



Influence of drip irrigation and polyethylene mulch on growth, yield and water productivity of tomato (*Solanum lycopersicum*) and brinjal (*Solanum melongena*) cultivars in eastern plains

SHIVANI¹, T L BHUTIA², SANJEEV KUMAR³ and A K SINGH⁴

ICAR Research Complex for Eastern Region, Patna, Bihar 800 014, India

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ABSTRACT

A field experiment was carried out during 2014-15, 2015-16 and 2016-17 in silty clay loam soil of Bihar, to study the effect of drip irrigation and black polyethylene mulch compared with furrow irrigation on growth, yield and water productivity of tomato (*Solanum lycopersicum* L.) and brinjal (*Solanum melongena* L.). Drip irrigation influenced the growth and yield characters of both vegetable crop as compared to furrow method of irrigation. Further, drip irrigation significantly increased the fruit yield of tomato and brinjal by 26.9 and 40 percent, respectively. Mulching also had a positive effect on yield attributing characters, viz. days taken to flowering, average single fruit weight and number of fruits/plant of both tomato and brinjal. Use of black polyethylene mulch gave 38.6 and 44.6% higher yield of tomato and brinjal compared with unmulched treatments (35 and 26 t/ha, respectively). Tomato variety Swarna Sampada and brinjal variety Swarna Shobha performed better over other varieties irrespective of drip and mulch. Drip irrigation in combination with black polyethylene mulch significantly increased the plant height, dry matter production, number of fruits/plant, fruit weight and finally raised the tomato yield and brinjal yield to 54.4 and 44.45 t/ha with 34% water saving. The average water productivity (17.0 and 13.9 kg/m³) of tomato and brinjal was also maximum in drip irrigated mulched crops.

Key words: Brinjal, Drip irrigation, Furrow irrigation, Polyethylene mulch, Tomato, Water productivity

Irrigation is of prime importance in cultivation of vegetable crops as it ensures favorable water balance within the root zone and fulfills the crop-water demand thereby improving crop productivity and input use efficiency. It is an important limiting factor of crop yield, because of its association with several factors of plant environment, which directly influence the crop growth and development (Yaghi *et al.* 2013). The eastern region has 18% of country's utilizable water resources (1094979 million cubic meter) with ultimate irrigation potential of 33.65 million ha meter. However, utilization of the created irrigation potential is only 65.5 %. On national level also the all India percentage of net irrigated area to total cropped area is even lower at 34.5% (FE Bureau 2017). On the other hand, the dependency on the production of irrigated land is increasing day by day to cater the needs of ever increasing population. This

calls for adoption of advanced irrigation methods such as drip irrigation for effective use and management of the available water resources and bringing more area under irrigation. In eastern region brinjal (*Solanum melongena* L.) and tomato (*Solanum lycopersicum* L.) are important vegetables and farmers generally grow them using ridge and furrow method with surface irrigation. In this method the major proportion of irrigation water is lost by evaporation and deep percolation due to which irrigation efficiency is reduced. Drip irrigation, provides frequent water application at slower rate in the vicinity of plant root zone and enable the plant to grow well without any ill- effect of water- stress between consecutive irrigations. This method has proved its superiority over other conventional method of irrigation, especially in the cultivation of fruits and vegetable due to decreased water requirement, increase in crop production and improved quality of produce (Jain *et al.* 2000).

Mulching is one of the important water management practices in which byproducts like wheat straw, rice straw, grass, sand or plastic films are spread on the soil surface to protect the soil from solar radiation or soil evaporation. Polyethylene is one of the most commonly used plastic materials for mulching because it is easy to process, odourless, has excellent chemical resistance and puncture resistance quality. It has high durability as

¹Principal Scientist (Agronomy) (sanshivani@rediffmail.com), ICAR RCER, Patna, Bihar. ²Scientist (Veg. Sci) (kikila.bhutia@gmail.com), NRC for Orchids, Pakyong, Sikkim. ³Principal Scientist (Agronomy) (shiv_sanjeev@yahoo.co.in) ICAR RCER, Patna. ⁴Principal Scientist and Head (Veg. Sci) (aksingh171162@rediffmail.com), ICAR RCER Research Centre, Ranchi, Jharkhand.

compared to other polymers. The use of polyethylene mulch in vegetable cultivation has increased by many folds throughout the world. This increase is due to benefits such as moisture conservation by reducing evaporation, control of weed incidence, regulates soil temperature, minimizes nutrient losses, reduction of certain insect pests, improves hydrothermal regimes of soil and finally high yield (Mahadeen 2014). Vegetables produced under mulch condition are free from dirt as no soil is splashed onto the produce (Vankar and Shinde 2007). The response of tomato and brinjal to drip irrigation was found to be different in different agro-climatic and soil conditions. Moreover, the response of different varieties to water may vary due to variation in water requirement, rooting pattern, transpiration rate and other morphological and biochemical processes. Numerous experiments have reported the positive response of polyethylene mulch and drip irrigation in several crops but information on combined use of drip irrigation and mulching is lacking in the eastern plains. Therefore, the present experiment was undertaken to study the influence of drip irrigation system with and without polyethylene mulch on growth, yield and water productivity of tomato and brinjal cultivars.

MATERIALS AND METHODS

The experiment was conducted during winter seasons of 2014-15, 2015-16 and 2016-17 at the ICAR Research Complex for Eastern Region, Patna (25° 35' N latitude, 85° 5' E longitude and 67 m above mean sea level), Bihar. The soil of the experimental field was silty clay loam with pH 6.8, electrical conductivity 0.2 dS/m in 1:2 soil:water solution, organic carbon 0.69%, available nitrogen 261 kg/ha, phosphorous 28.1 kg/ha and potassium 236 kg/ha. Rainfall received during crop growth period was 19.7, 6.5 and 13.5 mm, respectively during 2014-15, 2015-16 and 2016-17. The experiment was laid out in a split-split plot design with three replications allocating irrigation (drip and furrow) in the main plot, mulching (black polyethylene mulch and no mulch) in the subplot and varieties (3 each for tomato and brinjal) in sub-sub plot. The varieties included were Swarna Sampada (V_1), Swarna Naveen (V_2) and local variety (V_3) for tomato, and Swarna Pratibha (V_1), Swarna Shobha (V_2) and local (V_3) for brinjal. These varieties were developed at Research Centre, Ranchi (Jharkhand) of ICAR Research Complex for Eastern Region, Patna. One month old seedlings of tomato and 35 days old seedlings of brinjal were transplanted on 14th November each year at 75cm × 50 cm apart. The net plot size was 6 m × 4.5 m. Before planting

25 mm irrigation water was applied to all treatments to bring the soil water content up to level of field capacity in 0-60 cm soil depth. The recommended package of practices (cultural and plant protection operations) were followed to raise healthy crop of tomato and brinjal. The black polyethylene film of 50-micron thickness was used for mulching. The mulch film was spread manually over the prepared field and transplanting of seedlings was done by making holes of 5 cm diameter on the film. Recommended dose of fertilizer (100:80:80 kg NPK/ha through urea, DAP and muriate of potash) was applied to both vegetable crops. Full dose of phosphorous and potassium along with 50% nitrogen were applied as basal dose and remaining nitrogen was top dressed at 45 and 90 days after transplanting (DAT). Lateral drip lines having emitters at a distance of 50 cm were placed in each row below the polyethylene mulch as well as unmulched treatments. The water requirement for both tomato and brinjal was estimated on daily basis during the crop growth period. The volumetric water required for tomato/brinjal was computed by using the following equation:

$$V = E_p \cdot K_p \cdot K_c \cdot S_p \cdot S_r \cdot W_p$$

where, V is the volume of water required (m^3 or litre/day/plant), E_p is the value of Pan evaporation as measured by Class A Pan Evaporimeter (mm/day), K_p is Pan coefficient, K_c is crop coefficient, S_p is plant to plant spacing, S_r is row to row spacing and W_p is the fractional wetted area, which varies with different growth stages of the crop.

In the above said equation values of Pan co-efficient and crop co-efficient were taken as referred by Doorenbos and Pruitt (1977). Time required to operate drip irrigation system was calculated on daily basis taking into account the application rate per plant. However, the drip irrigation system was scheduled at one day interval and the water supplied to the plant was accumulation of two days water requirement (Table 1). Observations on water requirement, growth parameters like plant height and branches per plant were recorded at final picking stage and dry matter accumulation was recorded at first picking stage. Yield attributes at each picking stage were summed/averaged as per the case. Total yield of both tomato and brinjal was recorded and analyzed following the standard procedures.

RESULTS AND DISCUSSION

Effect of irrigation

Growth characteristics like plant height, number of branches, plant dry matter accumulation and flowering time

Table 1 Estimated water requirement for different growth stages of tomato and brinjal

Crop stage	Duration (days)	Crop coefficient	Pan coefficient	Dripper discharge (l/h)	Area occupied by the plant (m^2)	Time of operation over 2 days (min)
Initial	25	0.60	0.75	3	0.375	11.15
Mid	70	1.05	0.75	3	0.375	38.55
Late	30	0.90	0.75	3	0.375	40.26
Total	125					

of both crops were significantly influenced by irrigation method (Table 2). The results of pooled data of three years revealed that application of water through drip irrigation produced taller plants of tomato and brinjal with more number of branches. The height of drip irrigated tomato plant (101.2 cm) was 13 % more than the furrow irrigated plants (89.3 cm). Similarly in brinjal drip irrigated plants (69.1 cm) were 5.8% taller than furrow irrigated plants (65.3 cm). Singh *et al.* (2009) also reported increase in plant height and dry matter accumulation in drip irrigated tomato over furrow irrigated. This might be because of unfavourable moisture regime (moisture stress or excess) in the soil through furrow irrigation, less availability of nutrients for crop growth due to competition with weeds for nutrients. Weed biomass in the furrows was 90% lower in the subsurface drip irrigation than furrow irrigated tomato plots (Shrestha *et al.* 2007). Under drip irrigated condition the increased growth attributes might have supplied water and nutrients in adequate proportion, which resulted in triggering the production of plant growth hormone, viz. indole acetic acid (IAA) and higher number of leaves and branches throughout the cropping period (Sankar *et al.* 2008). Number of branches/plant was increased by 20% in tomato (14.3) and 12.8 % in brinjal (11.1) under drip irrigation method as compared to surface irrigation method (11.9 and 9.7 respectively). Higher plant height and more number of branches/plant were attributed to increase in dry matter accumulation in drip irrigated vegetables (Biswas *et al.* 2015). Drip irrigated tomato and brinjal attained 50 % flowering stage four and five days earlier than furrow irrigated crop (Table 2). The highest increase in the vegetative growth and earlier flowering under drip irrigation system might be due to the availability of soil moisture at optimum level in the plant root zone (Solaimalai *et al.* 2005). Slow

and frequent application of water through drip irrigation eliminates wide fluctuation of soil moisture resulting in better crop growth and yield.

Yield contributing characters like average number of fruits/plant, unit fruit weight, and yield of tomato as well as brinjal were highly influenced by irrigation methods (Table 3). Significantly higher number of fruits/plant and heavier unit fruit weight was observed under drip irrigation as compared to surface irrigation. Pooled data of three years showed the corresponding increase in number of fruits/plant and average single fruit weight with drip irrigation as 20 and 27.3 percent in tomato and 25.5 and 19.2% in brinjal. Paul *et al.* (2013) also observed significantly higher fruit weight of capsicum under drip irrigation as compared to control practices. In drip irrigation system, application of water at frequent intervals near the plant root zone increases the availability of nutrients and reduces leaching losses. More nutrient availability might have increased the translocation of photosynthates to storage organ resulting in an increased fruit weight and higher yield (Sanker *et al.* 2008). The results obtained from pooled data revealed that yield of tomato and brinjal both were significantly higher when water was applied through drip irrigation. An increase of 26.9 and 40% was found in the yield of tomato and brinjal, respectively with drip irrigation over furrow irrigation. The higher yield under drip irrigation can be attributed to the availability of optimal soil moisture regime in the crop root zone which reduced the nutrient losses. Frequent application of water under drip irrigation system prevents the plant from water stress condition and consequently produces higher yields than furrow irrigated crop. High-frequency water management by drip irrigation provides daily requirement of water to a portion of the root zone of each plant, and maintains a high soil matric potential in the rhizosphere

Table 2 Effect of irrigation method, mulch and varieties on growth parameters of tomato and brinjal (3 years pooled data)

Treatments	Plant height (cm)		No. of branches/plant		Dry matter production (g/plant)		Days to 50% flowering	
	Tomato	Brinjal	Tomato	Brinjal	Tomato	Brinjal	Tomato	Brinjal
<i>Irrigation</i>								
Furrow	89.3	65.3	11.9	9.7	200.9	207.2	66	68
Drip	101.2	69.1	14.3	11.1	240.7	229.0	62	63
CD (P=0.05)	2.4	2.1	2.1	2.2	24.5	20.1	2.3	2.2
<i>Mulch application</i>								
No mulch	82.1	74	11.3	8.5	203.1	199.7	67	68
With mulch	108.4	60.4	14.9	12.3	238.5	236.5	61	63
CD (P=0.05)	1.3	1.1	1.1	1.3	12.1	10.5	1.2	1.0
<i>Varieties</i>								
V ₁	94.0	67.2	13.7	11.5	223.5	221.5	65	66
V ₂	102.0	66.9	14.3	10.8	230.7	233.4	63	65
V ₃	89.4	67.5	11.4	8.9	208.2	199.4	64	66
CD (P=0.05)	1.9	NS	1.6	1.8	14.6	15.3	1.8	NS

Swarna Sampada (V₁), Swarna Naveen (V₂) and local variety (V₃) for tomato, and Swarna Pratibha (V₁), Swarna Shobha (V₂) and local (V₃) for brinjal.

Table 3 Effect of irrigation method, mulch and varieties on yield attributes and yield of tomato and brinjal (3 years pooled data)

Treatment	No. of fruits /plant		Average fruit weight (g)		Yield (t/ha)	
	Tomato	Brinjal	Tomato	Brinjal	Tomato	Brinjal
<i>Irrigation</i>						
Furrow	270	25.5	33.5	130.5	36.8	26.5
Drip	324	32.0	43	155.5	46.7	37.1
CD (P=0.05)	28	4	33	18	5.3	8.5
<i>Mulch application</i>						
No mulch	246.5	23.5	30	129	35.0	26.0
With mulch	347.5	34.0	46.3	157	48.5	37.6
CD (P=0.05)	15	2	3.1	13	2.8	2.01
<i>Varieties</i>						
V ₁	294	29	42.35	140	45.7	31.8
V ₂	345	34	32.6	156	40.5	35.1
V ₃	254	23.5	38.8	133	39.05	28.5
CD (P=0.05)	23	3	1.6	15	4.1	3

Swarna Sampada (V₁), Swarna Naveen (V₂) and local variety (V₃) for tomato, and Swarna Pratibha (V₁), Swarna Shobha (V₂) and local (V₃) for brinjal.

to reduce plant water stress which ultimately enhance the yield attributes and finally yield and yield quality (Lingaiah *et al.* 2005).

Effect of mulching

The results (Table 2) revealed that vegetative growth parameters of tomato and brinjal were significantly increased by using black polyethylene mulch as compared to unmulched condition. Mulching advanced the flowering stage in both the crop and allowed sufficient time for reproductive phase. The height of tomato and brinjal plants under mulch was 32 and 22.5% more than that of unmulched crop (82.1 and 74 cm, respectively). Number of branches/plant in tomato and brinjal were 31.8 and 44.7% more when grown with black polyethylene mulch as compared to unmulched crop (11.3 and 8.5, respectively). Use of polyethylene mulch retains and conserves soil moisture and improves moisture use efficiency (Kumar and Lal 2012). Unmulched crops produced lesser dry matter and branches/plant. Dry matter accumulation/plant was increased by 17.4 and 18% due to mulch application. Helaly *et al.* (2017) also reported significant effect of polyethylene mulch on vegetative characters of husk tomato. In tomato mulched crop attained 50% flowering stage six days earlier than unmulched crop while in brinjal five days earliness was observed in mulched treatment. Higher soil moisture content and soil temperature under polyethylene mulch improve the plant microclimate leading to early growth and development and finally advancement in the flowering time. Similar observations were also reported by Parmar *et al.* (2013) and Mahadeen (2014).

Mulching showed positive effect on yield and yield attributing characters such as average single fruit weight, and number of fruits/plant of both tomato and brinjal (Table 3). Jha *et al.* (2017) also reported beneficial responses of

vegetable crops to mulch in terms of growth, development and yield as compared to unmulched treatments. Number of fruits/plant and average fruit weight was .40.8% and 54.6% higher in tomato, and 54.6% and 20.9% higher in brinjal. The improvement in growth and yield attributes under mulched condition might be due to the enhancement in photosynthesis and other metabolic activities (Bhatt *et al.*, 2011 and Parmar *et al.*, 2013). In eastern plains during second fortnight of December to first fortnight of January the temperature remains very low which reduces the growth and development of plant under unmulched condition, whereas mulching decrease the fluctuations in soil temperature up to 30 cm soil depth, reduces soil compaction and improves soil condition which encourage the root growth of plants and consequently promote plant health and vigour (Snyder *et al.*, 2015). Application of polyethylene mulch influenced the fruit yield of tomato and brinjal greatly. Crop grown with polyethylene mulch increased the yield of tomato and brinjal by 38.6 and 44.6%, respectively. Higher yield under polyethylene mulch might be due to availability of sufficient soil moisture near the root zone and increase in soil temperature during severe winter days which resulted in an enhancement of soil environment around roots and further led to increasing plant growth, earlier production and ultimately higher yield. Mulching soil surface favourably influences the soil moisture regime by minimizing evaporation loss from the soil surface. As a result the extended retention and availability of moisture lead to higher uptake of nutrients, ensures better growth and finally higher yield attributes and yield (Mahadeen 2014).

Varieties

Choice of crop variety is a vital production input which plays an important role in augmenting the productivity of vegetables and considered as the important bio-innovation

that affects the livelihood and health aspects of the vegetable growers. Pooled data of three years showed that the growth, yield and yield attributing characters differed due to varieties (Table 2 and 3). In case of tomato, maximum plant height was recorded in Swarna Naveen (V_2) of tomato. The plant height of Swarna Naveen (102 cm) was 8 and 14% higher than Swarna Sampada (V_1) and local variety (V_3), respectively. Other growth characters like number of branches/plant and total dry matter also varied significantly with varieties. Swarna Naveen produced maximum number of branches followed by Swarna Sampada. Local variety produced 20.2 and 25.4% lesser branches than Swarna Sampada (13.7) and Swarna Naveen (14.3) respectively. Plants of Swarna Sampada and Swarna Naveen accumulated nearly similar amount of dry matter but were significantly superior to local variety. Reduction in dry matter production was recorded by 10.7 and 11.1% in local variety (208.2 g/plant) as compared to Swarna Sampada (223.5 g/plant) and Swarna Naveen (230.7 g/plant), respectively. In case of brinjal no significant difference in plant height was found among varieties. However, number of branches/plant and dry matter accumulation differed significantly among varieties. Swarna Pratibha produced significantly more number of branches/plant (29.2%) than local variety (8.9) but was at par with that of Swarna Shobha (10.8). Swarna Shobha produced 21.3% more branches than local variety. Similarly accumulation of dry matter/plant was lowest in local variety (199.4 g/plant), while Swarna Pratibha and Swarna Shobha were on par with each other (221.5 and 233.4 g/plant).

Yield and yield component of both tomato and brinjal were significantly influenced by varieties (Table 3). In tomato Swarna Naveen produced maximum number of fruits/plant which were 17.3 and 35.8 percent higher than Swarna Sampada and local variety, respectively. Number of fruits/plant in local variety was 15.7% lower than that of Swarna Naveen but in case of fruit weight it produced 11.9% heavier fruit than Swarna Naveen because of its bigger fruit size. However, the average fruit weight of Swarna Sampada was maximum and significantly higher than other two varieties. Tomato yield of Swarna Sampada was found significantly higher over Swarna Naveen and local variety. Swarna Sampada produced 12.8 and 17% higher tomato yield than Swarna Naveen and local variety, respectively. Yield of Swarna Naveen and local variety were statistically at par with each other. Number of fruits/plant, fruit weight and yield of brinjal variety Swarna Shobha was found respectively higher than Swarna Pratibha and local variety. Swarna Shobha produced 17.2 and 44.7 percent more fruits/plant over Swarna Pratibha and local variety, respectively. Minimum number of fruits/plant was recorded in local variety. The average fruit weight of Swarna Shobha and local variety were significantly higher than Swarna Pratibha. In case of fruit yield of brinjal maximum yield was obtained from Swarna Shobha variety which was significantly superior to Swarna Pratibha and local variety. Significant difference in yield was also obtained between

Swarna Pratibha and local variety. Swarna Shobha produced 10.4 and 23.2% more yield than Swarna Pratibha and local variety. Swarna Pratibha produced 11.6% higher brinjal yield than local variety. Increase in yield might be owing to higher yield attributes, viz. number of fruits/plant and fruit weight/plant. Swarna Sampada (V_1) variety of tomato and Swarna Shobha (V_2) variety of brinjal produced higher yield owing to either more fruit weight in case of tomato or more number of fruits and fruit weight/plant in brinjal. Sajid *et al.* (2016) also noticed the effect of varieties on yield attributes and yield of pea.

Interaction effect

The interaction effect of irrigation and mulching was found significant on yield of both vegetable crops (tomato and brinjal). Pooled data of three years showed that drip irrigation with mulch produced significantly the highest yield among other treatments followed by surface irrigation with mulch (Table 4 and 5). The beneficial effect of drip irrigation combined with mulch might be due to maintenance of balanced soil moisture in the active root zone with minimum water losses (Paul *et al.* 2013). The yield was significantly higher under both methods of irrigation in mulched treatment as compared to unmulched treatments. Furrow irrigation without mulch produced the least yield of tomato and brinjal both. Drip irrigation system with polyethylene mulch increased tomato and brinjal yield by 27.7 and 36% and 32.3 and 44%, respectively over furrow irrigated mulched crop and drip without mulch. The increased yield under polyethylene mulch irrespective of irrigation might have resulted from better water utilization, higher uptake of nutrient (Easmin *et al.* 2009) and excellent soil-water plant relationship (Biswas *et al.* 2015).

Water use and water productivity

The seasonal water use under drip irrigation was lower than furrow irrigation. Further drip irrigation coupled with

Table 4 Interaction effect of irrigation and mulching on yield of tomato (pooled data of three years)

Treatment	Polymulch	No mulch	Mean
Furrow irrigation	42.6	30.05	36.3
Drip irrigation	54.4	40	47.2
Mean	48.5	35.0	

CD (Irrigation): 5.3 ; CD (Mulch): 2.8 ; CD (Irrigation $\times$ Mulch): 3.97

Table 5 Interaction effect of irrigation and mulching on yield of brinjal (pooled data of three years)

Treatment	Polymulch	No mulch	Mean
Furrow irrigation	30.75	22.25	26.5
Drip irrigation	44.45	29.75	37.1
Mean	37.6	26.0	

CD (Irrigation): 7.2; CD (Mulch): 2.01 ; CD (Irrigation $\times$ Mulch): 2.85

Table 6 Effect of irrigation and mulching on economic water productivity and water saving (pooled data of three years)

Treatment	Rainfall (mm)	Irrigation (mm)	Yield (t/ha)		Economic water productivity (₹/m ³)		% water saved
			Tomato	Brinjal	Tomato	Brinjal	
Furrow irrigation without mulch	13.2	465	30.05	22.25	63	56	
Furrow irrigation with mulch	13.2	393	42.6	30.75	105	91	15.5
Drip irrigation without mulch	13.2	364	40.0	29.75	106	95	21.7
Drip irrigation with mulch	13.2	306	54.4	44.45	170	167	34.2

polyethylene mulch used minimum amount of irrigation water during all the three years (Table 6). Irrespective of irrigation, lesser amount of seasonal water was used by tomato and brinjal under mulched condition. Furrow irrigation without mulch used maximum amount of water for both tomato and brinjal but produced least yield among treatments.

The water productivity of both crops was higher when drip irrigation was coupled with mulching (17 and 13.9 kg/m³, respectively). Both the mulch treatments, i.e with furrow and drip irrigation showed higher average water productivity than no mulch treatments. Mulches reduced the rate of water loss through evaporation from soil surface. So, the soil- plant-water relationship was better in mulched crop and thereby increased water productivity. Average water productivity under drip irrigation was higher than furrow irrigation. Higher yield, water use efficiency and water productivity of drip over furrow method (surface) has also been reported in potatoes, tomato, pea, capsicum, Frenchbean etc (Biswas *et al.* 2015 and Jha *et al.* 2017). Least water productivity was observed in unmulched furrow irrigated treatments which might be due to more water use and lower yield than other treatments.

Application of drip irrigation with mulch saved 34% irrigation water as compared to unmulched furrow irrigation. Application of polyethylene mulch with furrow irrigation saved 15.5% irrigation water over unmulched furrow irrigation. Drip irrigation alone saved 21.7% irrigation water as compared to furrow irrigation alone (Table 6). The response of tomato and brinjal to drip either alone or with mulch was also reported by earlier investigators (Paul *et al.* 2013 and Jha *et al.* 2017) to be better in terms of water use efficiency and water saving over conventional furrow irrigation method. Bhogi *et al.* (2010) also reported that drip irrigation increase the irrigation potential by optimizing the use of available irrigation water and increase the yield of brinjal.

Economic water productivity

The economic water productivity of both tomato and brinjal crop was positively related with water productivity (Table 6) Results revealed that the economic water productivity of vegetables cultivated with drip irrigation in combination with mulching, was significantly higher over furrow irrigation method. Drip irrigation in combination with mulching used water efficiently and produced more yield

per cubic meter of irrigation water than all other treatments. Water loss through run off and evapotranspiration was much lower from real surface in drip irrigated mulched treatment, resulting in higher water productivity and economic water productivity. Drip irrigation system alone showed higher economic water productivity than furrow irrigation. Through drip irrigation precise and direct application of irrigation water is supplied in the root zone, which allows the crop to use water more efficiently as compared to furrow irrigation. Singh *et al.* (2009) also reported higher water productivity as well as economic water productivity of vegetable crops under drip irrigation system as compared to furrow irrigation system. Tomato and brinjal both have low economic water productivity under unmulched furrow irrigated system. This is mainly because of reduced yields under this method.

The result of three years study showed the significant effect of drip irrigation on the production of tomato and brinjal as compared with conventional furrow irrigation. In the absence of drip even mulch alone could increase the yield of tomato and brinjal. The use of drip irrigation with polyethylene mulch is a good option not only for water saving but also improving the quantity and quality of tomato and brinjal yield. Increased efficiency of water application in combination with increased yield, increased the water productivity as well as economic water productivity with integrated use of drip irrigation and polyethylene mulch.

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