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A Comparative Studies Between Drip Irrigation and Furrow Irrigation for Sugarcane and Banana in a Region Navsari

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ABSTRACT

This paper deals with the practices of comparative studies between Drip and Furroowirrigation system in Navsari. Drip irrigation is one of the important area which affects the livelihood of farmers directly. The drip irrigation helps to save the water and increase the productivity of crop. Drip and flood irrigation are two controlled system while flood irrigation uses gravity to water use efficiency (kg/ha-mm) in sugarcane and banana, To find out yield increased of improved practice over conventional practice for sugarcane and banana, To find out the economics (Rs/ha) under diferent treatment combinations and To estimate the electricity saving due drip method of irrigation in different crops.

KEYWORDS: Drip irrigation, Furrow (surface) irrigation, sugarcane, bananaa

❖ INTRODUCTION

Drip irrigation, also known as trickle irrigation or micro irrigation or localized irrigation, is an irrigation method that saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone through a network of valves, pipes, tubing, and emitters.

Furrow irrigation is defined as the group of application techniques where water is applied and distributed over the soil surface by gravity.

Sugarcane is an important crop in India. There are 35 million farmers growing sugarcane and another 50 million depend on employment generated by the 571 sugar factories and other related industries using sugar. In Uttar Pradesh, Maharashtra and Tamil Nadu, sugarcane plays a major role in the state economy.

Banna are the fourth most important food crop in the world after Rice, Wheat and Maize.

HISTORY AND PRESENT TRENDS OF DRIP IRRIGATION

Head irrigation has been used since ancient times, when buried clay pots were filled with water, which would gradually seep into the grass. Modern drip irrigation began its development in Afghanistan in 1866 when researchers began experimenting with irrigation using clay pipe to create combination irrigation and drainage systems.

Subsurface drip irrigation (SDI) uses permanently or temporarily buried dripperline or drip tape located at or below. It is becoming popular for row crop irrigation, especially in areas where water-supplies are limited or recycled water is used for irrigation

➢ Cropping Pattern

Multiplicity of cropping systems has been one of main features of Indian agriculture and it is attributed to rainfed agriculture and prevailing socio-economic situations of farming community.

It has been estimated that more than 250 double cropping systems are followed throughout the country and based on rationale of spread of crops in each district in the country, 30 important cropping systems have been identified.

➢ Prevalent Cropping System

Multiplicity of cropping systems has been one of the main features of Indian agriculture. This may be attributed to following two major factors:

Rainfed agriculture still accounts for over 92.8 million hectare or 65 per cent of cropped area. A large diversity of cropping systems exists under rainfed and dryland areas with an over riding practice of intercropping, due to greater risks involved in cultivating larger area under a particular crop.

One of the typical characteristics of subsistence farming is that most of the farmers resort to grow a number of crops on their farm holdings, primarily to fulfill their household needs and follow the practice of rotating a particular crop combination over a period of 3-4 years interchangeably on different farm fields.

➢ Patterns of crop diversification in Indian scenario

India is a country of about one billion people. More than 70 percent of India's population lives in rural areas where the main occupation is agriculture. Indian agriculture is characterized by small farm holdings.

Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lesson risk Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative cops to more remunerative crops.

➢ WORKING OF DRIP IRRIGATION SYSTEM

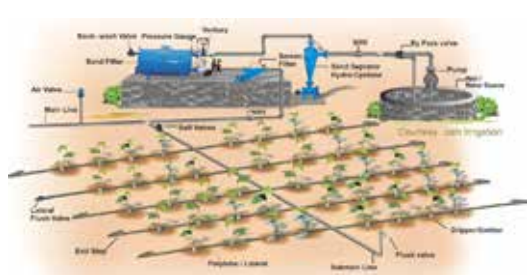

Fig. 1.1 Sketchamatic diagram of working of Drip irrigation system

➢ OBJECTIVES

1. To find out the water use efficiency (kg/ha-mm) and in sugarcane and banana.
2. To find out yield increased of improved practice over conventional

practice for sugarcane and banana.
3. To find out the economics (Rs/ha) under diferent treatment combinations.
4. To estimate the electricity saving due to drip method of irrigation in different crops

➢ **STUDY AREA**

The study area is situated in the navsari district of Gujarat state. The State of Gujarat lies between 21°70'and 20°45'N Latitudes and 73°24'and 73°07'North Longitude. It has long coast lines of approximately 600 km.

➢ **GEOGRAPHY**

Navsari is located at 20.95°N 72.93°E. It has an average elevation of 9m (29') above sea level. Weather in Navsari is sunny from September to May, rainy from June to August. The average maximum and minimum temperatures are 40 °C (104 °F) and 18 °C (64 °F) respectively. The average annual rainfall is 122 cm (48 in).

The soil of the region is black.

❖ **METHODOLOGY**

➢ **CULTURABLE OPERATIONS**

➢ **Preparation of land**

The experimental field was cross-cultivated by tractor drawn cultivator. Stubbles of previous crop were collected and removed from the field. Planking was done in both the directions to develop a fine tilth. The layout of experiment was done as per design employed.

➢ **Fertilizer application**

Furrows were opened manually in each plot keeping spacing as per treatment between two rows.

Required quality of nitrogen and phosphorus were weighed separately for each treatment and were placed in the respective plots about 5 to 6 cm deep.

A basal does of 40% nitrogen and 100% phosphrous as a basal dose were applied in spot application and fertigation treatment respectively.

Nitrogen was applied in the form of urea, whereas, phosphorus was applied in the form of single super phosphate.

➢ **Top dressing**

The crop was fertilized with the full dose of phosphate.

In fertigation 40% nitrogen was applied as a basal dose and remaining 60% nitrogen was applied in a four equal splits each at a one month interval.

While in spot application (control) treatment 50% nitrogen was applied as a basal dose and remaining 50% nitrogen in two equal splits at two months interval.

Installation of drip unit

A head unit connected to main water supply, which includes control valves, filters, pressure gauge etc Fertilizer tank connected with the system before filter unit Main and sub main lines of PVC having 75 and 63 mm diameter, respectively.

Lateral pipes having 16 mm diameter and dripper having capacity of 4 lph.

For sugarcane, the planting was done in paired row i.e. 60*60*120 cm., while banana was planted at 2.4*1.2 m row spacing and lateral was laid at 2.4 m spacing.

➢ **Irrigation**

The well water of good quality was used for irrigation the crop.

The drip irrigation treatment were given at an alternate days based on fraction of pan evaporation of two day.

Daily pan evaporation measured with the help of open pan evaporimeter installed in the plot.

The first irrigation (60 mm) was given just after planting and after a week light irrigation was applied for uniform germination and crop establishment.

Surface irrigation was applied when cumulative pan evaporation reached 60 mm and the depth of each irrigation was 60 mm.

Field water use efficiency(kg/ha-mm):-

The field water use efficincy was calculated by using following formula as suggested by Michael(1978)

The values are presented in the below table.

$$\text{Field water use efficiency}\left(\frac{\text{kg}}{\text{ha}}\text{mm}\right) = \frac{\text{yield}\left(\frac{\text{kg}}{\text{ha}}\right)}{\text{Total water applied (mm)}}$$

The gross realization in terms of rupees per hectare was calculated from the realization received from cane or fruit yields at the prevailing market price during the course of investigation.

The cost of cultivation was worked out considering the cost of all operations right from the cost of all inputs involved.

The net realization was worked out by deducting the total cost of cultivation from the gross realization per hectare for each treatment combinations and record accordingly.

The CBR was calculated on the basis of formula given below:

$$\text{CBR} = \frac{\text{Total income}\left(\frac{\text{Rs.}}{\text{ha}}\right)}{\text{Total expenditure}\left(\frac{\text{Rs.}}{\text{ha}}\right)}$$

Experiment Set up:

The experiment was conducted in plot No. E-12 of the Soil and Water Management Research Unit Farm, Navsari Agricultural University, Navsari during summer season of 2010-2011.

The soil sample of the experiment plot was analyzed for various physical and chemical properties. They were determined by drawing soil samples randomly before commencement of experiment from a soil depth of 0-15 cm.

➢ **Experimental plot**

Experimental design : Factorial Randomized Block Design
Replications : 4 (Four)
Plot size : Gross plot size- 5.4 m x 5.4 m
Net plot area : 29.16 sq.m
Distance between two : 2.6 m
Distance between two Plots : 1.8 m
Crop and Variety : Sugarcane CO5072 and Banana G9
Spacing : Sugarcane 0.60 x 1.20 cm
Banana- 1.50 x 1.50 m
Direction of sowing : East-west

Table 2: Physico-chemical properties of the soil of experiment plot.

Soil characteristics	Soil depth 0-15 cm	Methods of analysis (References)
(A) Mechanical analysis of soil		
i. Coarse sand (%)	0.69	International pipette method (piper, 1950)
ii. Fine sand (%)	9.17	
iii. Silt (%)	24.94	
iv. Clay (%)	65.20	
(B) Chemical characteristics of soil		
i. Organic carbon (%)	0.51	Walkley and Blacks rapid titration method (Jackson 1967)
ii.Available N (kg/ha)	218	0.32 % Alkaline KMnO4 (Subbiah and Asija 1956)
iii.Available P2O5 (kg/ha)	43	Olsen method (Jackson 1967)

iv.Available K2O (kg/ha)	502	Flame photometer method (Jackson (1967)
v. Soil pH	7.8	Potentiometric, (Jackson 1967)
vi. EC (dS/m at 250C)	0.21	Conductometric, (Jackson 1967)

❖ **EXPERIMENT RESULTS**

The results related to following terms are shown in Annexure I and II.

- Growth parameters
- Yield
- Economics
- Water use efficiency

Table 1 : Cultivation practices of sugarcane on research farm

Particulars	2011-12
Date of planting	09-12-11
Date of harvesting	06-11-12

9. Results and interpretation:

The results presented in tables 2 revealed that on research field with adoption of improved practices (drip irrigation, fertigation and paired row) recorded higher yield of sugarcane during the year and ultimately in the average also. On overall basis, the magnitude of increase in yield with improved practices (IP) over conventional practices (CP) was around 16-20 per cent. Beside considerable increase in yield, aadoption of this package of practices could also save 40 % each of water and fertilizer(N and K).

The data presented in tables 3 and 4 also showed improvements in growth and quality parameters of sugarcane with IP over CP on research farm.

Table 2: Yield of sugarcane under different package of practices on research farm

Treatments	Average Yield (t/ha)	Yield increse over CP (%)
IP	130	16
CP	112	-

Table 3 : Growth parameters of sugarcane under different package of practices on reserch farm

SN	Parameters	Packages	
		IP	CP
1	Total height (m)	5.20	4.90
2	Millable cane height (m)	3.18	3.12
3	No. of internodes/cane	25.55	24.75
4	Stem girth (cm)	2.78	2.47

Table 4: Quality parameters of sugarcane under different package of practices on reserch farm (Mean of 2011-12)

SN	Parameters	Packages	
		IP	CP
1	Brix	18.25	16.75
2	Pol / sucrose (%)	16.65	15.16
3	Purity (%)	90.69	89.92

10. Economics:

Considering the fixed and variable costs along with gross income, around 18 per cent higher net profit was realized with IP over CP (Table 5).

Table 5 : Economics (Rs/ha) of sugarcane under different treatments

Sr.	Particulars	IP	CP
1	Fixed cost	21340	2250
2	Variable cost	62000	71800
3	Total cost	83340	74050
4	Yield (t/ha)	130	112
5	Gross income	260000	224000
6	Net income	176660	149950
7	Additional income over CP	26710	_
8	CBR	2.12	2.02
9	Water use efficiency	74.28	53.33

Note: Sugarcane selling price: 2000 Rs/t

11. Result

Based on the cane yield and net profit realized from large scale experiment on research farm following conclusions are emerged.

- Adoption of improved practices (paired row, irrigation @ 0.6 PEF, fertigation of N & K) could enhance sugarcane productivity by 16 to 20 per cent along with saving in water as well as fertilizer to the tune of 40 %.
- Apart from increase in cane yield, improvement in quality parameters of sugarcane was also observed with improved practices over conventional practices.
- In order to experiment the improved package of practices in banana, every year large scale demonstrations were taken on research fields. The details are given in table 6.

Table 6: Details of improved package demonstration in banana at research farm

S. No	Location	Area (ha) and soil type	Spacing (m)	No. of plants per hacter	Remarks
1	Exp.Plot	0.30 (Clay)	2.4 x 2.4	4444	Drip + fertigation + mulching

8. Results and interpretation:

The results presented in table 7 revealed that with an adoption of improved practices consistently higher yield of banana was recorded during all the years on research farm. On overall basis, the magnitude of increase in yield with improved practices (IP) over conventional practices (CP) was around 20 per cent. Beside increase in yield, adoption of this package of practices could also save 40 % each of water and fertilizer (N and K).

Table 7: Yield of banana under improved package of practices on research farm

Sr. No.	Treatments	Yield (t/ha) (2011-12)	Yield increse over CP (%)
1	IP (2.4 x 1.2) (drip + BP + fertigation)	77 (17.52)	18
2	CP (2.4 x 1.2)	65 (16.65)	-

( ) : Yield (kg) per plant

Looking to the advantages of mulching in banana, aspecial project on pilot scale was taken. The yield level recorded with drip + fertigation + mulching was ranging from 76 to 89 t/ha as against 69 to 79 t/ha with drip alone. On over all basis, an extent of incease in yield with mulching over no mulch was around 13 per cent (Table 8).

Table 8: Yield of banana

Sr. No.	Yield (t/ha)		
	Drip + BPM	Drip alone	% increase over drip alone
1	80	71	13
2	86	73	18
3	89	79	13
4	76	69	10
5	84	73	15
6	69	61	13
7	78	67	16
Mean	80	71	13

Apart from fruit yield, the following characteristics could also achieve:

- Water saving 10 to 40 %,
- Fertilizer saving 10 to 20 %,
- Weed control 70 to 90 %,
- Early maturity 10 to 25 days,
- Increase in yield 10 to 18 % and
- Quality improvement.

9. Economics:

The technologies i.e., flood, drip, drip + fertigation and drip + fertigation + mulching yield, gross and net income economics is given in table. In spite of spacing variation, under IP higher net profit to the extent of 12 to 20 per cent over CP was realized. For knowing the overall economics of banana cultivation under different package of practices, irrespective of location, the cost of production and net profit were compared (Table 5). The results emphatically proved that with adoption of drip + fertigation + mulching and drip + mulching the net profit realized was Rs 2.90 and 2.83 lakh/ha, respectively, as against 2.32 lakh/ha with CP.

Table 9: Economics of banana cultivation at demonstration and pilot scale level

SN	Details	Demo. (1.5 x 1.5)	
		IP	CP
1	Annualized drip system cost (Rs/ha)	22000	3000
2	Cost of cultivation (Rs/ha)	160000	187000
3	Total cost (1+2) (Rs/ha)	182000	190000
4	Average yield (t/ha)	77	65
5	Income (Rs/ha)	462000	390000
6	Net income (Rs/ha)	280000	200000
7	Additional income (Rs/ha)	80000	-

Table 10: Overall economics of banana cultivation

Particular	Fruit yield (t/ ha)	Gross income (Rs/ha)	Total cost of cultivation (Rs/ha)	Net income (Rs/ha)	CBR	Water Use Efficiency (kg/ ha. mm)
Flood irrigation	62.50	375000	143000	232000	2.622	25.83
Drip + fertigation	71.00	426000	142600	283400	2.987	35.5

10. Result

Based on the fruit yield of banana and net profit realized at large scale demonstrations as well as at pilot scale level following conclusions are emerged.

Adoption of improved practices (irrigation @ 0.6 PEF, fertigation 60 % of RD N & K and mulching @ 42 – 67 %) in banana could enhance banana productivity by 13 to 21 per cent along with saving in water as well as fertilizer. This ultimately improves the net realization of banana cultivation by about 25 %.

Table 11 : Water Saving with Drip Irrigation Systems

Sr. No.	Crops	Water Saving (%)
1.	Sugarcane	50
2.	Banana	45

CONCLUSION

Based on the experiment results, it is concluded that with the help of the Drip irrigation

1. Water saving in sugarcane over surface irrigation 40%
2. Increase in sugarcane production 16-20%
3. Increase in sugarcane yield 18 t/ha.
4. Water saving in banana over surface irrigation 35%
5. Increase in banana production 13-21%
6. Increase in banana yield 18 t/ha.
7. Incease in yield with mulching over no mulch in banana 13%

ANNEXURE - II

BANANA

1.	Title	:	Pilot scale testing of improved package of practices for banana on research farm
2.	Location & agro climatic sub region	:	Research farm: Soil and Water Management Research Unit, NAU, Navsari, South Gujarat heavy rainfall zone (AES-III).
3.	Back ground information: Banana is an important fruit crop grown in Gujarat covering about 62000 ha area with an average productivity of 55 t/ha. Generally, banana is irrigated by flood method, but recently area under drip irrigation is increasing. Through experiment on only drip, drip with mulch and fertigation, it has been proved that yield and quality of banana fruits can be improved significantly. Not only this, it could also save water, fertilizer, weeding cost, improves soil health and induces early maturity. In order to popularize this technology among the farmers, it was necessary to demonstrate the whole package of practices on pilot scale and hence this program was taken up.		
4.	Objectives	:	Demonstration of improved package of practices on large scale in banana
5.	Experimental period	:	2011-12
6.	Season	:	Annual
7.	Crop & Variety	:	Banana, Grand Naine
8.	Experimental	:	Practices: A. Conventional practices (CP) Surface of irrigation : 16 to 20 each of 60 mm Mulching : Only earthing up was done Fertilization: 300:120:300 g NPK/plant The dose of 40:120:90 g NPK/plant was applied after one month of planting by ring method. The remaining quantity of N and K (260 g N & 210 g K/plant) were applied in two equal splits at three and five months after planting. Desuckering : Need based (Manually) Bunch coverage : Not applied
			B. Improved practices (IP) 1. Drip irrigation at 0.6 PEF on alternate day 2. Mulching : BPM (67% coverage after cessation of monsoon) was done 3. Fertigation: 180:120:180 g NPK/plant (i.e. 60 % RDof N and K) of which 40 %N and K and cent per cent P in two equal splits at monthly interval after one month of planting as soil application. While, remaining 60 % N and K were applied in 6 equal splits at a 15 days interval starting after three month of planting through drip. 4. Desuckering : It was done manually or 3 ml of diesel/kerosene 5. Bunch coverage: After complete opening of hands, the bunches were covered with blue LLDPE film (18 micron).
			(B) Design : Large plot technique
			(C) Replications : Non replicated

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