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Economics of Growing Okra under Drip Fertigation

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Abstract

Objective: To study the economic viability of Okra crop grown under different drip fertigation levels and different drip irrigation subsidy percentages. **Methods:** The field experiment was done at the research farm of department of Soil and Water Engineering, PAU, Ludhiana, India during 2014-15. The Nine drip fertigation treatments consisted of T_1 - 60% fertilizer Nitrogen (N) with irrigation applied at 0.60 IW/CPE (irrigation water/cumulative pan evaporation) ratio, T_2 - 60% fertilizer (N) with 0.80 IW/CPE ratio, T_3 - 60% N with 1.00 IW/CPE ratio, T_4 - 80% N with 0.60 IW/CPE ratio, T_5 - 80% N with 0.80 IW/CPE ratio, T_6 - 80% N with 1.00 IW/CPE ratio, T_7 - 100% N with 0.60 IW/CPE ratio, T_8 - 100% N with 0.80 IW/CPE ratio and T_9 - 100% N with 1.00 IW/CPE ratio. Economical viability of drip fertigation was evaluated by computing Benefit-Cost ratio (B/C ratio) for each of drip fertigation treatment obtained by dividing gross returns by total seasonal cost. Economic analysis was done as per the cost involved in drip irrigation system components and requirement of fertilizer for one hectare area. The seasonal cost of growing okra under drip fertigation was calculated by considering depreciation, life of components, interest, fertilizers, insecticide, labors and cost of cultivation of growing Okra. **Findings:** In case of no drip irrigation subsidy, 60% drip irrigation subsidy and 75% drip irrigation subsidy, maximum B/C ratio was obtained in T_5 treatment (2.25), (2.82) and (3.01) respectively; while minimum B/C ratio was obtained in T_1 treatment (1.52), (1.9) and (2.03), respectively. The statistical analysis revealed that combination of fertilizers and irrigation levels had significant effect on B/C ratio of Okra production. **Conclusion:** It is economically viable to grow okra under drip fertigation with 80% fertilizer (N) along with irrigation applied at 0.80 IW/CPE ratio, only if drip irrigation subsidy provided by the government is higher than 30%.

Keywords: Benefit-Cost Ratio, Drip Fertigation, Economic Viability, Okra, Subsidy

1. Introduction

Vegetables constitute an important part of daily human diet by providing vital nutritional elements to the food. Okra is a vegetable crop that belongs to the genus *Abelmoschus*, family *Malvaceae*. Okra is a crop which requires a long warm and humid growing season. Okra can be grown in all types of soils, but the soil should be friable. However, it grows best in light soils ranging from sandy loam to loam. Okra can tolerate slightly acidic soil condition (pH 6.8 to 6.0)[1]. Water is most important input in an assured vegetable production system, especially in areas where vegetable production lacks due to scarcity and or irregular distribution of rainfall specially from mid March to end of June (before the onset of monsoon).

Drip irrigation is the method of irrigation in which water is supplied to crop root zone at regulated rate and in addition fertilizer application can also be done along with irrigation which is called drip fertigation. Possibility of substantial fertilizer saving of 50 percent for okra under drip fertigation method in comparison to traditional method was reportred[2]. By minimizing fertilizer and water losses it gives economic benefit to the crop grower. The main disadvantage of drip irrigation system is its high initial cost. To reduce the burden on farmers, the government (state and central) provides financial subsidy[3]. Lack of knowledge and delays in getting subsidies are the other important factors for the non adoption of the drip irrigation[4]. Adoption of drip irrigation requires appropriate economic incentives to farmers', changes in

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the structure of production costs and increased value of production to achieve desired economic benefits[5]. Drip irrigation was reported to have the highest benefit-cost ratio[6]. A benefit cost ratio of 3.05 was reported for drip irrigated sweet pepper under low tunnels[7]. The problems faced by farmers to obtain financial support from government were highlighted and the economic appraisal of drip irrigation system for grapes was suggested as it can lead to high dividends[8]. Since, there is limited research work carried out on Okra crop grown under drip fertigation. Hence, the present study was undertaken.

2. Materials and Methods

To study the economic viability of Okra crop grown under drip fertigation an experiment was done at the research farm of department of Soil and Water Engineering, PAU, Ludhiana, India during year 2014–15. Ludhiana city is exposed to semi–arid and sub-tropical climatic conditions comprising three seasons; summer, monsoon and winter. The average annual rainfall of the area is 680 mm most of which is received during the monsoon season. Soil texture of the experimental area was sandy loam. The initial soil fertility conditions were determined by collecting soil samples from different locations of entire experimental area. All fertility parameters were found to be in optimum range but nitrogen level was lower. The treatments in the present study consisted of nine combination treatments of three fertilizer doses of recommended fertilizers (N) and three irrigation treatments based on IW/CPE ratio. Hence, the overall drip fertigation treatments of the experiment are as presented in Table 1.

In addition to above there was a control treatment with 100% dose of conventional fertilizer (N) under furrow irrigation method[9].

The experimental design was split plot design with three replications for each drip fertigation treatment. Farm operations such as well rotten farm yard manure incorporation with soil, tillage operation, planking and then levelling was done for preparing land. For the control treatments furrows and ridges were prepared with 45 cm ridge spacing. Then the treatment plots were demarcated. Seeds of okra (variety 'Punjab-8') were soaked in water for 24 hours and after that good quality seeds out of pre-soaked okra seeds were sown with row to row spacing of 34cm and plant to plant spacing of 20cm. For the control treatment, the seeds were sown on ridges with 45 cm X 15 cm spacing. Basic field operations such as hoeing of weeds, insecticide spraying as per the university recommendations[9] were performed at experimental site for ensuring proper growth.

Table 1. Details of treatments under drip fertigation

Sl. No.	Treatment	Description
1	T_1	60% N with 0.60 IW/CPE ratio drip fertigation
2	T_2	60% N with 0.80 IW/CPE ratio drip fertigation
3	T_3	60% N with 1.00 IW/CPE ratio drip fetrigation
4	T_4	80% N with 0.60 IW/CPE ratio drip fertigation
5	T_5	80% N with 0.80 IW/CPE ratio drip fertigation
6	T_6	80% N with 1.00 IW/CPE ratio drip fertigation
7	T_7	100% N with 0.60 IW/CPE ratio drip fertigation
8	T_8	100% N with 0.80 IW/CPE ratio drip fertigation
9	T_9	100% N with 1.00 IW/CPE ratio drip fertigation

The drip irrigation system was installed on the experimental area. The drip irrigation system consisted of water source, pumping unit, filters, pressure regulators, main lines, sub-main lines, fertilizer application setup, valves, tees, bends, laterals with inline emitters and end cap. For the experimental treatments, three fertilizer doses- 120 $kgha^{-1}$ of urea,160 $kgha^{-1}$ of urea, 200 $kgha^{-1}$of urea was used in drip fertigation and for control, urea was applied as per requirement of okra grown by conventional method as recommended by PAU, Ludhiana i.e., 200 $kgha^{-1}$ of urea[9]. First picking of okra was done in third week of May, while the last picking was done at the end July during the crop growing period (2014–15). The total weight of okra obtained for each treatment was used to compute yield (tha^{-1}) for each treatment.

Economic analysis was done as per the cost involved in drip irrigation system components and requirement of fertilizer for one hectare area. The seasonal cost of growing okra under drip fertigation was calculated by considering depreciation, life of components, seasonal interest, fertilizers, insecticide, labors and cost of cultivation of growing okra. Cost of cultivation of Okra is as shown in Table 2.

For the initial drip irrigation system cost, details of materials required along with its cost (obtained from

Table 2. Conventional cultivation cost (2014-15)

Sl. No.	Items	Rate	Quantity	Unit	Cost (INR)
1	Seed(g)	200	25	Kg	5000
2	Seed treatment	0	0		0
3	Manure and fertilizers				
	a) Urea	576	2	Quintal	1152
	b) FYM	130	50	Tonne	6500
4	Hoeing(No.)	2750	4	Number	11000
5	Irrigation (No.)	97	11	number	1067
6	Weedicide/ pesticide/fungicide				
	a)Coinfidore	2100	1	number	2100
7	Labour (hours)	35	750	Hr	26250
8	Tractors (hours)	375	8	Hr	3000
9	Marketing and transportation charges	1432	2.5	conversion factor	3580
10	Sub-total				59649
11	Interest @ 9 p.a				1342.103
12	Total cash variable expenses (10+11)				60991.1

national market in 2014–15) for one hectare land for the cultivation of Okra with drip irrigation system is shown in Table 3.

For seasonal cost of drip irrigation system, working life of drip irrigation components i.e., main line, sub main, fertilizer tank, venturi assembly and filters was considered as 12 years and for laterals with inline emitters considered working life was 5 years. Drip irrigation cost was calculated by considering no subsidy, 60% subsidy and 75 % subsidy. Economic viability of drip fertigation was evaluated by computing B/C ratio for each of drip fertigation treatment obtained by dividing gross returns by total seasonal cost. The results were also compared with B/C ratio of conventional method. The B/C ratio computed was statistically analyzed using analysis of variance (ANOVA) techniques, with at 5% level of significance.

Table 3. Drip system requirement for Okra cultivation in 1 hectare area

Item	Quantity	Number	Rate	Cost (Rs.)
90mm pvc pipes for sub-main line (4kg/cm^2)	Number	17	406	6902
90mm pvc pipes for main line (4kg/cm^2)	Number	17	406	6902
Sand filter (40m^3/hr)	Number	1	24720	24720
Screen filter (40m^3/hr)	Number	1	5402	5402
venturi (1.5’)	Number	1	3408	3408
Ball valve (Control valve)	Number	2	460	920
Air release valve	Number	1	518.93	518.93
Bye-pass assembly	Number	1	492.96	492.96
Non-return valve	Number	1	279.12	279.12
Flush valve	Number	2	119.9	239.8
Plain laterals of 12mm diameter	m	100	8.7	870
Grommet	Number	294	2.55	749.7
Take off	Number	294	2.55	749.7
inline lateral of 12mm diamter, Discharge=1.3lph, emitter size=0.3mm	m	14705	15	220575
Joiner	Number	600	2.7	1620
end cap 8 shape	Number	294	2.25	661.5
Fitting & Accessories 5% of total system cost				12527.82
5 Hp Pump (no subsidy available)	5hp	1	25000	25000
Total				312538.5

3. Results and Discussion

Results of the yield obtained under different drip fertigation treatments are presented in Table 4. From this, it is clear that maximum average okra yield was obtained in T_5 treatment (15.89 tha^{-1}) followed by T_8 (15.38 tha^{-1}) treatment, both of these are statistically at par with each other but superior to all other treatments. Average okra yield under control treatment was 11.4 tha^{-1}. The best drip fertigation treatment (T_5) in terms of okra yield showed increase of 39.39% in comparison to control treatment. The reason for obtaining such results may be due to reduced nutrient losses and water stress due to drip fertigation. The similar types of results showing increase in yield were reported by[10–16].

The gross returns were computed by multiplying average market rate of Okra during the crop harvesting period with the yield obtained and is presented in Table 4 for different treatments. The Seasonal gross expenditure incurred during the production of drip fertigated Okra under different treatment is also presented in Table 4 considering no drip irrigation subsidy, 60% drip irrigation subsidy and 75% drip irrigation subsidy. The different percentage of subsidy was taken as the state and central government provides different percentage of incentives for promotion of drip irrigation which is varying from region to region. The B/C ratios computed for all treatments and at different percentages of drip subsidy are presented in Table 4. B/C ratio under control treatment was 2.53. In case of no subsidy, under drip fertigation combination treatments, maximum B/C ratio was obtained in T_5 treatment (2.25) which also recorded maximum yield, whereas minimum B/C ratio was obtained in T_1 treatment (1.52). In case of 60% drip irrigation subsidy, maximum B/C ratio was obtained in T_5 treatment (2.82), whereas minimum B/C was obtained in T_1 treatment (1.9). While for 75% drip irrigation subsidy, maximum B/C ratio was obtained in T_5 treatment (3.01), whereas minimum B/C ratio was obtained in T_1 treatment (2.03). The combination of fertilizer and irrigation levels had significant effect on B/C ratio. The results obtained in Table 4 are in similar trends with results reported by[17–21]. The subsidy and technical support to farmers acts as an incentive to adopt this method on a large scale in India[22].

Effect of variation in subsidy percentage on B/C ratio of best treatment T_5 in comparison to control is illustrated in Figure 1. It is clear from Figure 1 that with increase in subsidy percentage B/C ratio is also increases. Around 30% drip irrigation subsidy level the value of B/C ratio of best drip

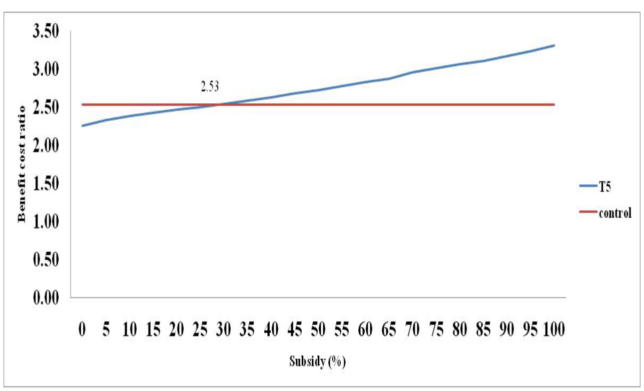

Figure 1. Effect of subsidy percentage variation on B/C ratio of okra crop.

Table 4. B/C ratios for different treatments

Treatments	Yield (tha^{-1})	(no subsidy) Gross return (INR)	Gross expenditure (INR)	Benefit cost ratio	(60% subsidy) Gross return (INR)	Gross expenditure (INR)	Benefit cost ratio	(75% subsidy) Gross return (INR)	Gross expenditure(INR)	Benefit cost ratio
T_1	10.68	144607	95512	1.51	144607	76121	1.9	144607	71273	2.03
T_2	12.44	168438	95512	1.76	168438	76121	2.21	168438	71273	2.36
T_3	12.03	162886	95512	1.71	162886	76121	2.14	162886	71273	2.29
T_4	12.16	164646	95742	1.72	164646	76351	2.16	164646	71503	2.3
T_5	15.89	215151	95742	2.25	215151	76351	2.82	215151	71503	3.01
T_6	14.32	193893	95742	2.03	193893	76351	2.54	193893	71503	2.71
T_7	12.75	172635	95972	1.8	172635	76581	2.25	172635	71733	2.41
T_8	15.38	208245	95972	2.17	208245	76581	2.72	208245	71733	2.9
T_9	15.02	203371	95972	2.12	203371	76581	2.66	203371	71733	2.84
CD (5%)		0.114			0.145			0.152		
Control	11.4	154356	60991	2.53						

fertigation treatment is approximately same as that of B/C ratio of control (2.53). For achieving maximum B/C ratio maximum subsidy should be provided by the government.

4. Conclusion

Maximum B/C ratio with drip irrigation subsidy of 75% was in T_5 treatment (3.01) and minimum in T_1 treatment (2.03). For okra production under traditional method B/C ratio was 2.53. The combination of fertilizers and irrigation levels had significant effect on B/C ratio. It was also observed that below 30% of drip irrigation subsidy it is uneconomical to grow Okra with drip fertigation.

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