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Effect of Sources and Methods of Irrigation on Yield and Water use Efficiency of Okra

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Abstract The objective of this study was to investigate the effect of sources and methods of irrigation on yield and water use efficiency of okra. The trial was conducted during summer 2014. The experiment was laid out in split plot design with four water sources viz. treated wastewater (I_1) , sewage water alternated with fresh water (I_2), fresh water (I_3), untreated sewage water (I_4) as main plots and four subplot treatments viz. ridge and furrow irrigation (M_1), alternatively alternate furrow irrigation (M_2), ridge and furrow at 50% depletion (M_3) and basin irrigation (M_4). M_1, M_2 and M_4 were irrigated at 30% depletion. The results obtained showed the significant impact of sources and methods of irrigation on yield and water use efficiency of okra. Significantly higher green pod yield (5.59 t ha^{-1}) and water use efficiency of okra (1.09 kg/m^3) were recorded when irrigation was scheduled with untreated sewage water which was on par with scheduling irrigation with treated wastewater. Among different methods, ridge and furrow irrigation a 30% depletion recorded significantly higher green pod yield (5.36 t ha^{-1}) and water use efficiency (0.99 kg/m^3) at the final harvest over the other methods. This study implies an advantage of using wastewater and ridge and furrow method of irrigation at 30% depletion in terms of maximum yield and water use efficiency.

Keywords Source, Method, Irrigation, Yield, Water use efficiency.

Introduction

It is the necessity of the present era to think about effective utilization of alternate irrigation water source for fresh water, such as domestic wastewater. Proper knowledge about the quality of water to be used for irrigation, health implications and the level of institutional awareness of wastewater related issues may help to deprive the dependence on fresh water resources in agriculture. Owing to ever increasing population, huge volume of domestic wastewater is being produced in cities. Indiscriminate disposal of such

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Table 1. Pod weight per plant (g), pod weight per plot (kg) and green pod yield (t/ha) of okra as influenced by sources and methods of irrigation. M_1–Ridge and furrow, M_2–Alternatively alternate furrow, M_3–Ridge and furrow at 50% depletion, M_4–Basin irrigation M_1, M_2 and M_4 were irrigated at 30% depletion.

Treatments	Pod weight (g/plant)					Pod weight (kg/plot)					Green pod yield (t/ha)				
	Method (M)					Method (M)					Method (M)				
Source (I)	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
I_1 Treated wastewater	97.85	70.03	86.79	99.39	88.52	10.84	7.54	9.34	10.40	9.53	5.58	3.89	4.82	5.38	4.92
I_2 Sewage water alternated with fresh water	95.17	67.73	79.98	86.56	82.36	9.88	6.94	8.08	8.31	8.30	5.1	3.69	4.15	4.29	4.31
I_3 Fresh water	85.10	60.94	65.39	70.36	70.45	9.53	6.71	7.60	8.59	8.11	4.92	3.46	3.92	4.43	4.18
I_4 Farmer's practice (untreated sewage water)	105.23	92.68	96.92	102.32	99.29	11.33	9.98	10.48	10.97	10.69	5.85	5.47	5.38	5.68	5.59
Mean	95.84	72.85	82.27	89.66	85.16	10.40	7.79	8.88	9.57	9.16	5.36	4.13	4.57	4.94	4.75

For comparing means of	SEm±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
Source of irrigation (I)	3.92	13.54	0.55	1.89	0.27	0.92
Method of irrigation (M)	1.93	5.63	0.21	0.60	0.11	0.33
I at same level of M	3.9	NS	0.41	NS	0.22	NS
I at same or different level of M	5.5	NS	0.72	NS	0.36	NS

water is a cause for pollution of fresh water resources. Adoption of appropriate wastewater treatment measures may help in reducing the excessive nutrient load as well as health risks on consumer and farmer groups.

At the same time it is absolutely necessary to realize that water is a scarce natural resource, although renewable by natural ways. Water use efficiency in general indicates the efficiency of crops in utilizing the water. A crop consuming less water with higher yield is more efficient than crop consuming less water with low yield potentiality with poor water use efficiency. Water use efficiency not only related to water used but also the yield in proportion to water used. Hence, any parameters to achieve higher yield or any parameters that can reduce the water consumption can increase field water use efficiency. At the same time, conservation and effective utilization of available irrigation water has to be taken care to achieve maximum water use efficiency and yield by adopting suitable irrigation methods. In the present investigation, the effect of different sources and methods of irrigation was studied on yield and water use efficiency of okra.

Materials and Methods

A field experiment was undertaken at the Main Agricultural Research Station, Dharwad during summer 2014 to study the effect of sources and methods of irrigation on yield and water use efficiency of okra. The trial was laid out in split plot design with four main plot treatments viz. treated wastewater (I_1), sewage water alternated with fresh water (I_2), fresh water (I_3), untreated sewage water (I_4) and four subplot treatments viz. ridge and furrow irrigation (M_1), alternatively alternate furrow irrigation (M_2), ridge and furrow at 50% depletion (M_3) and basin irrigation (M_4). Irrigation was scheduled based on per cent depletion of soil moisture. Total number of irrigations given was 16 for 30% depletion treatments and 13 for 50% depletion treatment. Irrigation was scheduled each time when soil moisture content was nearer to 17.47 and

Table 2. Water use efficiency (kg/m^3) of okra as influenced by sources and methods of irrigation. M_1–Ridge and furrow, M_2–Alternatively alternate furrow, M_3–Ridge and furrow at 50% depletion, M_4–Basin irrigation. M_1, M_2 and M_4 were irrigated at 30% depletion.

Treatments	Yield(kg/ha)					Amount of water applied (m^3)					Water use efficiency (kg/m^3)				
	Method (M)														
Source (I)	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean	M_1	M_2	M_3	M_4	Mean
I_1 Treated waste-water	5576	3890	4823	5380	4917	5420.40	4240.93	5109.90	5517.93	5072.29	1.04	0.92	0.94	0.98	0.97
I_2 Sewage water alternated with fresh water	5097	3687	4150	4287	4305	5339.80	4321.03	5073.97	5585.53	5080.08	0.99	0.88	0.88	0.86	0.90
I_3 Fresh water	4920	3460	3923	4433	4184	5449.23	4396.87	5077.57	5711.47	5158.79	0.87	0.78	0.72	0.68	0.76
I_4 Farmer's practice (untreated sewage water)	5847	5807	5383	5683	5680	5598.77	4462.00	5054.03	5789.33	5226.03	1.06	1.23	1.07	0.98	1.09
Mean	5360	4211	4570	4946	4772	5452.05	4355.21	5078.87	5651.07	5134.30	0.99	0.95	0.90	0.88	0.93

For comparing means of	SEM±	CD at 5%	SEm±	CD at 5%	SEm±	CD at 5%
Source of irrigation (I)	282.81	978.67	37.75	NS	0.039	0.135
Method of irrigation (M)	119.04	347.48	39.12	114.18	0.029	0.084
I at same level of M	238.09	NS	78.23	NS	0.058	NS
I at same or different level of M	380.04	NS	77.33	NS	0.065	NS

15.27% for the treatments 30 and 50% depletion respectively. Amount of water applied to each okra plots was measured by following volumetric method [1].

Results and Discussion

Sources of irrigation had a significant influence on green pod yield of okra (Table 1). Significantly higher green pod yield (5.59 t ha^{-1}) was recorded when irrigation was scheduled with untreated sewage water. The increase in yield with untreated raw sewage might be obviously due to abundant supply of nutrients and its full pledge use by crop which resulted in manifestation of luxuriant growth and hence crop could put forth its full potential in terms of economic yield [2—5]. However the yield obtained under raw untreated sewage water was on par with that of upon treatment i.e. treated wastewater (4.92 t/ha). Implying that, treated wastewater upon considerable exclusion of nutrient load through macrophyte uptake had an equal potential in manifestation of higher yield comparative with raw sewage. The yield attributes like number of pods (15.09/plant) and pod weight per plant (99.29 g/plant) were significantly higher (Table 1) with the application of untreated sewage water irrigation and was on par with treated wastewater irrigation. The essential macronutrients supplied through wastewater irrigation constituted an increase in number of pods borne per plant and pod weight per plant. Similarly, green pod yield of okra was significantly influenced by methods of irrigation (Table 1). Ridge and furrow irrigation recorded significantly higher green pod yield (5.36 t ha^{-1}) over the other methods [6, 7]. The increase in yield under ridge and furrow irrigation might be due to maintenance of optimum soil moisture at root zone throughout the growing period, which resulted in effective plant water uptake. Proper soil aeration might have promoted the growth of beneficial micro organisms and thereby induced rapid mineralization of organic matter through higher enzymatic activity in rhizosphere which resulted in higher nutrient availability and uptake by plants and thus

the plant growth and yield. The yield attributes like number of pods per plant (15.33/plant) and pod weight (95.84 g/plant) were also significantly higher (Table 1) with ridge and furrow irrigation over other methods. Sources of irrigation did not differ significantly with respect to amount of water applied to okra (Table 2). However, the amount of water applied ranged from 5072.29 m^3 to 5226.03 m^3. Methods of irrigation had significant effect on amount of water applied to okra (Table 2). Basin irrigation recorded significantly higher (5651.07 m^3) amount of water applied over the other methods. Sources of irrigation had a significant influence on water use efficiency at final harvest (Table 2). Significantly higher water use efficiency of okra (1.09 kg/m^3) was recorded when irrigation was given with untreated sewage water over other sources, however was on par with treated wastewater application (0.97 kg/m^3). The increase in the water use efficiency might be due to the higher yield obtained under irrigation with untreated wastewater over the other sources of irrigation. Similarly, methods of irrigation had significant effect on water use efficiency (Table 2). Ridge and furrow irrigation recorded significantly higher water use efficiency (0.99 kg/m^3) at final harvest over the other methods. The increase in water use efficiency under ridge and furrow irrigation might be due to higher yields (Table 1) [8].

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