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## Interaction effect of different drip irrigation levels and varieties on yield attributes of cabbage

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### Abstract

The field experiment was conducted for two *Rabi* seasons of year 2021-22 and 2022-23 on four irrigation levels (60 percent, 80 percent, 100 percent and 120 percent PE) and four varieties of cabbage (Golden Acre, Pusa Mukta, Pusa Cabbage -1 and Pusa Cabbage Hybrid -81) at Farm of College of Agriculture, S.K. R. A. U., Bikaner. The experiment was laid out in SPD (split plot design) with replicate three times. Results observed that drip irrigation at 100 percent PE with Pusa Mukta was recorded significantly increased weight of marketable head (789.2, 774.6 and 781.9 g plant<sup>-1</sup>) over other treatments during 2021-22 and 2022-23 and pooled mean basis, respectively. The weight of head with unfolded leaves (1179.06, 1161.40 and 1170.23 g plant<sup>-1</sup>) was recorded significantly higher with 120 percent PE over other treatments combinations in 2021-22 and 2022-23 and pooled mean basis, respectively.

**Keywords:** Pan evaporation, irrigation and cole crops

### Introduction

Cabbage (*Brassica oleracea* var. *capitata* L.) is a member of the Cruciferae family and a useful vegetable, belonging to the genus Brassica. Mediterranean region is the center of origin of cabbage and it has somatic chromosome number (2n=2x=18). In India, it was introduced in 15<sup>th</sup> century from Portugal. Cabbage is the second most important Cole crops after cauliflower. The area under the vegetable cultivations in India is 10.96 million ha with production of 197.23 million ton and the area of cabbage in India is 415 thousand ha with production of 9567 thousand ton (Anonymous, 2022) [1].

Cabbage contains vitamin A (110 IU), thiamine (0.08 mg), riboflavin (0.03 mg) and vitamin C (55 mg) per 100 g edible part. It is rich source of minerals including phosphorus (44 mg), potassium (114 mg), sodium (14.10 mg), calcium (39 mg) and iron (0.80 mg) (Fageria *et al.*, 2003) [4]. The edible part, head is formed by thickening of edible bud with tightly packed overlapping leaves. In cabbage, due to presence of Indol-3 carbinol, it protects against cancer. Cabbage head juice is also used as a remedy against poisonous mushroom.

In arid regions, the limited availability of water for cultivation enforced the idea of its proper use of water for irrigation. In the country, Rajasthan faces one of the biggest shortages of water resources. It has 13.80 percent of India's cultivable area, 5.50 percent of the population and about 18.70 percent of the country's livestock, but has only 1.16 percent of surface water (lakes and rivers) and 1.77 percent of groundwater (wells). Under such conditions, the micro-irrigation system, a better approach for water management in the field, played the most significant role in irrigating a large area with available water and increasing crop productivity and water use efficiency (Sivanappan, 2004) [9].

Drip irrigation helps in maintain the optimum moisture in root zone of plants and increased water use efficiency as well as yield of crop. Drip irrigation method also helps to reduce the over exploitation of ground water and environmental problems like water logging and salinity associated with the surface irrigation method. The drip irrigation method optimizes irrigation water and facilitates the application of water evenly and directly to the plant root zone at frequent intervals based on the crop's water needs through a network of plastic pipes. Many researchers have reported increased yield, quality, and achieving higher water use efficiency as well as water savings through drip irrigation (Gao *et al.*, 2010) [5]. Drip irrigation system has been found to be quite effective in limited availability of water not only to achieve higher productivity but also to save other inputs like pesticides, fertilizers and labor etc. Thus, introduction of drip irrigation will save huge amount of irrigation water which can be used

with to irrigate more areas (Mane *et al.*, 2008)<sup>[8]</sup>. Variety is an important factor for successful crop production. An improved variety signify higher yield than wild one. A number of varieties of cabbage are available for different environment with specific habit and characteristics. In the production of vegetable crops, major constraints to farmers is declining returns includes fluctuation in the productivity of varieties (Chattopadhyay *et al.*, 2007)<sup>[3]</sup>.

### Materials and Methods

The field experiment was conducted at the Instructional Farm, COA, S.K. Rajasthan Agricultural University, Bikaner during *Rabi* season 2021-22 and 2022-23. Bikaner is located at 28° 01' N and 73° 22' E at an altitude of 234.70 meters above mean sea level. According to the National Agricultural Research Project (NARP), Bikaner falls under the IC (Hyper

Arid Partially Irrigated North Western Plain Zone) agro-climatic zone. The treatment comprising of four irrigation levels (60, 80, 100 and 120 percent PE) in main plots and four varieties (Golden Acre, Pusa Mukta, Pusa Cabbage -1 and Pusa Cabbage Hybrid -81) in sub plots. The experiment was laid out as a split plot design (SPD) with three replications. Drip irrigation was carried out in experimental fields based on pan evaporation (PE), data recorded daily from Agro-Meteorological Observatory, ARS, Beechwal, Bikaner. Five weeks old seedlings of the cabbage having average height of about 10-15 cm were transplanted in evening at 45 x 30 cm row to row (R) and plant to plant (P) spacing, respectively. The irrigation events (month wise) and water applied during *Rabi*, 2021-22 and 2022-23 data are presented in table 1 and 2, respectively.

**Table 1:** Irrigation events (month wise) and irrigation water applied during *Rabi*, 2021-22

Month	Irrigation events	Irrigation water applied (mm) including rainfall			
		60% PE	80% PE	100% PE	120% PE
November (9-30)	11	109.8	146.4	183.0	219.6
December (1-31)	16	137.4	183.2	229.0	274.8
January (1-31)	12	123.0	164.0	205.0	246.0
February (1-13)	04	43.2	57.6	72.0	86.4
Total	43	413.4	551.2	689.0	826.8
Irrigation at transplanting (mm)		25.0	25.0	25.0	25.0
Rainfall (mm)		30.0	30.0	30.0	30.0
Total		468.4	606.2	744.0	881.8

**Table 2:** Irrigation events (month wise) and irrigation water applied during *Rabi*, 2022-23

Month	Irrigation events	Irrigation water applied (mm) including rain fall			
		60% PE	80% PE	100% PE	120% PE
November (11-30)	10	70.2	93.6	117.0	140.4
December (1-31)	16	81.0	108.0	135.0	162.0
January (1-31)	15	73.8	98.4	123.0	147.6
February (1-16)	06	42.6	56.8	71.0	85.2
Total	47	267.6	356.8	446.0	535.2
Irrigation at transplanting (mm)		25	25	25	25
Rainfall (mm)		0.0	0.0	0.0	0.0
Total		292.6	381.8	471.0	560.2

### Results and Discussion

Interaction effect of drip irrigation at 100 percent PE with Pusa Mukta produced significantly highest weight of marketable head (789.2, 774.6 and 781.9 g plant<sup>-1</sup>) in 2021-22, 2022-23 and pooled mean basis, respectively (table 4.7 to 4.9) as compared to other drip irrigation levels with different varieties of cabbage and which was at par with 120 percent PE with Pusa Mukta. However, the weight of head with unfolded leaves (1243.5, 1225.7 and 1234.6 g plant<sup>-1</sup>) significantly highest recorded with at 120 percent PE with Pusa Mukta than other treatment combinations. As increase in irrigation from 60 to 120 percent PE, the weight of marketable head as well as weight of head with unfolded

leaves were increased significantly with the irrigation levels in Pusa Mukta variety during both the years. This may be due to maintaining field capacity moisture in the soil in the drip irrigation system during the growing season, which increased plant growth at 120 percent of the PE drip irrigation level. The increased photosynthates with increased the availability of water might have lead to greater dry mass production which resulted into enhanced formation of reproductive structure and their growth, development and better initiation. Kumari (2023)<sup>[7]</sup> in cowpea, Kumar *et al.*, 2015<sup>[6]</sup> in cluster bean and Bhunia *et al.* (2015)<sup>[2]</sup> in fenugreek also recorded significant interaction of irrigation levels with varieties for yield and yield attributing traits.

**Table 3:** Interaction effect of irrigation levels and response of cabbage varieties on weight of marketable head (g plant<sup>-1</sup>)

Varieties	Irrigation levels (PE)														
	2021-22					2022-23					Pooled				
	60%	80%	100%	120%	Mean	60%	80%	100%	120%	Mean	60%	80%	100%	120%	Mean
V <sub>1</sub>	436.9	618.4	778.9	786.8	655.2	427.1	609.3	767.6	772.3	644.1	432.0	613.8	773.2	779.6	649.7
V <sub>2</sub>	440.3	621.5	789.2	812.9	666.0	429.3	609.3	774.6	798.2	652.8	434.8	615.4	781.9	805.6	659.4
V <sub>3</sub>	431.2	615.0	765.6	771.1	645.7	420.9	606.1	755.7	756.5	634.8	426.0	610.5	760.7	763.8	640.3
V <sub>4</sub>	321.6	557.6	725.5	734.0	584.7	311.8	549.1	713.0	719.3	573.3	316.7	553.4	719.3	726.7	579.0
Mean	407.5	603.1	764.8	776.2		397.3	593.4	752.7	761.6		402.4	598.3	758.8	768.9	
			S.Em.±	CD (5%)			S.Em.±	CD (5%)				S.Em.±	CD (5%)		
I at same level of V			13.7	40.0			13.5	39.4				9.6	27.3		
V at same level of I			10.6	31.0			10.1	29.4				10.3	29.4		

\*V<sub>1</sub> (Golden Acre), V<sub>2</sub> (Pusa Mukta), V<sub>3</sub> (Pusa Cabbage – 1), V<sub>4</sub> (Pusa Cabbage Hybrid – 81)

**Table 4:** Interaction effect of irrigation levels and response of cabbage varieties on weight of head with unfolded leaves (g plant<sup>-1</sup>)

Varieties	Irrigation levels (PE)														
	2021-22					2022-23					Pooled				
	60%	80%	100%	120%	Mean	60%	80%	100%	120%	Mean	60%	80%	100%	120%	Mean
V <sub>1</sub>	564.7	863.2	1073.6	1189.4	922.8	550.1	852.4	1056.9	1172.0	907.9	557.4	857.8	1065.3	1180.7	915.3
V <sub>2</sub>	584.9	870.0	1104.2	1243.5	950.6	568.5	857.6	1082.5	1225.7	933.6	576.7	863.8	1093.3	1234.6	942.1
V <sub>3</sub>	555.8	855.6	1054.9	1167.2	908.4	542.0	842.3	1040.2	1149.5	893.5	548.9	849.0	1047.6	1158.4	900.9
V <sub>4</sub>	398.3	770.3	999.3	1116.1	821.0	383.7	761.7	980.9	1098.3	806.1	391.0	766.0	990.1	1107.2	813.6
Mean	525.9	839.8	1058.0	1179.1		511.1	828.5	1040.1	1161.4		518.5	834.1	1049.1	1170.2	
			S.Em.±	CD (5%)			S.Em.±	CD (5%)				S.Em.±	CD (5%)		
I at same level of V			20.53	59.93			20.38	59.48				14.46	41.13		
V at same level of I			15.81	46.15			15.21	44.40				15.51	44.11		

\*V<sub>1</sub> (Golden Acre), V<sub>2</sub> (Pusa Mukta), V<sub>3</sub> (Pusa Cabbage – 1), V<sub>4</sub> (Pusa Cabbage Hybrid – 81)

## Conclusion

The combination of 100 percent PE drip irrigation with Pusa Mukta produced the highest weight of marketable head. While the weight of head with unfolded leaves was higher at 120 percent PE level with Pusa Mukta variety.

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