International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 3, April 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# Assessment of Crop Water Requirement for Wheat and Mustard Crop in Dharta Watershed

**Dashora, R.[1], Singh, P. K.[2], Purohit, R. C.[3], Kothari, M.[4], Jain, N.[5], Kothari, S.[6]**

[1]Research Scholar, Department of Soil and Water Engineering,
[2,4]Professor, Department of Soil and Water Engineering,
[3]Ex-Professor, Department of Soil and Water Engineering,
[5]Assistant Professor, Department of Electrical Engineering,
[6]Ex Professor, Department of Renewable Energy Engineering,
[1, 2, 3, 4, 5, 6]College of Technology and Engineering, MPUAT, Udaipur, Rajasthan, India

**ABSTRACT**

In countries where water resource is limited, assessment of crop water requirement is essential for judicial use of those resources. In most of the semiarid regions ground water is major source of irrigation for Rabi and Summer season. So pre assessment of crop water requirement helps farmers in decision making during cropping in Rabi and Summer season. From study crop water requirement of mustard and wheat crop was found about 226.7 mm and 319.3 mm. Irrigation requirement of Mustard and Wheat crop was found about 214.5 mm and 291.7 mm.

***KEYWORDS:*** *Crop water requirement, irrigation requirement, Dharta Watershed*

***How to cite this paper:*** Dashora, R. | Singh, P. K. | Purohit, R. C. | Kothari, M. | Jain, N. | Kothari, S. "Assessment of Crop Water Requirement for Wheat and Mustard Crop in Dharta Watershed" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-3, April 2020, pp.984-988, URL: www.ijtsrd.com/papers/ijtsrd30738.pdf

**IJTSRD30738**





## INTRODUCTION

Irrigation water covers major share of water consumption on Earth. Irrigation water defined by an adequate quantity of water, used in irrigation system for sustainable plant growth. About 70 percent of total fresh water in world used in irrigation. In India kharif cropping was dependent on monsoon but Rabi and Summer cropping mostly dependent on Ground water or reserved surface water like dam etc. Crop water requirement is an essential component for judicious irrigation planning in agriculture sector. Assessment of crop water requirement is dependent on climatic condition, rainfall and crop details. This study was conducted at small watershed scale like Dharta watershed. In watershed area groundwater is a major source of irrigation water. Most of the part of groundwater was used in Rabi season because Kharif was dependent on monsoon. The amount of supplemental irrigation given in Kharif was counted negligible consumption of groundwater. To identify actual groundwater consumption for irrigation purpose in Rabi season, estimation of crop water requirement of major crops grown in area was done. Major crops grown in watershed area in year 2014-15 was Wheat and Mustard.

## MATERIALS AND METHODS

**Location of Study Area:**

The study had been conducted in Dharta watershed situated in Bhinder block of Udaipur District, Rajasthan. The study area lied between the 73° 05' to 73° 15' N latitudes and 24° 30' to 24° 37' E longitudes and falls in Survey of India (SOI) top sheets of 45L/12. The area of watershed was about 6305 ha.

**Data Collection:** Mean monthly meteorological Data for Year 2014 was collected from nearest meteorological laboratory situated at College of Technology and Engineering. Parameters required for calculation were Maximum temperature (°C), Minimum temperature (°C), Relative Humidity (%), Wind speed (km/day), Sunshine (hrs). Rainfall data (mm) were collected in watershed area by semi-automatic tipping bucket instrument for year 2014.

**Estimation of crop water requirement:** To develop water management strategies, knowledge of actual water requirement of crops grown in area was essential. Estimation of actual crop water requirement for crops grown

in watershed area was done from CROPWAT 8.0 software. The determination of the Crop Water Requirement by this model depends on the determination of the reference evapotranspiration values using the available climatic data, rainfall data and crop information.

**Irrigation Scheduling:** Irrigation Scheduling is combination of two concepts: 1). When to irrigate and 2). How much to irrigate. Both the concepts are dependent on water requirement of crop. Time of irrigation is estimated on the basis of moisture content available in soil before application of irrigation. Amount of water given to the crop is subtraction of effective rainfall from crop water requirement. Irrigation scheduling will be done through CROPWAT 8.0 software.

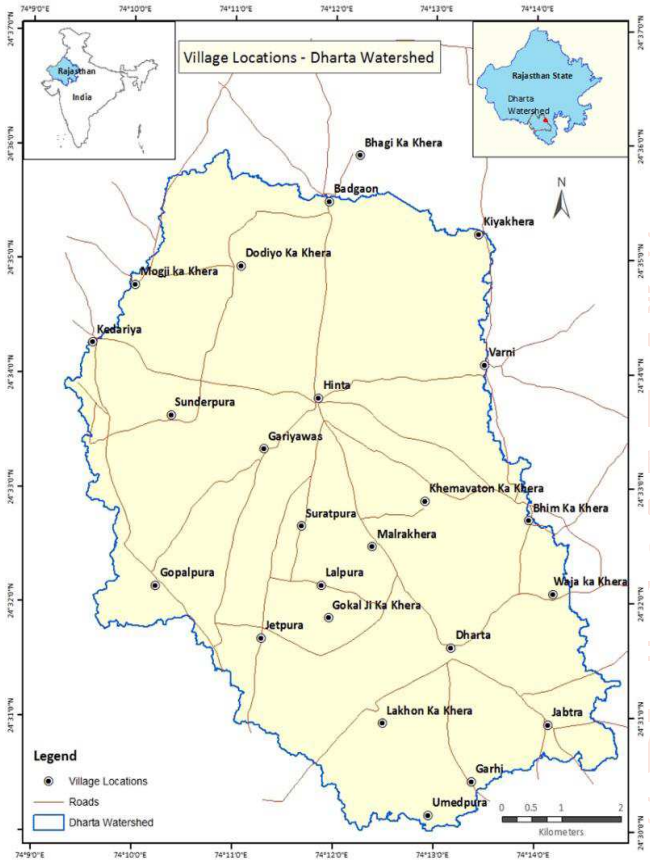



**Fig 1: Location Map of study area**

**Description of CROPWAT Model:** CROPWAT 8.0 was a computer program for the calculation of crop water requirements and irrigation requirements from existing or new climatic and crop data. Furthermore, the program allows the development of irrigation schedules for different management conditions and the calculation of scheme water supply for varying crop patterns. These data can be directly entered CROPWAT or imported from other applications. For the calculation of crop water requirements (CWR), CROPWAT needs evapotranspiration (ETO) values. CROPWAT allows the user to either enter measured ETO values, or to input data on temperature, humidity, wind speed and sunshine, which allows CROPWAT to calculate ETO using the Penman-Monteith formulae. The FAO Penman-Monteith method is recommended for determining $ET_0$ because it provides values that are very consistent with actual crop water use data worldwide, as it has been demonstrated through many years of evaluations reported in the scientific literature. This method overcomes the shortcoming of previously recommended methods, and explicitly incorporates both physiological and aerodynamic parameters. Moreover, procedures have been developed for using this method even with limited climatic data.

**Input Data used in Software:** The software required monthly climatic data like minimum maximum temperature (°C), sunshine hours, humidity (percent), wind speed (km/day) and rainfall data (mm) of year 2014-15 which were shown in Fig 2 and Fig 3. Crop details were shown on Fig 4 and Fig 5. These all details shown in window of CROPWAT 8.0 software so that anyone can understand the feeding and view of software.

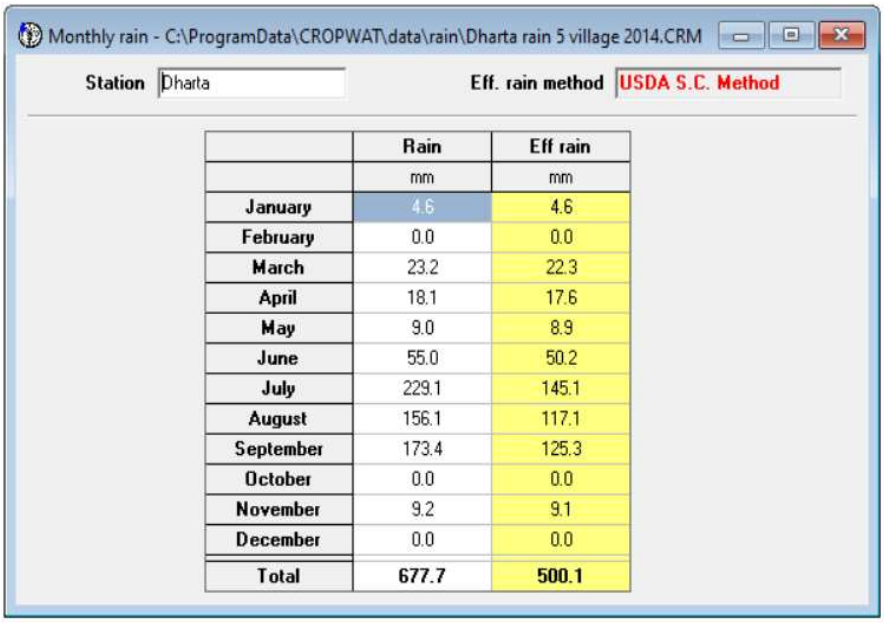
Monthly ETo Penman-Monteith - C:\ProgramData\CROPWAT\data\climate\ck ayra climate da...

Country: india  Station: ctae

Altitude: 582 m.  Latitude: 24.00 °N  Longitude: 73.00 °E

| Month | Min Temp | Max Temp | Humidity | Wind | Sun | Rad | ETo |
|---|---|---|---|---|---|---|---|
| | °C | °C | % | km/day | hours | MJ/m²/day | mm/day |
| January | 5.6 | 23.6 | 59 | 74 | 9.1 | 16.7 | 2.49 |
| February | 7.3 | 25.9 | 52 | 86 | 9.6 | 19.5 | 3.20 |
| March | 12.8 | 31.4 | 39 | 112 | 9.8 | 22.3 | 4.63 |
| April | 18.9 | 35.8 | 31 | 147 | 10.2 | 24.6 | 6.28 |
| May | 24.1 | 37.8 | 35 | 183 | 10.3 | 25.4 | 7.41 |
| June | 25.4 | 35.8 | 54 | 214 | 8.3 | 22.5 | 6.71 |
| July | 24.0 | 30.7 | 75 | 181 | 4.6 | 16.8 | 4.32 |
| August | 22.9 | 29.5 | 79 | 126 | 4.5 | 16.2 | 3.74 |
| September | 20.9 | 30.7 | 69 | 102 | 7.7 | 19.7 | 4.31 |
| October | 15.5 | 32.4 | 53 | 78 | 9.3 | 19.7 | 4.08 |
| November | 10.4 | 28.7 | 54 | 78 | 9.1 | 17.1 | 3.18 |
| December | 6.5 | 25.0 | 58 | 67 | 8.9 | 15.8 | 2.46 |
| Average | 16.2 | 30.6 | 55 | 121 | 8.4 | 19.7 | 4.40 |

**Fig 2: Monthly Climatic data of study area for crop year 2014-15 used in CROPWAT software**




| | Rain | Eff rain |
|---|---|---|
| | mm | mm |
| January | 4.6 | 4.6 |
| February | 0.0 | 0.0 |
| March | 23.2 | 22.3 |
| April | 18.1 | 17.6 |
| May | 9.0 | 8.9 |
| June | 55.0 | 50.2 |
| July | 229.1 | 145.1 |
| August | 156.1 | 117.1 |
| September | 173.4 | 125.3 |
| October | 0.0 | 0.0 |
| November | 9.2 | 9.1 |
| December | 0.0 | 0.0 |
| Total | 677.7 | 500.1 |

**Fig 3: Monthly rainfall and effective rainfall (year 2014-15) of the study area used in CROPWAT 8.0 software**

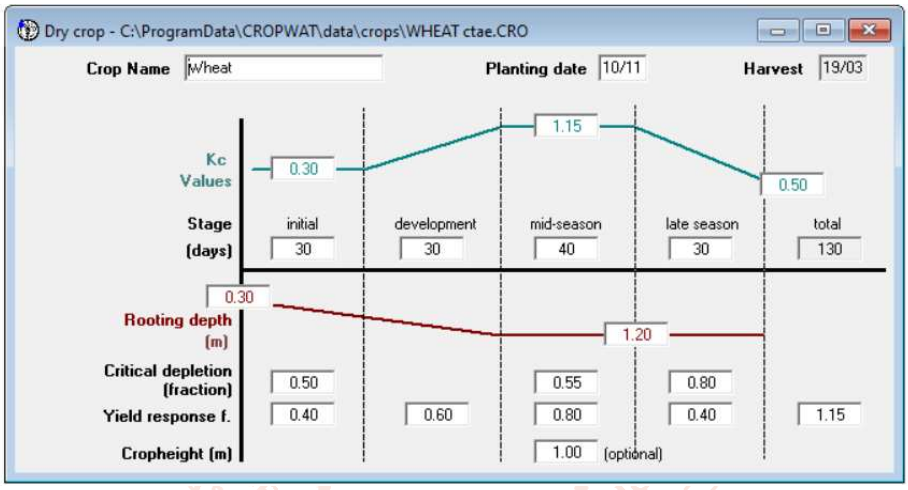



**Fig 4: Crop details of Wheat crop**

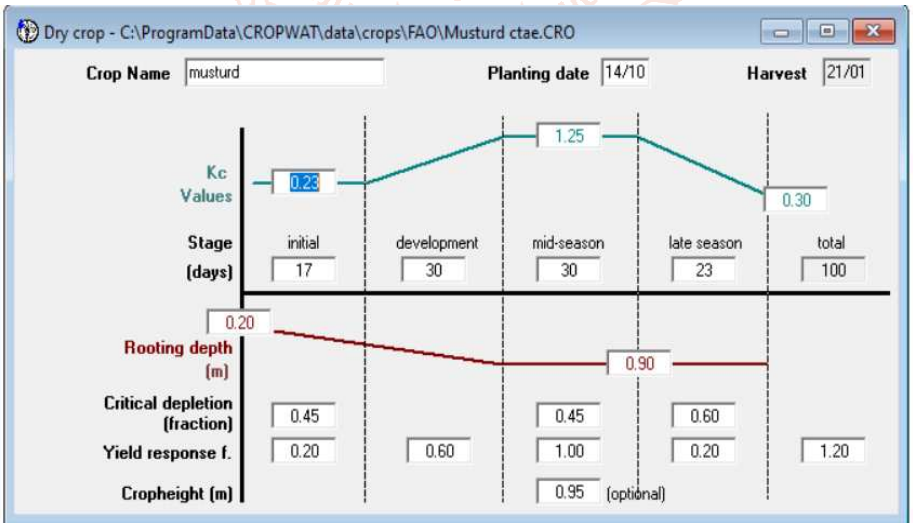



**Fig 5: Crop details of Mustard crop**

In figure 2, 3, 4,5 all data were feeded manually. In fig 2, Radiation (MJ/m2/day) and ET0 (mm/day) were calculated by software from details of minimum and maximum temprature, relative humidity, wind speed and sunshine hrs.

**RESULTS AND DISCUSSION**

**Crop water requirement:** Reference evapotranspiration was depndent of climaic conditions of area and particular time. Cropping period of Mustard crop and Wheat crop was about mid October to january end and mid November to March end. For mustard crop highest ET0 was found at the time of plantation. For Wheat crop Highest ET0 was found in March month.

After feeding these climatic, rainfall and crop data, software will automatically calculated decadal crop water requirement Etc and irrigation requirement. Calculation output of CROPWAT 8.0 software were shown in Table 1 and 2. From Table 1, it was found that range of Etc values found about 0.88 mm/day to 3.39 mm/day for mustard crop. Due to low effective rainfall quantity, Crop water requirement and irrigation requirement was about same. For Wheat crop Etc values ranged in between 0.81 mm/day to 3.99 mm/day. In late stage (Feb-march) temperature increased and results in increased evapotranspiration which increase crop water consumption.

**Table 1: Crop water requirement of Mustard crop from CROPWAT 8.0 software**

PLANTING DATE 14/10/2014

| Month | Decade | Stage | Kc | Etc | ETc | Eff rain | Irr. Req. |
|---|---|---|---|---|---|---|---|
| | | | coeff | mm/day | mm/dec | mm/dec | mm/dec |
| Oct | 2 | Init | 0.23 | 0.94 | 6.6 | 0 | 6.6 |
| Oct | 3 | Deve | 0.23 | 0.88 | 9.7 | 0 | 9.7 |
| Nov | 1 | Deve | 0.45 | 1.58 | 15.8 | 2.5 | 13.2 |
| Nov | 2 | Deve | 0.79 | 2.53 | 25.3 | 3.8 | 21.5 |
| Nov | 3 | Mid | 1.13 | 3.33 | 33.3 | 2.5 | 30.8 |
| Dec | 1 | Mid | 1.26 | 3.39 | 33.9 | 0.1 | 33.8 |
| Dec | 2 | Mid | 1.26 | 3.09 | 30.9 | 0 | 30.9 |
| Dec | 3 | Late | 1.24 | 3.08 | 33.8 | 0 | 33.8 |
| Jan | 1 | Late | 0.94 | 2.34 | 23.4 | 1.3 | 22.2 |
| Jan | 2 | Late | 0.53 | 1.32 | 13.2 | 1.9 | 11.3 |
| Jan | 3 | Late | 0.3 | 0.82 | 0.8 | 0.1 | 0.8 |
| | | | | | 226.7 | 12.4 | 214.5 |

**Table 2: Crop water requirement of Wheat crop from CROPWAT 8.0 software**

PLANTING DATE 14/11/2014

| Month | Decade | Stage | Kc | Etc | ETc | Eff rain | Irr. Req. |
|---|---|---|---|---|---|---|---|
| | | | coeff | mm/day | mm/dec | mm/dec | mm/dec |
| Nov | 2 | Init | 0.3 | 0.95 | 6.7 | 2.7 | 4.8 |
| Nov | 3 | Init | 0.3 | 0.88 | 8.8 | 2.5 | 6.3 |
| Dec | 1 | Init | 0.3 | 0.81 | 8.1 | 0.1 | 8 |
| Dec | 2 | Deve | 0.38 | 0.94 | 9.4 | 0 | 9.4 |
| Dec | 3 | Deve | 0.67 | 1.66 | 18.3 | 0 | 18.2 |
| Jan | 1 | Deve | 0.97 | 2.42 | 24.2 | 1.3 | 22.9 |
| Jan | 2 | Mid | 1.16 | 2.89 | 28.9 | 1.9 | 26.9 |
| Jan | 3 | Mid | 1.16 | 3.17 | 34.8 | 1.3 | 33.6 |
| Feb | 1 | Mid | 1.16 | 3.44 | 34.4 | 0 | 34.4 |
| Feb | 2 | Mid | 1.16 | 3.71 | 37.1 | 0 | 37.1 |
| Feb | 3 | Late | 1.08 | 3.99 | 31.9 | 0.1 | 31.8 |
| Mar | 1 | Late | 0.89 | 3.7 | 37 | 5.8 | 31.2 |
| Mar | 2 | Late | 0.68 | 3.13 | 31.3 | 8.7 | 22.6 |
| Mar | 3 | Late | 0.54 | 2.78 | 8.3 | 2.1 | 4.5 |
| | | | | | 319.3 | 26.6 | 291.7 |

In year 2014 ETc of mustard crop was found about 226.7 mm and irrigation requirement was about 214.5 mm. Dahiphale et al (2015) reported crop water requirement of mustard crop was about 229.6 mm for Jaisamand command of Udaipur District which was similar to findings of the current study. ETc and irrigation requirement of wheat crop for year 2014 was found about 319.3 mm and 291.70 mm respectively. Dahiphale et al (2015) reported crop water requirement of wheat crop was about 303.7 mm for Jaisamand command of Udaipur District which was similar to findings of the current study. Chavan et al (2009) also reported similar values of water requirement of wheat crop ranges between 309 to 363 mm for semiarid region. Arya et al (2017) also calculated crop water requirement of wheat was about 335 mm for Som Kagdar irrigation project in Udaipur region.

**Irrigation Schedule:**

Irrigation schedule was suggested for both Mustard and Wheat crop according to their crop water requirement from CROPWAT Software. Fig 6 and Fig 7 Shown suggested irrigation schedule. From Fig 6 it can be viewed that highest water required at 60 days after sowing. But in Wheat crop (from Fig 7) Highest water required at 105 days after sowing.

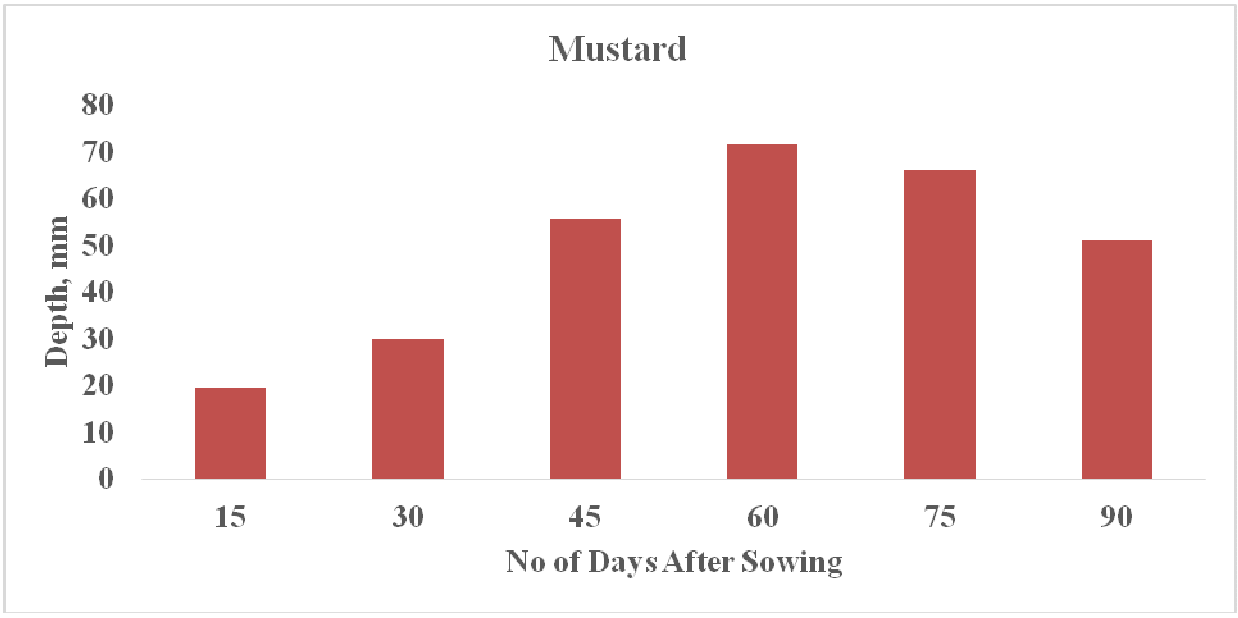



**Fig 6: Irrigation Schedule for Mustard crop at Fixed interval per stage (15 days)**

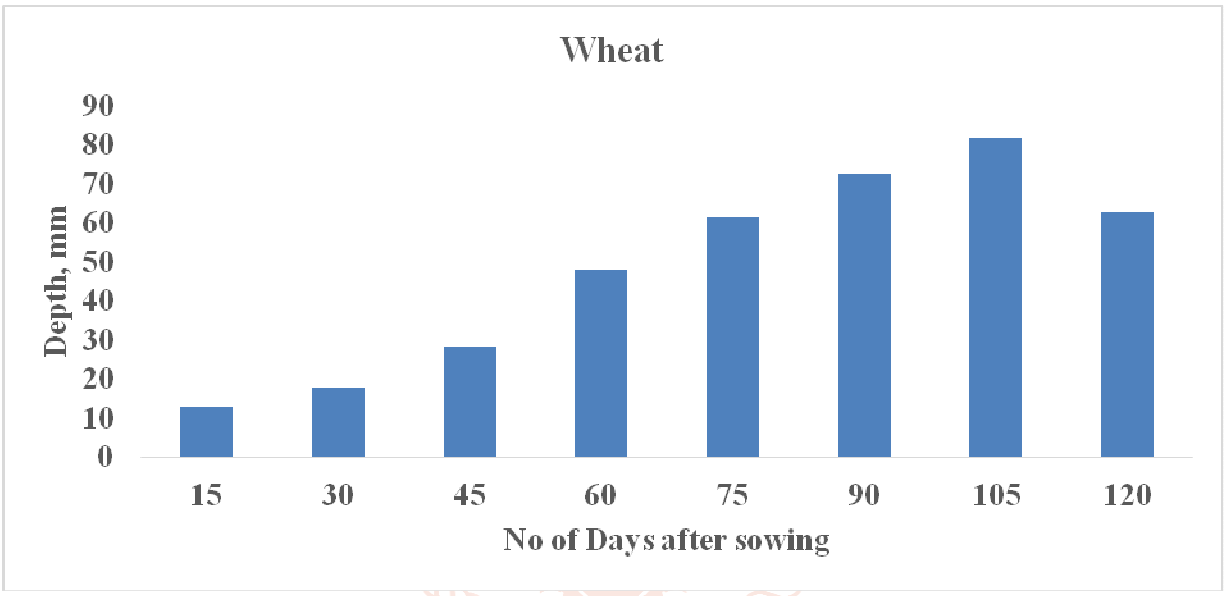



**Fig 7: Irrigation Schedule for Wheat crop at Fixed interval per Stage (15 days)**

## CONCLUSION

It was concluded from the study, crop water requirement is function of climatic condition, effective rainfall. It also depends on planting date of crop. CROPWAT 8.0 is a user friendly software for assessment of crop water requirement with easily available climatic and rainfall data. From the above study it can be concluded that Etc dependent of reference evapotranspiration (ET0 value) and Kc value of crop.

## ABBREVEATION

Kc = Crop Coefficient
ET0 = Reference Evapotranspiration, mm
Etc = Crop Evapotranspiration, mm
Irri. Req. = Irrigation Requirement, mm
Km/Day = Kilometre Per Day
Hrs = Hours
°C = Degree Celsius
Mm= Milli metre
% = Percent

## REFERENCE

[1] Arya, C. K., Singh, B., Purohit, R. C. and Dashora, L. K. 2017. "Development of Rotational Water Allocation Plan for a Command Area of Som-Kagdar Irrigation Project". *International Journal of Current Microbiology and Applied Sciences,* 6 (8) pp. 1808-1817.

[2] Chavan, M. L., Khodke, U. M. and Changade, N. M. 2009. Estimation of crop water requirement for irrigation planning in a semi-arid region. *International Journal of Agricultural Engineering,* 2 (2) pp: 236-242.

[3] Dahiphale, P., Singh, P. K., Kothari, M. And Garde, K. 2015. "Optimal Cropping Pattern for Jaisamand command of Udaipur district in Rajasthan, India. *Research Journal of Recent Sciences, Vol. 4, 1-7.*