Eco. Env. & Cons. 30 (2) : 2024; pp. (796-799)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i02.062

Assessment of Length of Growing Period Based on Index of Moisture Adequacy

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(Received 7 October, 2022; Accepted 7 December, 2023)

ABSTRACT

An agro climatic study was conducted at Akola region of Maharashtra using database of 47 years (1970-2016) to assess the length of growing period for Akola. The analysis of length of growing period done on weekly basis. The average annual rainfall for Akola estimated as 796.44 mm. The rainfall more than 30 mm was found to occur during 24 to 36 SMW and the highest weekly rainfall 56.62 mm found to occur in 32 SMW. The PET was observed more than 70 mm from 18 to 22 SMW. Mean LGP based on I_{ma} was 150 days, with 38.29 % of the total years recording LGP ≥ 160 days. The total rainfall of 1316.8 mm was available for 168 days of LGP in the year 1988. From the mean annual rainfall (796.44 mm) and length of growing period (150 days) the region was subjected to mild type of drought where crops can be grown with slight or no moisture limitation. It is therefore recommend planning the crops having crop period equal to or less than 150 days during *kharif* season.

Key words : *Assessment of Length, Moisture Adequacy*

Introduction

In the wet and dry climate, the length of growing season is mainly controlled by the availability of water. However, depending on rainfall in the determination of the length of growing season of agricultural crops could be of great risk in farming operations. This is because the difference in the soil with regards to the storage capacity and availability of soil moisture strongly influence agricultural potentialities than the volume of rainfall. This may be due to the fact that rainfall might runoff without entering the soil, particularly on hilly terrain. Hence, the balance between water within the root zone of the soil caused by rainfall and the water loss resulting from evapotranspiration is of fundamental significance in the determination of length of growing season of agricultural crops in the area. Therefore, rainfall (P) and potential evapotranspiration (PE) are pre-requisite parameters in the determination of growing season. However, the difficulty encountered in using the rainfall and PE model lies mainly in the inability to properly measure or estimate the components.

The length of the growing season in any given region represents the number of days the plant growth takes place. Information on length of growing period of a particular region helps in selection of cultivar (short / medium / long duration) of a particular crop. Knowledge on the date of onset of rains will help to plan the agricultural operations better, particularly, land preparation and sowing. The

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'length of the rainy season' is the duration between the onset and end of agriculturally significant rains. The length of the growing period (LGP) is defined as the length of the rainy season. This includes the period of soil moisture storage at the end of the rainy season, the post rainy season and winter rainfall, which can meet the crop water needs. Therefore, the LGP depends not only on the rainfall distribution but also on the type of soil, soil depth and water retention characteristics of the soil, air temperatures and daylight hours. Several methods were used to estimate the LGP using rainfall. The objective of this study is to identify the length of growing period based on index of moisture adequacy (IMA) for crop planning.

Materials and Methods

Location of Study Area

The study was conducted in Vidharbha region of Akola, Maharashtra state, which is situated between 20^0 70' N latitude and 77^0 02' E longitudes. It is at an altitude 282 m above sea level. Akola has a tropical wet and dry climate. The region is classified as hot moist semi- arid climate with medium and deep clay black soil (shallow loamy to clay black soil), medium to high AWC and LGP of 120-150 days. The mean daily relative humidity during monsoon, winter and summer is 73, 54 and 36% respectively. The rate of evaporation reaches up to 25.4 mm per day during May.

Data Collection

Daily rainfall, maximum and minimum temperature, relative humidity, bright sunshine hours and wind velocity data for Akola was collected from All India Coordinated Research Projects on Agrometeorology, Dr. PDKV Akola for period of 47 years from 1970-2016. The average AWHC was considered as 137.2 mm per metre depth for the deep clay black soil under the study (Anonymous, 2013, 2014, 2015). The average initial soil moisture was computed by using CROPWAT software. The average initial soil moisture was 115.0 mm per meter depth of soil was used for study.

Methodology

Computation of Potential evapotranspiration (PET)

The Penman-Monteith method is FAO recommended standard method and requires data as input at a greater extent. Daily meteorological data of maximum and minimum temperatures, wind speed, relative humidity, sunshine hours and solar radiation data is required by this standard method.

PET Calculator software Version 3.0 developed by Central Research Institute for Dryland Agriculture Hyderabad-59 was used for computation of potential evapotranspiration using the Penman-Monteith method (Rajasekhar *et al.*, 2015). The input parameters for the PET calculator software were weekly maximum temperature, minimum temperature, weekly relative humidity, weekly wind speed and weekly sunshine hours for Akola.

Length of growing period (LGP)

For determining the length of growing period (LGP), which is also regarded as the water availability period under rainfed condition, the concept of index of moisture adequacy (IMA), which is the ratio between AET and PET, has been considered. Since the study area falls under dry sub humid climatic condition, the onset of growing season was considered at a week when IMA was greater than or equal to 0.75 (Gupta *et al*., 2010), which is considered as the minimum moisture level for starting the sowing of rainfed crops. The termination of growing period was taken at a week from where IMA is less than 0.25 (Krishnan *et al.*, 1980).

For determination of LGP on weekly basis 'Weather Crop software' developed by All India Coordinated Research Project on Agrometeorology. Central Research Institute for Dryland Agriculture Hyderabad-59 was used.

Results and Discussion

Rainfall analysis

Rainfall analysis was carried out according to Standard Meteorological Weeks starting from 1st January to 31st December. Average weekly rainfall was estimated from the daily rainfall data during the period of 47 years from 1970-2016. The average weekly rainfall with coefficient of variation for 47 year for Akola station is presented in Fig. 1.

The results showed that the average weekly rainfall was 10 mm during 23rd and 41st week of year with 143.02 % and 225.53 % coefficient of variation and more than 40 mm during 24th to 35th week of the year. The rainfall more than 50 mm was observed during 31st to 32nd week of the year with 100.18 %

and 109.17 % variation. The maximum rainfall was found in 32nd week (56.62 mm) and minimum rainfall was found in 7th week (0.18 mm). The maximum variation was found in 15th SMW up to 541.14 % variation.

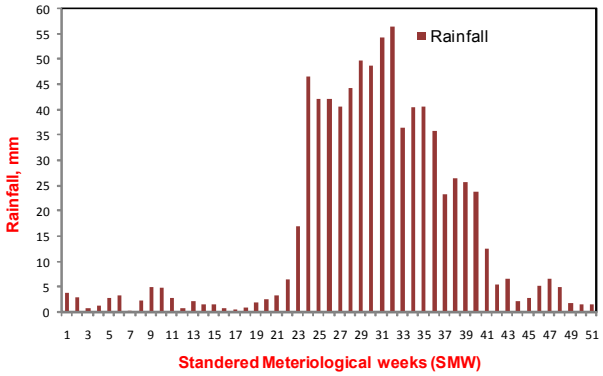

Fig. 1. Average weekly rainfall for Akola during 1970-2016

Analysis of potential evapotranspiration

'PET Calculator' software used to compute PET by Penman-Monteith method (FAO). Results show that average PET was greater than 40 mm during 9 SMW to 11 SMW, whereas the average PET was greater than 70 mm from 18 SMW to 22 SMW. PET was below 30 mm found in 46 SMW to 4 SMW except 52 SMW that is November to February month. There is no week found where PET was less than 20 mm. The highest PET was observed in 21 SMW weeks that is 81.12 mm with 17.10 % of coefficient of variation and the lowest was observed in 1 SMW week, i.e. 25.72 mm with 19.28% variation.

Length of Growing Period on the basis of Index of moisture adequacy (I_m)

The results on LGP showed that the earliest start of LGP occurred in 22 SMW in 1980 and 2000, whereas the delayed start of sowing week appeared in 30 SMW in 2004. From the values of the ends of LGP during different years, it was apparent that the earliest withdrawal of LGP occurred in 40 SMW and 46 SMW during 1980 and 2011, whereas the latest end of LGP was found to occur in 54 SMW in years 1986. Total length of LGP which was calculated over the period between start and end of LGP for each individual year revealed that the lowest LGP of 98 days was recorded in 2014, as against the highest LGP of 217 days in 1986.

When averaged over 1970-2016, it was observed that mean LGP accounts for 150 days with CV of 14%. Thus, it is obvious that there was variation in LGP year to year as evidenced by higher CV values. Out of 47 years, 63.82% of years recorded LGP being above the mean value and 36.18% years being below mean LGP. Out of the total number of years under study, 85.10% of the years recorded LGP e" 160 days.

The frequency of start of LGP at various SMWs was calculated which showed that frequency of occurring of start of sowing week varied from 2.2 % in 23-25 SMW. Thus, it is concluded that the sowing window in the region could be fixed during 22-25 SMW and hence, the farmers of the region could be alerted for undertaking sowing of rainfed crops during this period, i.e. from 22-25 SMW.

The result also showed that the total rainfall of 1316.8 mm was available for 168 days for year 1988. It also found that 217 days of LGP total rainfall was 785.7 for the year 1986. The lowest LGP of 98 days was recorded that 538.5 mm rainfall was available in 2014.

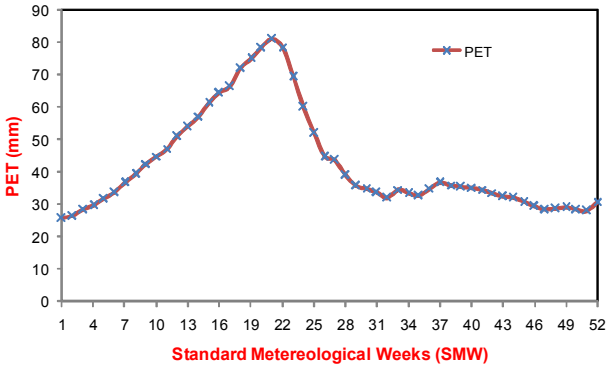

Fig. 2. Average weekly potential evapotranspiration for Akola

Conclusion

The information on LGP estimated through the water balance could be of immense help for crop planning under rainfed condition because of its utility in selection of crops or a variety under a crop in agreement with the duration of water availability period. The results revealed that in most of the years, the adoption of double cropping under rainfed condition could be feasible.

Under average rainfall condition, the LGP could be as high as 196 days extending from 23 to 50 SMW. When averaged over 1970-2016, the mean LGP becomes 150 days with CV of 14.42 %. Out of the total number of years under study, 85.10% of the

years recorded LGP ≥ 160 days. Appropriate crops and varieties under a crop matching with water availability period for making the sequential cropping during and seasons more successful should be selected under rainfed condition. The double cropping with maize in the season followed by the short duration rapeseed and pulses in season could be better choice for potential productivity evaluation under rainfed condition in the region. The sowing period identified for study area lies during 22-25 SMW during which the sowing of rainfed crops could be recommended for farmers.

Conflict of Interest: None

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