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# Performance of Tomato (*Solanum lycopersicum* L.) under Drip Irrigation with Peripheral Insect Proof Net

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## ABSTRACT

The performance of tomato (Var: Laxmi F1 Hyb.) under the covered periphery by insect proof net was evaluated at Central Institute of Agricultural Engineering, Bhopal during rabi 2013-15. An insect proof net of 40 mesh size was installed upto 3 m height covering entire peripheral boundary of the experimental field to create partially protected condition. Similar cultural practices were adopted in the adjoining open field as well as in the peripheral insect proof net. Low head drip irrigation system was installed in both the treatments for irrigating the crop. Plant biometric parameters such as plant height, number of branches, yield and quality parameters were monitored and evaluated. The study revealed that in the field with insect proof net, crop height increased by 22 per cent and yield increased by 44 per cent. The economic performance of the field with peripheral insect proof net was found to be better with about 35 percent higher net income than the open field condition (i.e. control).

**Key words:** *Insect proof peripheral net, Tomato (*Solanum lycopersicum* L.), Drip irrigation, Gravity fed drip*

## INTRODUCTION

Present day vegetables grown under field conditions are vulnerable and exposed to adverse impact of climate change causing several abiotic and biotic stresses which affect production, productivity and quality (Rajasekar et al., 2013). As a result of these stresses, the production gets affected mainly due to disease occurrence and pest infestation. Protected cultivation with drip irrigation has the potential to cope up with these stresses (Kishore et al., 2016; Saxena et al., 2013; Saxena et al., 2015). World over, insect nets or screens have commonly been used for protecting the crops from excessive solar radiation, weather effects on produce and to keep away insects. Structures made from insect netting have different names, e.g., insect net house, net house, and net greenhouse, indicating a lack of standardization of this production system. However, due to the costlier technology its adaptation is limited whereas partially protected cultivation technology is

comparatively cheaper and conducive in controlling the adversities caused due to these stresses which lead to increased production and productivity. Therefore, a top open partially protected structure made from insect proof net that covers the crop from all the sides up to a common flying height of common insects was thought to be a viable alternative to check the insects and disease vectors.

Tomato (*Solanum lycopersicum* L.), commonly called as poor man's orange, is an economically important vegetable crop grown in tropical and sub tropical regions and suitable for cultivation in garden as well as in large commercial farms. World wide area and productivity of tomato is about 4.73 mha and 33.6 t/ha, respectively whereas in India, it is 0.86 mha and 19 t/ha, respectively (Vanitha et al., 2013). Current production has great scope for improvement to meet the present requirement as well as the future demand. This could be addressed through better management options and/or by

introduction of suitable stress tolerant cultivars. Feng-cheng et al. (2010) demonstrated about 90 per cent reduction in the occurrence of yellow leaf curl virus in tomato, under a 50-mesh net house, mainly due to elimination of white flies. The distribution of flying height of different agricultural insects was studied and modeled by Byers (2011). However, no published research work in India or elsewhere could be seen on the use of peripheral insect proof net under drip irrigation. In this context a field experiment was conducted to study the impact of partially covered cultivation of tomato under drip using peripheral establishment of insect proof net during whole crop period. Its impact was evaluated and compared with the open field cultivation on growth, yield and quality as well as disease and pest incidence.

### MATERIALS AND METHODS

The field experiment was conducted at the experimental farm of ICAR-CIAE, Bhopal (23° 19' N latitude and 77° 24' E longitude and at altitude of 490 m above mean sea level) to evaluate the performance of tomato (Var: Laxmi F1 Hyb.) in the peripheral insect proof net as well as in the open field. The climate of this region is semi-arid and sub-tropical. Monsoon commences by the third week of June and ceases by the last week of September having an average seasonal rainfall of 936 mm, besides average annual rainfall of 1069 mm (Bajpai and Saxena, 2017). The soil of CIAE farm is vertisol which has clay texture, sub angular blocky type soil structure and infiltration rate of less than 10 mm/h,

average soil pH of the saturation paste 7.2, electrical conductivity of saturated paste extract, EC<sub>e</sub> 0.3 dSm<sup>-1</sup> and about 52 per cent clay content (Saxena et al., 2017).

A field of 3000 m<sup>2</sup> was selected for experiment. Half of the field was partially protected using insect proof net (40 mesh size) installed at its periphery upto 3 m height (Byers, 2011), Fig. 1a. The rest of the field remained open from all the sides and was closely located to that of the protected treatment and had sufficient buffer zone, Fig. 1b.

Nursery of tomato seedlings was raised and 28 days old seedlings were transplanted in both the treatments on the same day at 0.6 x 0.6 m (row x plant) spacing under a gravity fed drip irrigation system on Oct 25, 2013 and Nov 3, 2014. The drip irrigation system had 2 lph emitter discharge with emitter spacing of 0.6 m on the drip laterals of 16 mm size. The experiment was laid in the randomized block design layout with twelve laterals as replications among both the treatments. The treatments were then compared using F-test. Uniform crop cultural practices were adopted in both the treatments of insect proof net and in the open field. The NPK fertilizers were applied @120:50:50 kg/ha (Locascio et al., 1997). One fourth of nitrogen and full doses of P and K were applied just before transplanting while the remaining doses of N were applied manually in three equal splits on 45, 60 and 75 DAT (days after transplanting). The tomato fruits were picked up from 65 DAT till final harvest on 135 DAT i.e., on March 9, 2014 and March 18, 2015.



Fig. 1: Tomato grown under (a) drip in insect proof net peripheral boundary and (b) in adjoining open field condition

Crop growth and yield parameters were observed and analyzed as randomized block design.

Uniform plant protection measures were also followed in both the treatments. After transplanting, fungicide (Carbendazim 12%+ Mancozeb 63% @ 1.5 kg/ha and neem oil @ 4.0 l/ha was sprayed for plant protection measure as mentioned in Table 1 among both of the treatments on 12<sup>th</sup> and 15<sup>th</sup> day from the date of transplanting (DAT) respectively. Later on neem oil and other chemicals namely Imdachlorprid 17.8% SL @ 0.5 l/ha, Dichlorovous 76% EC @ 0.8 l/ha and Carbendazim 12% + Mancozeb 63% @ 1.5 kg/ha apart from 'neem' oil were administered as mentioned in both the treatments (Table 1).

**Table 1: Schedule of plant protection measure in the field**

SI No	Name of chemical	Day(s) of spray from DAT
1	Neem oil	15, 30, 45 and 60
2	Imdachlorprid 17.8 % SL	70
3	Dichlorovous 76% EC	90
4	Carbendazim 12 % + Mancozeb 63% WP	12, 40, 76

## RESULTS AND DISCUSSION

Mean plant growth parameters of tomato crop viz. plant height, number of branches per plant, number of fruit/plant, productivity along with quality

parameters like surface colour monitored under insect proof net and open field are given in Table 2. It may be seen from Table 2 that the yield, plant height and number of tomato fruits per plant were significantly higher inside the peripheral net than the outside.

The productivity of tomato, plant height and number of fruits produced per plant was found 44, 22 and 49 per cent higher in the treatment of inside peripheral boundary of net than that of open field. A higher yield was mainly due to lesser incidences of diseases and pest attack in the treatment inside the peripheral boundary. As observed from the yellow sticky strip (on a single side) placed inside the peripheral net boundary, the aphid count was 2285, which was about 13.9 per cent lesser against 2655 in the strip placed outside the boundary in the open field. Feng-cheng et al. (2010) also reported to have up to 82 to 100 per cent less occurrence of pest in tomato grown inside the insect proof condition of the shade net.

The economic analysis is presented in Table 3 for both of the treatments. The net income in the partially protected condition was assessed at about Rs. 2.7 Lakh as against Rs. 2.0 Lakh in the open field condition. At the present mean yield, the benefit cost (B:C) ratio of the treatment of peripheral net boundary (1.84) was computed to be lower than the BC ratio of the open field (2.27) but a high net income from the protected treatment of peripheral net (nearly 35 per cent higher) may attract better adoption in the farmers' field. The use of drip irrigation has been reported to have given a B:C

**Table 2: Mean values of tomato yield attributes and quality parameters**

Treatment	Yield t/ha	Plant height, cm	No of branches/plant	No of Fruit/plant	Brix value	L**	a**	b**
Inside peripheral net	83.68	69.08	14.17	61.17	3.43	47.43	28.18	32.92
Outside peripheral net	57.76	56.33	13.08	41.00	3.59	48.22	27.61	35.14
SEm+	6.93	2.79	0.96	4.79	0.09	0.69	0.86	0.64
CD0.05	22.42*	8.64	NS	15.11	NS	NS	NS	1.60*

\*CD at 10 level of significance

\*\*L, a and b are Hunter chart's colour values mathematically indicating L for lightness, a for opponents of green-red and b for opponents of blue-yellow as specified by the International Commission on Illumination



**Table 3: Economic analysis of tomato production**

Sr. No.	Particulars	Open field	Peripheral net boundary
1	Plant spacing (m x m)	60x60 cm	60x60 cm
2	Annual Fixed cost (Rs/ha)		
	a) Cost of Peripheral boundary		
	i) Initial investment	-	246500
	ii) Annual fixed cost (Life-5 yr; interest @ 9%)	-	64337
	iii) Repair & maintenance	-	3000
	Total Annual fixed cost		67337
	b) Water supply or pump, tube well and filtration unit		
	i) Initial investment	26000	26000
	ii) Annual fixed cost (Life-12 yr; interest @ 9%)	6786	6786
	iii) Repair & maintenance	1300	1300
	Total Annual fixed cost	8086	8086
	c) Drip components (Except filtration unit)		
	i) Initial investment	36520	36520
	ii) Annual fixed cost (Life-8 yr; interest @ 9%)	6573	6573
	iii) Repair & maintenance	1826	1826
	Total Annual fixed cost	8399	8399
	d) Cost of operation of drip irrigation (fuel/energy+ labour)	2745	2745
	Grand total (a + b + c + d)	19230	86567
3	Cost of cultivation, Rs/ha	61000	61000
4	Total production cost (2 + 3), Rs/ha	88234	147567
5	Yield (t/ha)	57.76	83.68
6	Gross income from produce, Rs/ha (@ Rs 5/kg)	288800	418400
7	Net income (6- 4), Rs/ha	200566	270833.5
8	Benefit cost ratio (6/4)	2.27	1.84

ratio higher than one in many cases (Pandey et al., 2010; Saxena and Gupta, 2006 a; Saxena and Gupta, 2006 b). Its impact could be better envisaged if considered at least two vegetable crops grown in consecutive seasons in a year, with better pest and disease management practices.

## CONCLUSIONS

The findings of the experiment conducted during rabi seasons in 2013-15 to monitor the performance of tomato (*Solanum lycopersicum* L.) under gravity fed drip irrigation surrounded by peripheral insect proof net has revealed that the growth and yield

parameters of tomato remained better in the insect proof net. A higher productivity of about 44 per cent was achieved among tomato grown under the insect proof net installed at the peripheral boundary. The yield, number of fruits per plant and plant height was found significantly different at 10 percent level for the crop inside and outside the peripheral net. It may be concluded from the experiment that a higher returns in terms of gross income could be achieved through cultivation of tomato in the peripheral net under gravity fed drip irrigation. The lesser incidence of pest and disease attack as evident from the sticky strips, invites more studies on the respective lines.

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## REFERENCES

- Bajpai Arpna; Saxena C K.** 2017. Temporal variability of hydraulic performance in drip irrigated banana field. *Res. on Crops*, 18: 66-71.
- Byers J A.** 2011. Analysis of vertical distributions and effective flight layers of insects: Three-dimensional simulation of flying insects and catch at trap heights. *Environ. Entomol.*, 40: 1210–1222.
- Feng-cheng X U; Hui L; Li-min L; Fang-fang, L L; Wen-hua C; Ding-peng L.** 2010. Initial report about prevention and controlling of tomato leaf curl virus with 50-mesh insect nets throughout the whole growing season. *China Vegetables*, 8: 61-64.
- Kishore Ravi; Gahlot V K; Saxena C K.** 2016. Pressure compensated micro sprinklers: a review. [DOI: 10.17577/IJERTV5IS010184]. *International Journal of Engineering Research and Technology*, 5: 237-242.
- Locascio S J; Hochmuth G; Rhoads F M; Olson S M; Smajstrla A G; Hanlon E A.** 1997. Nitrogen and potassium application scheduling effects on drip-irrigated tomato yield and leaf tissue analysis. *Hort. Science*, 32: 230-235.
- Pandey R S; Batra L; Qadar A; Saxena C K; Gupta S K; Joshi P K; Singh G B.** 2010. Emitters and filters performance for sewage water reuse with drip irrigation. *Journal of Soil Salinity and Water Quality*, 2: 91-94.
- Rajasekar M; Arumugam T; Kumar S R.** 2013. Influence of weather and growing environment on vegetable growth and yield. *Journal of Horticulture and Forestry*, 5: 160-167.
- Saxena C K; Bajpai A; Nayak A K; Pyasi S K; Singh R; Gupta S K.** 2017. Hydraulic performance of litchi and banana under drip irrigation. In: Goyal, Megh R., Panigrahi, Balram and Panda, S N. (Eds.) *Micro Irrigation Scheduling and Practices*, under the book series, "Innovations and Challenges in Micro Irrigation- Volume 7", Apple Academic Press, Inc. Waretown, NJ 08758 USA, 99-116.
- Saxena C K; Gupta S K.** 2006 a. Effect of soil pH on the establishment of litchi (*Litchi chinensis* Sonn.) plants in an alkali environment. *Indian Journal of Agricultural Sciences*, 76: 547-549.
- Saxena C K; Gupta S K.** 2006 b. Uniformity of water application under drip irrigation in litchi plantation and impact of pH on its growth in partially reclaimed alkali soil. *Journal of Agricultural Engineering*, 43: 1-9.
- Saxena C K; Gupta S K; Purohit R C; Bhakar S R; Upadhyay B.** 2013. Performance of okra under drip irrigation with saline water. *Journal of Agricultural Engineering*, 50: 72-75.
- Saxena C K; Gupta S K; Purohit R C; Bhakar S R.** 2015. Salt water dynamics under point source of drip irrigation. *Indian Journal of Agricultural Research*, 19: 101-113.
- Vanitha S M; Chaurasia S N S; Singh P M; Naik P S.** 2013. *Vegetable Statistics*. Technical Bulletin No. 51, IIVR, Varanasi, 73-77.