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RESEARCH PAPER

Studies on surface irrigation methods for sunflower in Dharwad district of Northern Karnataka

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Abstract : Field experiment was conducted to study the response of different methods of surface irrigation for sunflower at water and land management institute campus, Dharwad of Northern Karnataka during 2013-14 to 2015-16. The study revealed that, the increase in grain yield was 12.71 and 9.23 per cent in alternate furrow irrigation and in conventional furrow irrigation, respectively over flooding method of irrigation. The saving in irrigation water was to the extent of 29.60 and 12.12 per cent, respectively in alternate furrow irrigation and conventional furrow irrigation over flooding method of irrigation. The water productivity was 41.59, 30.89 and 25.82 kg/ha-cm in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation, respectively. The increase in water productivity was 60.61 per cent in alternate furrow irrigation over flooding method of irrigation and 19.56 per cent in conventional furrow irrigation as compared with that of surface flooding method. The gross benefit-cost ratios were 2.33, 2.25 and 2.06 in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation, respectively. The increase in net income per ha-cm of water used was 78.35 and 29.23 per cent, respectively in alternate furrow irrigation and in conventional furrow irrigation over flooding method of irrigation.

Key Words : Surface irrigation, Crop response, Water productivity, Benefit-cost ratio, Net profit

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INTRODUCTION

Water is a prime natural resource, a basic human need and precious national asset. In view of its limited supply and increasingly competing demands, it is imperative to use it with utmost efficiency. As a consequence of unscientific use of the limited irrigation potential developed at a huge cost, the productivity, profitability and environmental quality have been affected adversely. The scientific and judicious management of water is essentially needed for increasing and sustaining agricultural production to meet the mounting demands of the fast expanding population. The most critical input happens to be water, which has become scarce. In an effort to make irrigation more efficient to obtain more crops per drop of water, farmers have to adopt alternative improved irrigation methods over conventional flooding method of irrigation. Among all the surface irrigation methods, alternate furrow irrigation for wide spaced crops is an more efficient method to provide irrigation water at the root zone of plants and it permits

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the irrigator to limit the watering closely to the crop water requirements. Bandyopadhyay *et al.* (2010), Playan and Mateos (2006) and Prasad *et al.* (1987), Shaozhong *et al.* (2000) and Yvan *et al.* (1993) reported the benefits of alternate furrow irrigation and conventional furrow irrigation over flooding method of irrigation in terms of crop yield, water saving and water productivity of different crops.

MATERIAL AND METHODS

The study was conducted from 2013-14 to 2015-16 during *Rabi*/summer in Water and Land Management Institute, Dharwad of Northern Karnataka by growing sunflower hybrid Ganga-kaveri as test crop. The area under each treatment was 0.4 ha. The treatments comprising of alternate furrow irrigation [AFI], conventional furrow irrigation [CFI] and flooding method of irrigation [FMI]. Alternate furrow irrigation means one of the two neighbouring furrows were alternately irrigated during consecutive irrigation. In conventional furrow irrigation, every furrow was irrigated during each irrigation.Whereas in case of flooding method of irrigation, water was flooded to the field. The recommended package of practices was followed to all the treatments. The water applied through different methods of irrigation was measured through water meter. The observations were recoded on rainfall, quantity of water applied, plant height, ear head diameter and grain yield. The water productivity, gross benefit: cost ratio, net income, net income per ha-cm of water used and increase in net income per cm of water used over flooding method of irrigation were calculated following standard methods and with the prevailing market rates during the period of study.

RESULTS AND DISCUSSION

The data presented in the Table 1 revealed that the mean plant height of maize was 2.00, 2.05 and 2.08 cm, respectively in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation. The ear head diameter was 15.08, 14.25 and 13.94 cm, respectively in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation. The grain yield of sunflower was 14.66, 14.16 and 12.96 q/ha, respectively in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation. The

Table 1 : Year wise and mean vegetative growth and yield parameters of sunflower as influenced by different methods of surface irrigation

Sr. No.	Parameters	Alternate furrow irrigation				Conventional furrow irrigation				Flooding irrigation			
		2013 - 2014	2014 - 2015	2015 - 2016	Mean	2013 - 2014	2014 - 2015	2015 - 2016	Mean	2013 - 2014	2014 - 2015	2015 - 2016	Mean
1.	Average plant height (m)	2.01	2.03	1.97	2.00	2.05	2.06	2.03	2.05	2.07	2.11	2.05	2.08
2.	Average ear head diameter (cm)	14.95	15.17	15.13	15.08	14.11	14.13	14.50	14.25	13.77	13.95	14.10	13.94
3.	Grain yield (q/ha)	15.37	14.55	14.07	14.66	14.87	13.75	13.85	14.16	13.35	13.01	12.53	12.96
4.	Increase in grain yield over flooding method (%)	14.00	11.84	12.29	12.71	11.39	5.69	10.61	9.23	-	-	-	-

Table 2 : Rainfall, number and depth of irrigation, total water applied and water saving over flooding method of irrigation for sunflower under different methods of surface irrigation

Sr. No.	Parameters	Alternate furrow irrigation				Conventional furrow irrigation				Flooding irrigation			
		2013 - 2014	2014 - 2015	2015 - 2016	Mean	2013 - 2014	2014 - 2015	2015 - 2016	Mean	2013 - 2014	2014 - 2015	2015 - 2016	Mean
1.	Rainfall during cropping period (cm)	3.76	0.22	6.26	3.41	3.76	0.22	6.26	3.41	3.76	0.22	6.26	3.41
2.	Effective rainfall (cm)	3.76	0.00	6.02	3.26	3.76	0.00	6.02	3.26	3.76	0.00	6.02	3.26
3.	Number of irrigations	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
4.	Depth of each irrigation (cm)	4.37	4.73	4.71	4.60	6.05	6.13	6.11	6.10	6.61	6.82	6.75	6.73
5.	Total water applied for irrigation (cm)	30.59	33.11	32.97	32.22	42.35	42.91	42.77	42.68	46.27	47.74	47.25	47.09
6.	Total water applied including effective rainfall (cm)	34.35	33.11	38.99	35.48	46.11	42.91	48.79	45.94	50.03	47.74	53.27	50.35
7.	Saving of irrigation water over flooding (%)	31.34	30.65	26.81	29.60	17.83	10.12	8.41	12.12	-	-	-	-

Table 3 : Grain yield, increase in yield, water productivity, gross benefit cost ratio, net income and net income per ha-mm of water used for sunflower under different methods of surface irrigation

Sr. No.	Parameters	Alternate furrow irrigation				Conventional furrow irrigation				Flooding irrigation			
		2013 - 2014	2014 - 2015	2015 - 2016	Mean	2013 - 2014	2014 - 2015	2015 - 2016	Mean	2013 - 2014	2014 - 2015	2015 - 2016	Mean
1.	Grain yield (q/ha)	15.37	14.55	14.07	14.66	14.87	13.75	13.85	14.16	13.35	13.01	12.53	12.96
2.	Increase in grain yield over flooding method (%)	14.00	11.84	12.29	12.71	11.39	5.69	10.61	9.23	-	-	-	-
3.	Water productivity (kg/ha- cm)	44.75	43.94	36.09	41.59	32.25	32.04	28.39	30.89	26.68	27.25	23.52	25.82
4.	Increase in water productivity over flooding (%)	67.42	60.81	53.61	60.61	20.60	17.22	20.85	19.56	-	-	-	-
5.	Gross benefit:cost ratio	2.42	2.31	2.25	2.33	2.34	2.18	2.22	2.25	2.10	2.07	2.00	2.06
6.	Net income (Rs/ha)	23462	22285	21896	22548	22162	20125	21280	21189	18210	18127	17584	17974
7.	Net income per ha- cm of water used (Rs)	683	673	561	639	481	469	436	462	364	380	330	358
8.	Increase in net profit per ha-mm of water used over flooding (%)	87.64	77.27	70.13	78.35	32.04	23.52	32.13	29.23	-	-	-	-

increase in grain yield in alternate furrow irrigation and conventional furrow irrigation was to the extent of 12.71 and 9.23 per cent, respectively over flooding method of irrigation.

The mean depth of water applied during each irrigation was 4.60, 6.10 and 6.73 cm, respectively in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation.The total irrigation water applied was 32.22, 42.68 and 47.09 cm, respectively in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation. The total water applied including effective rainfall was 35.48, 45.94 and 50.35 cm, respectively in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation. The saving in irrigation water was to the extent of 29.60 and 12.12 per cent, respectively in alternate furrow irrigation and in conventional furrow irrigation over flooding method of irrigation (Table 2).

The water productivity was 41.59, 30.89 and 25.82 kg/ha-cm in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation, respectively. The increase in water productivity was 60.61 per cent in alternate furrow irrigation over flooding method of irrigation and the same was 19.56 per cent in conventional furrow irrigation over flooding method of irrigation. The gross benefit : cost ratios were 2.33, 2.25 and 2.06 in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation, respectively. The net income achieved was Rs. 22548, 21189 and 17974 per hectare in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation, respectively. The net income per ha- cm of water used was Rs. 639, 462 and 358 in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation, respectively. The increase in net income per ha-cm of water used was 78.35 and 29.23 per cent, respectively in alternate furrow irrigation and in conventional furrow irrigation over flooding method of irrigation (Table 3). The similar findings were reported in other crops by Bandyopadhyay *et al.* (2010), Playan and Mateos (2006) and Prasad *et al.* (1987), Shaozhong *et al.* (2000) and Yvan *et al.* (1993).

Conclusion:

Based on three years study it was concluded that, the increase in grain yield was 12.71 per cent and 9.23 per cent in alternate furrow irrigation and in conventional furrow irrigation, respectively over flooding method of irrigation. Considerable saving in irrigation water to the extent of 29.60 and 12.12 per cent, respectively in alternate furrow irrigation and in conventional furrow irrigation over flooding method of irrigation. The increase in water productivity was to the extent of 60.61 per cent in alternate furrow irrigation over flooding method of irrigation and 19.56 per cent in conventional furrow irrigation. The gross benefit cost ratios were 2.33, 2.25 and 2.06 in alternate furrow irrigation, conventional furrow irrigation and flooding method of irrigation respectively.

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