Cost economics study of tomato production under poly house and open field cultivation

---

ABSTRACT

The studies was performed by conducting the field experiments under polyhouse and open field at the Instructional Farm of Department of Irrigation and Drainage Engineering, Dr.Annasaheb Shinde College of Agricultural Engineering and Technology, Mahatma Phule Krishi Vidyapeeth, Rahuri during rabi seasons of 2013-14.These experiments state that the best practice found in different environmental conditions (Polyhouse and open field cultivation.) can be adopted for maximum economic returns from tomato cultivation. Polyhouse tomato cultivation was found best alternative tomato cultivation during rabi season to obtain maximum yield, net return and benefit:cost ratio. The combitation of 0.95ETc x 125 % RD (I_1x F_1) recorded maximum yield (437.98 tha^{-1}) under polyhouse cultivation and (149.98 tha^{-1})under open field cultivation. The maximum net income was found due to T_1 (0.95ETc x 125 %RD) treatment i.e. ₹ 2,95,210/- under polyhouse cultivation and In case of open field cultivation the maximum net income was found ₹ 5,527/- and benefit:cost ratio was found 3.29 under polyhouse and 1.13 under open field cultivation.

Key words: *polyhouse cultivation, cost economics , net present value and benefit cost ratio*

1INTRODUCTION

Tomato (*Solanum lycopersicum* L.) belongs to the family Solanaceae is one of the most popular and nutritious vegetable crop grown all over the world**.** Among vegetables, tomato is one of the crop grown in greenhouse worldwide. It is easy to grow as compared to peppers and cucumbers, and fruit yield can be very high under protection. Demand for tomatoes is usually strong due to vine-ripe nature and general overall high level of eating quality. There are two main types of tomato viz.(i) determinate or 'bush' tomato, and (ii) indeterminate or 'vine' tomato. Determinate cultivars are used mainly for processed food while indeterminate cultivars have been largely developed for greenhouse systems. Tomato is a warm season plant. It can withstand with severe frost conditions. Temperature and light intensity affect germination, vegetative growth, fruit set, pigmentation and nutritive value of this fruits. The minimum temperature for germination of seeds from 8^0 to 10^0C. The night temperature is the critical factor in fruit setting with the optimum range of 16^0C to 22^0C. fruits fail to set at 12^0C or below. (Ramesh 2010)

The cost of the polyhouse structure plays the decisive factor for adoption and sustainability of tomato production [9,10]. The cost of a polyhouse mainly depends on the quality of materials used for the structure and glazing and others like drip and mist systems. Against this background the present study was taken up to examine the economic viability of production of tomato under poly house cultivation and open field condition. The specific objectives were: to estimate cost and returns and to study the constraints in tomato production under protected condition. (Singh 2011)

2 MATERIALS AND METHODS

The field experiment was conducted at the Instructional Farm of Department of Irrigation and Drainage Engineering, Dr. Annasaheb Shinde College of Agricultural Engineering and Technology, Mahatma Phule Krishi Vidyapeeth, Rahuri during the period from November 2013 to May 2014. Geographically the farm lies at 74^0 38' 00" E longitudes and 19^0 20' 00" N latitude at 557 m above the mean sea levels in the central campus of Mahatma Phule Krishi Vidyapeeth, Rahuri.

2.1Experiment under Polyhouse and Open Field Cultivation

Response of tomato was studied under different irrigation regimes and fertigation levels under polyhouse and open field condition.. The size of polyhouse and open field was 25m x 20 m. Naturally ventilated polyhouse with thickness of UV PE film was 200 micron with side ventilation which create a favourable environment for plant growth. Whenever, the temperature increases in the polyhouse, the rollable polyethylene flap (side ventilation) was opened. But under low

temperature conditions the side ventilations was closed with the rollable polyethylene flap to conserve the heat inside the polyhouse. The polyhouse was provided with fogger system erected beneath the roof of polyhouse that protects the crop from prevailing high temperature during noon time.

This experiment was carried out in split plot design with nine treatments based on different combinations of irrigation levels and fertigation levels. Same treatments were followed in open field condition. Fertigation scheduling was done at an alternate days and silver - black polyethylene mulch was used commonly in all the treatments under polyhouse and open field.

2.1.1

List 1: Treatment Details

Sr. No.	Factor A : Irrigation level	Factor B: Fertigation levels
1.	I_1 = 0.95 ETc	F_1= 125% RD
2.	I_2 = 0.70 ETc	F_2 = 100% RD
3.	I_3 = 0.45 ETc	F_3= 75% RD

2.1.2

List 2: Experiment Details of the Polyhouse and Open Field cultivation.

Experimental design	Split plot design
No. of treatments	Nine
No. of replications	Six
Plant spacing	60 cm x 45 cm
Plot size	2.7 m x1m
Height of bed	0.45m
No. of rows /bed	2
No. of plants/bed	12
No. of plants/treatment	12
Total number of plants in polyhouse	12 x 6 x 9 = 648
Total number of plants in open field	12 x 6 x 9 = 648
Total plants in experiment	1296

The silver - black polyethylene mulch of 25 micron thickness was used commonly in all the treatments.

2.2Cost Economics

2.2.1Cost of Production

The cost of production was worked out for each treatment on the basis of 1008 m^2 area which is commonly used by farmers for erecting the polyhouse, under Government subsidy scheme. The economics of tomato under open field conditions was also worked on 1008 m^2 area for comparison purpose. The cost includes paid out cost on structure, hired human labor, seeds, fertilizers, water charges, interest on working capital, interest on fixed capital, depreciation, repair and maintenance of water supply system irrigation system. (Andhale 2012)

Depreciation

$$\text{Depreciation} = \left[\frac{\left(\frac{OC - JV}{L}\right)}{\text{No. of season}}\right]$$

where,

OC - Original cost
JV – Junk value (10 % of OC)
L- Life span

2.2.2Gross monetary returns

The gross monetary returns per hectare were worked out by considering the yield from different treatments and the prevailing market price of tomato.

2.2.3Net income

The net income was worked out by subtracting the cost of production from the gross monetary returns in each treatment.

2.2.4Benefit-cost ratio

The benefit-cost ratio was worked out by dividing the gross monetary returns to cost of production in each treatment under study. (Poornima 2016)

3 RESULT AND DISCUSSION

3.1Cost Economics of Tomato Production under Polyhouse and Open Field cultivation

The data regarding cost of cultivation, gross income, net income and benefit:cost ratio of tomato as influenced by different treatments under polyhouse and open field cultivation of 1008 m^2 area for the year 2031-14 and 2014-15 are presented in Tables 1 and 2, respectively.

3.1.1Cost of Cultivation

The data on cost of cultivation including the cost of soluble fertilizers, drip irrigation system components, insecticides and pesticides, *etc.*, for 1008 m^2 area of polyhouse and open field for both the years. The cost of cultivation was maximum (₹ 1,28,717/- and ₹ 1,30,085/-) and (₹ 41,173/- and ₹ 41,020/-) for the year 2013-14 and 2014-15 due to T_1 (0.95ETc x 125 % RD) under polyhouse and open field. (Figures. 1 and 2).

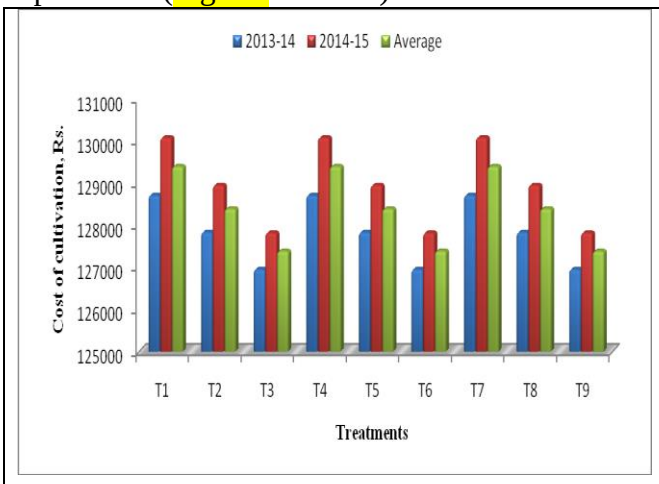

Figure 1. Cost of cultivation of tomato for 1008 m^2 area as influenced by different treatments under polyhouse cultivation.

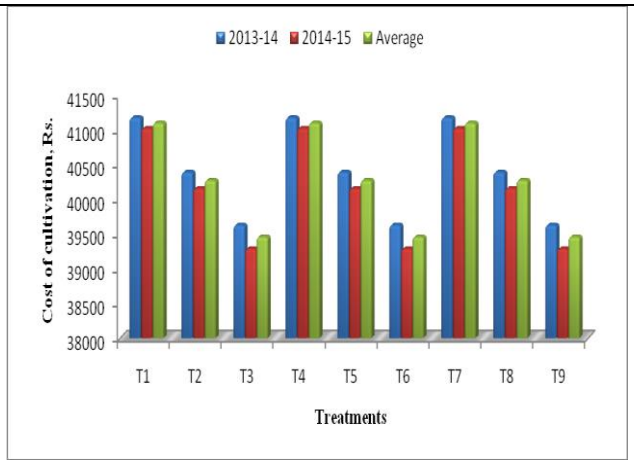

Figure .2.Cost of cultivation of tomato for 1008 m^2 area as influenced by different treatments under open field cultivation.

3.1.2Gross Income

The gross income of tomato from 1008 m^2 area of polyhouse and open field was obtained for each replicated plots. The average gross income under each treatment were reported in Tables. 1 and 2 for the respective years. The average maximum gross income ranged from (₹ 48,441/- to ₹ 4,24,612/-) and (₹ 9,763/- to ₹ 46,623/-) under polyhouse and open field. The maximum gross income was found due to T_1 (0.95ETc x 125 %RD) treatment i.e. ₹ 4,24,612/- followed by T_2 (0.95ETc x 100 %RD) treatment *i.e.* ₹ 3,59,689/- under polyhouse. In case of open field the maximum gross income was found due to T_1 (0.95ETc x 125 %RD) treatment *i.e.* ₹ 46,623/- followed by T_2 (0.95ETc x 100 %RD) treatment *i.e.* ₹ 37,173/-. (Figures. 3 and 4). Similar results was reported by Firake (2016).

Table. 1. Economics of tomato production for polyhouse cultivation of 1008 m^2 area as affected by different treatments in the year 2013-14 and 2014-15

Treatments	Cost of cultivation, Rs.			Gross income, Rs.			Net income, Rs.			B:C ratio		
	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average
I_1xF_1 (0.95ETc x 125 % RD)	128717	130085	129401	438588	410635	424612	309870	280550	295210	3.41	3.16	3.29
I_1xF_2 (0.95ETc x 100 % RD)	127836	128953	128395	370346	349031	359689	242510	220077	231293	2.90	2.71	2.81
I_1xF_3 (0.95ETc x 75 % RD)	126955	127822	127389	243344	260176	251760	116390	132354	124372	1.92	2.04	1.98
I_2xF_1 (0.70ETc x 125 % RD)	128717	130085	129401	268412	211980	240196	139695	81895	110795	2.09	1.63	1.86
I_2xF_2 (0.70ETc x 100 % RD)	127836	128953	128395	168657	146147	157402	40821	17194	29007	1.32	1.13	1.23
I_2xF_3 (0.70ETc x 75 % RD)	126955	127822	127389	143564	116507	130036	16609	-11315	2647	1.13	0.91	1.02
I_3xF_1 (0.45ETc x 125 % RD)	128717	130085	129401	126001	68467	97234	-2716	-61618	-32167	0.98	0.53	0.76
I_3xF_2 (0.45ETc x 100 % RD)	127836	128953	128395	60573	55874	58224	-67263	-73081	-70172	0.47	0.43	0.45
I_3xF_3 (0.45ETc x 75 % RD)	126955	127822	127389	52463	44418	48441	-74491	-83404	-78947	0.41	0.35	0.38

Table. 2. Economics of tomato production for open field cultivation of 1008 m^2 area as affected by different treatments in the year 2013-14 and 2014-15

Treatments	Cost of cultivation, Rs.			Gross income, Rs.			Net income, Rs.			B:C ratio		
	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average
I_1xF_1 (0.95ETc x 125 % RD)	41173	41020	41097	47709	45538.2	46623	6536	4518.1	5527	1.16	1.11	1.13
I_1xF_2 (0.95ETc x 100 % RD)	40388	40153	40271	39356	34989.6	37173	-1032	-5163.5	-3098	0.97	0.87	0.92
I_1xF_3 (0.95ETc x 75 % RD)	39626	39285	39456	29642	26480.8	28061	-9984	-12804.3	-11394	0.75	0.67	0.71
I_2xF_1 (0.70ETc x 125 % RD)	41173	41020	41097	24482	21487.6	22985	-16691	-19532.5	-18112	0.59	0.52	0.56
I_2xF_2 (0.70ETc x 100 % RD)	40388	40153	40271	18315	22132.4	20224	-22073	-18020.7	-20047	0.45	0.55	0.50
I_2xF_3 (0.70ETc x 75 % RD)	39626	39285	39456	19014	13674.2	16344	-20612	-25610.9	-23111	0.48	0.35	0.41
I_3xF_1 (0.45ETc x 125 % RD)	41173	41020	41097	14499	13773.9	14136	-26674	-27246.2	-26960	0.35	0.34	0.34
I_3xF_2 (0.45ETc x 100 % RD)	40388	40153	40271	12640	10000.3	11320	-27748	-30152.8	-28951	0.31	0.25	0.28
I_3xF_3 (0.45ETc x 75 % RD)	39626	39285	39456	10948	8577.5	9763	-28678	-30707.5	-29693	0.28	0.22	0.25

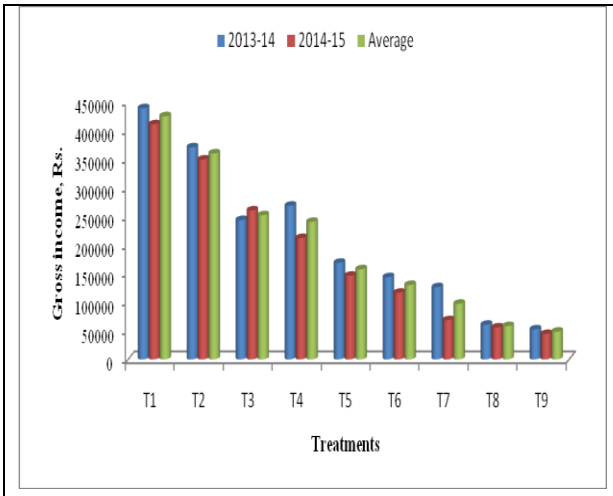

Figure 3. Gross income of tomato for 1008 m^2 area as influenced by different treatments under polyhouse cultivation.

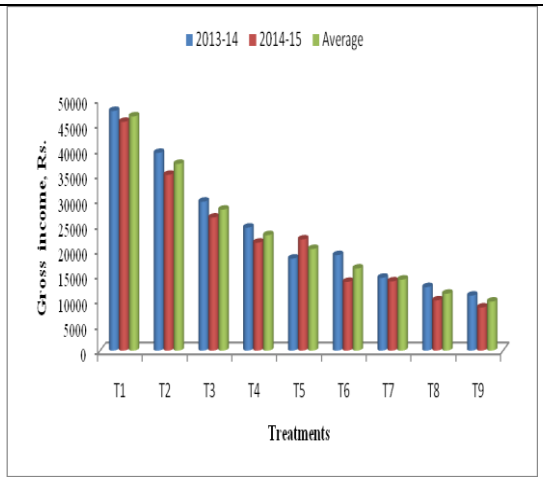

Figure.4. Gross income of tomato for 1008 m^2 area as influenced by different treatments under open field cultivation.

3.1.3Net Income

The net income of tomato from 1008 m^2 area of polyhouse and open field was obtained for each replicated plots. for both the years 2013-14 and 2014-15. The average net income under each treatment is reported in Tables (1 and 2) for the respective years. The maximum net income was found due to T_1 (0.95ETc x 125 %RD) treatment *i.e.* ₹ 2,95,210/- followed by T_2 (0.95ETc x 100 %RD) treatment i.e. ₹ 2,31,293/- under polyhouse. In case of open field the maximum net income was found due to T_1 (0.95ETc x 125 % RD) treatment *i.e.* ₹ 5,527/- (Figs. 5 and 6). The treatments indicating negative net income show the loss in net profit. (Parveen Kumar 2016)

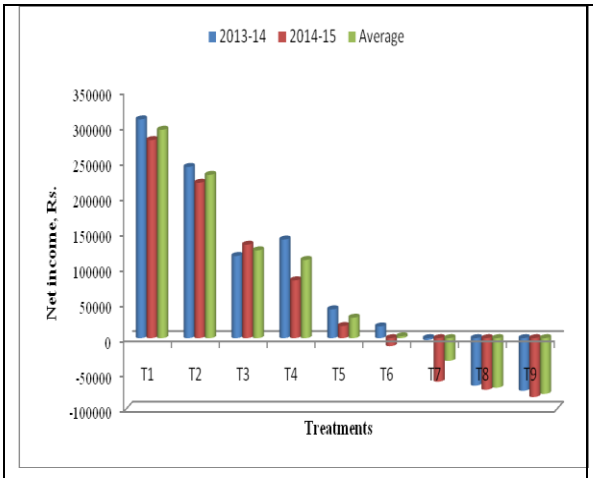

Figure 5. Net income of tomato for 1008 m^2 area as influenced by different treatments under polyhouse cultivation.

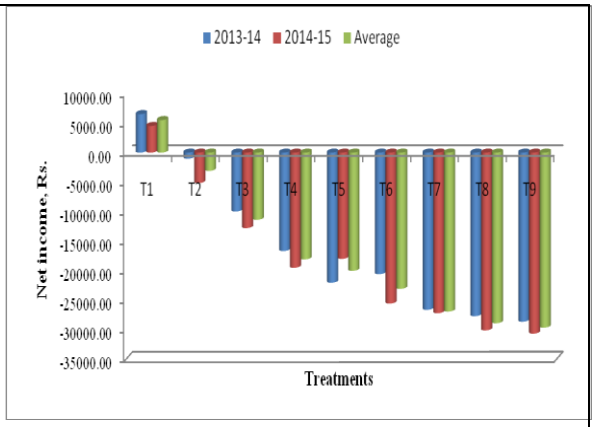

Figure. 6. Net income of tomato for 1008 m^2 area as influenced by different treatments under open field cultivation.

3.1.4B:C Ratio

The B:C ratio of tomato from 1008 m^2 area of polyhouse and open field was obtained for each replicated plots. The average B:C ratio under each treatment is reported in Tables(1 and 2) for

the respective years. The average B:C ratio ranged from ₹ 0.38 to ₹ 3.29 under polyhouse and ₹ 0.25 to ₹ 1.13 under open field . The average maximum B:C ratio was found due to T_1 (0.95ETc x 125 %RD) treatment *i.e.* ₹ 3.29 followed by T_2 (0.95ETc x 100 %RD) treatment *i.e.* ₹ 2.81 under polyhouse. In case of open field the average maximum B:C ratio was found due to T_1 (0.95ETc x 125 %RD) treatment *i.e.* ₹ 1.13 (Figs. 7 and 8). Results are inline with Firake (2016).

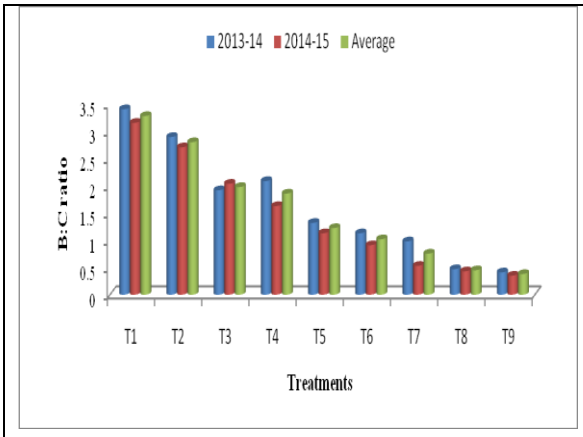

Figure.7. B:C ratio of tomato for 1008 m^2 area as influenced by different treatments under polyhouse cultivation.

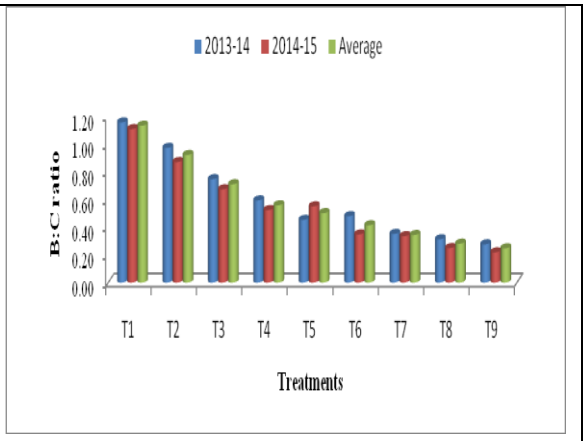

Figure. 8. B:C ratio of tomato for 1008 m^2 area as influenced by different treatments under open field cultivation.

4Conclusions

The experiments were conducted to know the study of cost economics of tomato production under, polyhouse and open field with irrigation levels and fertigation levels.

In case of polyhouse cultivation of tomato, drip irrigation scheduled daily at 0.95 ETc with 125% RD at an alternate day of fertigation be used for obtaining net return and benefit: cost ratio.

Under open field cultivation of tomato, drip irrigation scheduled daily at 0.95 ETc with 125% RD at an alternate day of fertigation be used for obtaining net return and benefit: cost ratio.

ACKNOWLEDGEMENT

we would like express our sincere gratitude to MPKV, Rahuri. for their invaluable support in facilitating the completion of our research. To extend our appreciation to the dedicated scientist to generously provided us with the oppourting to conduct the research, there by contributing to the advancement of knowledge in our field.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

5REFERENCES

1. Andhale, R.P. 2012. Effect of shadenet intensities and colours on micro-meteorologicalparameters, growth, yield and quality of capsicum.Unpub.Ph.D. Thesis, MPKV, Rahuri, pp.1-189.
2. Firake, N.N. 2016. Response of capsicum (*Capsicum annuum* L.) to different irrigation regimes under protected cultivation. Unpub.Ph.D. Thesis, MPKV, Rahuri, pp.1-683.
3. Nangare, D.D., Jitendra Singh, V.S. Meena, Bharat Bhushan and P.R. Bhatnagar. 2015. Effect of green shade nets on yield and quality of tomato (*Lycopersiconesculentum* Mill) in semi-arid region of Punjab. Central Institute of Post- Harvest Engineering and Technology (CIPHET) Abhor.
4. Parveen Kumar, R. S. Chauhan and R. K. Grover 2016. Economics analysis of tomato cultivation under poly house and open field conditions in Haryana, India. Journal of Applied and Natural Science 8(2): 846 - 848 (2016)
5. Poornima 2016. Yield response of drip irrigation cucumber to mulch and irrigation regimes under different shading nets. An unpublishrd M.tech thesis submitted to Mahatma Phule Krishi Vidyapeeth Rahuri.
6. Ramesh, K .S; T .Arumugam 2010. Performance of vegetables under naturally ventilated polyhouse condition. Mysore J. Agric. Sci. 44(4):770-776.
7. Singh, S., R. Sharda, P.P. S. Lubana and C. Singla. 2011. Economic evaluation of drip irrigation system in bell pepper (*Capsicum annuum*L. *var. grossum)*,ProgAgri,43:289-293
8. S. Senthilkumar, K. R. Ashok, M. Chinnadurai and S. P. Ramanathan 2018. An Economic Analysis of Capsicum Production under Protected Cultivation in North West Region of Tamil Nadu, India *International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706* .

9. Kumar P, Chauhan RS, Grover RK. Economics analysis of tomato cultivation under poly house and open field conditions in Haryana, India. Journal of Applied and Natural Science. 2016 Jun 1;8(2):846-8.

10. Duhan PK. Cost benefit analysis of tomato production in protected and open farm. International Journal of Advanced Research in Management and Social Sciences. 2016;5(12):140-8.