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WATER REQUIREMENT AND IRRIGATION SCHEDULING THROUGH DRIP SYSTEMS IN CABBAGE (*Brassica oleracea* var. *capitata*)

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ABSTRACT : An experiment was conducted to study the water requirement and irrigation scheduling in cabbage (*Brassica oleracea* var. *capitata*). The treatment consisted of three irrigation levels viz. 100%, 80% and 60% on ET (Evapo-Transpiration) basis and three irrigation scheduling viz. daily, once in two days and once in three days in split plot design. It is revealed that significantly higher yield was noticed at 60% ET treatment (569.80q/ha during first year of trial) whereas, 80% ET treatment (703.82 and 488.40q/ha) during second and third year of trial as compared to 100% ET. At 60% ET, irrigation scheduling at once in two days was found significantly superior in the first year while 80% ET with irrigation scheduling once in two days during second and third year of trials with respect to daily and once in three days. Maximum water use efficiency was obtained under irrigation at 60% ET with once in two days (115.81q/ha^{-cm}) irrigation treatment in the three consecutive years of experimentation. Irrigation at 80% ET with once in two days interval may be recommended for better yield and marketability in cabbage.

Keywords : *Drip irrigation, evapo-transpiration, water use efficiency, cabbage.*

Cabbage is a major cole crop next to cauliflower and India comes next to China in cabbage production. Conventional methods of irrigation and fertilizer application is followed in this crop which often leads to poor plant population, non uniformity in head size and lower yields. It is necessary for the vegetable crops grower to know how much water and when it should be applied to a particular crop for enhancing its productivity and can fetch good returns by increasing its marketability. Though water demand by the crop is less during winter season, crop often faces hidden water shortage under surface irrigation. Advanced irrigation method *viz.* drip irrigation will help in uniformly applying water to the field in the crop root zone at desirable intervals. Drip irrigation also saves 30-40% fertilizer/chemical with enhanced quality of produce and yield as compared to surface irrigation and is helpful in reducing labour cost, salt concentration in the root zone and disease incidence. Therefore, an effort has been made keeping all these in view to study the water requirement and irrigation scheduling on cabbage through drip irrigation with the objective to find out the optimum schedule of irrigation for maximum cabbage yield and water use efficiency.

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MATERIALS AND METHODS

A field experiment was conducted at Sabajpura farm, ICAR Research Complex for Eastern Region, Patna during 2001-02, 2002-03 and 2003-04 on cabbage. The cabbage variety C-139 was sown in nursery during first week of October and transplanted at the spacing of 60 x 45cm in the first week of November. The experiment was laid out in split plot design with three replications. The treatments as the main plot factors were irrigation level at 100% (I_1), 80% (I_2) and 60% (I_3) ET while as the sub-plot factors were scheduling at daily (S_1), once in two days (S_2) and once in three days (S_3). The drip irrigation systems were consisted of 2lph capacity online drippers. One lateral for one row of crop with one dripper per plant was adopted in each plot. Each sub-plot consisted of ten rows and ninety plants. The daily irrigation was applied in drip treatments at 1kg/cm^2 pressure. The daily pan evaporation was used to compute the daily water requirement of the crop through drip systems. The effective rainfall was computed by considering the pan evaporation and precipitation received during irrigation intervals. Recommended fertilizers were given as basal dose and top dressing twice through irrigation water. All other management practices were as per the recommendation available for the crop. The parameters viz. yield and water use efficiency were

undertaken during experimentation and analyzed using statistical methods as suggested by Panse and Sukhatme (10).

RESULTS AND DISCUSSION

Effect of irrigation scheduling on yield

The data presented in Table 1 indicated that significantly higher yield of cabbage and water use efficiency registered in treatment with irrigation 60% ET scheduling at once in two days in the first year. However, 80% irrigation scheduling with once in two days was promising in terms of yield in the second and third year of experimentation. The possibility of increased yield of cabbage due to the increased photosynthesis, maximum head weight and the production of more number of functional leaves resulting the formation of individual head. The increased yield under drip irrigation might have resulted due to better water utilization (Manfrinato, 9), higher uptake of nutrients (Bafna *et al.* 1), irrigation interval of 2 days (Gvozden *et al.* 5) and excellent soil-water-air relationship with higher oxygen concentration in the root zone (Gornat *et al.,* 4). These findings are corroborate with the result that drip irrigation scheduled at every second day frequency with irrigation level 79% ET resulted maximum yield of tomato and increased yield up to 27% (Dalvi *et al.,* 3). Prabhakar et al. (11) revealed that micro irrigation systems produced 17-29% higher marketable yield. Imtiyaz *et al.* (7) observed the higher mean marketable yield of cabbage (71.65 t/ha), spinach (33.53 t/ha), rape (73.22 t/ha), carrot (56.76 and 38.39 t/ha), tomato (46.81 t/ha) and onion (56.05 t/ha) for irrigation scheduled at CPE of 22, whereas, the yield 120.7 q/ha of early cauliflower were maximum under irrigation schedule based on IW/CPE=0.5.

Effect of irrigation scheduling on water use efficiency

The data pertaining to water use efficiency showed that field water use efficiency in different irrigation treatments ranged from 64.91 to 123.44 q / ha^{-cm}. It was 115.81 q / ha^{-cm}, 130.86 q / ha^{-cm} and 123.44 q / ha^{-cm} with irrigation 60% scheduling at once in two days during three consecutive years of experimentation, respectively. Whereas, the production potential was highest (569.80q/ha) during the first year. However, the production potential was 621.60 q/ha and 477.59q/ha during second and third year of observation, respectively. The similar results were reported by Chandio *et al.* (2) for cauliflower and Tiwari *et al.* (13) for cabbage where, yield was higher under drip irrigated plots resulting higher water use efficiency. Similarly, Kashyap (8) also found maximum water use efficiency in cauliflower by irrigation scheduling with 45% MAD of available soil water. The higher water use efficiency might be due to the lower rate of water loss through evaporation from soil surface under drip irrigation. Hao *et al.* (6) observed that irrigation frequency significantly increased the water use efficiency (WUE) and irrigation water use efficiency (IWUE). The irrigation at CPE of 22 mm resulted in higher irrigation production efficiency of cabbage (11.32 kg/m^3), spinach (3.35 kg/m^3), carrot (9.83 and 6.66 kg/m^3), tomato (5.90 kg/m^3) and onion (6.26 kg/m^3), but rape (12.03 kg/m^3) gave higher irrigation production efficiency at CPE of 33–55 mm (Imtiyaz *et al.,* 7). However, Saini and Singh (12) observed that drip at low level of irrigation (IW/CPE=0.50) gives more yield and saving of irrigation water as compared to other crop sequences.

Table 1: Effect of drip irrigation scheduling on cabbage yield and water use efficiency.

Treatments	Yield (q/ha)			WUE (q/ha^{-cm})		
	2001-02	2002-03	2003-04	2001-02	2002-03	2003-04
Main plots						
100% ET	529.92	691.24	460.15	64.91	87.28	71.96
80% ET	532.51	703.82	488.40	81.85	111.02	95.12
60% ET	569.80	621.60	477.59	115.81	130.86	123.44
C.D. (P=0.05)	**23.63**	**53.71**	**9.17**	**2.75**	**7.95**	**4.04**
Sub-Plots						
Daily	528.71	667.34	439.48	84.30	109.67	87.78
2 days	558.90	674.69	499.91	91.03	110.74	103.44
3 days	544.62	674.63	486.76	87.24	108.76	99.29
C.D. (P = 0.05)	**14.28**	**NS**	**4.31**	**2.98**	**NS**	**6.42**

CONCLUSION

The result obtained from the experimentation showed that drip system is very effective and efficient method of irrigation practices for raising cabbage crop and scheduling of irrigation once in two days at 80% ET found to be suitable for higher productivity of cabbage head (5.16%) and higher water use efficiency (66.64%) as compared to irrigation at 100% ET scheduling at once in two days.

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