Agriculture Update | February & May 2010 | Vol. 5 | Issue 1 & 2| 132-135 |

RESEARCH ARTICLE

Productivity and economics of cropping sequences under different irrigation methods

N.A. HIRWE AND A.S. JADHAV

See end of the article for authors' affiliations

Correspondence to :
N.A. HIRWE
Department of Agronomy, Shri Shivaji Agriculture College, AMRAVATI (M.S.) INDIA

ABSTRACT

A field experiment was conducted during 2005-06 and 2006-07 at Water Management Project, Mahatma Phule Krishi Vidyapeeth, Rahuri to compare cropping sequences under different methods of irrigation. Drip irrigation method recorded significantly more sugarcane equivalent yield, system productivity, nutrient use productivity, fertilizer use productivity than other irrigation methods. Brinjal-chilli sequence produced significantly more gross and net monetary returns as well as B:C ratio than sugarcane and cotton-beet root sequences. It would be therefore concluded that brinjal-chilli cropping sequence is better cropping sequence than sugarcane under drip irrigation for achieving higher crop productivity and more monetary benefits.

Key words : Irrigation Methods, Cropping sequences, Productivity, Economics

***Accepted :* December, 2009**

INTRODUCTION

Sugarcane accounts for 4 per cent of gross cropped irrigated area in Maharashtra but consumes around 60 per cent of total irrigation (Rath and Mitra, 1986). The continuous monocropping decreases the nutrient availability in the top 15-30 cm surface layer (Kapur, 1994). The advance micro-irrigation methods introduced recently such as drip, micro-sprinkler and irrigation through sub-surface porous pipe increase the productivity of crop and also save water. Cotton is another cash crop which was preferred by the farmers of the region. In view of sharply shooting prices, many farmers are adding vegetables to crop rotations as their water requirement is less (50-90 ha-cm). Due to their diversity and relatively short duration, they can easily be incorporated in many cropping systems. Focusing, the attention on increasing the cropping intensity as well as production per unit area, per unit drop and per unit time is now gaining importance. Change in cropping pattern not only brings change in farming system but also influences social and economical activities of the farmers.

Therefore, the present study was undertaken to compare the productivity and economical feasibility of cropping sequences under different irrigation methods.

METHODOLOGY

The field experiment was conducted during the seasons of 2005-06 and 2006-07 at All India Co-ordinated Research Project on Water Management, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (M.S.). The soil was well drained, clay in texture, low in available N (188.16 kg ha^{-1}) and medium in available P (16.45 kg P_2O_5 ha^{-1}) and very high in available K (720.8 kg K_2O ha^{-1}). The experiment was carried out in strip plot design with three replications. There were total 12 treatment combinations. Four irrigation methods *viz.*, surface, sub-surface irrigation through porous pipe, drip and micro-sprinkler irrigation methods assigned in one strip at east-west direction and three cropping sequences includes suru sugarcane, cotton-beetroot and brinjal-chilli assigned in another strip at north-south direction. Except beetroot, all crops were planted by paired row planting technique of 90-180 cm. For beetroot four row planting technique (45-90 x 10 cm) with BBF was adopted. Recommended fertilizer dose was applied for all crops involved in cropping sequences. The crops were raised with recommended agronomic package of practices.

The yield of cotton-beetroot and brinjal-chilli sequences was converted into sugarcane equivalent yield. Conversion was done into total monetary value. System productivity was computed by formula as suggested by Gangwar *et al*. (2006). Nutrient use productivity and fertilizer use productivity was worked by dividing sugarcane equivalent yield with total quantity of nutrient and fertilizer applied in cropping sequence, respectively. The total quantity of nutrient applied (N + P + K) for sugarcane was 480 kg ha^{-1}, for cotton-beetroot (305 kg ha^{-1}) and brinjal-chilli (400 kg ha^{-1}). The quantities of fertilizer (urea + SSP + MOP) applied for these sequences were 1454, 928 and 1226.5 kg ha^{-1}, respectively. The fertilizer use for nitrogen, phosphorus and potassium were urea, SSP and MOP, respectively for all cropping sequences. Economics was calculated on the basis of market prices of inputs and economical yield produce during the growing season.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented in Table 1, 2 and 3.

Effect of irrigation methods:

The sugarcane equivalent yield was significantly more under drip irrigation (182.77 t ha^{-1}) than surface and sub-surface irrigation method and was at par with micro-sprinkler irrigation methods. A drip irrigation method also recorded significantly higher system productivity (500.50 kg ha^{-1} day), nutrient use productivity (468 kg ha^{-1}), fertilizer use productivity (153.30 kg ha^{-1}) over surface and sub-surface irrigation methods. Drip irrigation might have created an ideal soil-plant-water-microbial relationship which increased use of applied nutrient and reflected in better crop yield and their productivity (Bangar and Chaudhary, 2004).

Surface method recorded significantly the lowest sugarcane equivalent yield, system productivity, nutrient use productivity and fertilizer use productivity mainly due to loss of applied nutrient through leaching and volatilization (Fenn and Kissel, 1973). These results corroborate the findings of Chavai *et al.* (2003)(Table 1).

The adoption of drip irrigation method produced significantly more gross (Rs. 162881 ha^{-1}), net monetary returns (Rs. 90410 ha^{-1}) than surface and sub-surface irrigation methods owing to more crop yield under drip irrigation method. Similar results were reported by Anonymous (2003). Surface irrigation method produced significantly lower gross monetary return than micro-irrigation methods and was at par with sub-surface irrigation method for net monetary return. The benefit cost ratio (2.31) was significantly more under drip irrigation than surface and sub-surface irrigation methods. It was significantly lower under sub-surface irrigation method (1.61) because of higher cost of the system and proportionately lower gross monetary returns (Table 1).

Effect of cropping sequences:

Brinjal-chilli sequence produced significantly more sugarcane equivalent yield (248.59 t ha^{-1}) than sugarcane and cotton-beet root sequence owing to higher biological productivity and more gross monetary return from the

Table 1 : Effect of irrigation methods and cropping sequences on sugarcane equivalent yield, systems productivity, nutrient use productivity, fertilizer use productivity, gross monetary returns, cost of cultivation, net monetary returns and B:C ratio (Pooled data of 2 years)

Treatments	Sugarcane equivalent yield (t ha^{-1})	Systems productivity (kg ha^{-1} day^{-1})	Nutrient use productivity (kg ha^{-1})	Fertilizer use productivity (kg ha^{-1})	Gross monetary returns (Rs ha^{-1})	Cost of cultivation (Rs ha^{-1})	Net monetary returns (Rs ha^{-1})	Benefit : Cost ratio
Irrigation methods								
Surface	132.90	364.17	336.89	112.05	118497	64645	53851	1.94
Subsurface	160.73	440.50	410.83	134.61	144060	88302	55758	1.61
Drip	182.77	500.50	468.00	153.30	162881	72471	90410	2.31
Microsprinkler	169.10	463.00	432.39	141.48	151603	74209	77245	2.13
S.E. $\pm$	5.24	17.50	15.45	3.69	3991	-	5768	0.07
C.D. (P=0.05)	14.60	47.25	42.53	12.12	14810	-	17409	0.21
Cropping sequences								
Sugarcane	128.91	353.00	268.71	88.67	118731	53538	65193	2.35
Cotton-beetroot	106.63	292.13	349.63	114.73	97291	80047	17260	1.22
Brinjal-chilli	248.59	681.00	617.75	202.69	216759	91264	125495	2.42
S.E. $\pm$	12.42	3.90	35.37	9.49	1475	-	5245	0.17
C.D. (P=0.05)	32.99	11.55	93.55	26.08	4109	-	14267	0.54
Interaction								
I x S	Sig.	Sig.	Sig.	Sig.	Sig.	-	Sig.	Sig.
S x I	Sig.	Sig.	Sig.	Sig.	Sig.	-	Sig.	Sig.

former sequence. These results are similar to those reported by Patel *et al.* (2003). Similarly, system productivity was also found to be maximum under brinjal-chilli and sugarcane sequence mainly due to better sugarcane equivalent yield of these sequences. Further, it was observed that, sugarcane recorded significantly the lowest nutrient (268.71 kg ha^{-1}) and fertilizer use productivity (88.67 kg ha^{-1}). Sugarcane consumed the more amount of nutrient and fertilizer followed by brinjal-chilli and cotton-beetroot sequence, but not reflected to them in terms of millable cane yield. Whereas, brinjal-chilli consumed proportionately lower amount of nutrient as well as fertilizer but proportionately produced more sugarcane equivalent yield and nutrient as well as fertilizer use productivity (Table 1).

The gross (Rs. 216759 ha^{-1}) and net monetary returns (Rs. 125495 ha^{-1}) were significantly more under brinjal-chilli sequence because of more biological productivity as well as better market prices. Sugarcane also produced significantly more gross and net monetary returns than cotton-beet root sequence. The benefit cost ratio (2.42) was significantly higher under brinjal-chilli sequence because of higher biological productivity of sequence. Inclusion of vegetables in cropping sequence is always profitable due to their better market prices. These results are inagreement with the findings of Sarkar *et al.* (2004) and Kisanswaroop (2004). The benefit:cost ratio was significantly the lowest under cotton-beet root sequence (1.22) because of lower gross monetary returns and proportionately higher cost of cultivation (Table 1).

Interaction effect:

Brinjal-chilli sequence recorded significantly more sugarcane equivalent yield, system productivity, nutrient use productivity and fertilizer use productivity than sugarcane and cotton-beet root sequence under all irrigation methods. It was mainly due to higher biological productivity as well as better market prices received from former sequence. Further, it was noticed that, micro-irrigation methods recorded significantly more sugarcane equivalent yield and system productivity in sugarcane and brinjal chilli sequence. Drip irrigation method recorded significantly higher nutrient, as well as fertilizer use productivity over surface irrigation method under all the

Table 2 : Sugarcane equivalent yield, systems productivity, nutrient use productivity and fertilizer use productivity as influenced by interaction between irrigation methods and cropping sequences (Pooled data of 2 years)

Treatments	Sugarcane equivalent yield (t ha^{-1})			System productivity (kg ha^{-1} day^{-1})			Nutrient use productivity (kg ha^{-1})			Fertilizer use productivity (kg ha^{-1})		
	Sugarcane	Cotton - Beet root	Brinjal - chilli	Sugarcane	Cotton - Beet root	Brinjal - chilli	Sugarcane	Cotton - Beet root	Brinjal - chilli	Sugarcane	Cotton - Beet root	Brinjal - chilli
Surface	102.98	92.13	203.60	282.00	252.50	558.00	214.67	302.16	493.83	70.82	99.27	166.00
Subsurface	134.70	106.28	241.21	369.00	291.50	661.00	280.83	348.50	603.16	92.65	114.52	196.67
Drip	138.58	116.52	293.20	379.50	319.00	803.00	288.83	382.17	733.00	95.31	125.54	239.06
Micro-sprinkler	139.39	111.57	256.35	381.50	305.50	702.00	290.50	365.67	641.00	95.87	119.56	209.01
Interaction	S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)	
I x S	7.88	25.18		22.86	68.72		24.36	73.91		6.55	20.78	
S x I	7.77	25.04		21.48	68.38		23.84	73.32		5.99	20.70	

Table 3 : Gross monetary returns, net monetary returns and B:C ratio as influenced by interaction between irrigation methods and cropping sequences

Treatments	Gross monetary returns (Rs ha^{-1})			Net monetary returns (Rs ha^{-1})			Benefit : cost ratio		
	Sugarcane	Cotton-Beet root	Brinjal-chilli	Sugarcane	Cotton-beet root	Brinjal-chilli	Sugarcane	Cotton-beet root	Brinjal-chilli
Surface	95218	82318	177955	53176	10088	98292	2.38	1.15	2.28
Subsurface	123635	97708	210838	50518	14113	102644	1.72	1.17	1.95
Drip	126989	106457	255198	785655	25225	167440	2.70	1.31	2.92
Micro-sprinkler	129082	102681	223047	78513	19616	133605	2.62	1.24	2.53
Interaction	S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)		S.E. ±	C.D. (P=0.05)	
I x S	8460	23390		8506	23411		0.08	0.29	
S x I	8626	23988		9304	25644		0.10	0.39	

cropping sequences because of better soil moisture distribution under drip. Brinjal-chilli sequence along with drip irrigation recorded significantly more sugarcane equivalent yield (293.20 t ha^{-1}), system productivity (803.00 kg day^{-1}), nutrient (733.00 kg ha^{-1}) and fertilizer use productivity (239.06 kg ha^{-1}). Therefore, it could be suggested that adopt brinjal-chilli sequence with drip irrigation for better productivity than sugarcane (Table 2).

The brinjal-chilli sequence recorded significantly more gross and net monetary returns under all irrigation methods due to better market prices (Table 3). Cotton-beet root sequence produced significantly lowest net monetary return under all irrigation methods due to higher cost of cultivation. All micro-irrigation methods produced significantly more gross monetary returns under brinjal-chilli and sugarcane, whereas, net monetary return under brinjal-chilli sequence only. Further, it was noticed that benefit-cost ratio was significantly the lowest under cotton-beet root sequence under all irrigation methods. It was mainly due to higher cost of cultivation and lower gross monetary return received by this sequence. However, benefit:cost ratio was at par with sugarcane under all irrigation methods. Significantly the lowest benefit:cost ratio was observed under sub-surface irrigation method in all the cropping sequences due to the highest fixed cost of irrigation methods. Thus, brinjal-chilli sequence under drip irrigation produced significantly more gross (Rs. 255198 ha^{-1}) and net monetary returns (Rs. 167440 ha^{-1}) as well as benefit : cost ratio (2.92) than other interactions which indicated its economical feasibility (Table 3).

Authors' affiliations
A.S. JADHAV, Faculty of Agriculture, Mahatma Phule Krishi Vidyapeeth, Rahuri, AHMEDNAGAR (M.S.) INDIA

REFERENCES

Anonymous (2003). Research report of irrigation water management, Mahatma Phule Krishi Vidyapeeth, Rahuri. pp. AE-16-23.

Bangar, A.R. and Chaudhari, B.C. (2004). Nutrient mobility in soil uptake, quality and yield of *suru* sugarcane as influenced by drip fertigation in medium vertisol. *J. Indian Soc. Soil Sci.,* **2** : 164-171.

Chavai, A.M., Sadaphale, S.S., Bhage, S.B. and Gurav, B.S. (2003). Opinion of drip adopters about nature and extend of benefit due to drip irrigation system used for sugarcane crop. *Co-operative Sugar*, **34** (12) : 961-962.

Fenn, J. and Kissel, S. (1973). Losses of applied nitrogen. *Soil Sci. Soc. America J.,* **37** : 855.

Gangawar, B., Katyal, V. and Anand, K.V. (2006). Stability and efficiency of different cropping system in Western Himalayan region. *Indian J. agric. Sci.,* **76** (2) : 135-139.

Kapur, M.L. (1994). Changes in available phosphorus and potassium after sugarcane and nutrient required for its maintenance. *Indian J. Soc. Soil Sci.,* **42** (2) : 660-662.

Kisanswaroop (2004). Yield and economic of vegetable crop rotation under Island condition. *Orissa J. Hort.,* **32** (1) : 92-94.

Patel, J.S., Patel, R.H., Sadhu, A.C., Meisheri, T.G., Upadhyay, P.N. and Parekh, V.P. (2003). Feasibility and economics of cotton based cropping system. *GAU Res. J.,* **28** (1-2) : 40-43.

Rath, Nilkanta and Mitra, A.K. (1986). Economic utilization of canal water in dry agriculture region. *Indian J. agric. Econ.,* **41** (2) : 131-140.

Sarkar, S.K., Gautam, B., Seethambram, Y. and Vijaya, N. (2004). Effect of intercropping sequence with vegetable in mango orchard under deccan plateau. *Indian J. Hort.,* **61** (2) : 125-127.

****
******