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Water Management for Pomegranate Orchards

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Abstract

Pomegranate has been an export-oriented crop for the last one or two decades and its area and production is growing rapidly in India. Domestic production and export demand are the driving forces behind the country's cultivation. India ranks first in the world in pomegranate production and Maharashtra is leading in pomegranate production in the country. Pomegranate production in Maharashtra is water deficient and hence water management is very important for pomegranate orchards to achieve targeted productivity. Therefore crops need to be irrigated as required. The water requirement of pomegranate orchards depends on the age of the plant, fruit load, season and soil type. In this study, we have given average monthly irrigation water requirement for pomegranate orchards in Maharashtra according to the age of the orchards. Also we have given the average irrigation water requirement in Ambe, Mrig and Hasta bahars of pomegranate orchards according to their age, season and growth stages.

Key words : Reference crop evapotranspiration, crop coefficient, pomegranate orchards, water management, ambe, mrig and hasta bahar.

Rainwater is the main source of water. Water is a limited resource and its efficient use is important especially in a country like India having growing population. Human actions such as rapid urbanization, ever-increasing population and deforestation have hampered the natural water cycle. This environmental imbalance resulted in uncertainty, irregularity and variability in regular rainfall. Currently, the world is facing challenges such as increasing demand for water, unequal distribution of water and declining water resources. The combined effect on agriculture has been such that crop planning and water management have become difficult and complex. Water management has a unique general importance in crop production. Water is the most important factor for crop production and crops (plants) need constant water. Both water scarcity and excess directly affect the growth and development of plants, resulting in adverse effects on their production and quality. Knowledge of reference crop evapotranspiration is required to determine irrigation water requirement, proper irrigation schedule and proper water management. The water requirement of the crop indicates the amount of water required to compensate for the evapotranspiration loss from the field grown in the specified period. Crop water requirement is usually expressed in liters/day, millimetre/day, millimetre/month or millimetre/season and is used for management purposes.

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Status of Pomegranate Cultivation in India : Pomegranate has been an export-oriented crop for the last one or two decades and its area and production is growing rapidly in India. Domestic production and export demand are the driving forces behind the country's cultivation. India ranks first in the world in pomegranate production and Maharashtra is

leading state for pomegranate production in the country. Maharashtra accounts more than 70% of the total area under pomegranate cultivation. Pomegranate is mainly grown commercially in Solapur, Sangli, Nashik, Ahmednagar, Pune, Satara, Osmanabad, Aurangabad, Dhule and Latur districts of Maharashtra. Ganesh, Saffron, G-137, Arakta and Mridula are the pomegranate varieties. Although India is the world's largest producer of pomegranate, the productivity per hectare of pomegranate is very low compared to other countries. Improper water management is one of the root causes.

Materials and Methods

Study Area : The study was carried out especially for Solapur, Sangali, Satara, Pune, Ahmednagar and Nasik districts of Western Maharashtra which is under water scarcity zone.

Data Collection : Meteorological data of 44 years (1975-2018) : Daily parameters (i.e. maximum temperature (Tmax, °C) and minimum temperature (Tmin, °C), maximum relative humidity (RHmax, %) and minimum relative humidity (RHmin, %), pan evaporation (Epan, mm), wind speed (WS, km hr^{-1}) at height of 2.0 m, sun shine hours (SSHr, hr), rainfall (R, mm)) etc. collected from

Indian Meteorological Department, Pune and crop coefficient (kc) values collected from unpublished PhD thesis submitted at MPUAT, Udaipur.

Estimation of Reference Crop Evapotranspiration : The most common FAO-56 Penman-Monteith equation was used for the estimating ETr for the present study (Allen *et al.*, 1998). The daily values of ETr¬ were calculated by given equation,

$$ET_r = \frac{0.408\Delta(R_n - G) + \gamma\left(\frac{900}{T+273}\right)u_{2(e_s - e_a)}}{\Delta + \gamma(1 + 0.34u_2)}$$

Where, ETr = reference evapotranspiration, (mm day^{-1}), G = soil heat flux density, (MJ m^{-2} day^{-1}), Rn= net radiation, (MJ m^{-2} day^{-1}), T = mean daily air temperature, (°C), γ = Psychometric constant, (k Pa $°C^{-1}$), Δ = Slope of saturation vapour pressure function, (k Pa $°C^{-1}$), es= saturation vapour pressure at air temperature T, (kPa), ea= actual vapour pressure at dew point temperature, (kPa) and u^2= average daily wind speed at 2 m height, (m sec^{-1}).

Crop Coefficient (kc) : The crop coefficient values (1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} years orchard) used for different Phenological stages i.e. new leaf initiation, crop development, crop maturity and crop harvesting (Meshram, 2010).

Pomegranate Evapotranspiration (ETp) : The values of average ETr and kc (1^{st}, 2^{nd}, 3^{rd}, 4^{th}, and 5^{th} years orchard) used to obtain Bahar-wise values of Pomegranate evapotranspiration (ETp) by equation,

$$ET_p = ET_r * K_c$$

Where, ET_p = Pomegranate evapotranspiration (mm day^{-1}), ET_r = Reference crop evapotranspiration (mm day^{-1}) and k_c = Crop coefficient of pomegranate.

Pomegranate Water Requirement (WR) : Water Requirement (lit day^{-1} $tree^{-1}$) = (Plant to Plant spacing * ET_p* Wetted area) / Drip Efficiency

Result and Discussion

Water Management : Pomegranate production in Maharashtra is water deficient and hence water management is very important for pomegranate orchards to achieve productivity. Crops need to be irrigated as required. Reference crop evapotranspiration is an important component of water requirement and

changes with climate, hence it is necessary to estimate reference crop evapotranspiration for different regions/districts. It is also important to know the crop coefficient according to the stage/age of pomegranate growth to consider the difference in water requirement at different stages/ages of pomegranate cultivation. Therefore, it is necessary to develop crop coefficients and determination of the water requirement of pomegranate for different regions. The water requirement of pomegranate orchards depends on the age of the plant, fruit load, season and soil type. The average irrigation water requirement for pomegranate orchards in Maharashtra on a monthly basis is shown in Table 1. The average irrigation water requirement of pomegranate orchards for ambe, mMrig and hasta bahars according to their age, season and growth stage are shown in Table 2, 3 and 4 respectively. While to determine the water requirement of pomegranate orchards, reference crop evapotranspiration has been studied for last 40 and more years in the major pomegranate growing districts of Maharashtra.

Table 1. Water Management of Pomegranate Orchards for Western Maharashtra

Month	Water Requirement (liters day^{-1} tree^{-1})				
	1st year	2nd year	3rd year	4th year	5th year and above
January	4	7	15	19	21
February	5	9	19	25	27
March	6	9	24	31	33
April	7	10	28	36	39
May	7	11	30	39	43
June	5	8	22	28	31
July	4	7	16	21	23
August	3	5	16	21	23
September	3	6	16	21	23
October	3	6	16	21	22
November	3	6	14	19	20
December	3	7	13	17	19

Water Application : Drip/micro irrigation system is use to irrigate pomegranate orchards. Drip/micro irrigation system is a technology of irrigating plants through a network of pipes. This helps to supply filtered water directly to the roots of the plant. Drip irrigation with one lateral and two drippers, for the first two years is use for watering pomegranate orchards; while drip irrigation with two laterals and four drippers from the third year to the fourth year; and from the fifth year onwards if the size of the trees

Table 2. Water Management in Ambe Bahar of Pomegranate Orchards for Western Maharashtra

Phenological Stages	Month	Water Requirement (liters day^{-1} tree^{-1})				
		1st year	2nd year	3rd year	4th year	5th year and above
Stress	December	3	7	13	17	19
New Leaf Initiation	January	4	7	15	19	21
Crop Development	February	5	9	19	25	27
	March	6	9	24	31	33
Maturity	April	7	10	28	36	39
	May	7	11	30	39	43
Harvesting	June	5	8	22	28	31
	July	4	7	16	21	23
Rest	August	Reduce water application				
	September					
	October					
	November					

Table 3. Water Management in Mrig Bahar of Pomegranate Orchards for Western Maharashtra

Phenological Stages	Month	Water Requirement (liters day^{-1} tree^{-1})				
		1st year	2nd year	3rd year	4th year	5th year and above
Stress	May	7	11	30	39	43
Crop Development	June	5	8	22	28	31
	July	4	7	16	21	23
	August	3	5	16	21	23
Maturity	September	3	6	16	21	23
	October	3	6	16	21	22
Harvesting	November	3	6	14	19	20
	December	3	7	13	17	19
Rest	January	Reduce Water Application				
	February					
	March					
	April					

Table 4. Water Management in Hasta Bahar of Pomegranate Orchards for Western Maharashtra

Phenological Stages	Month	Water Requirement (liters day^{-1} tree^{-1})				
		1st year	2nd year	3rd year	4th year	5th year and above
Stress	August	3	5	16	21	23
Crop Development	September	3	6	16	21	23
	October	3	6	16	21	22
	November	3	6	14	19	20
Maturity	December	3	7	13	17	19
	January	4	7	15	19	21
Harvesting	February	5	9	19	25	27
	March	6	9	24	31	33
Rest	April	Reduce Water Application				
	May					
	June					
	July					

grows too much, drip irrigation with two laterals and six drippers is to be done.

Inspection : Avoid excessive watering during the resting period until fruiting occurs. Gradually increase the quantity of water as required during the fruit growth period. Just keep increasing the quantity a month before the fruit harvesting and gradually reduce in the last month of harvesting. While gradually increase or decrease the watering but how much to reduce or increase, suppose you watered the fruit-garden today as shown in the tables, the next day after 24 hours measure the soil moisture, go 15-20 cm deep from the roots of the plant and take a soil sample. Close your fist to collect the soil in the fist.

If soil sample remains loose, mold has not forms, irrigate the crop as per the schedule provided in the tables.

If mold of the soil sample forms, throw it on the ground; if the mold breaks, assume the water is perfect, no need of watering. Next day after following the same procedure, decide whether it is necessary to irrigate or not.

If the mold of the soil sample forms and does not burst when thrown on the ground, it means water is high; irrigation is not necessary. Next day, fallow same procedure and decide whether it is necessary to irrigate or not.

Conclusion

Enhancing pomegranate farm productivity and income it is necessary to apply the exact amount of water to the crop as per its requirement in order to manage the scare water resources efficiently and judiciously. Thus farmers will be benefitted with water saving with higher water use efficiency.

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References

Allen, R. C., Smith, L. S., Pereira, D. R. and Smith, M. 1998. Crop Evapotranspiration. Guideline for Computing Crop Water Requirements. FAO Irrigation and Drainage Paper 56. FAO Rome. Italy. P. 300.

Meshram, D. T. 2010. Stochastic Modelling of Evapotranspiration of Pomegranate (*Punica granatum* L.). An unpublished thesis submitted to Maharana Pratap University of Agriculture and Technology, Udaipur - 313 001.