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Comparative Study of Irrigation Technique and Yield for Turmeric Crop: A case Study of Satara City

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Abstract: Irrigation is a technique to provide water for agricultural use. In India, most of time the agriculture sector depends on irrigation project for water supply. The monsoon season i.e. four to five months only there is precipitation. The day by day change in climate results in uneven and ununiform distribution of precipitation. The continuous rise in temperature and population creates the water shortage problem. The general tendency of farmers is, if we use more water for irrigation we have more crop yield. But sometime this logic fails due to waterlogging. In current scenario there is scarcity of water, so this work is mainly focusing on how to use water in optimum way. This research study imperates on optimum quantity of water used and crop yield. The experimental work consists of 2 hectors of turmeric field. The all conditions for growing this crop is same expect the irrigation method used. In 1 hector irrigation is done by drip and remaining by direct flooding i.e. furrow irrigation. The details studies were done for entire crop period. Analysis part consists of estimation of water, fertilizer, labor, Evapotranspiration and crop yield.
Key words: Irrigation, Methods of irrigation, Furrow irrigation, Drip irrigation, Evapotranspiration, Waterlogging.

I. INTRODUCTION

The Indian climate is characterized by mix and variable precipitation. The average annual rainfall in some areas of India is less than 100 mm per year. The Proper management of the irrigation systems is essential to achieving maximum efficiency of irrigation. The use of drip irrigation systems may provide an improvement in water use efficiency. These systems apply irrigation water directly around the root zone of crop instead of on the surface. This procedure reduces soil water evaporation losses from the soil as surface is not much wetted.

A. Irrigation may broadly be classified into

1) Surface irrigation can be further classified into

a) Flow irrigation *b) Lift irrigation*

When the water is available at a higher level, and it is supplied to lower level, by the mere action of gravity, then it is called flow irrigation.

If the water is lifted by some mechanical or manual means, such as by pumps etc. and then supplied for irrigation, then it is called lift irrigation.

2) Sub-surface Irrigation it is termed as sub-surface irrigation, because in this type of irrigation, water does not wet the soil surface. The underground water nourishes the plant roots by capillary. It may be divided into following two types:

a) *Natural sub-surface irrigation* *b) Artificial sub-surface irrigation*

B. Techniques of water distribution in the farms

There are various ways in which the irrigation water can be applied to the fields. Their main classification is as follows:

1) Free flooding or ordinary flooding: In this method, ditches are excavated in the field, and they may be either on the contour or

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up and down the slope. Water from these ditches, flows across the field. After the water leaves the ditches, no attempt is made to control the flow by means of levees, etc. since the movement of water is restricted, it is sometimes called as wild flooding.

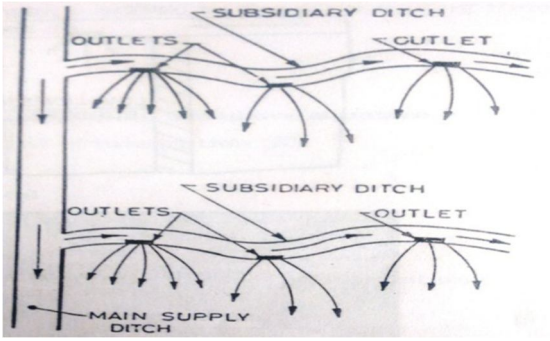

Fig.1 Free Flooding.

2) *Border Flooding:* In this method, the land is divided into number of strips, separated by low levees called borders. The land areas confined in each strip is order of 10 to 20 m in width, and 100 to 400 m in length. To prevent water from concentrating on either side of border, the land should be leveled perpendicular to flow. Water is made to flow from the supply ditch into each strip. The water flows slowly toward the lower end, and infiltrates into soil as it advances. When the advancing water reaches the lower end of strip, the supply of water to strip is turned off.

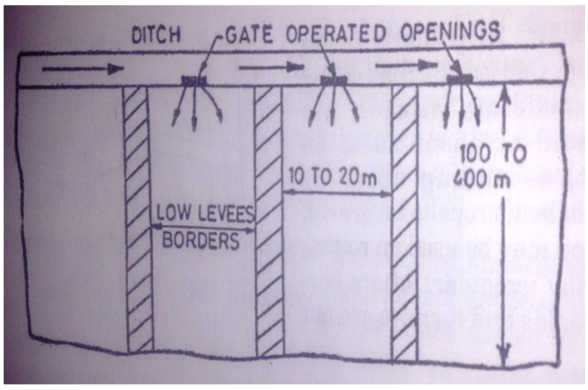

Fig.2 Border Flooding.

3) *Check Flooding:* Check flooding is similar to ordinary flooding except that water is controlled by surrounding the check area with low and flat levees. Levees are generally constructed along contours, having vertical interval of about 5 to 10 cm. this levees are connected with cross levees at convenient place. The confined plot area varies from 0.2 to 0.8 hectors. In check flooding, the check is filled with water at fairly high rate and allowed to stand until the water infiltrates. This method is suitable for more permeable soil as well as less permeable soil. The water can be quickly spread in case of high permeable soil, thus reducing the percolation losses. The water can also be held on the surface for a longer time in case of less permeable soils, for assuring adequate penetration. These checks are sometime used to absorb water, where the stream flow is diverted during periods of high run off.

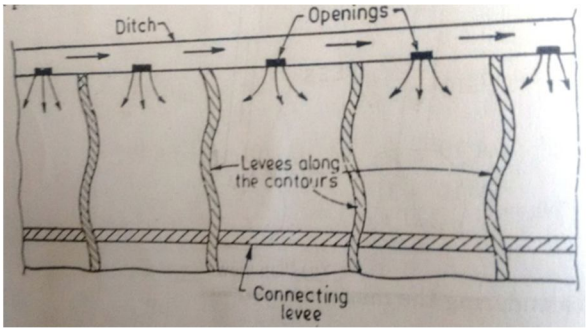

Fig. 3 Check Flooding.

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4) *Basin Flooding:* This method is special type of check flooding and is adopted specially for orchard trees. One or more trees are generally placed in the basin and the surface is flooded as in check method, by ditch water.

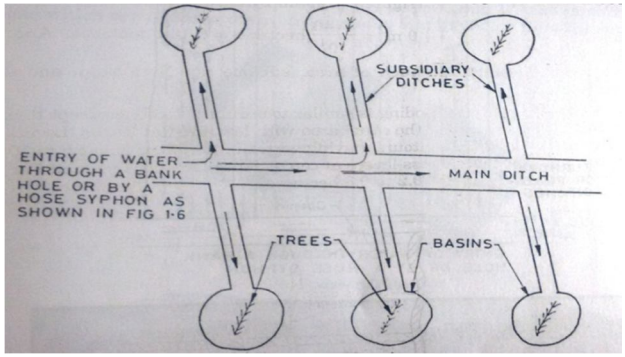

Fig. 4 Basin Flooding.

5) *Furrow Irrigation Method:* In flooding method water covers the entire surface while in furrow irrigation method, only one half portion of land surface is wetted by water. It therefore, results in less evaporation, less pudding of soil, and permits cultivation sooner after irrigation.

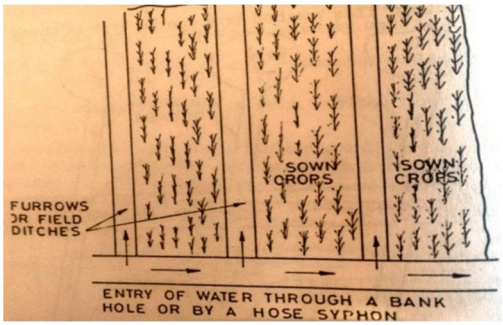

Fig. 5 Furrow Irrigation Method.

Fig.6 Sprinkler Irrigation method

Furrows are narrow field ditches, excavated between rows of plants and carry irrigation water through them. Spacing of furrows is determined by the proper spacing of the plants. Furrow vary from 8 to 30 cm deep, and may be as much as 400 m long.

6) *Sprinkler Irrigation method:* In this farm water application method, water is applied to the soil in the form of spray through a network of pipes and pumps. It is kind of artificial rain and, therefore, gives very good results. It is a costly process and widely used in U.S.A. It can be used for all types of soils and for widely different topographies and slopes. This method is not only costly but requires a lot of technicalities.

7) *Drip irrigation method:* Drip irrigation also called as trickle irrigation, is the latest field irrigation technique and is meant for adaption at place where there exist acute scarcity of irrigation water and other salt problem. In this method, water is slowly and directly applied to the root zone of crop of the plants, thereby minimizing the losses by evaporation and percolation.

This system involves laying of system of head, mains, sun mains, laterals, and drop nozzles. Water oozes out of these small drip nozzles uniformly and at a very small rate, directly into plants root area.

The head consist of pump to lift water, so as to produce desired pressure of about 2.5 atmospheres, to ensure proper flow in system. The lifted irrigation water is passed through a fertilizer tank, so as to mix the fertilizer directly in irrigation water, and then through a filter so as to remove suspended particles, to avoid clogging of drip nozzles.

The mains and sub-mains are the specially designed small size pipe, made up of flexible material like black PVC. The laterals are very small sized usually 1 to 1.25 cm dia, specially designed of black PVC.

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Fig. 7 Drip Irrigation Method.

Laterals can usually be up to 50 m long, and one lateral line is laid for each row of crop. The drip nozzles also called emitters or valves are fixed on laterals at regular interval of about 0.5 to 1 m so as to discharge water at small and with uniform rate.

II. LITERATURE STUDY

Low cost drip – Cost effective and precision irrigation tool in BT cotton, Published by Project Coordinator & Head under the Project National Agricultural Innovation Project "A Value Chain for Cotton Fiber, Seed and stalks: An Innovation for Higher Economic Returns to Farmers and Allied Stake Holders" Central Institute for Cotton Research. In this work after a field experiments on cotton crop author concluded that drip irrigation saves about 41.8% water than that of surface flooding. Also crop yield by drip is about 1.5 times more than furrow irrigation method.

The Comparison of Drip vs. Furrow Irrigation Systems and its Effects on California Agriculture. The main goal for this project is to analyze whether there is a year-to-year trend of more efficient watering practices being applied to farm crops. The following illustrates the core Tasks of the project: 1) Understand which methods of irrigation are most efficient in terms of water use efficiency. 2) Research water usage data from the Monterey County Water Resources Board to gather year-to-year data on how many acres of farmland in Monterey County were applied with water from furrow vs. drip irrigation. Efficiency of drip vs. furrow irrigation system with variable plant density on cotton under southern Punjab climatic conditions by Dilbaugh Muhammad. The conclusions of this study are water used by cotton crop by drip is 93 mm and that by furrow irrigation is 210 mm. the water saving by drip irrigation is about 53.30%.

III. MATERIAL AND METHODS

The working site is of Satara district at Kshetramahuli. A small village 5 km away from Satara city. The work consists of practical study on 2 hector turmeric crop field. 1 hector under drip and 1 hector under Furrow irrigation. The water available for site is of Krishna River, Canal system of Dhom Dam and Private well system. For study purpose well irrigation is preferred so to have calculation of water quantities.

An open well of size (15'x15'x10') feet is selected. The quantity of water is calculated from number of times well is to pump out. The field is located 500 m from well site. From well to site there is underground pipeline provided to carry water. A pump of 5 Hp is provided to lift water. All above mechanism for both fields is same, that is for drip irrigated field and Furrow irrigated field.

Now, in furrow irrigation field Furrows are prepared with the help of tractor. The lateral that is small series of furrows is formed manually to irrigate field. In drip irrigation, small laterals which are made up of Black PVC is prepared with machine and spread with the help of labors. The all required things are noted throughout from sowing to harvesting of turmeric crop. The technology and material are used which is locally available.

The main aim of study was to know the better method of irrigation for turmeric crop. For that all expenses and effort is note down. The mitigation on scarcity of water is one of the objectives of the study.

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Fig. 8 Field Drip

Fig.9 Field Furrow

Fig. 10 Drip Crop

Fig.11 Furrow Crop

Fig.12 Mature Drip Crop

Fig.13 Mature Furrow Crop

IV. RESULTS AND DISCUSSION

The study was conducted in field at Kshetramahuli, Dist- Satara, State- Maharashtra (India). The all reading of water and respective thing are subjected to Satara region. The labor rate, water rate , fertilizer rate and processing rate are related to that area, this rate may change place to place depend on region.

In India monsoon season is from June to September end approximately. The all agricultural activities like watering, tiling;

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ploughing and Weedering are almost close during this time. So there is no any expense in terms of labor or extra manure. The all reading was taken actually monitoring the field by author. The labor rate for field is about 200 rs. The fertilizers are given in liquid form for the crops in drip irrigation. The separate arrangement of pumps and filter is provided for that.

TABLE: 1 DETAIL OF WATER QUANTITY AND WEEDING.

Month	Watering times (nos.)		Quantity of water used(m^3)		Weedering (nos.)	
	Furrow Irrigation	Drip Irrigation	Furrow Irrigation	Drip Irrigation	Furrow Irrigation	Drip Irrigation
May	2	2	13500	9000	1	1
June	3	2	20250	9000	2	1
July	--	--	--	--	--	--
August	--	--	--	--	--	--
September	--	--	--	--	2	1
October	1	--	6750	--	1	--
November	3	2	20250	9000	--	--
December	3	2	20250	9000	--	--
January	4	3	27000	13500	--	--
February	3	2	20250	9000	--	--
Total	19	13	128250	58500	6	3

TABLE: 2 DETAILS OF WEEDING AND FERTILIZERS COST

Month	Weedering (nos.)		Weedering (Cost) rs.		Fertilizers cost (rs)	
	Furrow Irrigation	Drip Irrigation	Furrow Irrigation	Drip Irrigation	Furrow Irrigation	Drip Irrigation
May	1	1	14000	8000	30000	10000
June	2	1	28000	--	--	--
July	--	--	--	--	--	--
August	--	--	--	--	20000	3000
September	2	1	--	8000	--	--
October	1	--	14000	--	--	--
November	--	--	--	--	2500	1000

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December	--	--	--	--	--	--
January	--	--	--	--	--	--
February	--	--	--	--	--	--
Total	6	3	56000	16000	52500	14000

TABLE: 3 DETAILS OF RAW AND PROCESSED TURMERIC QUANTITY AND COST

Month	Raw turmeric/ hector(ton)		Processed Turmeric/hector (ton)		Cost of Harvesting turmeric (rs)	
	Furrow Irrigation	Drip Irrigation	Furrow Irrigation	Drip Irrigation	Furrow Irrigation	Drip Irrigation
March	12	18	9	14	60000	60000

TABLE: 4 DETAILS OF TURMERIC QUANTITY AND COST

Items	Furrow Irrigation(rs)	Drip Irrigation(rs)
Preparation of field	25000	40000
Seed Cost	45000	45000
Cost of water	18000	7000
Cost of Weeding	56000	16000
Cost of Fertilizers	52500	14000
Harvesting and Treatment	60000	60000
Electricity Cost	19500	10000
Other Maintenance	12000	20000
Cost of Final Product in market (rs)	5.4 lac	8.4 lac
Net Profit to Farmer (rs)	2.52 lac	6.28 lac

Byreferring local market rate for turmeric is 15000/- per 100kg for processed turmeric.

V. CONCLUSION

Turmeric *(Curcuma longa L)*, is the ancient and important spice of Indian Agriculture. It is also known as 'Indian saffron'. It is an important commercial spice crop grown in India. It is used in diversified forms as a condiment, flavouring and coloring agent and as a principal ingredient in Indian culinary as curry powder. The day by day change in climate due to various reasons, results in ununiform precipitation. The amount of water for agriculture purpose so goes on reducing. Thereby we have to use water in optimum way and have good income. The conclusions of this study are

A. The drip irrigation is seems to a better irrigation technique to turmeric crop, than that of furrow irrigation.
B. In the drip irrigation only area around the root zone get wetted, so as to reduce evaporation and percolation losses than furrow irrigation.
C. As less area get submerged or wetted less vegetation in drip irrigation so reduce lobour cost for ploughing or for weeder.
D. Fertilser and manures can be directly supplied at root zone so reduction in quantity and cost for labor.

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E. Fertilizers cost reduces up to 72% in drip irrigation.

F. In comparison with Furrow irrigation the saving of water about 54% in drip irrigation.

G. Watering frequency is getting reduced due to drip irrigation.

H. Crop yield is increased by drip irrigation up to 1.5 times more than yield in furrow irrigation method, as drip reduces waterlogging effect.

I. So the advantages by drip over furrow irrigation are increased crop yield, Proper use of land, reduced water quantity, labor cost and waterlogging effect.

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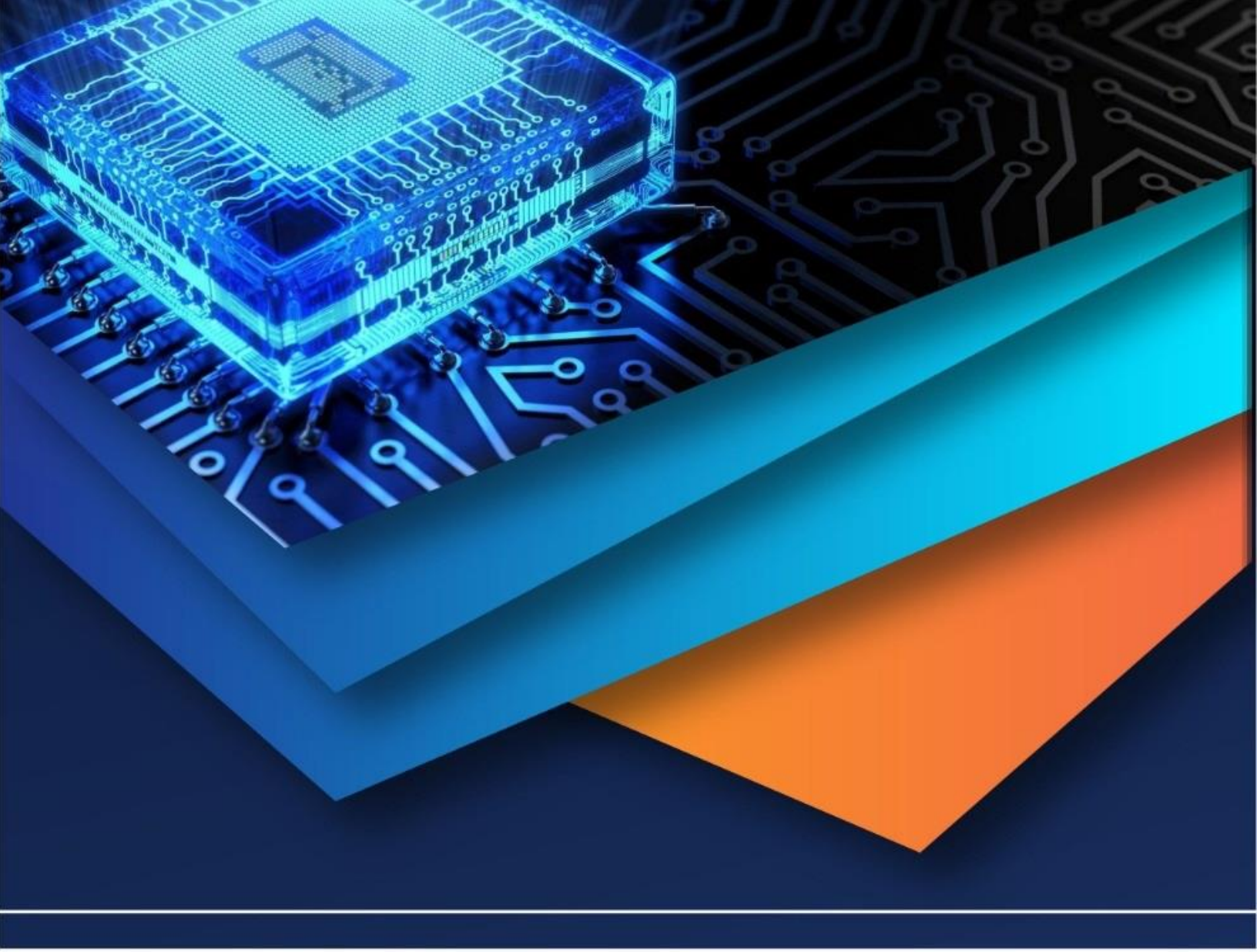

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