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Research Paper Engineering

Drip irrigation technique enhancing water and fertiliser use efficiency in cauliflower

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ABSTRACT

A field study on comparative performance of drip irrigation system and check basin irrigation system was conducted in cauliflower in sandy loam soil at ARS, Durgapura, Jaipur. Three treatments of drip irrigation - lateral with dripper spaced at 50 cm, 40 cm and 30 cm were taken to vary the quantity of water through drip irrigation system. The result was compared with the recommended check basin irrigation system i.e. five days irrigation frequency with 6.75 depth of irrigation. Three year data revealed that irrigating the cauliflower crop by drip irrigation system with dripper spaced at 30 cm, three hours operation of drip irrigation system and three day irrigation frequency saves 55. 18 per cent water, 46.66 per cent fertilizer and 33 .04 per cent labors besides enhancing the yield (24.66 %) and quality of produce. The drip irrigation system resulted higher water use efficiency (4.32q / ha-cm) than the conventional method of irrigation. The drip irrigation system was also found more cost effective (B: C ratio = 3.12) than the conventional method of irrigation ((B: C ratio =2.20).

Keywords : Drip irrigation, check basin irrigation, water use efficiency, fertigation

Introduction:

Rajasthan is the largest state of the country in term of geographical area. It is well endowed with the land and sunshine but is less fortune in available water resources. Ground water is main source of irrigation which is most precious and contributes only 2.9 per cent of total ground resource of the country (Yadav and Singh, 2008). Due to scarcity of surface water, 90% of the population is dependent on ground water for domestic use and 60 % for irrigation purpose. The ground water table is going down at the rate of about one meter per year and situation has reached under alarming position in some part of the state. The over exploitation of ground water and lack of dilution through recharge is resulting into degradation of ground water quality in many areas. Increasing ground water withdrawal by agriculture, domestic and industrial sectors coupled with inadequate recharge have greatly stressed the existing resources of the state. This has brought 140 blocks under over exploited and 50 blocks under critical category, out of the 237 blocks of the state. In decade and half time i.e. 1990 to 2004, there is not only sharp increase in ground water draft but the number of over exploited block has increased from 44 blocks in 1990 to 150 blocks in 2004. Critical and over exploited blocks together account for > 70 per cent area of the state (Mathur, 2009). Considering its scarcity in future, the planning and management of this resource and its optimal, economical and equitable use has become a matter of utmost urgency. Given such a challenging task, the only alternative remain is to use this resource most judiciously and most efficiently specially for irrigation purpose to sustain the availability of water forever.

Generally, check basin method of irrigation is used for irrigating the crops in arid and semi arid region, where about 40 per cent of water is lost in storage and conveyance (Srinivas, 2006). The use of conventional irrigation methods not only results in considerable water loss but it is also responsible for widespread salinity, water logging and leaching of nutrients from the rhizospere. On the other hand, drip irrigation has proved its superiority over these methods owing to precise and direct application of water in the root zone, without wetting the entire area. With drip irrigation water saving to the extent of 50 to 70% in tomato (Bafana et al., 1993; Sivanappan and Padamkumari, 1980) and 37 % in cauliflower (Ahluwalia et al., 1993) has been reported. Thus, to avoid the water losses and increase the water use efficiency drip irrigation system has been found an efficient tool of water application in vegetable cultivation.

Vegetables are fast growing, vigorous; most of root system confined only in upper layer of soil and required frequent irrigation. Thus vegetable are very sensitive to water stress. Also due to spaced planting, micro- irrigation/ drip irrigation is an effective, efficient and economic viable method for irrigation of vegetables. The experiment on vegetables indicate that drip irrigation system can save water up to 80 % with increase of yield up to 88% beside improving the quality of produce (Bahadur, and Rai 2006) . The drip irrigation system has created a greater impact in term of saving power (358 kwh), water (53%) and labour (63%) and also in application of input like fertilizers (334%) and plant protection chemical (9%). In total, there was saving of 70 % in irrigation cost (Bahadur and Singh, 2000). Keeping this in view the present investigation was carried out in sandy loam soil in cauliflower crop to evaluate crop water requirement and cost benefit analysis of drip irrigation as compared to traditional practices of irrigation i.e. check basin irrigation system.

Materials and methods:

In order to compare the performance of drip and check basin irrigation systems for irrigating cauliflower crop verity Snow ball -65 was transplanted on raised bed in drip irrigation and in check basin irrigation treatment translating of cauliflower was done in flat bed, bed size 3.5 x 3.0 m third week of October for three consecutive years. The plat to plant and row to row spacing was 30 cm and 40 cm respectively. The plants population per unit area was maintained equal in all treatments. Three treatments of drip irrigation i.e. T1= dripper line with dripper spaced at 50 cm, T2 = dripper line with dripper spaced at 40 cm and T3 = dripper line with dripper spaced at 30 cm were taken to vary the quantity of water. The trial was laid out in randomized block design with four replications. The soil was low in organic carbons (0.2%), P (25 kg/ha) and available K (150 kg/ha) with pH 7.7. The field capacity and permanent wilting point in 45 cm root zone soil profile were 10.22 and 3.82 per cent with the bulk density of 1490 kg/m3. Soil status was measured before conducting the trail. Irrigation application efficiency of surface method was 85 per cent. Net irrigation requirement volume of water required in the check basin

and required duration of irrigation was obtained as,

$$N_i = F_c - M_c \quad ....(1)$$

where, N_i = Net irrigation requirement

Fc = Field capacity

Mc = Available soil moisture content

Total volume of water required in check basin (Vw)

$$V_w = Ab \times Ni \quad ....(2)$$

Ab = Area of basin

Ni = Net depth of irrigation

Required duration of irrigation (Di)

$$D_i = \frac{V_w}{D} \quad ....(3)$$

where, D = discharge of stream

The drip irrigation system was operated with 7.5 hp centrifugal pump fitted in open well, maintaining operating pressure of 1.5 kg/ cm2. Inline lateral having discharge of 2.0 l/ dripper/h were used. Soil samples were collected from three successive layers (0-15, 15-30 and 30 - 45 cm) to determine the soil moisture content by gravimetric method before each irrigation and 24 hours after applying the irrigation such as consumptive use and water use efficiency were computed following the method by Dastane (1972). The average irrigation frequency in check basin method of irrigation was 5 days whereas in drip irrigation system it was 3 days. Transplanting of cauliflower seedlings for drip irrigation treatment was done on raised bed (100cm width and 12 cm height) in three rows at 30 cm plant to plant spacing and 40 cm row to row spacing. Thus two laterals were placed on each raised bed between two rows of cauliflower crop. Channels having 30 cm width were constructed on each ridge bed so that intercultural irrigation and harvesting operation can be done easily without damaging the plants. Drip irrigation system was operated for three hours so that field capacity can be maintained.

Result and discussion:

Comparative performance of drip and check basin irrigation is presented in Table 1. Three years yield data and polled data revealed that highest yield (219.13 q/ha) was obtained in treatment (T3) i.e. drip irrigation system with 30 cm dripper spacing. It was at par with cauliflower yield (209.26 q/ha) obtained in treatment (T2) i.e. drip irrigation with dripper spaced at 40 cm spacing. In conventional check basin irrigation system (T4) the cauliflower yield was found 167.86 q/ha. Cauliflower yield in treatment (T4) was significantly lower than the drip irrigation treatments (T2 and T3). It was obseserved that by application of drip irrigation system 24.66 per cent higher yield can be obtained in comparison to the check basin irrigation system. In drip irrigation treatment, (T2) 48.60 ha-cm water was applied whereas in check basin irrigation treatment (T4) 108.0 ha-cm water was applied. Thus, by applying drip irrigation treatment (T2) 55.18 per water saving was obtained. It can be also observed (Table 1) that drip irrigation treatment (T2) water use efficiency (WUE) was 4.32 q/ha-cm whereas in check basin irrigation treatment (T4) it was 1.55 q/ha-cm. thus, WUE water use ifficiency in check basin irrigation was quite lower than the drip irrigation treatment.

Table: 1 Yield obtained, water applied, water saving and water use efficiency in different treatment.

Treatment	Yield (q/ha)				Water applied (ha-cm)	Water saving (%)	WUE (q/ ha-cm)
	2005-06	2006-07	2006-07	Pooled			
(T1) = 50 cm dripper spacing	160.20	194.00	164.00	172.74	24.20	77.59	7.13
(T2) = 40 cm dripper spacing	197.40	230.40	200.40	209.26	48.40	55.18	4.32
(T3)30 cm dripper spacing	206.20	240.60	210.60	219.13	72.60	32.77	3.02
(T4) = Check basin irrigation	155.00	190.00	158.60	167.86	108.00	-	1.55
SEm±	7.74	8.51	8.57	9.90	-		-
CD at 5 %	23.85	26.25	26.43	28.25	-		-
CV %	9.63	8.91	10.45	-	-		-

It clearly indicates that vegetable contains large amount of water (80 -85 %), thus their yield and quality suffer rapidly under water stress. Cauliflower and most of vegetable are shallow – rooted: a short period of 2-3 days of moisture can reduce their yield. This was in agreement with the finding of Bahdur and Rai (2006). Drip irrigation system always maintains crop rhizosphere almost at field capacity, so crop never experience water stress at any stage.

Table: 2 Comparative cost benefit ratio, labor and fertilizer saving in drip and check basin irrigation system

treatment	Fertilizer applied (kg)	Fertilizer saving (%)	Labour engaged (man-h/ha)	Labour saving (%)	B : C ratio
(T1) = 50 cm dripper spacing	40	46.66	1848	33.04	2.58
(T2) = cm dripper spacing	40	46.66	1848	33.04	3.12
(T3) = 30 cm dripper spacing	40	46.66	1848	33.04	3.27
(T4) =Check basin irrigation	75	46.66	2760	-	2.20

Under fertigation technique in drip irrigation system, the fertilizers were applied directly into plant's root zone through drip irrigation. Besides enhancing the cauliflower yield and WUE the drip irrigation system also saves fertilizer (33.04%). It clearly indicated in table 2 that there is considerable saving (33.04%) in labor as the drip irrigation system needs labour only to start and stop the system. In spite of high installation cost of drip irrigation system (T2) it was found cost effective (B: C ratio 3.12) than the conventional irrigation method (B: C ratio 2.20).

REFERENCES

1.Ahluvalia, M.S. Singh, Baldev and Gill. B.S Gill. (1993). Drip irrigation system: its hydraulic performance and influence on tomato and cauliflower. J. Water Mangt. 1: 6-9. | 2. Bahadur, A. and Singh K.P. (2000).Micro irrigation: A viable option for water economy. Souvenir of AICRP on Vegetable Crops, presented in XIX Group meeting on Vegetable Research., pp 29-31. | 3. Bahadur, A. and Rai Mathura (2006). Use drip irrigation for higher yield in vegetables. Indian Horticulture. May-June: 8-9. | 4. Bafanaa, M. ; Daftadar, S.Y.; Kade, K.K. and R.S. Dhotre. (1993). Utilization of nitrogen and water by tomato under drip irrigation. J. Water Mangt. 1: 1-5. | 5. Mathur, R.P. (2009), Ground water scenario and management challenges Rajasthan, Workshop on Water Scenario, Efficient Use and Management in Rajasthan. Central Ground Water Board, WR, Jaipur13-14 March 2009. pp. 96-101. | 6. Sivanapann, R.K.and Padamkumari O. (1987). Drip Irrigation. Keerthi Pub. House Pvt.Ltd., Coimbatore. | 7. Srinivas, K. (2006). Water Use Efficiency in Horticulture. Souvenir National Symposium on Improving Input Use Efficiency in Horticulture, PP- 5-8. | 8. Yadav K.K. and Singh, P.K. (2008). Ground water recharge through percolation ponds in Rajasthan. Indian Farming. January, 2008, 14-15.

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