Effect of different drip irrigation levels and cabbage varieties on potassium content and uptake of head

ABSTRACT

An experiment was conducted for two *Rabi* seasons in the years of 2021 and 2022 on four irrigation levels (60 per cent, 80 per cent, 100 per cent and 120 per cent PE) and four varieties of cabbage (Golden Acre, PusaMukta, Pusa Cabbage -1 and Pusa Cabbage Hybrid -81) at College of Agriculture, SKRAU, Bikaner. The experiment was laid out in split plot design with three replications. Results showed that the maximum potassium content in head was obtained under 120 per cent PE of irrigation level (2.03, 2.02 and 2.02 per cent) which was significantly higher over 60 per cent PE irrigation level (1.74, 1.72 and 1.73 per cent) and it was statistically at par with 80 per cent PEand 100 per cent PE irrigation level during the year 2021, 2022 and on pooled mean basis, respectively.The significantly higher uptake of potassium by head (92.21, 93.89 and 93.05 kg ha-1) was recorded under 100 per cent PE level over 60 per cent PE level (62.70, 63.63 and 63.17 kg ha-1) which was statistically at par with 120 per cent PE and 80 per cent PE irrigation levels during 2021, 2022 and on pooled basis, respectively. Among the varieties, significantly higher uptake of potassium by head recorded under PusaMukta variety (86.05, 87.40 and 86.72 Kg ha-1) over the Pusa Cabbage Hybrid -81 (71.74, 72.03 and 71.89 Kg ha-1) and it was at par with Golden Acre and Pusa Cabbage -1 were statistically at par with PusaMukta variety of cabbage.Potassium content in cabbage head was not significantly affected with different cabbage varieties during both the experimental years.

Key words: Pan evaporation, Drip irrigation and Cole Crops

Introduction

Cabbage (*Brassica oleracea var. capitata*L.) is a member of Brassicaceae or Cruciferae family and a useful vegetable, belongs to the genus Brassica. Mediterranean region is the center of origin of cabbage crops and it has somatic chromosome number (2n=2x=18). In India, it was introduced in 15th century from portugal. Cabbage is a slow growing biennial crop of temperate region. However, its cultivation is equally successful in

the tropical and sub-tropical regions. It is important vegetable grown throughout the world. Cabbage is the second most important cole crops after cauliflower. Cabbage contains vitamin A (120 IU), thiamine (0.06 mg), riboflavin (0.03 mg) and vitamin C (50 mg) per 100 g edible part. It is rich in minerals including phosphorus (44 mg), potassium (114 mg), calcium (39 mg), sodium (14.1 mg) and iron (0.8 mg) Fageria*et al*., 2003). 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, limited availability of irrigation water enforced the idea of its efficient use of irrigation water. In the country, Rajasthan faces one of the greatest scarcities of water resources. It has 13.88% of India's cultivable area, 5.57% of population and about 18.70 % of country's livestock but it has only 1.16 % of surface water (lake & river) and 1.70% of the ground water (well). Thus, Rajasthan a state with about 10% of land area has only around 1% of the country's water resources. Under such circumstances, micro- irrigation, an efficient approach for irrigation water management has played a most significant role to bring more area under irrigation with the available water and increasing the productivity of crop and water use efficiency.Drip irrigation helps in maintain the optimum soil moisture in root zone of plants and with increased water use efficiency as well as yield of crop. "Drip method of irrigation also helps to reduce the over exploitation of ground water and environmental problems associated with the surface method of irrigation like water logging and salinity. Drip irrigation system optimizes the irrigation water and facilitates application of water uniformly and directly to the root zone at frequent intervals based on crop water requirement through a closed network of plastic pipes"(Mane *et al*., 2008).

"Irrigation scheduling based on climatological approach is considered as most scientific approach as it integrates all the weather parameters giving them natural weightage in a given climate-plant continuum" (Parihar*et al*., 1976). In arid Western Rajasthan, drip irrigation on the basis of climatological approach hold great promise for minimizing water loss and improving its utilization efficiency and yield. The climatological approach permits the formation of irrigation time tables for different crops. Pan evaporation based scheduling of irrigation is a proper and scientific approach to provide required irrigation water through drip system for harnessing potential yield of cabbage crop.

"Variety is an important factor for successful crop yield. 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. The increase in production is achieved through use of high yielding varieties of cabbage such as Golden Acre, PusaMukta, Pusa Cabbage-1 and Pusa Cabbage Hybrid-81. In vegetable crops production, major constraint in the diminishing returns of the growers includes varietal fluctuation in the productivity" (Chattopadhyay*et al*., 2007)."The cultivar itself plays a great role for higher yield of the crop. There is a wide scope of increasing cabbage production with evaluate the new suitable cultivars. There are many cabbage varieties available in the market. Prior to recommendation for farmers, varietal performances need to be determining" (Moniruzzaman, 2011).

Material and Methods

The field experiment was conducted at Instructional Farm, College of Agriculture, SKRAU, Bikaner during *Rabi* season of 2021 and 2022. Bikaner is situated at 28^{o} 01'N latitude and 73^{o} 22'E longitude at an altitude of 234.70 meters above Mean Sea Level. As per NARP, Bikaner falls in Agro climatic zone IC (Hyper Arid Partially Irrigated North Western Plain Zone). The treatment comprising of four irrigation levels (60, 80, 100 and 120 per cent PE) in main plots and four varieties (Golden Acre, PusaMukta, Pusa Cabbage -1 and Pusa Cabbage Hybrid -81) in sub plots. The experiment was laid out in split plot design with three replications.

Drip irrigation was given to experimental fields on the basis of pan evaporation (PE) by the prevailing atmospheric conditions recorded daily from Agro-Meteorological observatory, ARS, Beechwal, Bikaner. Five weeks old seedlings of the crop having average height of about 10-15 cm were transplanted in evening at 45 x 30 cm row to row and plant to plant spacing, respectively.

Results and Discussion

The increasing level of drip irrigation, increased the potassium content and uptake in head during both the years.The maximum potassium content in head was obtained under 120 per cent PE of irrigation level (2.03, 2.02 and 2.02 per cent) which was significantly higher over 60 per cent PE irrigation level (1.74, 1.72 and 1.73 per cent) during the year 2021, 2022 and on pooled mean basis, respectively. The treatment 120 per cent PE remains statistically at par with 80 per cent PE (1.97, 1.90 and 1.93 per cent) and 100 per cent PE (1.99, 1.97 and

1.98 per cent) irrigation level during the year 2021, 2022 and on pooled mean basis, respectively. On the basis of pooled mean analysis, the potassium content of cabbage head at 120 per cent PE level, increased in tune of 26.33 per cent over 60 per cent PE irrigation level.The significantly higher uptake of potassium by head (92.21, 93.89 and 93.05 kg ha^{-1}) was recorded under 100 per cent PE level over 60 per cent PE level which was statistically at par with 120 per cent PE (87.30, 88.38 and 87.84 kg ha^{-1}) and 80 per cent PE (83.90, 82.70 and 83.30 kg ha^{-1}) irrigation levels during 2021, 2022 and on pooled basis, respectively.As pooled data the uptake of potassium by head increased under 100 per cent PE level in tune of 5.94, 11.71 and 47.31 per cent over 120 per cent PE, 80 per cent PE and 60 per cent PE level of irrigation.

The availability of nutrients in the soil and their translocation is also increased by proper and continuous supply of moisture, which increased the plant vegetative growth. Increased K content in cabbage head could be attributed to more moisture in the rhizosphere, which was solubilized the nutrients and allowed the plants to extract more K content from the soil through root proliferation. Due to complete stomata opening, this encourages higher absorption of nutrients and potassium content in head. The transpiration flow increases, when adequate soil moisture is available in soil. Bhunia*et al.* (2015) in fenugreek andRajak*et al.* (2015) in cabbage in cowpea also reported similar results. The improved nutritional environment in the root zone as well as in the plant system augments nutrients translocation in plant parts along with irrigation water. The concentration of nutrient in a plant and the crop's biology determine the nutrient uptake. The increase in nitrogen, phosphorous and potassium uptake by plants may have contributed to the improvement in nutrient concentration and biomass yield. These findings are supported by Dasila*et al.* (2016) in cowpea, Abd El-Kader *et al.* (2010) in okra, and Harisha*et al.* (2017) in fenugreek.

Among the varieties, potassium content in cabbage head was not significantly affected with the different varieties of cabbage during both the years of 2021, 2022 and pooled mean basis. The significantly higher uptake of potassium by head recorded under PusaMukta variety (86.05, 87.40 and 86.72 Kg ha^{-1}) over the Pusa Cabbage Hybrid -81 (71.74, 72.03 and 71.89 Kg ha^{-1}) during 2021, 2022 and on pooled basis, respectively.The Golden Acre (84.49, 84.98 and 84.73 Kg ha^{-1}) and Pusa Cabbage -1 (83.84, 84.18 and 84.01 Kg ha^{-1}) were statistically at par with PusaMukta variety of cabbage.The increased head yield in different cabbage varieties might have also increased dry matter production which ultimately increased the nutrient (NPK) uptake in cabbage head. Haque (2005) in cabbage, Singh *et al.* (2021) in

fennel and Kumari (2023) in cowpea were also observed that uptake of nutrients was significantly affected with different varieties.

Table 1 Effect of irrigation levels and response of cabbage varieties on potassium (K) content and uptake in head

Treatments	K content in head (%)			K uptake in head (Kg ha^{-1})		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Irrigation levels						
60% PE	1.74	1.72	1.73	62.70	63.63	63.17
80% PE	1.97	1.90	1.93	83.90	82.70	83.30
100% PE	1.99	1.97	1.98	92.21	93.89	93.05
120% PE	2.03	2.02	2.02	87.30	88.38	87.84
S.Em.±	0.06	0.05	0.04	6.60	5.56	4.31
CD (P=0.05)	0.20	0.17	0.12	22.84	19.23	13.29
Varieties						
Golden Acre	1.95	1.91	1.93	84.49	84.98	84.73
PusaMukta	1.98	1.96	1.97	86.05	87.40	86.72
Pusa Cabbage – 1	1.95	1.91	1.93	83.84	84.18	84.01
Pusa Cabbage Hybrid - 81	1.84	1.83	1.84	71.74	72.03	71.89
S.Em.±	0.05	0.05	0.04	3.97	3.44	2.63
CD (P=0.05)	NS	NS	NS	11.60	10.04	7.47

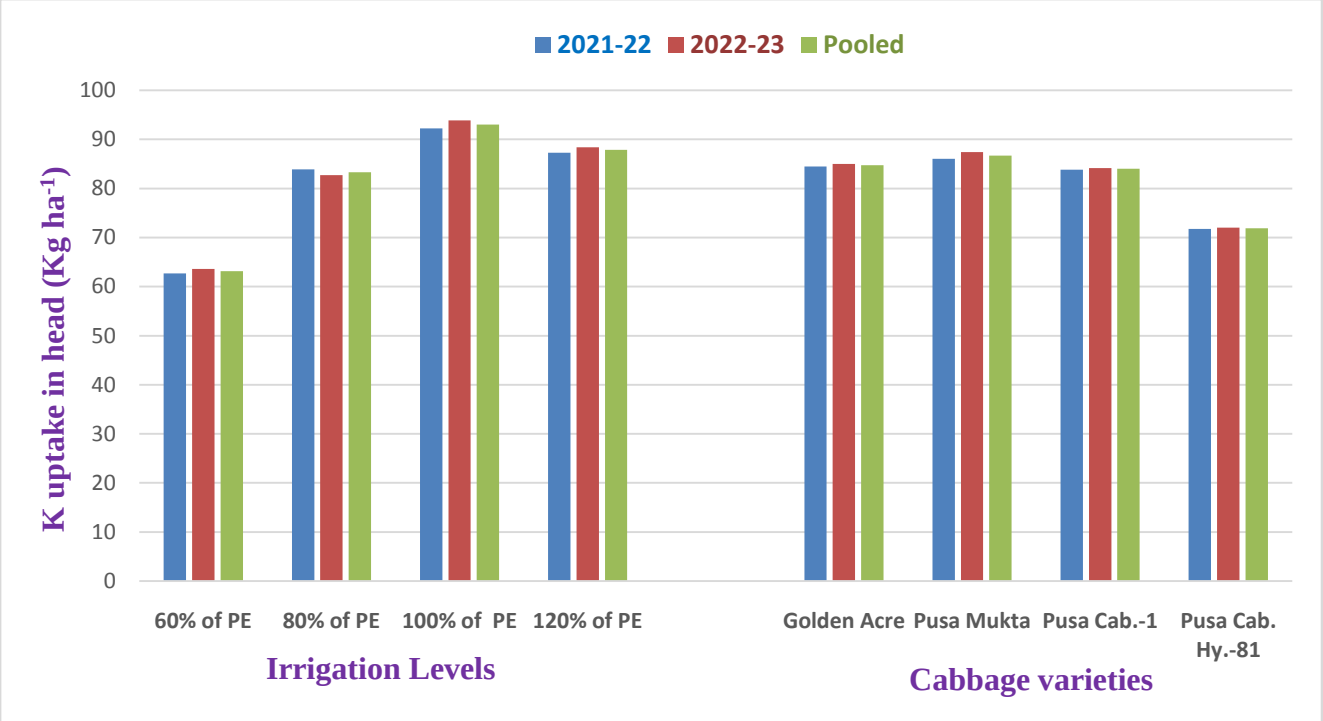

Fig 1 Effect of irrigation levels and response of cabbage varieties on K uptake in head (Kg ha^{-1})

Conclusion

The treatment 100 per cent PE irrigation level was found to be significantly maximum potassium content and uptake in head during both the years. The significantly maximum potassium uptake in head was recorded under PusaMukta.

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