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A Review on Performance Evaluation of Plastic mulch & Drip Irrigation in Tomato plant cultivation in Mulakalacheruvu Mandal, Chittoor District, Andhra Pradesh- A case study.

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Abstract
Tomato (Solanumlycopersicum) is the edible fruit vegetable originated in Peruvian & Mexican region. Tomato is the most important food crop in India. India is the 2nd largest nation in the world to produce tomato and it produces about 19 million tons/year. Tomato finds consumptions in many ways and most commonly as an ingredient in dishes, sauces, salads and drinks. It is a warm season crop, temperature below 10^0C and above 38^0C may adversely affect the plant tissues thereby effecting the plants physiological activities. The present study attempts to review the Plastic mulch and Drip irrigation method to grow Tomato for Madanapalle area in Chittoor district of Andhra Pradesh, India. Madanapalle is located at 13.55^0N-78.50^0E with an average elevation of 695m. This region has an average annual temperature of 30.35^0C and the average precipitation of 438mm. With the ongoing struggle and challenges of water scarcity, Drip irrigation plays a vital role to conserve the water usage and enhance the water use efficiency. Drip irrigation involves application of water to the subsurface by drops at a rate lower than infiltration rate of soil. Plastic Mulching is used to suppress weeds and conserve water by lowering evapotranspiration to enhance crop production and landscaping. The study also aims to review the effectiveness of combination of Plastic mulch and drip irrigation for water management and suggest these techniques amongst the farmer community to enhance the yield and also to battle against water scarcity.
Key words: Tomato, Mulching, Drip irrigation, Water scarcity, Infiltration, Evapotranspiration

Introduction
Tomato (Solanumlycopersicum) is the edible fruit vegetable originated in Peruvian & Mexican region. It is an important crop with a great value of nutrient source of vitamin A and C and medicinal value. This crop in India is adopted for growing in the wide range of climatic condition and ranks 2nd largest nation in production worldwide. India has exported about 267,198.49 metric tons (MT) of tomato in 2016-17. Tomato finds consumptions in many ways and most commonly as an ingredient in dishes, sauces, salads and drinks. It is a warm season crop, temperature below 10^0C and above 38^0C may adversely affect the plant tissues thereby effecting the plants physiological activities. For the fresh markets Tomatoes are grown from transplants and on plastic mulched beds (Figure 1). Drip irrigation (also known as, 'trickle irrigation', 'feeding bottle technique') in India is practiced widely especially for the fruit and vegetable crops. This technique supply right quantity of water directly into the root zone of plantation with the regular interval of time and thus optimizing the water use (Kumar et.al.,2005). This rightly matches the consumptive use of water and demand for optimal growth to enhance the growth with improved crop yield [1, 2]. Optimal utilization of water in the arid and semi-arid regions due to non-uniformity and uncertainty of rainfall has encouraged the use of more efficient methods of water application like drip irrigation.

Drip irrigation reduces the effect of Evapotranspiration drastically and cut down the exploitation of ground water usage. Water is conveyed through flexible pipes under low pressure and thus soil moisture is maintained at field capacity all the time. Drip irrigation has high duty in comparison with other conventional method. This technique was first implemented in Israel owing to the fact of scarcity of water. Thus, with an effective water saving technique up to 80% in different crop with enhanced crop yield [3], drip irrigation is widely used for all the crops except for paddy that requires standing water. According to the central institute of agriculture engineering about 39% of water can be saved by adopting drip irrigation for Tomato crop. (Table 1 and 2)

Commercial tomato producers have not fully adopted for drip irrigation technique due to cost effectiveness and intensive management process [4]. Further, due to economic viability and weak resources base farmers are often reluctant in adopting this method of irrigation. The motive behind this study was to review the Tomato plant cultivation under drip irrigation and to bring forth the efficiency of this system for growing Tomato crop.

Figure 1: Drip irrigation

Figure2: Plastic mulched beds

Table No.1: Comparison of water use in traditional and drip irrigation for Tomato crop (Source: central institute of agriculture engineering)

Traditional method		Drip irrigation method		saving of water	increase in yield
Water (mm)	Yield (t/ha)	Water(mm)	Yield (t/ha)		
33	32	180	48	39%	50%

Statistics of Tomato plantation

Tomato is the most important food crop in India. Madhya Pradesh, Andhra Pradesh and Karnataka are the leading producers of Tomato. According to the sources [5] total area under Tomato plantation in 2015-16 was 773.88 thousand hectares with a production of 18731.97 Thousand MT. Use of hybrid seeds has enhanced the yield of production. Peak harvesting season for Andhra Pradesh is January to December. Tomatoes are sensible to refrigeration and freezing. Table no. 2 shows the storage condition of this plant.

Table No.2: Storage conditions of Tomato

Particulars	Mature Green	Pink	Ripe
Temperature	13^0-18^0C	10^0-13^0C	7^0-10^0C
Relative humidity	85-90%	85-90%	85-90%
Storage period	2 -3 weeks	7-10 days	3-5 days

Statistics of Drip Irrigation

Drip irrigation minimizes the losses such as deep percolation, surface runoff and soil erosion by applying water by drops to the active root zones of the plants under cultivation. This will also help in curbing the weed growth. This method of irrigation is suitable and economical for the water scare areas and with the undulation topography, shallow and sandy soil. The greater benefits of this technique is that, it permits the application of fertilizers and pesticides along with the water and thus resulting in the healthy and higher crop yields. Drip irrigation minimizes the harvesting period (398 days) as compared to flooding method (435 days) [1]. Drip irrigation enhanced the yield in plant (39.87 t/ha) as compared with that obtained by conventional method(37.09 t/ha).[6].This system adopted for banana crop resulted double the yield in Hawaii.[7] Proper and consistent nourishment of soil by maintaining the moisture content at field capacity throughout the crop period is the key strategy behind the drip irrigation technique. Comparing with furrow irrigation, highest net returns and benefit cost ratio were obtained in drip irrigation[8]. Drip irrigation is more profitable than the conventional method (surface irrigation)[6]

Material and Method

The experiment study was conducted at Mulakalacheruvu Mandal, Chittoor District, Andhra Pradesh, India is located at 13.55^0N-78.50^0E with an average elevation of 695m. This part of the area is a Rayalaseema region of Andhra Pradesh. The summer temperatures around 36° to 38 °C. Similarly the winter temperatures are relatively low ranging around 12 °C to 14 °C. South West monsoon (June-September) is the major source of rainfall with an average of 438.00mm. The soils in the district constitute 57% red loamy, 34% red sandy and the remaining 9% is covered by black clay black loamy, black sandy and red clay. The agricultural area (0.405ha) selected for this experiment has the red loamy soil and the water source is bore well suitable for irrigation. Laboratory test results on water and soil is shown in Table no.3

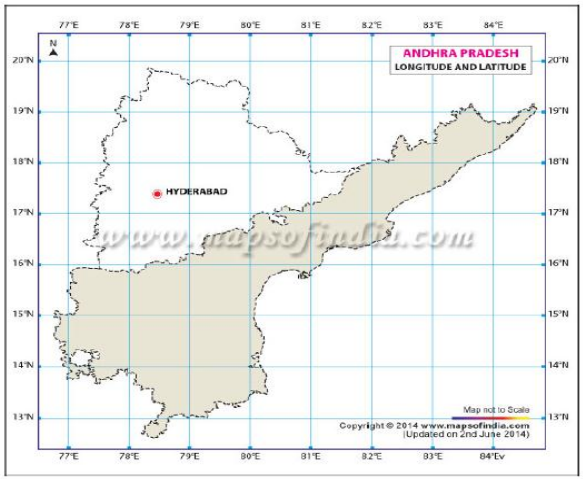

Figure 3: Chittoor District, Andhra Pradesh, India

Table No 3: Test on Water and Soil sample collected from project site

Parameters	Observed values			Standard Values
	Sample 1	Sample 2	Average	
a) Water				
pH(pH meter)	7.4	7.5	7.45	6.5-8.5
pH(pH paper)	7.2	7.4	7.3	6.5-8.5
Calcium hardness	300	290	295	0-300mg/l
Total Dissolved solids(TDS)	1030	1050	1040	0-2000mg/l
b) Soil				
Moisture content	7.407%	9.090%	8.248%	-
Liquid limit	28%	27%	28.5%	-
% of Sand	36	34	32	-
% of Silt	46	42	42	-
% of Clay	18	24	26	-

The experiment set consisted of various drip irrigation accessories, namely, screen filter, mains, sub-mains, laterals, drippers and few others. 2 numbers of 2 horse power (hp) submersible pump was used to lift the water from bore wells. 75mm and 50mm diameter main and sub-main pipes were used respectively. A single mesh screen of 100µ is the filter for irrigation water. Linear low density polyethylene pipe of 12mm diameter as laterals with dripper of 4 liters per hour (LPH) capacity was used. Plastic mulch was laid with Tomato hybrid MAHY701 seeds at zigzag spacing (Figure 4).

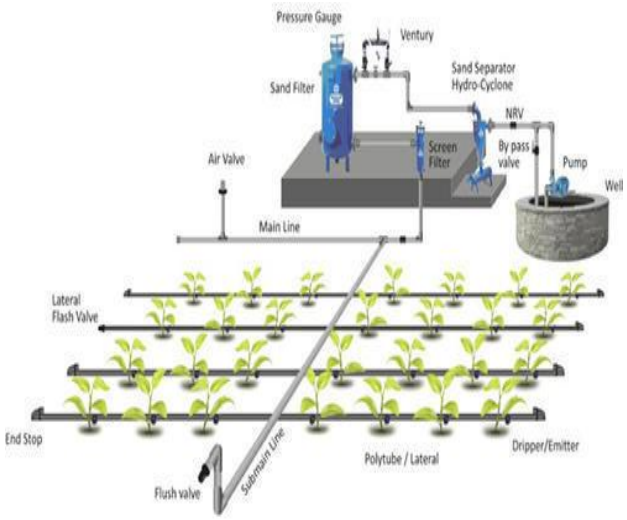

Figure 4: Drip irrigation system and accessories

Results and discussion

Economic analysis in agriculture provides necessary information and adequate knowledge on selection criteria of irrigation methods. This will help the farmer community to count on the measures of comparison namely, Cost of cultivation per hectare, Net income per hectare, Cost of production per quintal, Material cost per hectare, Input-output ratio, Income analysis and returns.

Present work focuses more on economic analysis (Table no.4 and 5). The capital investment on drip irrigation depends on the following factors:

i. Types of crops and soil
ii. Frequency of application of water
iii. Area of irrigation
iv. Topography (elevation, water sources and distances)
v. Existing farm equipment.

This study clearly suggest advantages of drip irrigation over convention methods. It is concluded from the study that drip irrigation is very efficient and effective method for cultivating tomato planation. The practice of drip irrigation among farmer community should be encouraged in tomato plantation.

Table no.4: Cost of installation and Men & material charges for drip irrigation for Tomato planation.

Sl. No	Particulars	Cost per acre (0.405ha) of land in Rs.	Remarks
1	Drip irrigation components	20,000	Equipment's include: Pipes(Laterals, Main& Sub-main pipe) Filter system, Connectors &Fittings
2	Plastic mulch, 2400mt at Rs.5 per mt.	12,000	Plastic mulch can be used for 2 crop seasons
3	Sticks, 2000 Nos. at Rs.15 per No.	30,000	Sticks can be reused for several crop seasons.

Sl. No	Particulars	Cost per acre (0.405ha) of land in Rs.	Remarks
4	Thread	15,000	used for tying the sticks with crop
5	Seeds	12,000	MAHY701 seeds
6	Fertilizer	20,000	-
7	Pesticides	12,000	-
8	Preparation of land	15,000	-
9	Hired labour	24,000	120 man-hours at Rs.200 per hour
10	Miscellaneous	10,000	-
11	Billing Tax and transportation to market	80,000	-
	Total input cost	**250,000**	-

Table no.5: Net income and input output ratio of Tomato planation.

Sl.No.	Particulars	Details for 0.405 ha. of cultivation
1	Input cost (Rs.)	250,000
2	Tomato Yield (quintal)	450
3	Selling Price(Rs./quintal)	1500*
4	Gross income	675,000
5	Net income	425,000
6	Input-output ratio	1 : 2.700

**market price varies and for the convenience of author this price is consider*

Figure5. Tomato plantation under drip irrigation at the stage of harvesting

Conclusion

Even though farmers are aware of benefits of drip irrigation system, but, they are resistant to practice this system due to insufficient information about benefits of drip irrigation system. Community training programs are much needed to ensure the adoption of this system. It is also an appeal to the venders registered under various government schemes to provide appropriate training facilities to these farmers. There is also requirement of spreading awareness of various government schemes under ***Pradhan MantriKrishiSinchaiYojana(PMKSY)***suchas, ***'JalSanchay'*** and ***'JalSinchan'*** with the theme ***'Per drop –more crop'***.

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