

Original Research Article

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Economic Feasibility of Drip Irrigation Regimes with Mulching in Mango cv. Pant Sinduri

Rashmi Upreti^{1*}, Vijay P. Singh¹ and P.K. Singh²

¹Department of Horticulture, ²Department of Irrigation and Drainage Engineering, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India

*Corresponding author

ABSTRACT

Keywords

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An investigation was carried out on sandy loam soils of *tarai* regions of Uttarakhand to analyze the potential of drip irrigation along with mulch technically as well as economically. The treatments of the study were comprised of four irrigation levels (0.3, 0.4, 0.5 and 0.6 P.E) with mulch (silver/ black-100 micron) and non-mulch conditions along with control (100% P.E). The study revealed that drip irrigation along with mulch showed better performance in terms of yield, water use efficiency as well as economics. Maximum yield of 18.72 t/ha along with maximum net return of Rs 213990.94 per hectare and B: C ratio of 4.20 was recorded in T₇ (0.5 P.E along with mulch). So the experiment suggests that drip irrigation along with mulch has the potential to provide greater benefit by optimizing the use of water resources.

Introduction

Mango is an important fruit crop of tropical and subtropical region due to availability of congenial climatic conditions. The country's mango production is estimated to be up by 8 per cent to 21.02 million tonnes in the 2017-18 crop year on higher output by major growing states (Anon, 2018). Cost economics plays a pivotal role in any crop production programme, since from the farmers' point of view, the ultimate goal is the net profit they get out of it. High net return from mango could be assured by increasing the productivity through adoption of appropriate

management practices. Drip irrigation is an advanced technique of water application which increases productivity of fruit crops along with efficient management of valuable inputs like water, fertilizer. Drip irrigation has helped in increasing yield by 84% and saved water by 40% as compared to conventional system (Tiwari *et al.*, 2004). Mulching plays a beneficial role of minimizing soil erosion, temperature regulation, soil moisture conservation, weed elimination and prevention of fertilizer leaching. Increased pod yield as well as soil moisture was reported by Behera *et al.*, (2006) by the use of LDPE mulch and increased fruit yield of Nagpur Mandarin by

25% due to use of LDPE mulch has been reported by Mohanty *et al.*, (2002). Hence the present study was conducted to study the economic viability of drip irrigation along with mulch.

Materials and Methods

A field experiment was conducted at Precision Farming Development Block of Horticulture Research Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar to evaluate the economic viability of drip irrigation along with mulch during 2015-16. The centre is located at *tarai* region lies at 29° North latitude, 79.3° East longitude and at an altitude of 243.84 meters above mean sea level. It has humid subtropical climate and the maximum temperature ranges from 32 - 45° C in summer and minimum temperature ranges from 0 to 4.4° C in winter. Soil type is sandy loam with pH 6.5, organic carbon 0.69 per cent and infiltration rate 1.5 mm/hr. The experiment was conducted on 20-year-old trees of Mango cv. Pant Sinduri planted at 8 m spacing in a square system. The experiment was disbursed in a randomized block design. The treatments of the study were comprised of four irrigation levels (0.3, 0.4, 0.5 and 0.6 P.E) with mulch (silver/ black-100 micron) and non-mulch conditions along with control (100% P.E). All the treatments were replicated 3 times and 3 trees served as a unit of treatment in each replication.

Water use efficiency (kg/ tree-mm water) was calculated as the total obtained yield/tree was divided by total water quantity applied in each treatment multiplied by 100. The amount of water used to produce unit amount of finished product is termed as water productivity. After taking into consideration the variables, fixed input and their corresponding rates, the cost incurred on each treatment was calculated. The yield obtained from different treatments was converted into gross return in rupees

based on prevailing local market prices. Net return in each treatment was calculated by deducting cost of cultivation from the gross return. Benefit – Cost ratio was computed in each treatment by dividing gross return with cost of cultivation.

Estimation of irrigation water requirement:

$$V = E_{pan} \times K_p \times K_c \times A \times W_p - ER$$

Where,

V – Volume of water required (L/ day/ plant)

E_p – Pan evaporation (mm/day)

K_p – Pan coefficient

K_c – Crop coefficient

A – Canopy Area

W_p – Factorial wetted area, which varies with different crop growth stage

ER – Effective rainfall (mm)

Scheduling

Irrigation was scheduled by calculating ET using pan evaporation measurements adjusted by crop coefficient. Evaporation data were collected from a US Weather Bureau Class A evaporation pan (Epan) located at about 2 km from this site. Epan was adjusted by a crop coefficient (K_{crop}) to calculate ET. The crop coefficients used were those developed for mature mango trees and their values were adjusted for small canopy size by the method proposed by Ley (1994). Irrigation water requirement was calculated on daily basis and then summed up for drip irrigation of plants at two days interval.

Results and Discussion

Significant differences have been recorded with respect to fruit yield and water use efficiency in mango cv. Pant Sinduri through different irrigation levels with and without mulch.

Table.1 Effect of different irrigation levels with and without mulch on yield and water saving in mango cv. Pant Sinduri

Treatments	Yield (kg/ tree)	Water Use Efficiency (kg/ l)	Total water used (l)	Water productivity (l/ kg)
T ₁ (0.3 PE without mulch)	58.66	0.21	275.50	4.69
T ₂ (0.4 PE without mulch)	72.33	0.19	390.60	5.40
T ₃ (0.5 PE without mulch)	82.33	0.17	488.04	5.93
T ₄ (0.6 PE without mulch)	88.00	0.17	507.26	5.76
T ₅ (0.3 PE with mulch)	91.67	0.33	275.50	3.01
T ₆ (0.4 PE with mulch)	105.00	0.27	390.60	3.72
T ₇ (0.5 PE with mulch)	120.00	0.25	488.04	4.08
T ₈ (0.6 PE with mulch)	116.67	0.23	507.26	4.35
T ₉ (100 % PE under conventional method)	83.00	0.04	1952.15	23.52
C.D at 5%	9.20	0.26	–	–

Table.2 Effect of different irrigation levels with and without mulch on cost economics of mango cv. Pant Sinduri

Particulars	Treatments								
	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	T ₇	T ₈	T ₉
Fixed cost									
Drip installation cost (₹)	70000	70000	70000	70000	70000	70000	70000	70000	-
Drip system cost / yr	5833.33	5833.33	5833.33	5833.33	5833.33	5833.33	5833.33	5833.33	-
Life (yrs)	12	12	12	12	12	12	12	12	-
Depreciation @ 10% (₹)	7000	7000	7000	7000	7000	7000	7000	7000	-
Interest cost @ 12% (₹)	700	700	700	700	700	700	700	700	-
Sub total	13533.33	13533.33	13533.33	13533.33	13533.33	13533.33	13533.33	13533.33	

Mulch (100 μ) ₹	-	-	-	-	12480	12480	12480	12480	-
Life (yrs)	-	-	-	-	4	4	4	4	-
Mulch cost / year	-	-	-	-	3120	3120	3120	3120	-
Rate ₹ / m ²	-	-	-	-	4	4	4	4	-
Depreciation @ 10% (₹)	-	-	-	-	1248	1248	1248	1248	-
Interest cost @ 12% (₹)	-	-	-	-	374.4	374.4	374.4	374.4	-
Sub total	-	-	-	-	4742.4	4742.4	4742.4	4742.4	-
Operational cost									
Plant protection	2000	2000	2000	2000	2000	2000	2000	2000	2000
Fertilizer	5000	5000	5000	5000	5000	5000	5000	5000	5000
Harvesting	1400	1400	1400	1400	1400	1400	1400	1400	1400
Sub total ₹ / 27 plants	8400	8400	8400	8400	8400	8400	8400	8400	8400
Total operational cost ₹/ha	48533.33	48533.33	48533.33	48533.33	48533.33	48533.33	48533.33	48533.33	48533.33+ 8000*
Total cost ₹/ha	62066.66	62066.66	62066.66	62066.66	66809.06	66809.06	66809.06	66809.06	56533.33
Yield kg/tree	58.66	72.33	82.33	88	91.67	105	120	116.67	83.00
Yield kg/ha	9150.96	11283.48	12843.48	13728	14300.52	16380	18720	18200.52	14770.08
Selling price ₹/kg	15	15	15	15	15	15	15	15	15
Gross return ₹/ha	137264.40	169252.20	192652.20	205920.00	214507.80	245700.00	280800.00	273007.80	194220.00
B:C ratio	2.211	2.726	3.103	3.317	3.210	3.677	4.203	4.086	3.435

Maximum yield has been recorded in T₇- 0.5 PE with mulch (120 kg/ tree) which was closely followed by T₈- 0.6 PE with mulch (116.67 kg/ tree) having no significant differences between these two values. Minimum yield was found in T₃- 0.3 PE without mulch (58.66 kg/ tree). Statistically maximum water use efficiency has been recorded in T₅- 0.3 PE along with mulch (0.33 kg/ l) which was closely followed by T₆- 0.4 PE along with mulch (0.27 kg/ l) and minimum in T₉- 100 per cent PE under conventional method of irrigation (0.04 kg/ l). The increase in water use efficiency in all drip irrigated treatments along with mulch over conventional method of irrigation was mainly due to considerable saving of water and yield enhancement results were endorsed by Kumar *et al.*, (2008) under drip irrigated mango *cv.* Arka Anmol, Sharma *et al.*, (2011) while working with drip irrigation in guava and Sulochanamma *et al.*, (2005) in pomegranate.

According to Sharma *et al.*, (2011) saving of water combined with higher yield under drip irrigation and mulch treatments might be the possible reasons for increased WUE. Generally, water productivity in conventional method of irrigation registered higher value as compared to drip with mulch and without mulch condition. Among drip irrigation levels, higher drip irrigation levels registered higher values of water productivity compared to lower irrigation levels. Maximum value of water productivity was reported (23.52 l/ kg) in conventional method of irrigation. It was noticed from the table 1 that highest water productivity was noticed in treatment supplied with lower water through drip irrigation along with mulch (3.01 l/kg). Above finding was also supported by Sharma *et al.*, 2013 in guava.

A well maintained drip irrigation system may have a life span of 10-12 years, hence for the present study a life span of 12 years was

considered for drip and for computation. Cost of cultivation under drip, and conventional irrigation was worked out for various treatments. Maximum cost of cultivation under drip with mulch is due to high cost of installation of drip as well as mulch in addition with labour charges because of its proper handling and management. More expenditure on electricity at different irrigation levels increases cost of cultivation in case of irrigation at higher drip irrigation levels. But maximum gross return of Rs 280800 per hectare along with maximum net return of Rs 213990.94 per hectare and benefit cost ratio of 4.203 was also obtained in T₇- drip irrigation at 0.5 PE along with mulch (Table 2). Above findings were also confirmed by Agrawal and Agrawal (2007) in pomegranate *cv.* Ganesh they recorded higher net income of Rs 70,560 per hectare and benefit cost ratio of 1:2.67 under T₃- 8 litres of water per hour through trickle irrigation. Similarly Joshi *et al.*, (2011) reported that drip irrigation at 100 per cent of estimated irrigation water requirement provides highest fruit yield, net seasonal income of Rs. 420297 and BC ratio of 6.52 in Litchi grown under drip fertigation. Drip irrigation is the frequent and slow application of water to the soil, near the root zone of the plants through mechanical devices called emitters that are located at selected points along water delivery lateral LLDPE pipes. This efficient irrigation technique has led agriculture with existing human resources development and technology should be viewed as one of the eco-technological approaches to attain sustained and enhanced agricultural production and productivity without any burden on environmental degradation.

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