epan	0.049	0.38	1.46	2.49	4.13
SEm ±	0.001	0.012	0.027	0.026	0.071
C.D (P=0.05)	0.003	0.042	0.096	0.091	0.249
Sub treatments (hybrids):					
V <sub>1</sub> : Indra	0.051	0.39	1.43	2.45	4.07
V <sub>2</sub> : Orobelle	0.047	0.33	1.37	2.40	4.01
V <sub>3</sub> : Bomby	0.042	0.29	1.33	2.36	3.94
SEm ±	0.00	0.005	0.005	0.004	0.006
C.D (P=0.05)	0.001	0.014	0.014	0.013	0.018
Factor B at same level of A					
SEm ±	0.001	0.020	0.047	0.045	0.122
C.D (P=0.05)	NS	NS	NS	NS	NS
Factor A at same level of B					
SEm ±	0.001	0.014	0.028	0.027	0.071
C.D (P=0.05)	NS	NS	NS	NS	NS

### Potassium uptake (kg ha<sup>-1</sup>)

At 30 DAT, K uptake was higher under 1.0 Epan (0.49 kg ha<sup>-1</sup>) on par with 1.0 Epan (0.44 kg ha<sup>-1</sup>) followed by 0.8 Epan (0.39 kg ha<sup>-1</sup>) and lowest under 0.6 Epan (0.31 kg ha<sup>-1</sup>) (shown in table- 3). Among the hybrids, Indra (0.46 kg ha<sup>-1</sup>) showed significantly higher K uptake compared to Orobelle (0.40 kg ha<sup>-1</sup>) and Bomby (0.37 kg ha<sup>-1</sup>). 1.0 Epan (2.53 kg ha<sup>-1</sup>) at 60 DAT recorded higher K uptake on par with 1.2 Epan (2.26 kg ha<sup>-1</sup>) followed by 0.8 Epan (2.05 kg ha<sup>-1</sup>) and lowest under 0.6 Epan (1.79 kg ha<sup>-1</sup>). Indra (2.23 kg ha<sup>-1</sup>) among the hybrids recorded higher K uptake compared to Orobelle (2.16 kg ha<sup>-1</sup>) and Bomby (2.08 kg ha<sup>-1</sup>).

1.0 Epan (7.95 kg ha<sup>-1</sup>) showed higher K uptake and was on par with 1.2 Epan (7.12 kg ha<sup>-1</sup>) at 90 DAT

followed by 0.8 Epan (6.21 kg ha<sup>-1</sup>) on par with 0.6 Epan (5.19 kg ha<sup>-1</sup>). Among the hybrids, Indra (6.76 kg ha<sup>-1</sup>) recorded higher K uptake compared to Orobelle (6.60 kg ha<sup>-1</sup>) and Bomby (6.50 kg ha<sup>-1</sup>). At 120 DAT, 1.0 Epan (12.36 kg ha<sup>-1</sup>) recorded higher K uptake which was on par with 1.2 Epan (11.08 kg ha<sup>-1</sup>). 0.8 Epan and 0.6 Epan were on par with each other and recorded 10.18 kg ha<sup>-1</sup> and 9.24 kg ha<sup>-1</sup>, respectively.

Higher K uptake of capsicum at 150 DAT was recorded by 1.0 Epan (20.21 kg ha<sup>-1</sup>) followed by 1.2 Epan (18.47 kg ha<sup>-1</sup>), 0.8 Epan (15.97 kg ha<sup>-1</sup>) and lowest was under 0.6 Epan (13.94 kg ha<sup>-1</sup>). Among the hybrids, Indra (17.77 kg ha<sup>-1</sup>) showed higher K uptake which was on par with Orobelle (17.24 kg ha<sup>-1</sup>) and Bomby (16.43 kg ha<sup>-1</sup>).

**Table 3 :** Potassium uptake (kg ha<sup>-1</sup>) of capsicum influenced by different drip irrigation levels and hybrids under shade net at different days after transplanting.

Treatments	30 DAT	60 DAT	90 DAT	120 DAT	150 DAT
<b>Main treatments (Irrigation levels):</b>					
<b>I<sub>1</sub>: Drip irrigation at 0.6 Epan</b>	0.31	1.79	5.19	9.24	13.94
<b>I<sub>2</sub>: Drip irrigation at 0.8 Epan</b>	0.39	2.05	6.21	10.18	15.97
<b>I<sub>3</sub>: Drip irrigation at 1.0 Epan</b>	0.49	2.53	7.95	12.36	20.21
<b>I<sub>4</sub>: Drip irrigation at 1.2 Epan</b>	0.44	2.26	7.12	11.08	18.47
<b>SEm ±</b>	0.013	0.091	0.343	0.529	0.314
<b>C.D (P=0.05)</b>	0.045	0.320	1.209	1.866	1.108
<b>Sub treatments (hybrids):</b>					
<b>V<sub>1</sub>: Indra</b>	0.46	2.23	6.76	11.35	17.77
<b>V<sub>2</sub>: Orobelle</b>	0.40	2.16	6.60	10.98	17.24
<b>V<sub>3</sub>: Bomby</b>	0.37	2.08	6.50	10.68	16.43
<b>SEm ±</b>	0.04	0.011	0.020	0.052	0.273
<b>C.D (P=0.05)</b>	0.012	0.034	0.062	0.158	0.826
<b>Factor B at same level of A</b>					
<b>SEm ±</b>	0.022	0.157	0.594	0.916	0.544
<b>C.D (P=0.05)</b>	NS	NS	NS	NS	NS
<b>Factor A at same level of B</b>					
<b>SEm ±</b>	0.014	0.093	0.344	0.536	0.546
<b>C.D (P=0.05)</b>	NS	NS	NS	NS	NS

### Conclusion

TDM was significantly higher at 1.0 Epan at 30,60,90,120 and 150 DAT than the 1.2, 0.8 and 0.6 Epan. Among the hybrids, Indra recorded higher TDM compared to Orobelle and Bomby. Nutrient uptake (N, P & K) was higher at 1.0 Epan at all the growth stages when compared to all the irrigation levels. Indra among the hybrids recorded higher N, P & K uptake compared to Orobelle and Bomby.

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