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Efficient water management through drip irrigation in wheat

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ABSTRACT

A field experiment was conducted during *Rabi,* 2016-17 to evaluate the "Efficient water management through drip irrigation in wheat". The trial comprised with seven irrigation treatments and four replications in Randomized Block Design. The result revealed that significantly higher grain yield (45.44 q/ha) was recorded through drip scheduled at 1.2 IW: CPE ratio. However, it was statistically at par with the treatments, 80% PE (44.55 q/ha), 100% PE (44.81 q/ha) and 1.0 IW/CPE ratio (42.34 q/ha). Significantly higher biomass yield was found under the treatment 100% PE (90.6 q/ha). The yield attributing characters like, earhead per sq. meter and test weight (g) were reflect significant effect, while, there was no effect of treatments on number of grains per earhead. Significantly higher number of earhead per m^2 (505 Nos.) was recorded under drip irrigation scheduled at 100% PE which was at par with 1.2 IW/CPE ratio (491 Nos.). Due to significant effect of treatments, higher test weight was registered under drip irrigation scheduled at 1.0 IW/CPE ratio (53.48 g). The highest water consumption (420 mm) recorded under check basin treatment, while, the highest water saving (49.38 %) registered under drip irrigation scheduled at 60% PE.

Key words: Drip irrigation, irrigation scheduling, water use efficiency, water saving

Wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.] is the most important staple food crop of the world and emerged as the backbone of India's food security. It is grown all over the world for its wider adaptability and high nutritive value. It is an important winter cereal contributing about 38% of the total food grain production in India. Wheat straw is an important source of fodder for a large animal population in India. In India, wheat is the second most important cereal crop after rice covering an area of 30.79 million hectares. Total annual production of wheat in India is 98.51 million tonnes with the productivity of 3.20 tonnes per hectare during 2017-18 (Anon. 2017-18). India is the second largest wheat producer (approximately 12 per cent world's wheat production) and consumer after China. In Gujarat, wheat is an important *rabi* crop and is grown almost throughout the state with 1.05 million hectares area under cultivation, total production of 3.05 million tonnes and an average yield of 2.89 tonnes per hectare during 2017-18 (Anon. 2017-18).

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Wheat is a high water consuming crop. Water is one of the important and costlier inputs in modern agriculture. It is well established fact that water stress reduces wheat grain yield. In general, water requirement of semi-dwarf wheat varieties is about 45 cm in the form of 4-6 irrigations with a depth of 4-7 cm (Sharma, 2005). In North Gujarat, underground water is the main source of irrigation water which is very costlier and very poor in quality. Due to, Narmada canal, wheat growing area under canal irrigation also have to increase year by year. But, due to higher frequencies as well as over irrigation of underground or canal irrigation, the soil health deteriorates which reflects to decreasing crop productivity and its quality. Wheat production and its quality also affect due to water stress. Therefore, there is a need of efficient utilization of irrigation water through appropriate irrigation method and it's scheduling for achieving higher water and crop productivity. Drip irrigation has proved its superiority in widely spaced crops. Therefore, experiment was planned to check the possibilities of drip irrigation method for efficient water management in closed space wheat crop.

MATERIALS AND METHODS

A field experiment was conducted during the *Rabi,* 2016-17. The experimental soil was sandy loam with pH-7.79, electrical conductivity (EC) 0.36 ds/m, organic carbon 0.33 % with available N (162 Kg/ha), P_2O_5 (37.72 Kg/ha) and K_2O (289 Kg/ha). The experiment was laid out in Randomized Block Design with 7 irrigation treatments in 4 replications. The treatment consists of six irrigation schedules of drip irrigation with one check basin, *i.e*. T_1- 60mm irrigation depth in check basin method, T_2-60% PE, T_3-80% PE, T_4-100% PE, T_5-0.8 IW/CPE (62.5 CPE), T_6- 1.0 IW/CPE (50 CPE) and T_7- 1.2 IW/CPE (41.6 CPE). Application of water was given according to the treatment in which PE basis treatments; water quantity applied in 100% PE treatment is equal to cumulative value (mm) of Pan Evaporation (CPE) of every three days intervals and it was 80% & 60 % for 80% PE and 60% PE, respectively. According to IW/CPE basis irrigation scheduling, irrigation water applied for 50 mm depth when IW/CPE ratio reached at 1.2, 1.0 and 0.8 means when CPE value is 41.6 mm (1.2 IW/CPE), 50 mm (1.0 IW/CPE) and 62.5 mm (0.8 IW/CPE). While in check basin irrigation method, crop was irrigated by 60 mm depth at every critical stage. All other cultivation practices were adopted as per recommendations. There was no rainfall during the crop season. Wheat variety GW 451 sown at 20.0cm spacing between two rows by using 125 kg/ha seed rate and crop fertilized by recommended dose i.e. 120-60-40 kg/ha N-P_2O_5-K_2O, respectively. Sowing was done on 16th November, 2016 and crop harvested on 20th March, 2017. Water use efficiency (WUE) was calculated by dividing grain yield with total irrigation water. The values of "F" was worked out and compared with the values of table F at 5 per cent level of significance. The value of S.Em ±, C.D. and C.V. per cent were also calculated (Cochran and cox, 1967).

Table 1 Yield attributes and yields of wheat as affected by different treatments

Treatments	Plant height (cm)	Earhead/ m^2	Grains/ earhead	Test weight (g)	Yield (q/ha)	Biomass yield (q/ha)	Water used (mm)	% Water saving	WUE (kg/ha/mm)	% increase area irrigation
T_1- 60mm depth check basin	85.3	400	34	47.83	31.11	89.1	420	--	7.41	36
T_2- 60% PE	84.1	433	35	52.48	37.72	85.9	213	49.38	17.74	62
T_3- 80% PE	87.1	470	32	51.00	44.55	73.4	263	37.27	16.91	101
T_4- 100% PE	83.6	505	35	45.38	44.81	90.6	314	25.16	14.26	17
T_5- 0.8 IW/CPE (62.5CPE)	79.8	405	33	52.50	29.33	82.8	260	38.09	11.28	35
T_6- 1.0 IW/CPE (50CPE)	71.5	458	34	53.48	42.34	60.9	310	26.19	13.66	62
T_7- 1.2 IW/CPE (41.6 CPE)	79.3	491	30	50.30	45.44	67.2	360	14.28	12.62	0
CD (0.05)	5.7	40.89	NS	4.45	6.60	12.5	-	-	-	-
S.Em±	1.91	13.76	1.05	1.50	2.22	4.21	-	-	-	-
CV%	4.68	6.09	6.32	5.94	11.30	10.71	-	-	-	-

RESULTS AND DISCUSSION

Grain yield:

Effect of different irrigation methods and its schedules was significant on wheat grain yield (Table 1). Significantly higher grain yield (45.44q/ha) was recorded under drip irrigated at 1.2 IW: CPE ratio, however, it was statistically at par with all drip scheduling irrigation treatments, except 60% PE and 0.8 IW/CPE. The highest grain yield (45.44 q/ha) was recorded under drip irrigation scheduled at 1.2 IW/CPE and it was statistically significantly superior over check basin method (31.11q/ha).

Higher grain yield which was due to the cumulative effect of improvement in growth and yield attributes such as effective tillers m^{-2} and test weight. It was also found due to sufficient moisture in the soil profile under higher irrigation frequency with small quantity of water under drip irrigation which increases the availability of plant nutrients which reflect to more dry matter production. These results are in conformity with the results of Abdelaraouf and Habbasha (2014),Chen *et al*. (2015), Chouhan *et al*. (2015)[b] Chouhan *et al*. (2015)[a] and Dholiya *et al*. (2017).

Biomass yield:

The result revealed that the effect of different methods and schedules was significant on biomass yield of wheat. Significantly higher biomass yield (90.6 q/ha) was recorded when the crop was irrigated through drip at 100% PE, however, it was statistically at par with scheduling drip irrigation at 60% PE and 0.8 IW: CPE as well as check basin irrigation method. The lowest biomass yield (60.9 q/ha) was recorded under drip irrigation scheduling at 1.0 IW: CPE. Higher biomass yield was recorded under the drip irrigation scheduling at 100% PE due to the cumulative effect of better vegetative growth and its attributes. These findings are in agreement with the results of Abdelraouf and Habbasha (2014) Chouhan *et al*. (2015)[b] and Dholiya *et al*. (2017).

Earheads per m^2:

Effect of different irrigation treatments and its scheduling was found significant. Significantly higher number of earheads per m^2 was noted under drip irrigation scheduling at 100% PE (505), though it was at par with 1.2 IW/CPE ratio (491) and 80% PE (470).

Earhead per sq. metre might be increase due to frequent and adequate supply of irrigation water under drip irrigation which creates favorable condition in root zone to supply more nitrogen and phosphorus which increased cell turgidity. The present findings are in closely related with the results of Chouhan *et al*. (2015)[b] and Dholiya *et al*. (2017).

Grains/earhead:

There was no significant effect found on number of grains per earhead under different irrigation methods and its scheduling. Numerically higher number of grains per earhead (35 Nos.) was recorded under drip irrigation scheduling at 60% and 100% PE, while, the lowest at 1.2 IW/CPE (30 Nos.).

1000 grain weight:

Drip irrigation scheduling exerted significant effects on test weight. Drip irrigation scheduling at 1.0 IW/CPE significantly influenced higher test weight (53.48 g), however, it was at par with all drip irrigation scheduling treatment except 100% PE and it was significantly superior over check basin irrigation method (47.83 g).

Under drip irrigation scheduling the crop was irrigated with adequate quantity of water at narrow intervals which provide continuous sufficient soil moisture to the crop which resulted higher photosynthesis at grain filling and development stages and ultimately reflect on higher grain test weight These results are closely accordance with Chouhan *et al*. (2015)[b].

Water used (mm):

Among different treatments, the lowest amount of water used in drip irrigation scheduling at 60% PE (213 mm) while, the highest quantity of water

utilized in check basin irrigation method (420 mm).

% Water saving:

Among different irrigation treatments, maximum water (49.38 %) saving was observed under drip irrigation scheduling at 60% PE (213 mm) as compare to check basin irrigation (420 mm) which should be increased 101 % area under irrigation.

Water use efficiency (kg/ha/mm):

The efficient water utilization by wheat crop was observed under drip irrigation scheduling as compare to the check basin irrigation method. The highest WUE was recorded under drip irrigation scheduling at 60% PE (17.74 kg/ha/mm) which was followed by 80% PE (16.91 kg/ha/mm), 100% PE (14.26 kg/ha/mm) and 1.0 IW/CPE (13.66 kg/ha/mm).

CONCLUSION

A field experiment was conducted to evaluate the response of drip irrigation at different scheduling against check basin irrigation. Drip irrigation increased the plant growth and yield attributes as well as grain and biomass yield of wheat. Based on the results, wheat crop should be irrigated under drip irrigation scheduling at 80% PE for comparatively higher grain yield (44.55 q/ha) and saving irrigation water (37.27 %).

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