Research Paper Engineering

Potato Crop Performance and Economics Under Various Irrigation Systems

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ABSTRACT

The field experiments were conducted for consecutive two years to assess the crop performance and economics of various irrigation systems for potato crop during winter season (Oct. to Feb). Total five difference irrigation treatments T1,T2,T3,T4 and T5 were selected.(where T1= Drip(0.8 PEF) with lateral in each row, T2 = Drip (0.8 PEF) with lateral in each pair, T3= Irrigation through perforated pipe , T4= Irrigation through micro-sprinkler at 1.0 IW/CPE ratio (40 mm) and T5= Furrow irrigation at 0.8 IW/CPE ratio(60mmdepth).A distinct increase tubers yield (Table:1) was observed with T1(424.12 Q/ha)(Drip each row) and T2 (406.75 Q/ha) (Drip each pair) during both the years and in pooled data. The increase in number of tubers/ plant under treatment T1 and T2 over T5 (331.65 Q/ha) (furrow method) was to the tune of 26.91% and 21.10%, respectively, on pooled data basis. Irrigation through perforated pipes (T3) achieved the lowest water use efficiency (77.38 kg/ha-mm). Irrigation through T1 (146.25 kg/ha-mm) and T2 (140.26 kg/ha-mm) achieved the highest water use efficiency compare to other irrigation treatment. Irrigation through perforated pipes (T3) achieved the lowest Benefit cost ratio (1.31). Irrigation through T2 (1.64) achieved the highest Benefit cost ratios compare to other irrigation treatment.

Keywords : Various irrigation system for Potato crop, water use efficiency, benefit cost ratio

INTRODUCTION

During the winter season, there is a higher yield potential of Potato in region of North Gujarat State. However, the biggest constraint is the limited water resources. One of the critical challenges to water resources management is to shift from the extensive supply oriented approach to the one focusing upon deficit applications (stegman et al. 1980) there are several ways of increasing efficiency in irrigation. One way is changing from surface to pressurized methods of irrigation and second is to apply deficit water. The extent to second is to apply deficit irrigation is to increase the water use efficiency of a crop by eliminating irrigations that have little impact of yield. The resulting yield reduction may be small compared with the benefits gained through diverting the saved water to irrigate additional area or other crops for which water would normally be insufficient under traditional practices. Before implementing a deficit irrigation programme, it is necessary to know crop yield responses to water applications.

OBJECTIVE

To compare the production of tuber yield, water use efficiency and benefit cost ratio obtained under various irrigation systems for potato crop

STUDY AREA AND METHODOLOGY:

Study area: The study was carried out at Dehgam taluka, dist-Gandhinagar, north Gujarat region, India to assess the Potato crop performance under various irrigation systems during winter season (Oct. to Feb) for consecutive 2 years. The potato variety selected for the present investigation was Kennebec. The row lateral spacing (T1=45cm T2=90cm, T3=90cm and T4=3m), seed rate (3000kg/ha) and fertilizer rate were kept as F: 75 % Recommended dose of N &K kg/ha for this region. The water meters were used to measure the volume of water applications. Dripper discharge T1&T2= 8lph, T4= 47lph and T3 =discharged measured by water meter .Dripper distance T1&T2= 50cm.The inlet of the drip line was fitted with sub main by the 16mm grommet take off. The other end of the drip line was closed by the end plug of 16mm.

Economics:

The cost of cultivation excluding cost of irrigation included cost of various inputs like cost towards land preparation, seeds, seed treatment, fertilizer, sowing, agro chemicals, weeding, inter culturing, harvesting, threshing, cleaning and packing etc. The cost of seeds, fertilizer and agro chemicals were taken following the recommended package of agronomic practices. The cost of irrigation includes the cost of labour, electricity and maintenance required for the irrigation application. The fixed cost included the cost of pumping/delivery and irrigation system. It was assumed that the 7.5 HP pumping system can serve 6 ha area (4ha/season, 2 season/year) for 15 years as per USDA. Also, it was assumed that the irrigation system could be useful for 2 seasons per year. The life of the drip irrigation system was taken as 10 years. Formula for calculating Annual cost for irrigation methods

$$CRF = \frac{I\,(1 + I)\,n}{(1 + I)\,n - 1} = X$$

Where CRF = Cost Recovery Factor
I = Interest rate =12%, n = Life of set,
Annual cost(Y)
=X x Total cost of drip / sprinkler /perforated set,
Seasonal cost = Y/3

RESULTS AND DISCUSSION:

Crop Performance:

The data as presented in Table-1 indicated that, during the first year, the highest yield of 428.09 Q/ha was under treatment of T1 using seasonal water of 290 mm and lowest yield

of 321.66 Q/ha was under treatment of T5 using seasonal water 290mm. However, during the second year, the highest pod yield of 420.17 Q/ha was observed in the treatment of T1 using seasonal water 290mm and lowest yield of 341.63 Q/ha was under treatment of T5 using seasonal water 290mm.

Shown Table-1 Total quantity of irrigation water applied in mm, potato yield in Q/ha and water use efficiency obtained under different irrigation treatment.

Looking to the performance of different irrigation methods on water use efficiency Table-1., spectacular increase has been observed with T1 (Drip each row) followed by T2 (Drip each pair) over the traditional furrow method (T5). Irrigation through perforated pipes (T3) achieved the lowest water use efficiency (77.38 kg/ha-mm). Though micro-sprinkler (T4) performed better than perforated pipes (T3) but inferior to the traditional furrow method. Thus drip has proved its superiority computing the highest water use efficiency (146.25 kg/ha-mm). Thereby increase in yield over other methods. Achievement of maximum yield with minimum water use has led to higher water use efficiency. These results are in accordance with Awari and Hiwase (1994), singh (2006), Patel and Patel (2001), Pawar et al., (2002) and Sasani et al., (2006).

CROP RESPONSE MODELS:

The knowledge of crop yield response to water inputs is highly desirable to make sound irrigation management decisions. The following crop response models could be developed using the observed data for this region.

Economics:

In order to evaluate effectiveness of the treatments, the relative economics of each treatment was worked out for net profit, so that the most effective and remunerative treatment combination could be found out.

The gross realization in terms of rupees/hectare was calculated from the realization received from tuber yield at the prevailing market price during each year. The cost of cultivation was worked out considering the cost of all operations right from the preparation of land to the harvesting of the crop and cost of all inputs involved .The net realization was worked out by deducting the total cost of cultivation from the gross realization for each treatment combination.

The BCR was calculated as:

BCR= Total income (Rs/ha)
Total expenditure (Rs/ha)

Mean realization, average cost of production, and benefit: cost ratio as influenced by different irrigation treatment (methods). (On Pooled data basis) shown in Table- 2

Table: 1 Total quantity of irrigation water (mm), Potato yield in Q/ha and water use efficiency obtained under different irrigation treatment.

Treatment	Total quantity of irrigation water(mm)			Potato yield ,Q/ha			Water use efficiency kg/ha-mm		
	1st year	2nd year	Average	1st year	2nd year	Average	1st year	2nd year	Average
T_1	290	290	290	428.09	420.17	424.12	147.61	144.88	146.25
T_2	290	290	290	405.90	407.60	406.75	139.97	140.55	140.26
T_3	429	432	430.5	323.48	345.13	334.30	74.88	79.89	77.38
T_4	370	370	370	326.89	352.91	339.90	88.35	95.38	91.87
T_5	290	290	290	321.66	341.63	331.65	110.92	117.80	114.36

Table :2 Mean realization, average cost of production, and benefit : cost ratio

Treatments	Tuber yield Q/ha	Potato selling prize Rs/kg	Average cost Rs/ha	Mean realization Rs/ha		Benefit cost ratio
				Gross	Net	
T_1	424.12	2.9	83,590	1,22,995	39,407	1.47
T_2	406.75	2.9	71,657	1,17,958	46,301	1.64
T_3	334.30	2.9	73,843	96,947	23,104	1.31
T_4	339.90	2.9	65,400	98,571	33,171	1.51
T_5	331.65	2.9	63,256	96,179	32,923	1.52

Economic viability

The acceptance of improved production technology involving costly inputs like drip irrigation sets, mini sprinkler sets, perforated pipe set, and fertilizers for potato crop by farmers depends on the economic returns from the inputs used.

In the study, among various methods of irrigations, T2 (Drip each pair) ranked top accruing the highest net return of Rs. 46,301 ha-1 followed by T1 (Drip each row) (Rs. 39,407 ha-1). Among rest of the methods, T4 (Micro-sprinkler) ranked third in terms of net return (Rs. 33,171 ha-1). Perforated pipe method I3 realized the lowest net return of Rs. 23,104 ha-1. Whereas furrow method achieved net return of Rs. 32,923 Rs. ha-1. (Table: 2).This indicates that the net realization was increased under drip methods of irrigations via; T1 (Drip each row) and T2 (Drip each pair). Similar findings have been reported by Ahire et al., (2002) and Singh (2002).

The highest BCR of 1.64 was obtained under irrigation method T2 (Drip each pair). Denis and Kumar (2007) also observed highest benefit cost ratio with drip irrigation.

CONCLUSIONS:

A distinct increase tubers yield (Table: 1) was observed with T1 (424.12 Q/ha) (Drip each row) and T2 (406.75 Q/ha) (Drip each pair) during both the years and in pooled data. Irrigation through T1 (Drip each row) (146.25 kg/ha-mm) and T2 (Drip each pair) (140.26 kg/ha-mm) achieved the highest water use efficiency compare to other irrigation treatment in this zone. Irrigation through perforated pipes (T3) achieved the lowest Benefit cost ratio (1.31). Irrigation through T2 (1.64) achieved the highest Benefit cost ratio (Table: 2) compare to other irrigation treatment.

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