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Crop Planning with Probability Analysis

R D Bansod

Author's Affiliation: Professor and Head, Department of Agriculture Engineering Section, College of Agriculture, Pune, Maharashtra 411 005, India.

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Abstract

Daily rainfall data (1994-2013) for Pune station was analysed to estimate the averages of weekly, monthly, seasonal and annual rainfall and its variability. Probability analysis showed that occurrence of probable rainfall was of 448.1 mm, 68.1 mm, 10.5 mm and 600.8 mm respectively for the Kharif, Rabi, summer and annual at 76% confidence level, the occurrence of rainy days was found to be 41, 33, 4 and 1 day for the annual, Kharif, Rabi and summer season, respectively. The highest rainfall of 1376.2 mm is recorded in the month of July 2013. The rainfall was assured during standard meteorological Week 24 to 27 and 32 to 40. Occurence of dry spell is also seen indicated the need of construction of water harvesting structures for life saving irrigation for the survival of crops. Keeping in view the rainfall pattern and its distribution in the area, suggestions have been made to modify the microclimate with respect to crop planning to increase the quality and productivity under rainfed conditions. Different cropping strategies are suggested such as selection of early maturing varieties, change in crops, cropping pattern, rainwater harvesting techniques.

Keywords: Crop planning; Probability; Rainfall; Weibull plotting method.

Introduction

The amount of rainfall and its distribution is very important characteristics that affect the agricultural productivity in the rainfed regions (Subash et al., 2012). Rainfall being the only source of moisture for crops in rainfed farming, its prediction for occurrence over period of time based on past records is very important for crop planning using any reliable methods (Bouman and Young 2001; Mishra, et al., 2003; Srivastava, et al., 2004; and Burns, et al., 2007). Probability analysis is one of the reliable tools for predicting the rainfall behaviour and has been used extensively by many researchers for successful crop planning (Panigrahi & Panda, 2002; Mukesh, et al., 2011; Jakhar et al., 2011; Subudhi et al., 2012). There are large variations in the quantity of rainfall received within state. With these views, the present study was carried out to study rainfall and rainy days variability pattern, probability analysis of rainfall and rainy days and suggesting crop planning for Pune taluka.

Materials and Methods

Pune station is located at 18031' N latitude and 730 51' E longitudes. The daily rainfall data of 20 years (1994-2013) for Pune station was collected from IMD. The collected daily rainfall data then converted into weekly, monthly, seasonally viz. kharif (June-September), Rabi (October-January) and summer (February - May) and annual rainfall distribution patterns were critically examined and simple statistics such as mean, standard deviation and coefficient of variation of rainfalls and rainy day

Corresponding Author: R D Bansod, Professor and Head, Department of Agriculture Engineering Section, College of Agriculture, Pune, Maharashtra 411 005, India.

E-mail: rtuljapur1808@gmail.com

estimated. The probability analysis was performed using Weibull plotting method (Chow, 1964), which is as follows:

$$P = [m/(n + 1)] * 100$$

Where, P is the plotting position (%)

m is the rank of data

n is the total number of record years.

The recurrence intervals were calculated using the following relationship T = 1/P in which T is the return period (years).

Result and Discussion

The highest and lowest values of annual rainfall are 1978.9 mm and 424.7 mm is recorded during year 2013 and 2002 respectively and it is also seen that highest and lowest values of rainy days are 75 and 35 recorded in year 2005 and 2002 respectively. The highest seasonal rainfall 1921.1 mm recorded during Kharif (June-September) season of 2013 and 2012 recorded the lowest rainfall 369.4 mm which is 261% and 50% of average seasonal rainfall (734.9 mm). The highest number of rainy 65 in 2005 and lowest rainy days 28 in 1995 are recorded. During Rabi (October-January), the area experienced highest rainfall of 281.8 mm in 2009 and lowest seasonal rainfall of 13.6 mm in 2002 which is 215% and 10% of average seasonal rainfall (131.2 mm) respectively. Rabi (October-January) season experienced highest rainy days 13 in year 1997 and lowest 1 in year 2002. Whereas summer (February - May) season received highest rainfall 72.3 mm in year 2004 and lowest 2.8 mm in year 2013 received highest and lowest rainfall is 268% and nearly 10% of average seasonal rainfall (27 mm). Summer (February - May) season recorded highest number of rainy days of 5 during 2005 and lowest 1 in year2012. The highest value of monthly rainfall 1376.2 mm is recorded in the month of July 2013. The data on variability of weekly rainfall during the year 1994-2013 at Pune reveals that the highest weekly rainfall of 430.3 mm is recorded during 27th standard meteorological Week (2-8, July) of 2013 year. it is observed that Kharif (June-September) season received mean rainfall 734.9 mm which constituents 82.3 % mean rainfall of years with coefficient of variation 50.2. Fig. 1 depicts the weekly rainfall and rainy days pattern along with coefficients of variation for all 53 standard meteorological week.

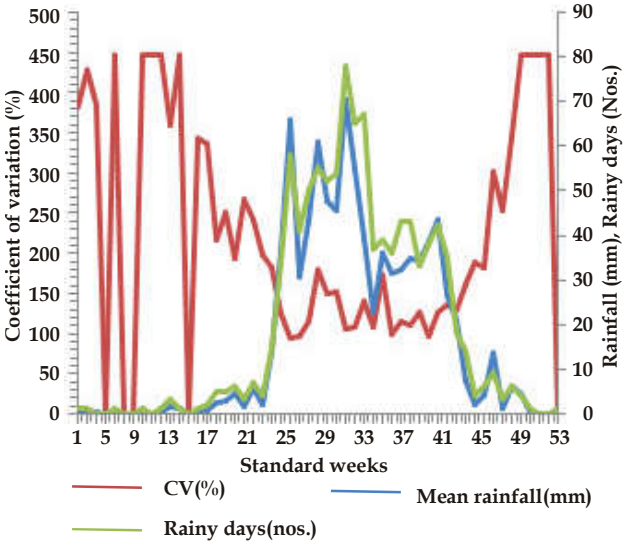

Fig. 1: Variation in weekly rainfall, rainy days and coefficient of variation.

Using Weibull's formula probability of occurrence of rainfall and rainy days for annual and seasonal calculated and presented in Table1. Probability of occurrence of 1098.9 mm rainfall is 25%, means after every 4 year this event will happen. For 50% and 75% probability chances, rainfall occurrence of annual rainfall is 608.8 mm and 788.4 mm respectively.

Conclusion

Kharif season is best for cropping with good rainfall of 448 mm in 33 days. While in Rabi farmers need to select less water consumptive crops because only 68 mm rainfall is possible in 4 days. Alternate arrangement for supplementary irrigation must be ensured by considering soil moisture condition. In summer (February - May) only 10mm of rainfall is available in one day. So cropping is not possible without irrigation. Farmers are advised to start sowing in month of June from second and complete in third week. Also rainfall received during month of July in first decade was well but in next decade it has became very erratic showing much high coefficient of variation. Means after sowing of crops in June farmers need to keep attention on dry spell occurring in July to survive crops. Removal of monsoon starts from month of October. It gets completely removed in month of November, so sowing of Rabi crops should be carried out in first fortnight to 3rd week of October. Weekly rainfall analysis reveals that standard meteorological Week 1 to 15 received very less rainfall with higher values of co-efficient of variation. Standard meteorological Week 4, 6,

Table 1: Possible cropping strategy : For Kharif (June-September).

Early season drought (delayed onset)	Normal Crop/ Cropping system	Change in crop / cropping system	Agronomic measures	Remarks on Implementation
Delay by 2 weeks June 4th week	Low land Paddy	Indrayani, Pavana, Phule Samrudhi	Staggered planting in nurseries for timely availability of seedlings	Seed Source: MPKV, Rahuri, College of Agriculture, Pune, Kolhapur, Dhule, NSC, MSSC, Private Co., Distributors. The self help groups should be involved
	Green gram	Kopargoan	-	
	Soybean	Jawahar Soybean	-	
	Groundnut	JL-24, JL-501, JL-286	Hoeing and weeding	
	Pearl millet	Shraddha, Saburi, Shanti	As above	
Delay by 4 weeks July 2nd week	Low land Paddy	Indrayani, Pavana, Phule Samrudhi	Staggered planting in nurseries for timely availability of seedlings	Seed Source: MPKV, Rahuri, College of Agriculture, Pune, Kolhapur, Dhule, NSC, MSSC, Private Co., Distributors. The self help groups should be involved
	Groundnut	JL-24, JL-501, JL-286 Groundnut + Pigeon pea (6:2)	Hoeing and weeding Protective irrigation	
	Pigeon pea	Vipula, BDN-708, ICPL-87	Hoeing and weeding at 20 DAS Opening of conservation furrows after every two rows	
	Soybean	JS-335, JS-9305	Hoeing and weeding at 30 DAS	
Delay by 6 weeks July 4 th week	Low land Paddy	Indrayani, Pavana, Phule Samrudhi	Staggered planting in nurseries for timely availability of seedlings	Seed Source: MPKV, Rahuri, College of Agriculture, Pune , Kolhapur, Dhule, NSC, MSSC, Private Co., Distributors. The self help groups should be involved
	Pearl millet	Shraddha, Saburi, Shanti	Hoeing and weeding in sunflower at 20 DAS Hoeing and weeding at 20 DAS Opening of conservation furrows after every two rows	
	Groundnut	Sunflower (Bhanu)	Hoeing and weeding in sunflower at 20 DAS	
Early season drought (Normal onset) followed by 15-20 days dry spell after sowing leading to poor germination	Low land Paddy	-	Seedlings by Dapog method for resowing if needed	For hoeing, prefer slit and entire blade hoe. Can be popularized through Govt. programmes
	Sorghum	Resowing if needed	Intercultivation, weeding and hoeing	
	Pearl millet	As above	As above	
Terminal drought (Early withdrawal of monsoon)	Low land Paddy	-	-	Rainwater harvesting through farm ponds
	Groundnut	-	-	
	Pearl millet	-	-	

For Rabi (October-January): Wheat (Malav shakti, GW 322, WH147), Rabi sorghum (Mahabeeej 7, Vasuda (TSV kranti)), safflower (S4, Sharada, Parbhani), sunflower (SS56) and chickpea (Vijay Phule, Chaffa, Vishwas).

7 and 13 were without any rainfall and rainy days. Standard meteorological Week 16, 17, 18 recorded mean weakly rainfall 2.47, 2.97, 4.63 mm respectively. But this rainfall record showed more co-efficient of variation. There was complete removal of monsoon from standard meteorological Week 44. Farmers are advised to select short day varieties which will adopt short of rainfall and yield economically. If irrigation facilities are available then one should plan as per water requirement of crops sown.

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