The Bioscan 10(1): 243-246, 2015
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF DIFFERENT TYPES OF IRRIGATION AND GROWING METHODS ON GROWTH, YIELD ANDWATER-USE EFFICIENCY OF TOMATO (*LYCOPERSICON ESCULENTUM* MILLER)

G. V. SUBBA REDDY* D. V. PATIL, B.SRIHARI RAO AND B. NAGENDRAPRASAD
B. C. T. - Krishi Vignana Kendram Haripuram, Rambilli (Mandal) Visakhpatnam - 531061, A. P., INDIA
e-mail: gvsreddy5417@gmail.com

KEYWORDS
Drip irrigation
Black polyethylene
Water use efficiency
Trellising
Tomato

Received on :
08.12.2014

Accepted on :
27.02.2015

***Corresponding author**

ABSTRACT
A two year field study was conducted during 2012-2013 and 2013-2014 on light textured soils of BCT- KVK Visakhapatnamdistrict to investigate the effect of different types of irrigation and growing methods on growth, yield, water-use efficiency and economics of tomato (*Lycopersicon esculentum* Miller). Drip + polythene mulch + trellising given maximum values for fruit yield (62.21 t/ha), plant height (91.22 cm), fruit weight (88.33 g), plant dry matter (49.32g) and less weed growth (6.12 gm^{-2}) compared to drip + polythene mulch and drip alone. Highest water use efficiency (1.44) was observed in drip + polythene mulch + trellising followed by drip + polythene mulch (1.26). Use of black polyethylene mulch + drip + trellising recorded significantly highest net income (161134 Rs./ha). In case of surface irrigation, furrow + black polythene mulch + trellising recorded highest fruit yield (43.82 t/ha), fruit weight (83.33 g), plant height (83.32 cm) and plant dry matter (41.32 g) followed by furrow + black polythene mulch (35.23 t/ha, 75.62 g, 75.66 cm,36.34g). Less weed growth was observed with furrow + polythene mulch + trellising (30.23gM^{-2}) and furrow + black polythene mulch (30.36 gM^{-2}) when compared to control (62.76 gM^{-2}). Highest net returns (102708 Rs./ha) and benefit cost ratio(2.41) recoded with furrow + black polythene mulch + trellising. Among all the treatments drip + black polythene mulch + trellising recorded highest values for all the parameters.

INTRODUCTION

Drip irrigation is very important and efficient method of irrigation when compare to other conventional method of irrigation. Drip irrigation playing very important role by using less water and getting more yields especially in the cultivation of fruits and vegetables due to precise and direct application of water in root zone. A considerably saving in water, increased growth, development and yield of vegetables under drip irrigation has been reported (Raina *et al.,* 1999; Imtiyaz *et al.,* 2000: Rajbir singh *et al.,* 2009). The use of black polyethylene mulch in vegetable production has been reported to control the weed incidence, reduces nutrient losses and improves the hydrothermal regimes of soil (Ashworth and Harrison, 1983; Chakarborty and Sadhu, 1994; Singh, 2005). Now a days there is need to get more yield by intervention of new cultivation practices. Staked or Trellising tomato given more yield and quality fruits by reducing fruit rot and other diseases than normal tomato (sowely and Dambay, 2013; Kemble *et al.,* 2004). However, there is a need to study more regarding the effect of drip irrigation plus polyethylene mulch and in conjunction with trellising compared to surface irrigation on growth and yield of tomato especially in case of light soils. As tomato is the most important vegetable crop, such information is required for developing new strategies for intensive production of vegetables. Therefore, the present investigations were undertaken to study the effect of different typesof irrigation with and without polyethylene mulch, trellising on growth, yield and water-use efficiency of tomato.

MATERIALS AND METHODS

A field experiment was conducted during 2012-2013 and 2013- 2014 at BCT – KVK instructional farm Haripuram Visakhapatnam district Andhra Pradesh India. The soil of the experimental plot was sandy loam in texture having pH 8.4, poor in organic carbon and available nitrogen, medium in phosphorus and rich in potash content. The following seven treatments were applied in a Randomized Block Design and replicated thrice: T1: Furrow irrigation; T2: Furrow irrigation with black polythene mulch; T3: Furrow irrigation+black polythene mulch with trellising T4: Drip irrigation; T5: Drip + black polyethylene mulch; T6: Drip + black polyethylene mulch with trellising; T7: control.Eavapo transpiration measured by using of USDA classes a pan. The area of plot was 16.0 m^2 and buffer zone spacing of 1.5 m was provided between the plots. In the treatment of furrow irrigation,furrow irrigation + black polyethylene mulch, 14 irrigations each of 5 cm depth were applied.Thirty days old seedlings of tomato cv. Lakshmi were transplanted on the field by using row to row and plant to plant distance of 90 and 45 cm respectively. All the recommended cultural and plant protection operations were followed to raise the healthy crop. For mulching, black polyethylene film of 50 μ thicknesses was spread manually over the prepared field and tomato seedlings were transplanted by making holes of 5 cm diameter on the film. Lateral drip lines having emitters at 45 cm distance with a discharge rate of 4 liters per hour were placed in each row of plants both in unmulched treatments and below the polyethylene mulch

treatments. Data were recorded on plant height, weed growth, fruit weight and fruit yield using standard methods. After the final harvest, the plants were cut at soil surface and the dry weight of top growth (stem and leaves) were determined after complete drying at 60°C. The water use efficiency was computed by dividing tomato yield with total water applied (cm). For economic analysis, total cost of production (fixed and operating costs of drip irrigation system) under different irrigation schedules with and without mulch was estimated (Imtiaz *et al.,* 2000). The total cost of production was calculated by adding fixed cost, operating cost and cost of cultivation. The gross returns for different treatments were calculated taking into account the wholesale prices of tomatoes. The net returns were calculated considering gross returns and total cost of production. The benefit cost ratio (B: C) was estimated dividing gross return by total cost of production for each treatment.

RESULTS AND DISCUSSION

The data on growth parameters like plant height and dry matter (Table 1) indicated that drip irrigation plus black polythene mulch treatment with trellising method recorded higher plant height (91.22 cm) and dry matter production (49.32g) of the plant over drip plus black polythene mulch (83.32 cm, 42.43 g) and drip irrigation alone (80.40 cm, 41.22 g). In case of surface irrigation furrow irrigation plus black polythene mulch with trellising recorded highest valves for plant height (86.32 cm) and dry matter production (41.32 g), followed by furrow irrigation plus black polythene mulch (75.66 cm, 36.34g) and furrow irrigation (72.32 cm, 32.40g). Lowest values were recorded with control for plant height (67.52cm, 28.12g) and dry matter production. Bhella (1988), Bafna *et al.* (1993) and Raina *et al.* (1999) also reported significantly higher plant growth of tomato with drip irrigation compared to surface irrigation. These results also in accordance with Srivastava *et al.* (1994) and Rajbir singh *et al.* (2009) while investigating effect of drip irrigation with mulch on tomato.

The results of plant growth and dry matter production reveal that while comparing trellising and other treatments,trellising tomato recorded highest values in both the treatments, drip and furrow irrigation. Trellising or staking in tomato increase the plant height and dry matter production due to more area expose to sunlight (Kemble *et al.,* 2004). Sowley and Damba, 2013 found highest plant height and dry matter production in staked or trellising tomato.

Data pertaining to fruit weight, in case of drip irrigation, highest fruit weight was recorded with drip plus black polythene mulch with trellising followed by drip with black polythene mulch and drip irrigation alone. Furrow irrigation plus black polythene mulch with trellising given highest fruit weight when compared to furrow plus black polythene mulch and furrow irrigation alone. In case of mulching treatments, with and without drip irrigation recorded maximum fruit weight irrespective trellising method.

Control recorded least fruit weight compared to all treatments. Elkner and Kaniszewski (1995) also observed significantly higher fruit weight of tomato under drip irrigation as compared to control practices.The increased yield under drip irrigation might have resulted due to better water utilization (Manfrinato, 1974), higher uptake of nutrients (Bafna *et al.,* 1993) and excellent soil-water relationship with higher oxygen concentration in the root zone (Gornet *et al.,* 1973). Srivastava *et al.* (1994) and Rajbir singh *et al.* (2009) also recorded higher fruit weight with drip irrigation and block polythene mulch.

The data on fruit yield, highest fruit yield found in the trellising tomato in case of furrow and drip irrigation. Highest fruit yield was recorded with drip irrigation plus block polythene mulch with trellising (62.21 t ha^{-1}), followed by drip irrigation with black polythene mulch (54.32 t ha^{-1}) and drip irrigation and alone (46.20 t ha^{-1}). In case furrow irrigation furrow irrigation plus black polythene mulch with trellising given highest yield(43.82 t ha^{-1}) compared to furrow irrigation with black polythene mulch(35.23 t ha^{-1}) and furrow irrigation alone(30.30). Fewer yields were recorded with control (26.23 t ha^{-1}). Surface irrigation resulted in wastage of water in deep

Table 1: Effect of different types of irrigation and growing methods on growth, and water use efficiency of Tomato.

Treatments	Plant height (cm)	Fruit weight (g)	Plant dry matter (g)	Weed growth (gm^{-2})	Water applied (cm depth)	Water use efficiency(t $ha^{-1}cm^{-1}$)
T1:furrow method	72.32	74.23	32.40	59.32	70.0	0.46
T2: Furrow +mulch	75.66	75.62	36.34	30.36	69.2	0.50
T3:furrow+mulch+ trellising	83.32	83.33	41.32	30.23	69.2	0.70
T4:drip	80.40	83.21	41.22	57.12	43.1	1.09
T5:drip+mulch	83.42	84.32	42.43	6.30	43.1	1.26
T6:drip+mulch+trellising	91.22	88.33	49.32	6.12	43.1	1.44
T7:control	67.52	67.20	28.12	62.76	70.0	0.41

Table 2: Effect of different types of irrigation and growing methods on yield and economics of Tomato

Treatments	Yield t/ha	Cost of production Rs./ha	Gross returns Rs./ha	Net returns Rs./ha	B/C ratio
T1:Furrow method	30.30	62532	121200	58668	1.93
T2: Furrow +mulch	35.23	67560	140920	73360	2.08
T3:Furrow+mulch+ trellising	43.82	72572	175280	102708	2.41
T4:Drip	46.20	74250	184800	110550	2.48
T5:Drip+mulch	54.32	78354	217280	138926	2.77
T6:Drip+mulch+trellising	62.21	87706	248840	161134	2.83
T7:Control	26.23	57456	104920	47464	1.82

percolation, leaching of available plant nutrients and poor aeration resulting in poor yield (Raina *et al.,* 1999). Our results are in accordance with the earlier findings of Bhella (1988) who observed 70% higher tomato yield under drip irrigation as compared to surface irrigation. Bafna *et al.* (1993) and Raina *et al.* (1999) also reported increase in tomato yield with drip irrigation to the extent of 40% compared to surface irrigation. Highest yield observed with plastic mulch due to less infestation of early blight in tomato (Jambhulkar *et al.*, 2012). Use of trellising with drip irrigation on tomato, yield increased up to 20 - 30 % and improved the marketable quality of the tomatofruits (Kemble *et al.,* 2004). Zhai *et al.* (2010) also found highest yield in tomato with drip irrigation. Suman Sharma *et al.* (2013) highest fruit yield found with drip irrigation along with nitrogen fertigation in guva.

The data on water use efficiency indicated that drip irrigation plus black polythene mulch gave significantly maximum water use efficiency over drip irrigation and furrow irrigation. Drip irrigation plus black polythene mulch with trellising method given maximum water use efficiency (1.44 t $ha^{-1}cm^{-1}$) followed by drip irrigation with black polythene mulch. Minimum water use efficiency was recorded with control (0.41t $ha^{-1}cm^{-1}$). In case of surface irrigation furrow irrigation plus block polythene mulch recorded maximum water use efficiency with and without trellising method.Minimum water use efficiency was recorded with control (0.41t $ha^{-1}cm^{-1}$).The result confirms the earlier findings of Bafna *et al.* (1993), *Raina et al.* (1999) and Rajbir singh *et al.* (2009) on water-use efficiency of drip irrigated tomato crop.

Application of black polyethylene mulch increased the yield under all levels of irrigation though the response was comparatively higher under drip with trellising (T_7). Higher yield under mulch treatments might be due to its favourable effect on weed control. There was complete elimination of weeds under black polyethylene mulch, whereas in unmulched plots weeding was done manually seven times during both years of experimentation. Chakaraborty and Sadhu (1994) and Singh (2005) also reported complete elimination of weeds with the use of black polyethylene. The higher fruit yield under polyethylene mulch may also be ascribed to reduced nutrient losses due to weed control and improved hydrothermal regimes of soil (Ashworth and Harrison, 1983; Bhella, 1988; Singh, 2005).

Total cost of production, gross returns, net returns and benefit: cost ratio of tomato as affected by different treatments is presented in Table 2. Trellising with black polyethylene mulch with and without drip irrigation registered higher net returns and benefit: cost ratio as compared to drip and furrow irrigation. Among different types of irrigation, drip irrigation plus black polythene mulch with trellising given maximum net returns (161134 Rs.ha-1) and higher benefit cost ratio(2.83) and followed by drip irrigation with black polythene mulch (138926, 2.77 Rs.ha-1) and drip irrigation alone(110550 Rs.ha-1, 2.48) in tomato. However, in case of surface irrigation highest net returns (102708 Rs.ha-1) and benefit: cost ratio (2.41) was found with furrow irrigation plus black polythene mulch with trellising followed by furrow irrigation with black polythene mulch (73360 Rs.ha-1, 2.08) and furrow irrigation alone (58668Rs. ha-1, 1.93). Minimum net returns (47464 Rs.ha-1) and benefit cost ratio (1.82) with control. Rajbir singh *et al.* (2009) found highest net returns and benefit cost ratio with drip irrigation with black polythene mulch while investigating on effect drip irrigation and polythene mulch growth, yield and economics in tomato cv. Rupali. Same results were found by Srivastva *et al.* (1994) while investigating on effect of drip irrigation with black polythene mulch in tomato. Sowely and Damba (2013) found highest market net returns with stalked or trellising tomato.

REFERENCES

Ashworth, S. and Harrison, H. 1983. Evolution of mulches for use in the home garden. *Hort. Sci.* **18(2):** 180-182.

Bafna, A. M., Daftardar, S. Y., Khade, K. K., Patel, P. V. and Dhotre, R. S. 1993. Utilization of nitrogen and water by tomato under drip irrigation system. *J. Water Manage.***1(1):** 1-5.

Bhella, H. S. 1988. Tomato response of trickle irrigation and black polyethylene mulch. *J. Am. Soc. Hort. Sci.* **113(4):** 543-546.

Chakarborty, R. C. and Sadhu, M. K. 1994. Effect of mulch type and colour on growth and yield of tomato. *Indian J. Agric. Sci.* **64(9):** 608-612.

Doorenbos, J., Pruitt, W. O., Aboukhaled, A. and Dastane, A. B. 1984. Guidelines for predicting crop water requirements. *FAO irrigation and drainage paper* no. 24, FAO, Rome.

Elkner, K. and Kaniszewski, S. 1995. Effect of drip irrigation and mulching on quality to tomato fruits. *Acta. Hort.* **379:** 175-180.

Gornat, B., Goldberg, D., Rimon, D. and Asher, B. J. 1973. The physiological effect of water quality and method of application on tomato, cucmber and pepper. *J. Am. Soc. Hort. Sci.* **98(2):** 202-5.

Imtiyaz, M., Mgadla, N. P., Chepete, B. and Mothobi, E.O.2000. Yield and economic returns of vegetable crops under varing irrigation. *Irrigation Sci.* **19:** 87-93.

Jambhulkar, P. P., Meghwal, M. L. and Kalyan, R. K. 2012. Efficacy of plastic mulching, marigold intercropping and fungicidal spray against early blight of tomato caused by *alternaria solani.The Bioscan.* **7(2):** 365-368.

Kemble, J. M., Tyson, T. W. and Curtis, L. M. 2004. Guide to CommercialStaked TomatoProduction in Alabama. *The Alabama Cooperative Extension System*, ANR-1156.

Locascio, S. J., Olsen, S. M. and Rhoads, F. M. 1989. Water quantity and time of N and K application of tickle irrigated tomatoes. *J. Am. Soc. Hort. Sci.* **114(2):** 265-268.

Manifrinato, H. A. 1974. Effect of drip irrigation on soil water plant relationships. *Second International Drip Irrigation Congress* pp. 446-451.

Raina, J. N., Thakur, B. C. and Verma, M. L. 1999. Effect of drip irrigation and polyethylene mulch on yield, quality and water-use efficiency of tomato. *Indian J. Agric. Sci.* **69:** 430-433.

Singh, R. 2005. Influence of mulching on growth and yield of tomato (*Lycopersicon esculentum*) in north India plains. *Vegetable Sci.* **32(1):** 55-58.

Rajbir Singh , Satyendra Kumar, Nangare, D. D. and Meena, M. S. 2009. Drip irrigation and black polyethylene mulch influence on growth, yield and water-use efficiency of tomato. *African J. Agricultural Research* Vol. **4(12):** 1427-1430.

Sowley, E. N. K. and Damba, Y. 2013. Influence of Staking And Pruning on Growth And Yield Of Tomato In The Guinea Savannah Zone Of Ghana. *International J. Scientific and Technology Research* Volume 2, Issue **12:** 103 -108.

Srivastava, P. K., Parikh, M. M., Sawani, N. G. and Raman, S. 1994. Effect of drip irrigation and mulching on tomato yield. *Agriculture water management*. **27:** 179-184.

Suman Sharma , Sanmay, K. R. Patra1, Gokul, B. Roy and Soumen, B. 2013. Influence of drip irrigation and nitrogen fertigation on yield and water productivity of guava. *The Bioscan*. **8(3):** 783-786.

Zhai, Y. M., Shao, X. H., Xing, W. G., Wang, Y., Hung, T. T. and Xu, H. L. 2010. Effects of drip irrigation regimes on tomato fruit yield and water use efficiency.Food, *Agriculture and Environment* Vol. **8, Issue 3&4:** 709-713.